



**INSTABILITY AND VOLATILITY OF ECONOMIC GROWTH
UNDER TRANSITION: AN APPLICATION OF EXOGENOUS
GROWTH THEORY**

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Dedicated to my Mother

to whom all this work was sort of a promise

Abstract

The aim of this thesis is to explore growth processes in transition economies (TEs) by analysing differences between growth patterns in the course of transition and the smooth growth paths characteristic of developed market economies. Accordingly, the thesis builds upon the neoclassical growth theory in the transition context to develop a modified theoretical model that conceptualizes transition as a non-linear process consisting of three distinct stages or regimes of growth: the crash or adjustment stage; the recovery stage; and the take-off stage. Namely, instead of describing transition as a movement along one steady state linear growth path, this new approach depicts transition as a process of radical adjustments or shifts between growth paths caused by big structural changes in the economy. This theoretical model is tested not only informally against the observed growth patterns under transition, but also through a series of econometric investigations: (1) Perron's procedure for testing for structural breaks in the presence of a unit root in the data series; (2) a univariate Markov Switching Model (MSM) for assessing (a) whether or not the different hypothesized regimes exist in the data and (b) if different growth regimes do exist, both the instability between and volatility within growth regimes; and (3), a multivariate MS VAR model estimated as a small vector autoregression that repeats the univariate MSM investigation into growth regimes but conditional on both physical and human capital variables.

The empirical evidence supports the concept of non-linear growth characterised by structural changes and regime shifts. In particular, the univariate MS analysis suggests that most TEs (19 from 26) have passed through all three regimes or stages of transition, with variations across groups in terms of the recorded mean GDP growth rates and the volatility in each regime. Conversely, the multivariate analysis brings forward a somewhat different depiction. Namely, although generally confirming the idea of instability and volatility, the MS VAR analysis suggests that only an elite "few", the five most developed TEs, now EU members have managed to pass through all three stages of transition, as identified in our theoretical model. They can be regarded as having completed their journey by becoming developed market economies. In contrast; all the others recorded only two distinct regimes. This result is consistent with our theoretical model in identifying three main stages or growth regimes in the transition process.

Finally, the thesis appraises a new notion of transition as a process of dramatic non-linear changes that require correspondingly bold policies, particularly if the third regime leading to the developed market economy status is to be attained. Although this thesis does not prescribe specific policy recommendations, it does provide a particular perspective for policymaking, namely one oriented to long-run supply-side reforms.

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Abbreviations

- AIC - Akaike Information Criterion
ARMA - Autoregressive Moving Average Models
B&H – Bosnia and Herzegovina
BCs - Baltic Countries
CIA – Central Intelligence Agency
CEECs- (Central Eastern European Countries
CIS - Commonwealth of Independent States
DF GFC test - Dickey–Fuller Ggeneralized Least Squares test
DGP - Data Generating Process
EBRD – European Bank for Restructuring and Development
EU – European Union
FRG - Federal Republic of Germany
GDP – Gross Domestic Product
GDR - German Democratic Republic
GFC – Gross Fixed Capital
HQ - Hannah-Quinn criterion
ICT – Information Communication and Telecommunications
ILO – International labour Organisation
IMF – International Monetary Fund
ITU – International Telecommunication Union
LDCs - less developed countries
MS VECM - Markov Switching Vector Equilibrium Correction Mechanism
MSM – Markov Switching Models
OECD – Organisation for Economic Cooperation and Development
SEECs - South Eastern European
SOEs- State Owned Enterprises
TEs – Transition Economies
TFP – Total Factor Productivity
UN – United Nations
UNECE - United Nations Economic Commission for Europe
US – United States
VAR – Vector Autoregressive Regression
WB – World Bank
WDI – World Development Indicators
EUROSTAT - Directorate-General of the European Commission responsible for providing statistics on the EU and candidate countries.

Chapter One

1 Introduction

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1.1 Research background

The second half of the past century was marked with the idea of three distinct economic systems: a capitalist First World; a developing Third World; and a socialist Second World that emerged after the World War II (Sachs and Warner, 1996). Many features distinguished those systems: the role of the state in the economy ranging from complete planning of economic activity to completely free markets; the character of industrial ownership, varying between state, social and private; varying levels of economic activity measured by Gross Domestic Product (GDP) per capita; different standards of living; different ideologies, values and norms; different growth policies and, consequently, various growth patterns. However, the idea of three worlds was drastically changed at the beginning of the 1990s, the years that witnessed the collapse of socialism and the emergence of the process named transition.

Generally, transition was described as a unique process of transformation of the former socialist countries from a system of central planning to the institutional arrangements of a free market economy (Blanchard, 1997). Leaving aside all the political and social considerations of such a fundamental change, the main argument in favour of moving to a market economy was a widespread certainty that the introduction of a market economy would improve productivity and also the living standards in former socialist economies (Glün and Klasen, 2000). It was anticipated that after some short period of adjustment and contraction of economic activity the new system should lead to recovery and sustained growth. However, for a number of reasons these aims and “wishes” have not been realized equally in all transition economies (TEs). While some were successful and managed to recover very rapidly, others experienced prolonged transitional recession that lasted much longer than expected, accompanied by deeper contraction and recovery which has not been as smooth as predicted. Instead of rapid recovery and robust growth, the prolonged recession turned out to be a Great Transition Crisis, continuing in “lagging” transition countries over two decades (Havrylyshyn, 2001).

Given the ambiguity and its diversified results, transition has come sharply into research focus, attracting vast scientific attention. Yet there is no unified theory that explains it in all its dimensions. This is mainly due to the lack of coherent theory that encompasses and explains all the movements during transition (Havrylyshyn, 2001). Deficiency of the “system paradigm” of transition, as Kornai (1998) names it, was rather expected simply because transition by definition is a profound but *temporary* change leading to capitalism. Transition is not a completed system but rather a developing process that is difficult to theorize due to its dynamism, constant changes and the lack of a steady state. In explaining the nature of transition, Kornai (2000, p.25) actually emphasized the uncertainty and unpredictability of the transition process, validating its exceptionality.

The transition from socialism to capitalism has to be an organic development. It cannot be done otherwise. It is a curious amalgam of revolution and evolution. It is a trial-and-error process, which retains or liquidates old institutions, and tries out, accepts or rejects new ones. Each element in the process might be very rapid, fairly rapid or slow. Each has its own appropriate speed. Some episodes call for a one-stroke intervention. Many other processes advance by incremental changes.

There was no “already made” theory to guide real growth processes in transition countries at the time when transition started, i.e. in the early nineties, so the new and unique changes and processes were to be undertaken in the absence of comprehensive awareness of the possible outcomes (Havrylyshyn, 2001). Implemented growth strategies and economic policies were guided by countries’ goals, by advice from foreign advisers, by countries’ own experience and in some cases by “trial-and-error” politics. In fact, in reality, a number of questionable policy choices were made, while exerting significant social constraints on the efforts to bring about reforms (Svejnar, 2002, Easterly et al., 2006). In consequence, the results differed widely across the transition world (Kornai, 2006).

1.1.1 Analysis of growth in transition vs. developed or mature economies

The complex reality accompanied by the absence of appropriate theory affected the studies of growth in transition. Adhering to existing paradigms, many transition researchers analysed growth in transition through the writings of Solow and the pioneers of new growth theories, rooted in the reality of developed industrialized economies.¹ In fact, former socialist economies at the beginning of the nineties shared some features with developed economies: they were highly industrialized; they had an educated labour force; although compared to industrial economies, technology development was lagging (Campos and Coricelli, 2002). However, diverging development paths among mature industrial economies and transition economies came into sight during the actual process of transition.

The initial contrast emerged because of the various nature and dynamic development paths of these two groups in the late nineties. Namely, while industrial countries had a long and gradual tradition in market mechanism and accompanying institutions, transition countries had to “build” or develop a new market apparatus on the inherited basis in a relatively short period (Rider and Knell, 1992). This huge requirement for transition countries produced numerous side effects and unexpected problems, some practically not found in industrial economies.

Furthermore, discrepancies between industrial and transition countries were especially evident during the first stage of transition with respect to policies implemented and to their achieved results. Namely, while transition economies were working on policies for the introduction of a market economy - such as large-scale privatization and hard budget constraints, macroeconomic stabilization, liberalization of prices and trade and so on - the

¹Henceforth, the categorization of the IMF is used. According to this, countries are divided into three groups: industrial countries (in some cases we refer to them as developed or mature market economies); transition countries (economies); and developing countries (economies).

industrial economies dedicated themselves to developing industrial policies, technology policies, research and development and educational improvement; i.e. policies appropriate for the problems and needs of mature market economies (Zecchini, 1997). Actually, at the beginning of the nineties, both groups of countries reacted completely differently to different sorts of recessions. The latter ones facing a "normal" recession, associated with an inventory cycle recovered rapidly, while the former faced a recession, or even better named, a crisis that destroyed their real assets - both physical and human - via sudden obsolescence; hence, their recovery was slower and more difficult (Stiglitz, 2010). Accordingly, while advanced industrial countries did unusually well in the 1990s, transition countries experienced sharp recessions (Svejnar, 2002).

Observing the severity of recessions in different TEs at the beginning of the nineties, Kornai (1994) emphasized the fact that the market recession of a mature industrial country is not comparable to the "transformational recession". While the former that comprises the downward part of the business cycle causes no fundamental structural changes in the economy, the latter is caused and causes major structural changes that may result in a prolonged recovery (Stiglitz, 2010). Hence, Stiglitz (2010) claimed that many assumptions of the models of growth cannot fit the transition reality properly and they need to be adjusted and relaxed in order to accommodate transition facts.

1.1.2 Analysis of growth in transition vs. less developed countries

If the view that transition as a process stands apart from the typical development of a market economy is accepted, a further question that arises in this theoretical debate is whether transition processes in former socialist countries have common features with developments in the third world or less developed countries (LDCs). Again, there are more differences than similarities. Namely, in the early nineties developing countries were facing many severe problems: high population growth, accompanied by low life expectancy, low levels of industrialization, low levels of productivity, high poverty and mortality, weak education and

weak institutions (Griffiths and Wall, 2001, Agénor, 2000). In the same period, former socialist countries started with far better economic foundations that gave them more in common with the industrial world. Although former socialist countries experienced sharp decreases in economic activity accompanied by deterioration of some social indicators (Glün and Klasen, 2000), these changes were not comparable to the “poverty trap” development models characteristic for developing countries.² Emphasizing the distinction, Ofer (2000) acknowledged that developing and transition countries have travelled distinctly different roads with the same destination of full economic modernization.

This brief discussion separates transitional experience as particular and different from both industrial and developing economies’ growth paths.³ At the same time, it indicates the limitations of the standard growth framework in comparison to the transitional reality; neither the growth analyses of developed nor the growth models of less developed economies can accommodate transition stylized facts well. Indeed, the challenge to the conceptual framework commonly used to study growth is a leading theme that will be developed theoretically and empirically throughout the thesis.

1.1.3 Transition and its specific time scope

Together with the lack of an appropriate growth model, an additional specific problem related to the time horizon of transition worth mentioning is that transition is a temporary process that has already ended in some transition countries.⁴ Furthermore, even in the case of lagging countries, the transition experience has lasted two decades, which is not long

² For comprehensive explanation of poverty traps models see Azariadis and Stachurski (2005).

³ In fact, this distinction is already confirmed and supported by the international organizations categorizations such as those of IMF, World Bank, United Nations, although with slight differences with regard to used denominations.

⁴ EU accession is usually considered an ending point of transition. However, it should be kept in mind that even after accession, transition countries differ from the old member states especially with respect to the technical developments as it will be discussed in chapter 3, section 3.2.3.

enough for the analysis of long-run growth of output and its determinants as understood by classical and new growth theories⁵ (Svejnar, 2002). Additionally, neither can the short-run approach (the business cycle approach) help in this research programme, since the primary interest is not the temporary disequilibrium and the movement of actual output from potential output. The interest is rather focused on medium-term growth, on the structural adjustments that occurred and had prolonged influence on growth patterns during transition. Hence, although the length of transition is relatively short, the treatment of transition in a growth rather than in a business cycle context, pursued in this thesis, can be justified on several grounds:

- firstly, the nature of the recession faced by the former socialist economies was deep, severe and far from a “normal” business cycle recession as recorded in developed mature economies in the nineties;
- secondly, the causes of these changes, particularly the huge adjustments in physical and human capital and institutions, are the determinants of growth which usually do not experience such huge changes in the course of a business cycle as typically described in the economic literature; and,
- finally, the results in terms of huge structural changes did not and in some cases still do not resemble the characteristics of a “normal” recovery as known in business cycles analyses (Aguilar and Gopinath, 2004; Durlauf et al. 2004; Kornai, 1998; Stiglitz, 2010).

Consequently, in this thesis a particular approach to growth, developed in Prichett (2001) has been adopted:

This “growth” is neither a (gradual) change in the equilibrium rate of growth nor a temporary deviation of output from its current potential. Rather it is the dynamic adjustment process to a

⁵ Empirical studies for industrial countries concerning growth usually analyse periods of more than 40 years.

change in the level of potential output. Any policy reform that raises potential output, no matter how slightly, creates a period in which the economy to move from the lower to the higher level of output, must “grow” faster. When the change in output level is substantial then this can result in an extended period of potentially very rapid “growth” (or decline) as part of the dynamic adjustment process... and, transition from a given equilibrium steady state rate of growth to another...

“Policy” or “institutional change” can change the level of potential output, perhaps substantially. In discrete cases—such as the unification of East and Western Germany—this is easy to see. The potential output of East Germany shifted dramatically... Pritchett (2001, p.6).

Relying on Pritchett’s idea of ‘regime shifts’, transition is perceived as a “process of permanent structural changes and adjustments towards some desirable equilibrium” (Pritchett, 2000, p.21). Unlike smooth and gradual adjustment in mature economies, transition countries instead experience huge shifts on the road to the desired equilibrium, moving from one regime to another. Each regime can be thought of as a specific balanced growth path characterized by specific growth behaviour, specific long-run growth, volatility and particular determinants. Systematic analysis of such growth regimes and understanding the dynamics of transition between regimes in the course of the overall process of transition is the major purpose of this thesis.

1.2 The research agenda

One important question motivated the research agenda of the thesis. What happens to growth when conditions such as the obsolescence of physical and human capital occur in an economy instantaneously? As mentioned, these huge changes are distinct from the reoccurring developments of the business cycles; hence, they cannot be accommodated by business cycle theories (Krolzig, 1998; Kim and Nelson, 1999). On the other hand, also the standard growth theory is not automatically applicable for explaining growth in the course of transition due to the fact that all the theoretical models of growth rest on assumptions valid

for mature industrial economies, not allowing for sudden and huge structural changes in the economy⁶ (Solow, 1994). Therefore, the thesis contributes to this theoretical debate by critically developing a new view, a new theoretical model of transition, explaining it as a process comprising of various "stages" and "phases" caused by huge structural changes in the economy. Based on the neoclassical model, the present approach relies on the idea of growth regimes; i.e. different balanced growth paths with different long-run average growth and different growth volatility. In the course of transition, the internal shocks push an economy from one regime to other causing sharp changes in the growth rate. At any point in time, a country's growth performance depends on what regime is in effect, and its average long-run growth rate also crucially depends on how it switches between regimes and what fraction of time it spends in each regime.

With this alternative description of the growth patterns, this thesis attempts to answer further research question; in particular, when do countries switch from one regime to another? The empirical univariate analysis gives information on the timing of the switches and the persistence of the identified regimes, accompanied by their specific mean GDP growth rate and volatility for each country. In addition, the question was whether this switch was related to labour and physical capital growth rates. Having a short span of data available, the analysis focuses on growth in transition economies (TEs) in groups and, more importantly, individually. Although less common in the empirical literature of growth, the individual approach emphasizes the variation of the growth experience within countries and enables identification of growth regimes and shifts. The main tool used for empirical identification of the regimes is the Markov Switching Modelling (MSM), whose application can be considered as an original contribution to empirical research on analysing transition patterns.

⁶The mainstream growth models were developed prior to the emergence of transition in 1990s; i.e. they were developed in the mid-fifties and eighties.

A caveat about the time span, quality and comparability of data should also be introduced at this point. Dabrowski et al. (2000) document several data related problems: short annual data series and overstated output levels and growth rates under socialism; and their understatement during transition because of tax evasion, the large informal sector and weak statistical institutions. In addition, in the case of some countries, for example for Bosnia and Herzegovina, Serbia, Montenegro, and Kosovo,⁷ data are incomplete for periods of war and conflicts. In general, transition researchers agree upon the fact that no “single true real GDP series” exists for transition countries, emphasizing the need for their careful interpretation (De Melo et al., 1996).

1.3 Structure and overview of the thesis

This study is structured in three parts. The first part, comprising Chapters 2 and 3 focuses on reviewing and analysing the growth processes in all transition countries, with emphasis on the differences and similarities observed in the various groups of transition economies. Chapters 4 and 5 are mainly theoretical, comprising the application of the neoclassical growth theory to the growth processes in transition countries. Additionally, this part offers insights into the new developments in growth literature; discussing the concepts of the volatility and instability of growth. The last part, comprising chapters 6 and 7 is empirical and examines empirically the instability and volatility of growth processes in the course of transition. Chapter 8 provides the conclusions.

More specifically, Chapter 2 presents a critical assessment of the growth processes in transition countries taking a historical perspective. Namely, at the beginning, the main stylized facts about growth in pre-transition are presented. Their relevance is twofold: firstly, because the imperative of planned economies in the previous socialist system was precisely

⁷Kosovo is introduced in this thesis after the Declaration of independence in 2008; although it should be mentioned that its international status is still being negotiated.

economic growth; and secondly, because pre - transition growth features were the base for further growth developments, characterizing the transition. Starting from that point, this chapter summarizes various definitions of transition and describes the main features of the four regional groups of transition countries already established in transition literature: Central-Eastern European Countries (CEECs), South-Eastern European Countries (SEECs), Baltic Countries (BCs) and Commonwealth of Independent States (CISs). In addition, this chapter presents the general facts of growth, which eventually leads to reassessment of the familiar categorization and to the introduction of a new categorization of transition countries differentiated by three distinct real GDP and growth patterns: rapid-J group, slow-J group and incomplete-U group of transition countries. Further elaboration of the various growth patterns reveals the fact that transitional experience can be stylized into specific short time periods, i.e. stages of transition separated by key points, which share common but also display divergent characteristics for various groups of transition countries. This preliminary analysis opens the need for further analysis and assessment of this initial idea.

The following chapter 3 provides a descriptive analysis of the determinants of growth that have been identified in the cross-country literature as being associated with economic growth in transition. Namely, capital accumulation, human capital and technological change, government policies, institutions and shocks are depicted over the established time frame of transition, including the comparison of growth performance and determinants vis-à-vis the most successful rapid-J group. The comparison among various transition groups helps in recognizing growth determinants and features peculiar to each group. Foremost, this description enables the recognition of the specific processes and variable co-movements in different stages of transition for various groups. The stylized picture from this chapter is used to inform a model of growth in the course of transition in the following chapter 4.

Chapter 4 reviews the main theoretical background and applies the neoclassical growth theory to transition growth regimes. Taking into consideration the complex reality in the

course of transition, this theoretical chapter firstly puts an emphasis on modifying some of the Solow assumptions in order to allow for an open economy, sudden emergence of shocks and the existence of non-perfect markets in the economy, all of which facilitates the development of a model that better fits transition reality. Based on a novel set of assumptions, the chapter further develops a new theoretical approach for understanding transition by combining the Solow model with the idea of transition as a permanent dynamic adjustment process. Namely, instead of describing transition as a movement along one steady state linear growth pattern this new approach depicts it as a process of adjustments or shifts between different steady-state growth paths towards new “desired” steady-state growth rates. The process is modelled by means of three interlocked diagrams presenting growth rates, labour productivity and output movements through different phases and stages of growth caused by big structural changes in the economy. This perception of transition is new in growth transition literature to our knowledge and aims to fill gaps in the existing analysis, manifested in an inability to explain the specific pattern of growth in transition.

Chapter 5 develops the idea of shifts or different regimes further, theoretically and empirically. Emphasizing the importance of instability, this chapter centres attention on episodes of growth or policy shifts as they are explained in the recent growth literature (Aguar and Gopinath, 2004; Pritchett, 2000). In addition, it draws attention to the concept of volatility in the course of transition, i.e. fluctuations of growth within each growth regime. Following the theoretical discussion, this chapter proceeds with empirical investigation of instability and volatility of growth in each transition country individually. The applied standard tests offer some evidence indicating a huge crash in the data series, as well as evidence on the volatility of growth in the course of transition. However, the applied techniques in this chapter have some significant drawbacks, although they do help to establish and develop the idea that non-linear modelling might be a better choice for modelling growth in transition. Namely, the concept of transition as a series of shifts between successive growth regimes developed in Chapter 4 suggests a non-linear empirical strategy, because it will allow the parameters to adjust reflecting structural changes and will also be informative on the dynamics within each growth regime. By putting the accent on

structural changes in the course of transition, this thesis completely abandons the convention of studying growth by using a linear approach, which makes it different from previous studies of growth in transition.

Borrowed from business cycle analyses, non-linear modelling by means of estimating Markov Switching Models in particular is undertaken in Chapter 6, because these have the capability to capture huge shifts in macroeconomic growth paths at the same time as detecting the volatility within each regime. The introduction of this kind of modelling in growth analysis is a relatively new idea. However, its implementation in the case of transition countries is original to our knowledge. Overcoming the disadvantages of the standard univariate tests applied in chapter 5, Markov Switching Modelling offers further insights into GDP growth patterns in the course of transition, allowing switches to be determined by the features of the data generating process (DGP), taking into account also the volatility of the data series. The univariate analysis in this chapter suggest that most of the countries recorded growth paths with three regimes in the course of transition, though characterized by various volatility. In contrast, only seven countries, three of which belonging to the incomplete-U group, proved to fit the two-regime model better. In addition, the results advanced in this chapter fit the regime description of the theoretical model with the high volatility and negative growth rates in the first regime and decreasing volatility and positive growth rates in later stages of transition, though with group-specific variations.

The goal of chapter 7 is to investigate and offer additional evidence on the instability and volatility of growth in the course of transition, though taking into account some additional variables important for growth such as: employment growth rate and physical capital growth rate alongside GDP growth rates. Namely, in an extended multivariate MS VAR model this chapter offers a model that can replicate some of the stylized facts, which we outlined in the descriptive analysis, at the same time as capturing the non-linear nature of growth in transition together with some of the main determinants that contributed to it. Although with limited explanation power, the rich structure embedded in extended Markov switching VAR

model captures primarily the character of regime switches along with their timing. The results advanced in this chapter suggest that the multivariate analysis brings forward different depiction of growth from one established in the univariate analysis for some of the countries. Namely, according to multivariate results, only few, more precisely, five most successful countries experienced three regimes in the course of transition, while most of them recorded only two regimes, suggesting that most of the transition countries are still very far away from the desired growth pattern characteristic for the developed Western European economies (Kornai, 2012). In fact, for most of the transition countries still the main priority is getting the policy mix right in order to finish the transition.

Chapter 8 concludes, highlighting the main objectives and findings of this research. In general, the notion that the growth process in the course of transition was/is very much different from the smooth linear growth processes observed in the developed market economies was the main motivating research question and incentive, pursued throughout the whole thesis. This conception was investigated on several levels:

- Firstly, *on the real economy level*, the stylized fact on the huge systemic shocks such as: sudden and huge obsolescence of physical capital, huge unemployment and vast changes in systems' features and in the nature of technical progress were analysed. Their stylized patterns confirmed the fact that transition growth pattern is characterised by big interruptions and changes that have not been commonly observed in the mature developed economies.
- Secondly, *on the theoretical level*, this thesis examined the possibilities to adopt and modify the conventional mainstream exogenous theory in order to create a theoretical framework that will allow for the big structural changes in the course of transition. As a result, a different perception of growth in the course of transition was developed, which can be described as a *stages switching process* instead of a smooth

linear process already known in the conventional growth literature. Moreover, this notion was further developed in the concepts of instability and volatility of growth.

- Finally, *on the empirical level*, this thesis scrutinized whether the suspicion of non-linear instable growth exist in data sets of transition countries, by developing a rather novel approach to modelling growth through the application of non-linear models, Markov Switching Models in particular. The conducted univariate and multivariate analyses in MS VAR system confirmed the instability and volatility as peculiar characteristics of growth in transition, hence confirming the idea of broken growth pattern characterised by various regimes or stages of growth.

Chapter Two

2 Growth in the course of transition

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2.1 Introduction

Realization of positive and sustainable growth, i.e. stable increase in total production per capita, accompanied by a rising productivity level and improvement in other indicators of well-being is one of the most important macroeconomic goals of every economy. This commitment becomes even more pronounced in the case of transition economies where the initial economic shock of transformation from planned to market economy typically resulted in sharp falls in economic activity. Furthermore, transition countries experienced sharp deterioration of various social indicators associated with substantial costs in terms of rapidly rising poverty and inequality (Glün and Klasen, 2000). Thus, the main goal of all transition countries was the recovery of economic activity, i.e. increasing the economic growth rate, which in addition was supposed to enable catching up with the European industrialized mature economies. However, in spite of this common wish, transition countries differed in the realization of the goal. While “successful ones” managed to embark on catch-up, others have not been able to achieve this goal and were characterized as “lagging transition countries”⁸(Kornai, 2006, Havrilyshyn et al., 1998, Gomulka, 2000, Stiglitz, 1999, Sachs and Warner, 1996).

The sharp difference in the achieved success in the course of transition motivates the main purpose of this research agenda, which is not only to gauge the success of transition in all transition countries⁹, but also to examine more generally the growth processes in transition countries. In order to do so, this chapter continues by assessment of the legacies of a planned economy in section 2.2, followed by definitions about transition in section 2.3. This section also presents the different types of reforms that countries undertook in the course of transition. The following section 2.4 offers stylized facts of growth rates in the course of

⁸ More on the different categorizations of transition countries is given in section 2.4.

⁹ This research seeks to include all transition countries in the research. However, it needs to be mentioned that in some analyses some countries are left out due to the lack of data. Usually, the newly independent countries such as Serbia, Montenegro and Kosovo belong in this category together with Bosnia and Herzegovina for which data are missing for the first years of transition due to war conditions.

transition, which concludes with a more general summary of countries' performances in the course of transition. In the last section 2.5 the idea of divergent growth patterns in the course of transition is established. Based on the analyses of real GDP index and growth rates movements, transition is portrayed as a process in which several key points can be identified, dividing it into several stages. This depiction sets the basis for further analysis of the determinants of growth in the following chapter 3. In conclusion, the main findings of the analyses are summarized, followed by the main hypotheses that define the research agenda.

2.2 Brief description of pre – transition growth path

The consensus of many economists is that the collapse of centrally planned economies was due to the absence of market mechanisms and their substitution by plan and to social or state ownership instead of private property. However, it should be noted that even under these circumstances former socialist economies were recording high growth rates comparable to market economies during the late sixties and seventies (Sjöberg,1999, Krugman and Venables, 1995). During that period huge transfers from agriculture to the increasing industry sector resulted in large gains in aggregate productivity. In addition, their rapid growth in output could be fully explained by rapid growth in inputs: expansion of employment; increases in education levels; and, above all, massive investment in physical capital (Krugman and Venables, 1995). Even so, certain systematic problems emerged throughout the socialist period that could not be resolved even by the market-oriented reforms that some of these countries implemented in late socialism, such as in Hungary and Yugoslavia.¹⁰

¹⁰Yugoslavia is a noteworthy case. In late 1950, Yugoslavia adopted the strategy of market socialism, workers self-management, decentralized decision making and liberalized its trade with the western world (Rider and Knell, 1992). However, the market in Yugoslavia functioned as a price-setting mechanism to some extent, albeit without the allocation dimension. The retention of the centralized allocation system, which distorted profits and goods prices, remained the basic problem with the reforms implemented in Yugoslavia. In consequence, Yugoslavia developed similar systematic problems common to centrally planned economies (Horvat, 1982, Bićanić, 2002).

The main features of socialist economies can be summarized in several stylized facts. The most profound attribute was the absence of private property. Instead, state or social property prevailed. In addition, market mechanisms were missing. The market was substituted by the extensive economic plan as the main determinant of the prices of goods and factors (Sjöberg, 1999). As the state or social property prevailed, the capital market did not exist and banks functioned on a non-commercial basis (Svejnar, 2002). The labour market was strongly suppressed for ideological and social reasons, producing a deteriorating effect on the level of productivity, which made socialist firms less competitive in world markets (Nikoloski, 2009). In addition, a politicized wage system discouraged personal development and individualism that have the potential to further spur innovations and technological advance.

Without markets, supporting economic institutions did not exist. For example, in the situation of prevalent state or social property there was no need to enforce property rights (Currie, 2003). Instead, the dominance of social property was achieved through the nationalization of industry and collectivization of agriculture at the beginning of socialism.

As far as economic growth strategy was concerned, former socialist countries followed the Soviet-type strategy of forcing the rapid growth of industry, especially emphasizing the development of basic goods sectors or engines of growth such as iron, steel and heavy industry (Svejnar, 2002). Yet, while a small number of large enterprises dominated the industrial sector, little benefit was drawn from economies of scale. In summary, economic activity and organizations were built and functioned following the narrowly pursued priorities of the planning authorities.

Because of this situation, deteriorating processes were inevitable in all centrally planned economies. In fact, the administrative planning model that produced rapid industrialization

also created the impetus for its stagnation. Kornai (1981) offers a reasonable explanation of what actually happened in centrally planned economies, suggesting that the institutional setting was responsible for the creation of sellers' markets and hence extensive growth. Namely, according to him, soft budget constraints for enterprises - such as state grants, negotiable taxes or soft credits - resulted in insensitivity of enterprises to price changes (or a so-called seller's market). As the activity was not properly evaluated on the market, enterprises allocated resources inefficiently, and generated excess unconstrained demand for inputs: labour and capital, which additionally fuelled the overall excess demand. In favour of this claim, Ericson (1996) suggested that many of those enterprises that were producing in planned economies, placed in a market environment might be indeed net value destroying. Producing practically non-saleable goods, enterprises were unable to cover even the variable cost of production, once market conditions prevailed (Akerlof et al.1991). In summary, the seller's market created excess demand and a tendency for constant increase of production, accompanied by an increasing overinvestment. This gave rise to relatively high growth rates, along with huge problems - bottlenecks, shortages, ineffectiveness and misallocation of factors. Because of the excess demand, labour and capital were fully employed, and overinvestment led to extensive growth and hidden inflation Kornai (1981). Lack of incentives for innovation added to the deformations on the chosen development path. In other words, growth was not supported by appropriate technological progress and innovations, but rather by more capital on a constant technical level, especially in the latest period before transition.¹¹ In the absence of innovation and technical progress, extensive output growth lead to diminishing returns that eventually caused growth rates to decline (Solow, 1956, Krugman, 1994). Confirming the assertion of extensive growth, Bairam (1988) further suggests that increasing returns did not play an important role in determining productivity growth in socialist countries of the Soviet type. In summary, extensive growth, low technological progress and misallocations of resources break the dynamic relationship between output growth and productivity growth (Rider and Knell, 1992). Socialist countries

¹¹This idea of low initial technical level compared to the industrialized economies is further developed in chapter 4.

were good in extensive, but not in intensive development; that is, they were good in mobilizing resources, but not in utilizing them efficiently (Sjöberg, 1999).

In their international relations, the former socialist countries also followed pervasive plan projections formed by the commitments to enhance trade within the socialist block and to sustain semi-autarchic self-sufficiency among these countries (Gros and Steinherr, 1995). Michalopoulos (1999) suggests that, within this block, trade diversion effects were dominant, i.e. replacement of more effective producers and suppliers from non-socialist economies with the partners' less effective producers. However, in this view it should be noted that not all socialist countries were equally dependant on socialist markets (Gros and Steinherr, 1995). For example, because of the liberalization of trade, Yugoslavia was among the less dependent countries with respect to trade with its socialist partners, together with Hungary and Poland (Michalopoulos, 1999). However, regarding trade and production, interdependence among the republics of the Former Yugoslavia, the Former Soviet Union and Czechoslovakia was relatively high as compared to independent socialist states. Absence of national borders and the same currency stimulated intra-state trade among the republics and established vertical chains of production in many areas, which lead to miss-specialization within some of the former united republics. The breakup of these big states preceding transition introduced new national borders and currencies that strongly influenced trade flows during transition (Bićanić and Ott, 1997).

In conclusion, central planning left the legacy of a broadly distorted structure of factors, production and output. Not only was the physical production capacity obsolete, but also the organizational structures, business and management skills, professional work methods and ethics were outdated too. On these grounds, transitional countries were challenged to build a modern market economy together with parliamentary democracy, while opening their borders for cooperation with the rest of the world.

2.3 Broad definition of transition

The particular path towards a modern market economy was transition – a multidimensional process of political, economic, social and institutional changes. In many cases, this process was accompanied by dissolution of the former socialist economies.

1. The main political change was supposed to be the introduction of parliamentary democracy and in many cases consolidation of new states.
2. In parallel, economic change was to pave the way from planned to market economy through many interrelated processes (Fischer and Gelb, 1991, Hamma et al., 2012).
 - Liberalization of economic activities, prices and markets;
 - Development of market-oriented instruments for macroeconomic stabilization;
 - Achievement of effective enterprise management;
 - Privatization, accompanied by more efficient allocation of resources;
 - Introduction of hard budget constraints;
 - Liberalization of the exchange and trade system;
 - Reduction of the state role and establishment of a competitive environment.
3. Institutional change during transition meant creation of new institutions and formal and informal rules appropriate for the changed society (Burki and Perry, 1998, Fukuyama, 2006). Institutional restructuring also encompassed the processes of “depolitization” of the institutions and the economy and establishment of an institutional and legal framework to secure property rights, the rule of law and transparent market regulations;
4. Social change included all significant transitional costs related to transition such as increased inequality, growth of poverty, changes in the values and norms system, and a higher level of criminality in society. The extent of these costs appears to have

been underestimated, though it proved to be very high especially in “lagging” transition countries. (Round and Williams, 2010, Pecijareski and Roceska, 1998).

All these changes were supposed to be realized within a process of creative destruction, i.e. destruction of the inappropriate legacies of the old system and erection of new necessary system elements (European Bank for Restructuring and Development, 1997). However, the result was a slump in economic activity in the first stage of transition, followed by recovery of economic activity and reorganization of the whole society. Thus, transition often was referred also as a complex chain of policies to implement market mechanisms, to enhance structural changes and reallocations, to stimulate enterprise efficiency, new investments and hence, recovery and growth. However, this proved to be difficult, especially in the cases of some groups of transition countries, SEEC and CIS in particular. In these countries the destruction was rapid while creation went more slowly, resulting in deep recessions. Hence, Kornai (1994) named transition an institutional no-man’s land and disruption. Similarly, Blanchard and Kremer (1997) referred to transition as disorganization among suppliers, producers and consumers. In addition, many other researchers rejected the view of transition as a creative destruction process, emphasizing the specific problems that arise during transition (Mitckiewicz and Zalewska, 2001; Hoff and Stiglitz, 2004, Round and Williams, 2010).

A broad conceptual policy difference among transitional countries was the choice of the method of transition. Countries grouped into two broad approaches: one that chose a rapid method of transition moving towards a market economy; and the other the so-called gradual method of transition (Roland, 2000). Most countries chose the first method of transition, as many participants in that process suffered from an obsession with speed and impatience, as Kornai (2006) suggests, which made reforms easily subordinated to political and power purposes. Still, not all countries were equally dedicated to reforms. Analysing countries’ commitment to reforms, Svejnar (2002) divides the reforms into two types:

- Type I reforms, that were quite easily implemented: macroeconomic stabilization; price liberalization; reduction of direct subsidies; breakup of trusts, state-owned

enterprises and the monobank system; removal of barriers to the creation of new firms; carrying out small-scale privatization; and introduction of a social safety net.

- However, Svejnar (2002) attributes the differences among transition countries to the achievements of so called Type II reforms, such as large-scale privatization; in-depth development of a commercial banking sector and an effective tax system; labour market regulations and institutions related to the social safety net; and establishment and enforcement of a market-oriented legal system and accompanying institutions. In addition, he accentuates the fact that the reform of greatest importance seems to be the development of a functioning legal framework and the corporate governance of firms.

The nature, sequencing and the content of the reforms were different in various groups of countries (Hamma et al., 2012). While the German Democratic Republic (GDR) can be considered to have followed an approach that could be described as a true global shock therapy;¹² Poland and Czechoslovakia can be classified also as fast reformers. Hungary is also cited in this group, with the caveat that it started market-oriented reforms under socialism. Other transition countries, although declaratively dedicated to fast reforms, were unable or unwilling to pursue a rapid strategy for transition. Although the precise nature of the transition has differed considerably, the features of the lagging countries have included lack of implementation of the type II reforms. Consistent with lagging reform, the outcomes differed greatly too (Havrrylyshyn et al., 1998).

Generally, studies support the claim that a larger extent of structural reforms leads to better growth performance in the long run and, on the other hand, slow or no reforms produce discontent and additional system problems (Balcerowicz, 2001; Svejnar, 2002). Hence, the

¹²The reunification of GDR to Federal Republic of Germany (FRG) is considered as an instant shock of transition from socialism to capitalism in the transition literature.

central question for most transition countries concerned the management of rapid structural changes that were required to sustain growth (Chenery, 1975).

2.4 Stylized facts of transition

2.4.1 Familiar regional groups of transition countries and their growth patterns

For two decades, former socialist countries have been undergoing a process of transition from planned to market economy. However, today it becomes clear that transition was characterized by considerable differences across countries in the speed with which the old system was abolished and reforms introduced. Hence, in transition literature various classifications of transition countries with respect to their economic performance and geographical reference can be found. The most general categorization that takes into account both criteria distinguishes all transition countries in two main groups:

1. The first one, “successful” transition countries that managed to join the EU in a relatively short period of time, comprise countries of:
 - Central Eastern European Countries (CEECs) such as Poland, Slovenia, the Czech Republic, Hungary, the Slovak Republic; and
 - The Baltic Countries (BC) comprising Latvia, Lithuania and Estonia.
2. On the other hand the second group of “lagging” transition countries consists of:
 - South Eastern European Countries (SEECs) including Croatia, Macedonia,¹³ Albania, Kosovo, Bosnia and Herzegovina, Serbia, Montenegro,¹⁴Romania and Bulgaria;¹⁵ and,

¹³ Macedonia in further text is referred by its constitutional name, though in the international community often its provision reference is used - "the former Yugoslav Republic of Macedonia" (often abbreviated as FYROM).

- The Commonwealth of Independent States (CIS) group including Russia and the Ukraine as well as Armenia, Azerbaijan, Belarus, Georgia, Moldova, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

This familiar categorization of four regional groups given above will be used in the initial investigations with a view to testing its consistency with respect to any diversity that might exist within the various groups of countries.

It is difficult to identify the exact year in which the transition began in the former socialist block. In a few countries, market-oriented reforms were introduced even under the old system, for example in Yugoslavia, Hungary and Poland. However, usually the “real” transition in many studies has been related to major changes in the political systems, which matched several important events: unification of the GDR with the Federal Republic of Germany (late 1990); dissolution of Yugoslavia (late 1990); break up of CMEA¹⁶ (early 1991) and dissolution of the USSR (late 1991). For the purposes of this research it will be assumed that 1990 is the starting year of transition, from which period most of the countries of interest experienced significant changes. In the cases where data for 1990 are missing, the analysis will start with 1991 data.

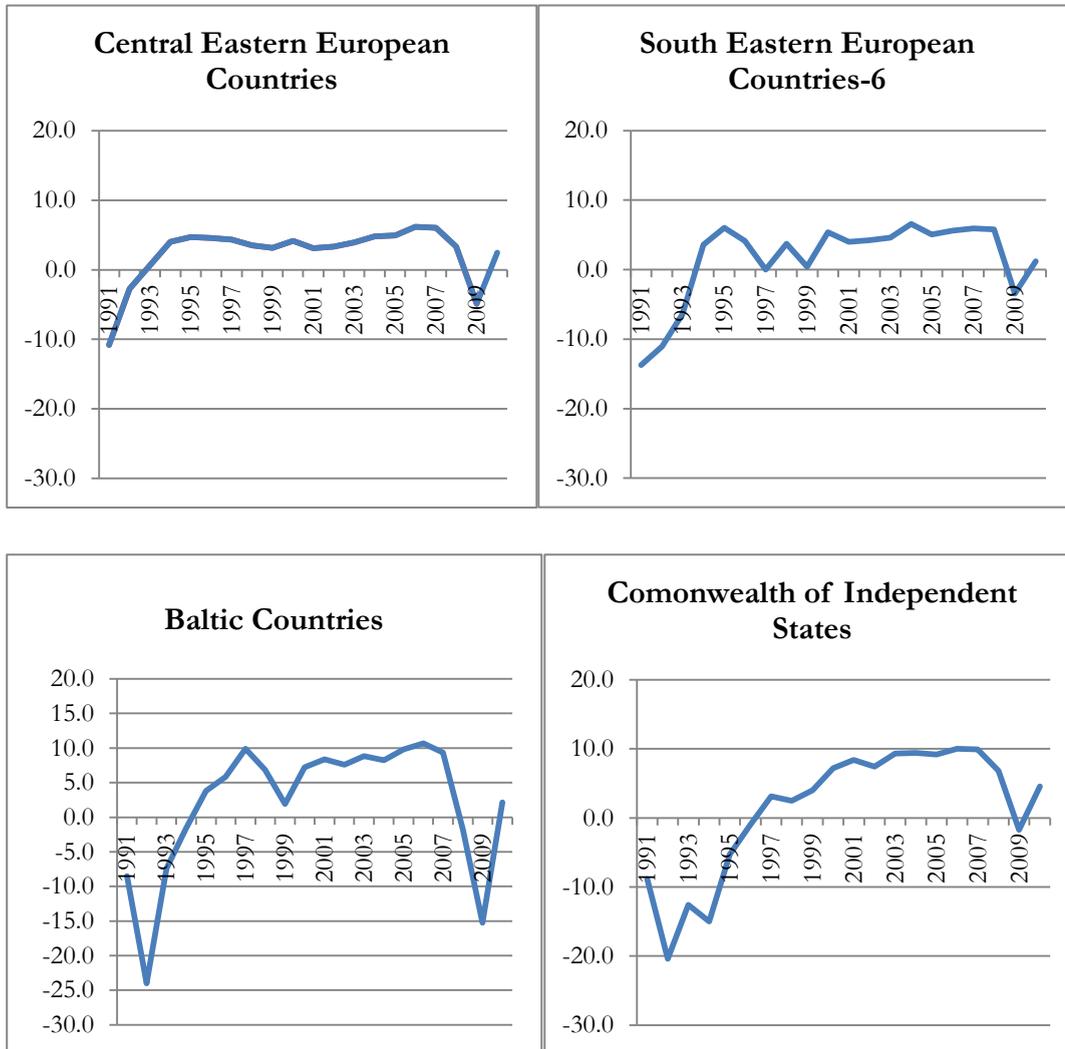
The beginning of transition was marked by a sharp decrease in economic activity in all transition countries. Figure 2.4-1 presents average growth rates in the four regional groups of transition countries as given in section 2.4, measured by the annual per cent change of GDP per capita. In the figure, the y-axis gives the groups’ average growth rate in per cent change of GDP per capita. The average rate is in percentage changes.

¹⁴ Some countries such as Montenegro and Kosovo proclaimed independence comparably later than the others, for example Montenegro in 2006 and Kosovo in 2008.

¹⁵Romania and Bulgaria joined the EU in 2007.

¹⁶CMEA was an organization so called the Council for Mutual Economic Assistance built up for closer cooperation among some of socialist countries. The Former Yugoslavia and Albania did not participate in this organization.

Figure 2.4-1 Annual per cent change of GDP per capita (% annual)



Note: Although the group of SEEC-7, lately was extended to SEEC-9 to include the newly-proclaimed independent states of Montenegro and Kosovo, in terms of the data availability this group is actually reduced to SEEC-6, or even SEEC-5 in some cases, due to the fact that data for Bosnia and Herzegovina and Serbia are missing.

Source: Author's calculations based on Appendix 2.1., p.457 A) and B). Data Source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

The figures reveal several variations among different regional groups of countries.

- Firstly, the severity of recession differed across regions, with the BCs and the CISs experiencing sharp decreases in economic activity (to levels of -25 and -20 per cent, respectively) and CEECs and SEECs undergoing less severe decline (to levels of -10 and -14 per cent, respectively).
- The second point is related to variation in the length of recession. The recovery i.e. positive growth (in terms of averages of their growth rates) was most rapidly achieved in the CEECs from the beginning of 1992, followed by the SEECs in 1993 and the BCs in 1994. The CISs experienced recovery the last, starting from 1997.
- Thirdly, after the first fall, two groups – the BCs and the SEECs recorded a second severe decrease in growth rates in the middle of transition, which can be designated as a possible reversal in the recovery process (Merlevede, 2003). For the SEECs, the reversal repeated twice, in 1997 and 1999, while the BC recorded only one additional contraction in mid-transition in 1999. However, after this shock, in the BCs growth rates returned to relatively high rate levels, above 8 per cent, while in the SEECs growth continued at around 5 per cent or less.
- Lastly, the Financial Crisis hit the various groups with different severity, with the BCs experiencing the biggest fall to a level of - 15 per cent. CEECs, SEECs and CIS fall to levels of -5, -3 and -1.8 per cent respectively. By 2010, all countries' groups returned on the recovery path. Evidently, the Crisis hit hardest the most developed or better named ex-transition countries that became members of the European Union in 2004, leaving the Transition World, while it exerted less influence on the “lagging” transition group (European Bank for Reconstruction and Development, 2009).

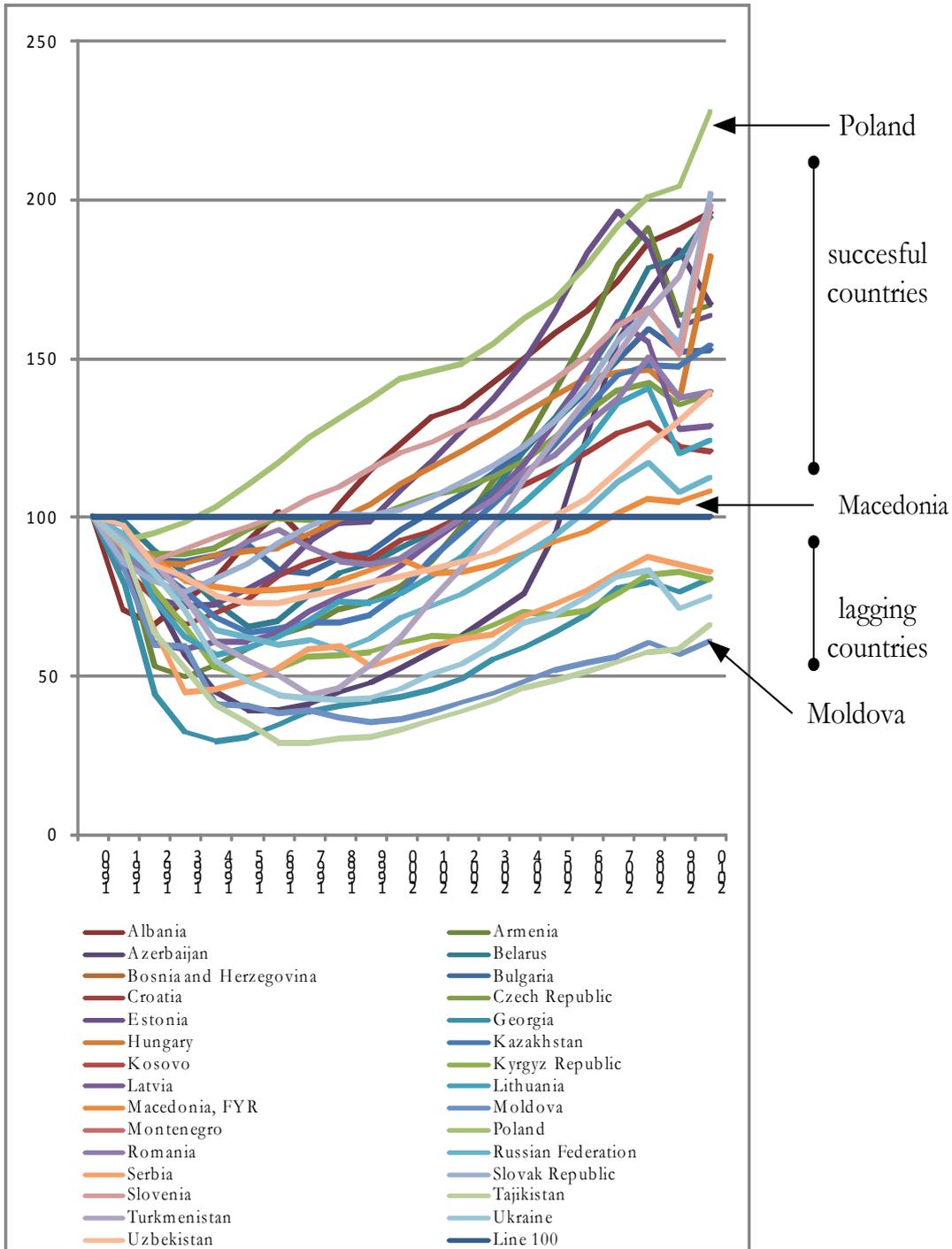
2.4.2 Countries' performances in real GDP during transition: reassessing the regional groups

A more appropriate comparison among transition groups should take into account the differences among countries with respect to the start of transition and should consider countries' performance not only in rates but also in GDP levels during the actual transition. Hence, in this section, regional groups are reconsidered taking into account the movement of real GDP in the course of transition. Keeping in mind the lack of data, the World Bank data series on real GDP per capita¹⁷ transformed into indexes are used in order to gauge countries' performance (see Appendix 2.2.A) and B), p.459). The y-axis presents the real GDP transformed into an index, with the starting value of 100 in 1990.¹⁸

¹⁷The World Bank gives a long definition of the indicator used. GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant local currency. Source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

¹⁸ Again, due to lack of data for 1990 countries such as Bosnia and Herzegovina, Kosovo and Montenegro are excluded from the analysis.

Figure 2.4-2 GDP in transition countries (index 1990=100)



Source: Author's calculations based on World Bank data, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

Although relatively imprecise, the figure above suggests one strong observation: not all countries have performed equally well in the course of transition. The line of index 100 makes clear a split between two main groups:

- First group – the “successful group” includes countries that managed to surpass the initial GDP level, not considering the timing, with Macedonia being the marginal case (slightly above the line 100, pointed out with an arrow in the figure); and,
- Second group – the “lagging group” that includes countries that did not manage to regain the initial GDP level by the end of 2010.¹⁹

Evidently, among the extremes of Poland and Moldova, (their growth patterns are pointed with arrows on the figure above), there is an array of various growth patterns of the individual transition countries. A closer look into these patterns paves the way towards a new categorization of transition countries, which will be further discussed in the next section.

2.5 Introduction of the new categorization of transition countries

Different growth patterns depicted in Figure 2.4-2 can be distinguished by several characteristics, such as: number of years of downturn; year in which the country managed to return to the starting position of GDP per capita; altitude of the index achieved in later transition; and also movement of the index for the whole transition. The figure showing the distinction of the countries in the three groups is given in full in the Appendix 2.3, p. 461. While, the priority criteria or categorisation is the year in which the country managed to return to the starting position of GDP per capita, the splitting year-point dividing the rapid-J and the slow-J group, taken to be the year 2000, is identified in concert with the other

¹⁹ Although the latest edition of *World Development Indicators* of April 2012 was used as a source of data, the data available ended by 2010.

criteria. In that respect, two countries, Bulgaria and Czech Republic seem to be marginal cases.

- Namely, although Bulgaria regained its starting GDP level in 2001, that is only one year later than the splitting point; according to the movement of the index for the mid and late transition, it is more close to the slow-J group of countries. In addition, the highest reached altitude of the index of 159.5 is more comparable with the slow-J group of countries, characterised with on average highest altitude of 155.9.
- On the other hand, Czech Republic that recorded a highest index of only 142.3, which is the lowest amongst the rapid-J group and also lower than the one recorded in Bulgaria, is categorised in rapid-J group of countries. This is due to two reasons: Czech Republic managed to regain its starting level of GDP in 2000, and its index movement is more comparable to those of the rapid-J group of countries.

Accordingly, a new categorization of countries can be established dividing the countries into three new groups, named after the shape of the growth pattern curve: the rapid-J group; the slow-J group; and the incomplete-U group of countries. In Table 2.5-1 below, the criteria, the new categorization and the stylized facts of each group are summarized.

Table 2.5-1 Stylized facts of the growth patterns in the countries in transition

Pattern of growth:	Countries involved:	Length of initial decline (in years)	Year of regained starting level of GDP per capita in 1990	The highest altitude of the index	Year in which the highest altitude was achieved	Pattern of growth:	Countries involved:	Length of initial decline (in years)	Year of regained starting level of GDP per capita in 1990	The highest altitude of the index	Year in which the highest altitude was achieved
Rapid-J group	Albania*	3	1996	195.9	(2010)	Slow-J group	Armenia	4	2003	191.1	(2008)
	Czech Rep.*	4	2000	142.3	(2008)		Azerbaijan	6	2006	184.1	(2009)
	Estonia	4	2000	196.0	(2007)		Belarus	6	2002	194.2	(2009)
	Hungary	4	1999	182.6	(2010)		Croatia ***	4	2002	129.3	(2008)
	Poland	2	1994	227.8	(2010)		Kazakh.**	6	2003	154.0	(2010)
	Slovak Rep.	4	1998	201.8	(2010)		Latvia	4	2003	161.4	(2007)
	Slovenia	3	1996	198.2	(2010)		Lithuania	5	2004	140.6	(2008)
On average	3	1997	192.1		Russia**		7	2006	117.2	(2008)	
Incomplete-U group	Kyrgyz Republic	6	Not yet	82.8	(2009)		Uzbekistan	7	2006	139.2	(2010)
	Moldova***	7	Not yet	60.8	(2010)		Turkmenistan	8	2004	198.0	(2010)
	Serbia	6	Not yet	87.4	(2008)		Bulgaria*	4	2001	159.5	(2008)
	Ukraine	10	Not yet	83.4	(2008)		Macedonia	6	2007	107.1	(2010)
	Georgia	5	Not yet	80.1	(2010)		Romania**	3	2003	150.4	(2009)
	Tajikistan	8	Not yet	65.5	(2010)						
On average	7	Not yet	76.6		On average	5	2003	155.9			

Note: *- countries that experienced reversal in 1997; ** - countries that experienced reversal in 1998; *** - countries that experienced reversal in 1999; Macedonia recorded a reversal in 2001 and the Kyrgyz Republic in 2002.

The table offers an important generalized insight into economic performance in various transition countries. It also enables reconsideration of the previous broad grouping of the countries by putting an emphasis on one additional important criterion-*the year in which countries regained their starting GDP per capita position*.

- If countries are grouped by this indicator, then the first broad group of “successful countries” i.e. the countries above the line 100, can be divided into two subgroups:
 - *Rapid-J group* consisting of countries that managed to restore their GDP per capita level by 1997 on average;
 - *Slow-J group* consisting countries that managed to recover their GDP per capita level by 2003, on average.
- The third group of “unsuccessful transition countries” remains unchanged, encompassing the countries below the line 100 that did not manage to restore their GDP per capita initial level until 2010. This group is named the *incomplete-U group* of countries.

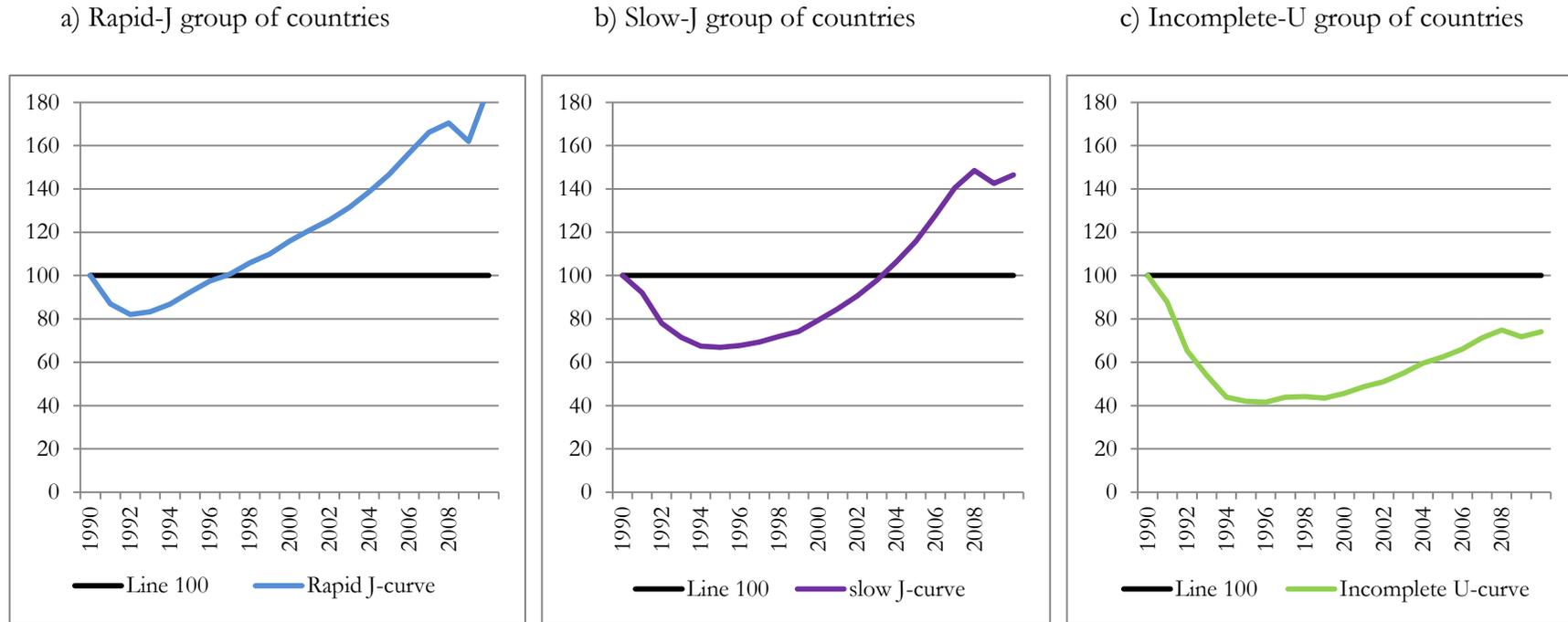
Others features also distinguish the above groups. Namely, in terms of the *length of the decrease of the economic activity*, on average, it is the greatest in the incomplete-U group – i.e. 7 years; followed by the slow-J group of countries with 5 years of falling GDP; and, lastly, the rapid-J group with decrease lasting only 3 years on average.

In terms of *the altitude of the index achieved in the course of transition*, evidently the highest altitude on average is recorded in the rapid-J group of countries of 192.1 index points; then the slow-J group of countries of 155.9 index points; and, lastly, the incomplete-U group recording only 76.6 index points by 2010. Or, in simple terms, while the first group managed on average to double its initial GDP, the slow-J group managed to surpass by over a half its initial GDP per capita level, the lagging incomplete-U group managed to recover only 77 per cent of their initial position.

2.5.1 Divergent patterns in real GDP among new groups

Based on Figure 2.4-2 and the new categorization of transition countries offered in Table 2.5-1, stylized figures to represent the divergent growth paths are obtained, with the y-axis presenting the growth indexes for the three groups of countries and index 100 being marked by a bold black line (Figure 2.5-1). In Appendix 2.3, p. 461 full plots representing each individual country grouped in the “new” groups are given.

Figure 2.5-1 Divergent real GDP paths in the three groups (group aggregates)



Source: Author's own calculations based on Appendix 2.2.A) and B), p.459. Data source: World Bank (2012), *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

1. The first group featuring the “rapid-J growth curve” consists of transitional countries that succeeded in achieving sustainable growth after a relatively short period of time (Figure 2.5-1.a). This group comprises: Albania, the Czech Republic, Estonia, Hungary, Poland, the Slovak Republic and Slovenia, i.e. mainly CEECs. After an average of 3 years of decline of economic activity, they have been recording sustainable growth rates for a long period, on average overtaking their starting positions in 1997. The U - curve of growth that was usually used to explain exactly this group growth path, eventually turned into a rapid-J curve of sustained and increasing growth. It can be said that their growth path actually took the form of the famous U - shape growth path up till the mid - stage of transition (1997), characterized by two development stages: the first one with strong backward movements, reflected in decreased output and rising unemployment and inflation; and the second stage, characterized by recovery and macroeconomic stabilization (Blanchard, 1997). Afterwards, i.e. after 1997, in later transition, this pattern prolonged into a rising path that eventually transformed the U-curve into a J-curve, meaning that these countries managed to sustain their growth in the long term.
2. The second group featuring the “slow-J curve” comprises the countries that experienced delayed recovery: Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, Kazakhstan, Latvia, Lithuania, Russia, Romania, Macedonia, Uzbekistan and Turkmenistan (Figure 2.5-1.b). On average, the recovery in these countries started 5 years after the beginning of transition. However, they managed to show gradual improvements as a group managing on average to reach their 1990 positions in late 2003, which is 6 years later than the rapid-J group of countries. Their growth path can be described as a slow-J shape, different from the rapid-J curve. One smaller subgroup of countries that experienced reversals in their growth path also belongs to this group, as mentioned in the note to Table 2.5-1.

3. The last group is the “incomplete-U curve” of countries, characterized by the absence of a second development stage of sustainable recovery. This group comprises Georgia, Tajikistan, Ukraine, Serbia, Moldova and the Kyrgyz Republic. They show some slight improvements in the recent period but still they are far from regaining the level of 1990.

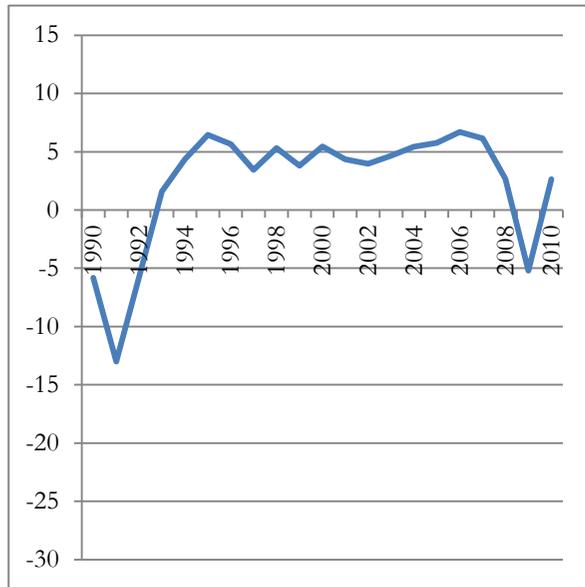
As it can be noticed all curves recorded reversals in late transition after 2008 due to the impact of the Global Financial Crisis, with it being most prominent in the rapid-J group and most modest in incomplete-U group.

2.5.2 Divergent patterns in growth rates among new groups

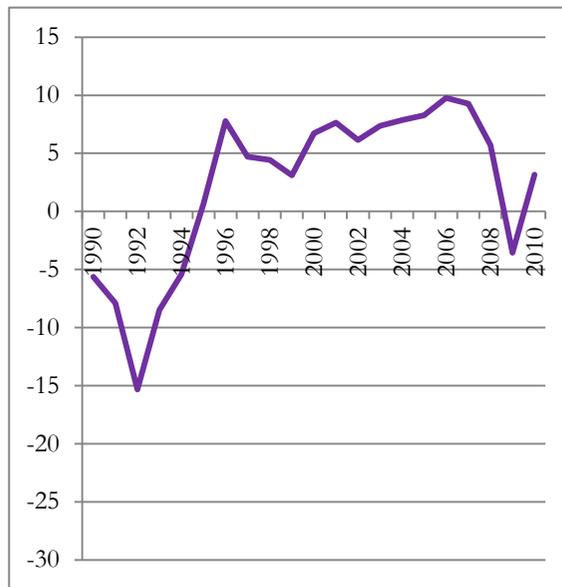
Based on the new categorization, Figure 2.5-2 presents average growth rates in the three new groups of transition countries as given in section 2.5, measured by the annual percentage change of GDP. In the figure, the y-axis gives the groups’ average growth rate in per cent change of GDP.

Figure 2.5-2 Annual per cent change of GDP (% annual) (in averages for the new groups)
(Rapid-J group, slow-J group and incomplete-U group)

a) Rapid-J group of countries



b) Slow-J group of countries



c) Incomplete-U group of countries



Data source: World Bank data, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

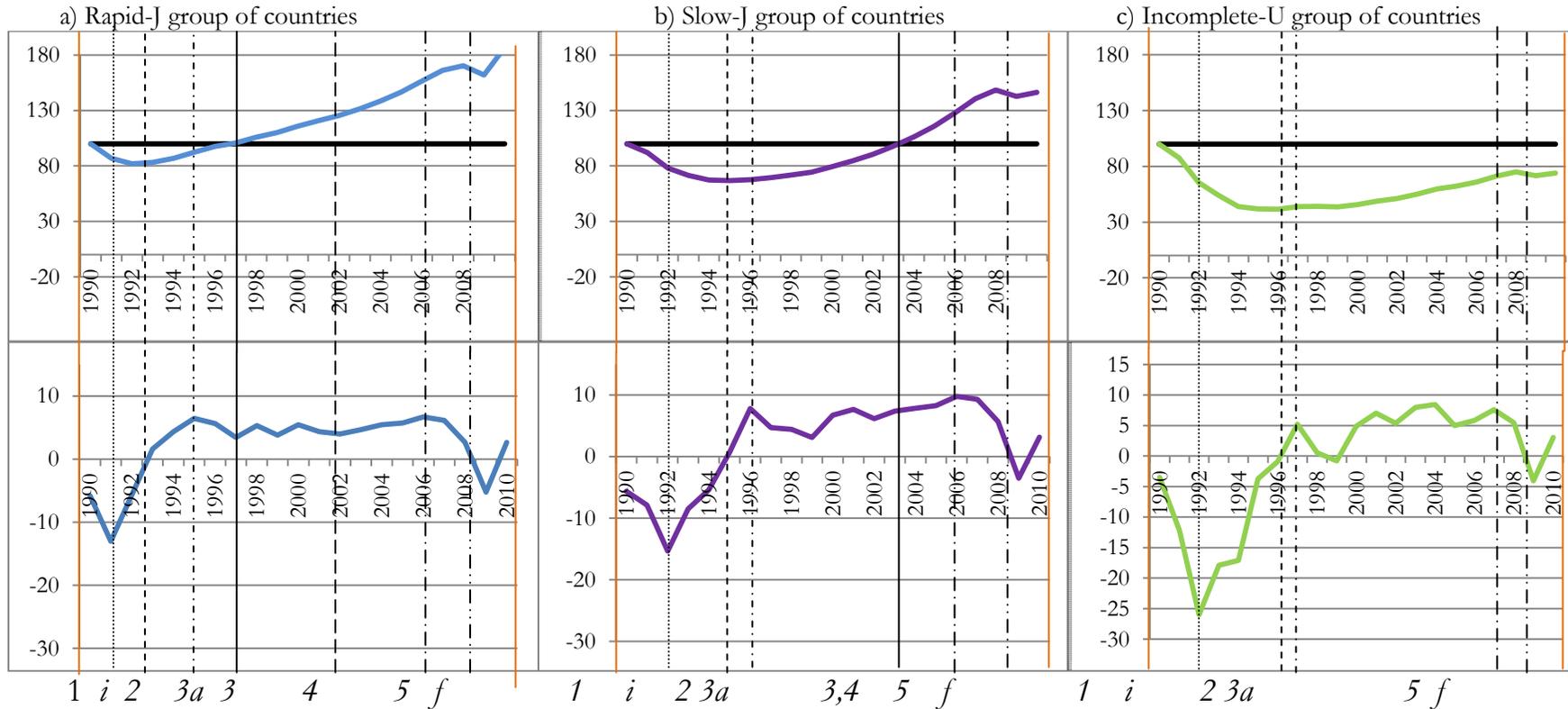
When the average growth rates are observed, several conclusions can be made:

- Firstly, the rapid-J group of countries on average recorded the least severe recession, reducing growth to -13 per cent, which after a relatively short period turns into positive growth rates, i.e. in 1993. After this initial shock, the growth rates are restored to an average level of 5 per cent, although these are relatively volatile until 2001. Afterwards, until 2007, i.e. until the downturn of on average to -5 per cent caused by the Great Financial Recession, growth rates in the rapid-J group show an increasing and less volatile trend.
- The second group of slow-J countries is characterized on average by a more severe initial recession, with output growth falling on average to over -15 per cent, which gives way to positive growth rates in 1995, followed by fall until mid-1999. Afterwards, the average growth rates for this group increase significantly, although recording higher volatility than the rapid-J group. This volatility is stabilized in late 2003 when the growth rates start to record increasing and less volatile trend, which is again interrupted by the downturn caused by the Financial Crisis, though as graph shows on average it is slightly smaller than one recorded in rapid-J group.
- The third group of incomplete-U countries recorded the highest initial drop to over -25 per cent and remained in the sphere of average negative growth rates until late 1997. After turn to positive average growth rates is recorded, the following period again witnessed decreasing average growth rates, and even negative ones in the middle of 2000. Afterwards, positive, but highly volatile average growth rates characterize the growth pattern of this group until 2009 and turn into negative growth rates again.

2.5.3 Divergent growth patterns in the course of transition: joint picture of real GDP and growth rates movements

If Figure 2.5-1 and Figure 2.5-2 are presented in concert, they offer an appealing portrayal of transition as a process that can be exemplified by several key points. Each point in the new Figure 2.5-3 is identified in a manner that represents a particular turning point, whether in the growth rate patterns or in the real GDP patterns. Figures retain the same axes as before, with the upper block presenting the real GDP index and the lower block presenting the GDP growth rate patterns for each group of countries. The figure is accompanied by Table 2.5-2, which gives the time balance, i.e. the dating of the various identified points of transition for each group. Based on this, the length of certain stages or phases of transition can be easily calculated and compared between the groups. For accuracy, red vertical lines mark the years - 1990 and 2010.

Figure 2.5-3 Divergent growth paths in the course of transition (Real GDP, top panel and real GDP growth rates, lower panel)



Source: Author's Own calculation based on Figure 2.5-1 and Figure 2.5-2. Data source: World Bank data, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

Table 2.5-2 Dating of certain points of transition (on average for the groups)

Dating	Brief description of each point	Rapid-J group	Slow-J group	Incomplete-U group
Point 1	Start of transition	1990	1990	1990
Point <i>i</i>	Lowest growth rate	Middle 1991	Middle 1992	Middle 1992
Point 2	Zero growth rate, lowest real GDP index	Early 1993	Early 1995	Late 1996
Point 3a	Highest positive growth rate in early transition	Middle 1995	Middle 1996	Middle 1997
Point 3	Recovery of the initial real GDP	1996	Middle 2003	
Point 4	Lowest positive growth rate in late transition, end of period of volatile and low positive growth rates	2001	Middle 2003	
Point 5	Highest positive growth rate in late transition	Middle 2006	Middle 2006	Middle 2006
Point <i>f</i>	GDP growth rates falling into negative zone as a result of the Global Financial Crisis	2008	Early 2008	Early 2008

Source: Author's Own calculation based on Figure 2.5-3. Data source: World Bank data, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

In Table 2.5-2, **Point 1** marks the start of transition for all countries' groups. Immediately after this point, sharp decrease in growth rates as well as in real GDP is experienced in all groups, however with various dating of the identified subsequent turning points.

- **Point *i*** represents the lowest growth rate position in the course of transition.
 - After this point the real GDP still decreases, however the growth rates- although still negative - record increase.
- **Point 2** represents zero growth rates, accompanied by the lowest real GDP index. This is the bottom position of the rapid-J, slow-J or incomplete-U curve as presented in the upper panel of figures. The end of negative growth rates was earliest achieved by the rapid-J group, i.e. 3 years after the start of transition, while in the slow-J and incomplete-U groups the period with negative growth rates lasted longer, respectively 5 and 6 years.

- After this point, GDP growth rates turn positive and real GDP starts to increase.
- **Point 3a** presents the highest positive growth rates in early transition, which leads to point 3 in the rapid-J and slow-J group of countries, though with a delay in the later.
- **Point 3** represents the recovery of the initial real GDP. Evidently, this point in the rapid-J group is achieved after a short period, more than 4 years on average, of achieving positive growth rates. However, in the slow-J group it is achieved after a prolonged period of positive but relatively volatile growth rates lasting above 8 years on average. In the incomplete-U group, it is never achieved. In this group, the growth rates even return to negative territory in middle transition.
 - After this point, real GDP increases in both groups, the rapid-J and slow-J group, until the shock of the Global Financial Crisis in late 2008 (point **f**). The growth rates in this period are positive in both groups, but their patterns in terms of length and volatility are different.
- Namely, in the rapid-J group just after the recovery, firstly follows a period of relatively low and volatile growth rates, observed until 2001 i.e. when the lowest positive growth rate in late transition is recorded. This point is marked as **point 4**. Until this point, the increase in real GDP is modest, only 20 index points on average for the group as a whole.
 - However, after this point in the rapid-J group follows a period of positive, steady increasing growth rates accompanied by a remarkable increase in real GDP, measured by over 40 index points, which eventually is interrupted by the Global Financial Crisis.
 - For the slow-J group of countries, point 3 is not only the recovery point but also the point that marks an end of a positive but volatile growth rates and a start of a rather steadily increasing pattern in the period between 2003 and 2006. Hence, this group does not record the point 4, as it was described and

established for the rapid-J group, but it seems that point 3 to some extent overlaps with point 4 for the slow-J group of countries. It is similar to the ‘rapid-J group’s point 4’ in the sense that it marks the end of a positive but volatile growth rates and the start of an increasing growth rates, but it differs from it in the sense that it is a recovery point as well; while for the rapid-J group the recovery point 3 was recorded earlier. After this point, GDP increases by 30 index points for the slow-J group on average.

- **Point 5** marks the highest growth rates achieved in late transition and thus the end of the positive increasing growth rates. After this point, the growth rates decrease for a while.
- **Point f** marks the drop sharply into negative growth rates because of the impact of the Global Financial Crisis.

2.6 Conclusion

Now, two decades after the start of transition, it becomes clear that the familiar picture of the U-curve growth pattern established in the transition literature needs to be reassessed in order to be able to describe growth patterns other than those of the successful CEEC group, to include other transition countries that were less successful in the course of transition. When many features - real GDP index path, GDP growth rates path, the years of downturn and recovery, the height of the index achieved and the volatility of growth rates - are analysed in concert, several other variations of the transition U-curve emerged. In turn, these variations informed a new categorization of transition countries: the rapid-J group, the slow-J group and the incomplete-U group. The main aspects that differentiate groups are: the shapes of the GDP growth patterns and the years needed to regain the initial real GDP level.

This newly identified categorization sheds some new light on the transition process itself. It shows that transition is not a simple linear growth process, but a process characterized by strong switches in the main growth indicators. In turn, these need special attention when applying growth theory to, or undertaking growth empirics on, the course of transition. As shown, different stages of transition were identified in this chapter marked by key turning points. Identifying differences and common features of these stages as well as their explanation using growth theory and empirics is the purpose of this thesis.

In the next chapter, attention is focused on the determinants of growth and possible differences within the various stages of transition as well as between the various groups of transition countries. As is well known, many complex interactions and many possible determinants have caused growth in the relatively short period of transition (Fischer and Sahay, 2004). However, it is interesting to explore how factors have developed in the course of transition, whether they differentiated between the various groups in terms of depth of changes and timings, and how they contributed to the actual growth patterns in each group.

Chapter Three

3 Determinants of growth in the course of transition

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3.1 Introduction

According to the Soubbotina and Sheram (2000), national wealth is defined as the sum of:

- Physical capital, accumulated through investment in machinery, equipment, buildings and physical infrastructure and so on. less depreciation;
- Human capital, the stock of competences embodied in the labour force;
- Technical progress; and
- Social capital, reflecting infrastructure and institutions, which are difficult to measure.

This classification, notably the first two, comprises the main determinants of growth analysed by growth theory and the associated growth empirical literature. However, today, the list has been heavily enlarged by many new determinants and factors belonging to the last two categories that have been shown with some degree of empirical regularity to be consistently related to economic growth. Although, some of the new determinants are not completely explained by the growth theories, they still prove to be significant as factors that explain growth patterns (Barro, 1991). Consequently, today in growth analyses some of the variables routinely included in growth equations are explicitly derived from theoretical models and some of them from less formal approaches introduced by influential authors (Temple, 1999).

In the case of transition countries, the challenge of identifying growth determinants is even more pronounced having in mind the specific characteristics of the transition process explained in the previous chapter. However, beside the absence of strong theory linkages, many variables peculiar to transition proved to be significant in empirical analyses (McMahon and Squire, 2003). Thus, Fischer et al. (1996a, p. 231) suggest:

A useful way to think about the current growth prospects of the transition economies is to consider them subject to two sets of forces: those arising from the transition and transformation process, and the basic neoclassical determinants of growth. The further along a country is in the transition process, the less weight on the factors that determine the transitional growth rate and the greater the weight on the standard determinants of growth.

The stylized facts from the previous chapter set the scene for a closer investigation of the record and nature of growth observed so far, which describes different patterns of growth in the various groups of countries. The objective of this chapter is to assess a number of factors that differentiate the country groups at various stages of transition. In order to do so, this chapter provides a descriptive analysis of the determinants of growth, which should enable recognition of the factors that caused the lagging growth in some countries. The analysis is mostly focused on the broad features that enable comparison between the country groups. Admittedly, every variable of interest - as for example human capital developments or structural changes in the course of transition - can be analysed more deeply and, hence, can offer deeper insight into the peculiarities of transition. Nevertheless, for the purposes of this study the focus is on a rather broad portrayal without going into detailed analysis. Building on the insights from this and the preceding chapter 2, the next chapter 4 will aim to theoretically model those stylized facts.

This chapter is organized as follows. In section 3.2, traditional growth determinants are presented, with an emphasis on the main factors leading to divergence in economic performance. Section 3.3 gives an overview of the growth determinants specific for the context of transition, while section 3.4 assess the overall productivity movements in various groups of transition countries. Section 3.5 brings the whole evidence together, while section 3.6 gives the conclusions and rationale for further development of the theoretical background.

3.2 Main growth determinants

Having described countries' economic growth patterns in Chapter 2, here classification into three groups is adopted: rapid-J group, slow-J group and incomplete-U group of countries.²⁰ Nevertheless, it should be noted that the groups are not exactly homogeneous with respect to all conducted analyses and findings, which is to be expected considering the number of countries involved and their peculiar characteristics. For example, two Baltic countries - Lithuania and Latvia are listed in the slow-J group in chapter 2; but, by many indicators belong to the rapid-J curve group as sections 3.2.3 of this chapter show. However, in the analyses they are included in the originally identified slow-J group. Additionally, it should be noted that this is still preliminary analysis intended to offer initial insight into the various groups; however, it is not a definitely established categorization. Namely, the groups' consistency and categorization remains to be developed and tested through the theoretical and empirical work later in the thesis. In the following sections, the macroeconomic developments in the various groups of countries are outlined.

3.2.1 Physical capital

In growth theory, the relation between the growth of physical capital stock and growth (in terms of output and productivity) is positive (Schreyer and Dirk, 2001). Physical capital stock refers to any manufactured asset that is applied in the production process, such as equipment, machines, buildings, or vehicles; and depends on capital formation, which is considered as a joint result of two processes with opposite signs: investments and depreciation through time (Samuelson and Nordhaus, 2004; Diewert, 2004). Depending on changes in those variables,

²⁰In the following text, various labels are used interchangeably to name a group of countries, for example: rapid – J group, rapid –J curve or rapid- J countries.

capital stock may expand over time increasing the available capital per worker and thus the overall productivity in the economy. Thus, tracking the changes in investments and depreciation gains special interest in growth studies.

However, in spite of its importance, estimates of capital stock and its changes are rare for transition countries. Legacies of the previous system deter the assessment of the capital accumulation process in transition countries (Akerlof et al., 1991). As mentioned, in section 2.2 the efforts to over invest at the beginning and overstate physical capital in the later stages of socialism resulted in a doubtful calculation of the capital stock at the very beginning of transition. During the actual transition, lack of data on investments and especially on depreciation, which was changing unpredictably, added to the problem of its assessment. Therefore, the huge obsolescence of physical capital at the onset of transition and possible changes later could only be speculated on in growth studies, but not completely estimated and confirmed. This important issue will be extensively discussed in section 3.2.1.2.

3.2.1.1 Gross Fixed Capital Formation

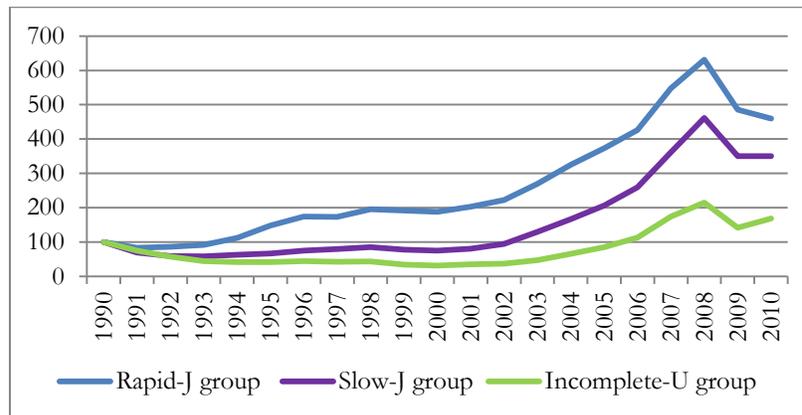
Investments are identified in the growth literature as one of the key factors of growth. In the case of industrial economies, investments enter growth accounting and regression studies as a main indicator that resembles the movements in physical capital stock under the assumption of a relatively stable depreciation rate. However, as far as transition countries are concerned the investments role in growth regressions has changed. Namely, in the absence of a stable depreciation rate they cannot proxy the movement in physical capital stock appropriately (Havrylyshyn, 2001, Duczynski, 2003). Having this caveat in mind, there is still disagreement among researchers about the influence of investment on GDP growth in the course of transition. Some studies support this relation claiming that investment may play significant role

in GDP growth during transition (Wolff, 1999). Conversely, some scholars suggest that aggregate net new investments are not so important in the initial phase of transition, having in mind the overinvestment in the previous system in socialist countries. However, their importance may increase in the later stages of transition, when undergoing country catch-up with the western economies. Havrylyshyn (2001) justified this assumption by describing the development paths of the Central Eastern European Countries (CEECs).

On the contrary, Gomulka (2000) documented decrease in investment rates by the end of socialist period, when the investment level was cut by one third of their previous share in GDP in most socialist countries. This decreasing trend of investments measured by the Gross Fixed Capital (GFC) formation continued in the very first years of transition, although with various trends in different groups of transition countries (Appendix 3.1, p.463). The stylized picture is given in Figure 3.2-1 below, where the y-axis gives the GFC formation indicator²¹ in unweighted averages for the three groups turned into an index.

²¹The World Bank gives the indicator definition. Gross fixed capital formation (International US\$) (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. Data are in International U.S. dollars. Aggregation method: Gap-filled total. Source: World Bank national accounts data, and Organization for Economic Cooperation and Development National Accounts data files.

Figure 3.2-1 Gross fixed capital formation in indexes (1990=100) in various groups of transition countries (unweighted averages)



Notes: Due to lack of data, the averages are calculated without including data for: B&H, Kazakhstan, Kosovo, Montenegro, Serbia and Turkmenistan.

Source: Author's own calculations based on data sources: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

What is obvious is that gross fixed capital formation index lines for various groups of countries resemble the lines of economic performance identified in chapter 2, Figure 2.5-1. Gross fixed capital formation fell the most in the incomplete-U group of countries and was stalled for almost fifteen years. Similarly, in the slow-J group, GFC fell and that delayed recovery for more than a decade. In comparison, the rapid-J curve group after the much smaller first shock managed to increase investments extensively and steadily, achieving the highest index compared to other transition groups by the beginning of 2008 when the Global Financial Crisis started.

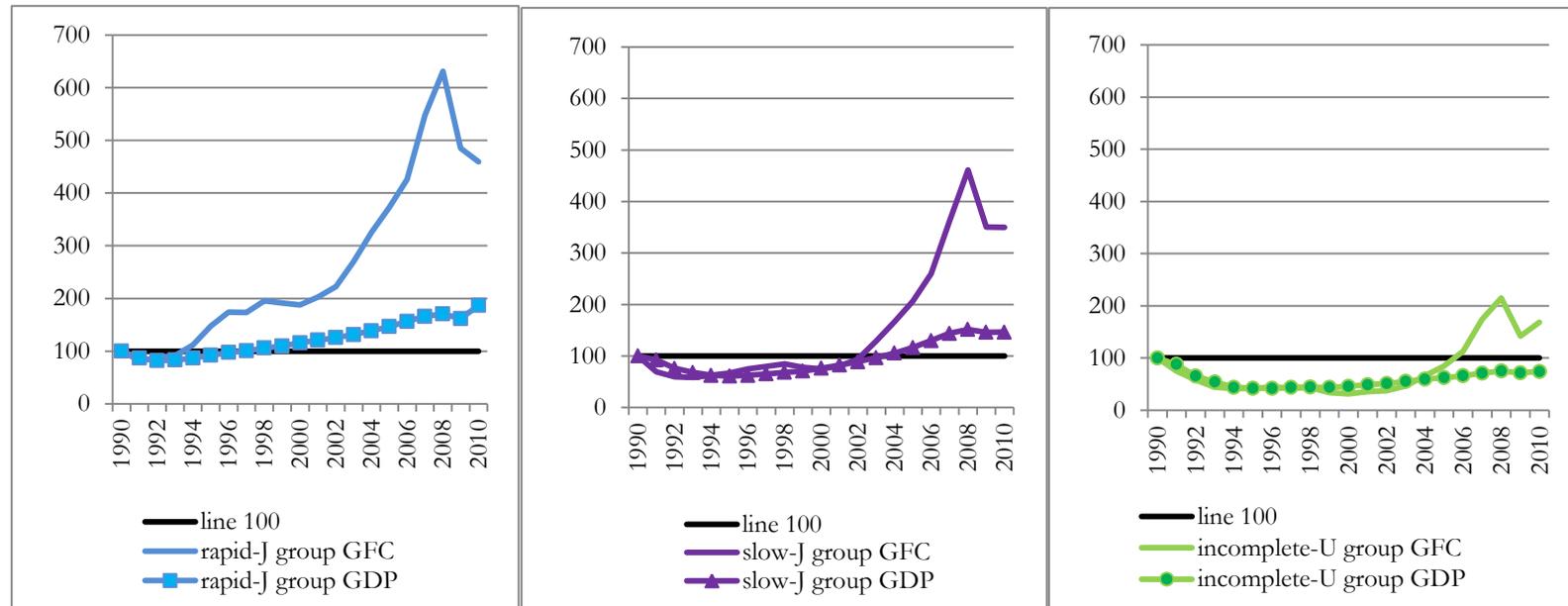
There are some additional observations worth making. Namely, investment declined sharply in the early 1990s in all transition countries, but it is unclear what the impact of investment movements on the GDP pattern was. Thus, in addition, GDP movements (marker lines) and GFC movements (full lines) turned into indices are given (based on Figure 2.5-1 in chapter 2 and Figure 3.2-1). In Figure 3.2-2, the y-axis gives the calculated indexes of GDP per capita and GFC.

Figure 3.2-2 Gross Fixed Capital Formation (GFC in graphs), averages for the groups, in indices (1990=100) and GDP per capita (GDP in graphs), averages for the groups, in indices (1990=100)

a) Rapid-J group

b) Slow-J group

c) Incomplete-U group



Note: These figures represent jointly Figure 2.5-1 in chapter 2 and Figure 3.2-1. Source: Author's Calculations based on the sources: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

Notably, these figures suggest different stories for all three groups of transition countries.

- The common feature is the obvious downward overlap among the two indicators at the onset of transition in all countries groups. Additionally, similar overlap can be observed at the point of regaining the starting positions, except for the incomplete-U group countries, where the revival in GFC is not accompanied by similar recover in the GDP index. However, in the other two groups the increase in GFC preceded the revival in GDP index.
- Another point worth noting is that the slow-J and incomplete-U group of countries recorded unstable GFC index movements, with this indicator experiencing reversals during the first almost fifteen years or so of transition, which might have affected the length of the recovery, among other factors (Merlevede, 2003). Analysts usually attribute their volatile dynamics to the inhospitable environment for investments and to the unclear-defined rules and regulations. In contrast, the rapid-J curve countries recorded a continuously positive relatively sustained rise in this indicator.
- The next observation considers the patterns of the GFC and GDP indexes after the return point (=100). Namely, although all groups had regained their starting positions of GFC index at different points of time, they all after that point record a period in which the GFC index is doubled. This stage is relatively short, being the most visible and long in the case of the rapid-J curve countries (from 1994 to 2002, approximately) and less obvious in other groups (in the slow-J group from 2002 to 2006 and in the incomplete-U group from 2006 until 2008). After this stage, the GFC index rises sharply in the first two groups except in the incomplete-U group, with the highest increase in the rapid-J curve countries after 2002, followed by the lesser increase in the slow-J only after 2006. Unfortunately, these positive changes are sharply reversed after 2008.

- From all groups only the incomplete-U group did not manage to recover its GDP per capita index by the end of 2010;²² and did not manage to record sustained increase in the GFC index.

In summary, the figures suggest the importance of the changes in physical capital for growth in the course of transition. In general, countries that traced slow recovery and instability in this indicator were delayed in their recovery; and, in most cases, GFC revival preceded the regaining of the starting GDP per capita position. An additional appealing feature is that the GFC index doubled in the first increase and remained in that position for a while in the middle transition, after which it recorded additional sharp jump upwards. This three-phased movement is the most obvious in the rapid-J group of countries (see full line in Figure 3.2-2.a.); although less distinct in other groups (as mentioned in the third bulleted paragraph).

Although suggestive, these figures do not reveal anything about the underlying composition of investment in the private and public sectors or anything about the investment structure with regard to buildings, new machines, equipment and R&D. These might be crucial elements for explaining investment impact on growth during transition but, due to data unavailability, have to be left aside. As mentioned, an additional caveat is that this indicator shows only the movements of the newly formed capital in the course of transition, taking into account neither the inherited physical capital nor the obsolescence or depreciation in the course of transition.

²²The data used in this thesis are borrowed from *World Development Indicators*, the latest edition April 2012. However, they include data only till 2010.

3.2.1.2 Depreciation and obsolescence

The picture about capital formation during transition is not complete if the depreciation of physical capital is not taken into account. In general, depreciation is defined simply as the rate of decrease of a value of the physical capital. More specific definition of depreciation suggests that the life of assets is determined by two factors:

- Wearing out as a function of its previous use, which refers to its functional depreciation; and,
- Obsolescence or wearing out as a function of demand variations for the produced goods with time and technological progress (Gylfason and Zoega, 2002).

In general, age is a reasonable proxy for functional wearing out, assuming continuing use in each period of its life, whilst low demand and reducing price for goods is a proxy for obsolescence²³ (Barreca, 1999).

The problem of depreciation and obsolescence of the capital stock emerged at the beginning of transition in most transition countries (International Monetary Fund, 1998). Low investments during the last stage of socialism falsely reported in the balances of the enterprises masked the intensive functional wearing out of the assets. Consequently, low quality of the products and sharp falls in demand, especially from industrialized countries, confirmed the problem of obsolescence and lower asset values or, in some cases, complete uselessness of the capital (Laski and Bhaduri, 1997, Ericson, 1996). In fact, according to Ericson (1996), capital was largely “net value destroying”, because market value of the output produced was insufficient to cover the full

²³More on obsolescence definitions and categorizations is to be found in Barreca (1999).

costs of production. In support, Akerlof et al. (1991) suggest that most of the East German plants could not cover their variable costs.

However, although the problem of mass obsolescence and hence complete depreciation of physical capital was revealed with full intensity in reality, studies about growth in transition did not make much of this, because of the difficulty of analysis and lack of data. Starting with missing data on amortization from the socialist system, analysts could not follow capital formation processes during transition. Thus, having in mind the above caveat and the absence of reliable data, only simple comparative and descriptive analysis amongst countries is possible.

Based on such (rare) studies that have been completed, some conclusions about the extent of the obsolescence problem in transition economies can be inferred (Laski and Bhaduri, 1997, Ericson, 1996, Akerlof et al., 1991, IMF, 1998). Some growth accounting studies suggest that the asset values decreased by approximately 30% in the first stage of transition. For example, growth accounting analysis for Hungary suggests a one – off reduction in the capital stock of 35% at the beginning of transition, corresponding to 20% arising from the loss of SMEA markets and a further 15% due to disorganization and low quality production (IMF *Country Report*, 1998). The first term was intensified by the trade liberalization that switched domestic demand for goods towards cheap and often higher quality imported goods (Laski and Bhaduri, 1997). The demand shock that according to theory proxies obsolescence induced a sharp decline in the productive potential, because capital equipment was not adequate to produce high quality products for industrial countries or domestic consumers (Popov, 2007). Similar studies conducted in East Germany pointed out the need for roughly \$50 billion to \$100 billion a year to rebuild the obsolete capital stock. Estimates were validated in reality later on (Burda and Hunt, 2001, Akerlof et al., 1991). In other countries, this problem probably was even more severe,

considering the fact that Hungary and East Germany²⁴ were relatively more developed than were most transition economies at the onset of transition.

The issue of obsolescence can be considered as highly relevant for conducting growth analysis. This problem is also so important because it affected the actual processes of restructuring and reallocation in transition countries. Deficiency of proper information for the available and usable assets in the unstable transitional environment obscured decisions about the viability of firms, which eventually lead to fallacious closure or tolerance of some firms and continual life of inefficient firms (Ericson, 1996).

3.2.1.3 Profit paths in the course of transition

In a situation when the data on movements of physical capital are deficient, maybe a better telling measure of the changes in the physical capital stock are profit changes in the course of transition (McMillan and Woodruff, 2002). However, again the data on profits are missing or, even if they exist, they must be taken with caution, due to the fact that in the course of transition there was huge tax evasion, particularly in some countries; hence, inadequate data on profits²⁵ (Martinez-Vazquez and Alm, 2003; Katz and Owen, 2011). For that reason, discussion below will be mainly comparative and descriptive offering the main stylized facts on profit's path in the course of transition.

²⁴ East Germany is a special case. Obsolescence was much more amplified there by one-to-one conversion of the eastern Mark into the western Mark (DM).

²⁵ McMillan and Woodruff (2002) documented this problem and tried to fill the gap by conducting surveys of the manufactures in selected countries in transition. However, the data and studies on this matter remain relatively ambiguous.

When considering profits, one difference emerges as most relevant in the case of transition countries and that is the separation between the state and the *de novo* sector. Namely, the profit paths in these two sectors differed greatly in various countries at different stages of transition. In addition, both sectors recorded huge quantitative and qualitative changes, through the privatization process and the development of entrepreneurship in the former socialist countries (Havrylyshyn and Gettigan, 1999). However, despite the differences, the literature review on this issue offers some general observations (Djankov et al., 2002; Earle and Sakova, 2000, Ericson, 1996, McMillan and Woodruff, 2002, Hamma et al., 2012, Havrylyshyn and Gettigan, 1999).

- The onset of transition was generally marked by two distinct situations with respect to profits. Namely, the state owned sector characterized by over-employment was highly inefficient, which resulted with enterprises recording losses instead of profits as mentioned in section 3.2.1.1 (Ericson, 1996). In fact, that is the period in which most countries undertook a privatization project in order to increase overall efficiency and productivity in the society²⁶(Hamma et al., 2012). At the same time, this period was also the period of the initial emergence of new mainly small and medium enterprises that were highly profitable. McMillan and Woodruff (2002) found that in Poland and Russia, for example, profits ranged between 17 and 25 per cent, respectively, of the invested capital in 1990, while at the same time small businesses in the United States typically earned returns between 9 per cent and 15 per cent on assets. They attributed these relatively high profits to the fact that in the heavily distorted environment there were many unfilled market niches, which only the firms that were able to overcome the impediments to doing business could easily fill. In addition, the low capital per worker level also was a precondition for reaching high profits, which is in

²⁶As is well known, not all countries managed to realize privatization with equal speed or success (Hamma et al., 2012). According to the *Structural Indicators data* from European Bank for Restructuring and Development (2011) among the fastest reformers were the CEECs and the Baltic Countries (Havrylyshyn and Gettigan, 1999).

accordance with the neoclassical theory.²⁷ However, on the whole, the appearance of new firms at the onset of transition was only initial and small scale, and, therefore, the general conclusion for this starting period is that profits were on a relatively low level, as a result of the dominance of the state sector in the economy and only modest development of the new sector (McMillan and Woodruff, 2002).

- Afterwards, middle transition is characterized by two processes: downsizing the state sector even further; and by the massive creation of new firms, although the paces of these processes differed across various groups. For example, the entry of new firms on the market in the rapid-J group of countries was comparably faster than in other groups. The private sector (as a share of GDP) increased from approximately 15 per cent on average in 1991 to above 40 per cent in 1994 in the rapid – J curve group, according to the European Bank for Restructuring and Development, 2011).The 25-percentage-point increase was apparently largely the result of new entrants and relatively fast and successful privatization (Bennett et al., 2004). On the other side of the spectrum, mainly the incomplete-U group countries and some of the slow-J group countries could not manage to develop their private sectors so easily and rapidly. In the following Table 3.2-1, selected transition countries from these two groups are presented by their private sector share, accompanied by the year for which the data are available.

²⁷The additional elaboration on this matter will be given in the next Chapter 4.

Table 3.2-1 Private sector share in selected transition countries

	Slow-J group		Incomplete-U group
Country	Azerbaijan	Croatia	Georgia
Share of private sector in GDP	60% (2006)	65% (2006)	65% (2005)
Country	Belarus	Montenegro	Serbia
Share of private sector in GDP	30% (2010)	65% (2010)	65% (2010)
Country	Kazakhstan	Macedonia	Tajikistan
Share of private sector in GDP	65% (2006)	65% (2006)	55% (2010)
Country	B&H	Russian Fed.	Moldova
Share of private sector in GDP	60% (2010)	65% (2010)	65% (2010)
Country	Turkmenistan	Uzbekistan	Ukraine
Share of private sector in GDP	25% (2010)	45% (2010)	60% (2010),

Source: European Bank for Restructuring and Development (2011). *Structural indicators on Transition Economies*.

In terms of profit movements, this difference in public and private sector developments creates two groups of countries.

- The successful group comprising the rapid-J group was characterized by sharp downsizing of public sector. In this group, profits of both sectors were stabilized due to increased competition and better government regulation.
- All the other countries belong to the lagging group, for which profit assessment remains still vague due to the existence of problems of corruption and extra-legal payments (McMillan and Woodruff, 2002; McMillan and Woodruff, 2000). This group is also characterized by a still big public sector, which might indicate lower profits on the whole, considering lower efficiency and productivity of this sector (European Bank for Restructuring and Development, 2011). Additionally, this group is characterized by lack of competition and monopolized market structures in many industries, which in turn creates conditions for high profits for some but very rare firms.

The differences among the two groups became even more pronounced in the later transition, when the long-run effects of investments played out their role in the economy. Additionally, even in later transition, by 2010, some countries such as Belarus or Turkmenistan, for example, have less than a 30 % share of the private sector in GDP (European Bank for Restructuring and Development, 2011b). Evidently, the entry of new firms in some countries was hindered by the environment, mainly created by the weak governments (Polterovich and Popov, 2005).²⁸

- Namely, the first group, which managed to create a normal economic environment in a relatively short period, recorded an increase in profits in late transition, due to the relatively low wages and still high unemployment rate (EBRD, 2000). This encouraged investments and foreign investments further, and increased the contribution of the private sector to GDP.
- On the other hand, in the second group some governments actively made it hard for the private sector to operate by expropriating part of the profits. In the transition literature, the expropriation of profits through official corruption was identified as the most conspicuous of such actions. The studies of McMillan and Woodruff (2000, 2002) and the surveys of the European Bank for Restructuring and Development on assessing risks of running businesses confirmed this situation. In the long run, this negative environment that seized profits actually resulted in increased risk in managing businesses, which eventually lead to decreasing investments and unequal profits earned on unfair merits²⁹ (Glaser-Segura et al., 2006).

In general, rare evidence on profits in the course of transition suggests that profit paths actually reflected the character of the whole economic environment in the countries. Low, unstable and unpredictable environments at the beginning of transition created conditions for unstable,

²⁸Additional discussion on the weak government role in the course of transition is given in section 3.3.1 of this chapter.

²⁹More on the perceptions of the firms on the macroeconomic and social environment is presented in section 3.2.4 of this chapter.

unpredictable and in some cases very high profits, which is in accordance with the neoclassical theory assumptions (Hamma et al., 2012). However, not all potentially high profits could have been realized due to the general instability at the beginning of transition.³⁰ Additionally, for the same reason, profits could not play out their complete allocative role in the economy. In later transition, in some countries they gain their role as resources allocator as the complete environment becomes more stable and predictable (Hamma et al., 2012). Under the condition of high unemployment, profits actually raise in successful transition countries in late transition. On the other hand, in transition countries with an unstable economic environment, profits continue to be constrained by the existing constraints in the economy (Capolupo, 2012).

3.2.2 Human capital and labour

Human capital is a specific concept that augments the role of the labour force in production. This concept is not interested only in the employment quantity but also in the employment structure and its quality. The main argument is that ability of workers to adopt new skills during production, to learn by doing, to imitate and to innovate depends greatly on their education (Lucas, 1988).

The concept of human capital and its measures are highly developed and tested for the case of developed countries. However, regarding this issue, transition countries enclose some peculiar features. The most appropriate depiction of the educational structure of the employed are the years of schooling of every worker. However, these data are not available for transition countries. In most growth literature, secondary school gross ratios are used as a proxy for human capital (Arandarenko, 2007). Figures on secondary school enrolment available from *World Development Indicators* (World Bank, 2012) reveal interesting trends: secondary gross

³⁰ The idea of distinguishing between the potential and the actually realized profits at the onset of transition will be further elaborated in chapter 4.

enrolment ratios generally are high, though, show some variations in the first stage of transition for some of the transition countries in which specific conditions of war or conflict prevailed. However, although in general the figures on secondary enrolment in transition countries are high by international standards, it is questionable whether the workers skills gain are in accordance with the demand of new markets (Arandarenko, 2007).

3.2.2.1 Obsolescence of the human capital

One of the controversial achievements of the socialist system was in the field of education, being probably the most impressive during the first half of the socialist period. However, later on some qualitative deficiencies of the educational system under socialism emerged because of various reasons: political and ideological pressure on research and training; isolation from world achievements; and an emphasis on memorizing instead of development of analytical skills (Ronnås, 1997). Overall, education was poorly adjusted to the needs of the emerging market economy and to the civil society supposed to be built up in the course of transition (Arandarenko, 2007). In addition to the problems in the educational system, the inherited economic structure affected obsolescence in further ways. Before transition, heavy industries dominated in most transition countries such as mining, forestry, steel production, and farming. All these primary production branches employed a workforce with relatively low education, which was extensively laid off during transition (Campos and Corriceli, 2002). In transition, this orientation reflected itself in an increased proportion of unskilled workers in the unemployed work force. Furthermore, those workers employed in vibrant sectors such as trade, services, and computer-based industries did not have the corresponding market orientation and skills (Arandarenko, 2007). In that context, Capolupo (2012) analysis on growth determinants and GDP per capita growth rates indicated that real GDP growth in all the eight countries was mainly driven by physical capital accumulation, whereas the contribution of human capital was insignificant or even negative.

In the context of human capital, one more characteristic is of interest. Namely, long-term unemployment,³¹ which negatively influences workers skills and abilities, is severe in transition countries, particularly in lagging groups. In addition to long-term unemployment, non-participation, as a special adjusting labour market mechanism, comprising the inactive population that can work, but it is not interested in finding a job, increased significantly during transition; in some transition countries, the inactivity rate reached 45% (Nikoloski, 2009). Usually the explanations of this situation for transition countries are found in so-called “discouraged workers”, formed from the unmotivated part of the work force that is mostly with lower education and at the age tails (Nikoloski, 2009). In a growth context, the increase of non-participation rates implies less competitive pressure in the labour market for skills improvements and education.

Having all these qualitative issues concerning human capital in the background, the analysis of the contribution of human capital to growth will resolve to the analysis of its quantity. Indeed, this is rather unusual since the qualitative issues of human capital have enormous importance for growth, especially in developed mature economies. However, in this thesis the research focus is towards the big structural changes in factor determinants that in the case of human capital were predominantly reflected in the huge changes in the quantity of the employed labour force rather than in changes in its characteristics and skills. Hence, in section 3.3.3 additional discussion is given on the peculiarities of labour market adjustments in transition.

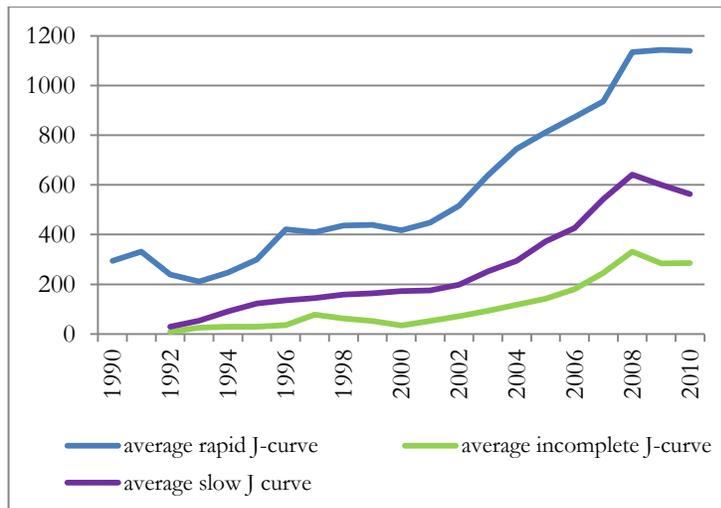
³¹Long-term unemployment comprises unemployment of people over 1 year (according to International Labour Organisation definitions).

3.2.2.2 Wage system adjustments during transition

An additional indirect and simple measure of labour productivity movements in a country is real wage evolution, which may be assumed to vary directly with labour productivity in the case of developed market economies. Yet, in the peculiar conditions of transition, wages also depend on specific adjustments on the labour market alongside the productivity movements (Cashell, 2004). For example, in a specific case of high long-term unemployment, labour productivity might follow an increasing path accompanied by stagnant or even decreasing wages, as long as there is huge supply of additional labour on the markets. This section offers an additional insight into wage movements in countries in transition as this indicator can assist in completing the picture of labour market adjustments in transition countries in a comparative perspective. Since this indicator encompasses only the manufacturing sector and lacks data for the starting years of transition and for some countries, it should be noted that its explanatory power is very limited and narrow.³² In the figure, the y-axis presents the average real manufacturing sector wages for selected transition groups.

³² The averages are calculated by taking only the available data for the countries in each group. Since in various groups data are missing for various periods these data should be taken with great caution.

Figure 3.2-3 Real manufacturing wages for selected groups of transition countries (in unweighted averages, in US\$)³³



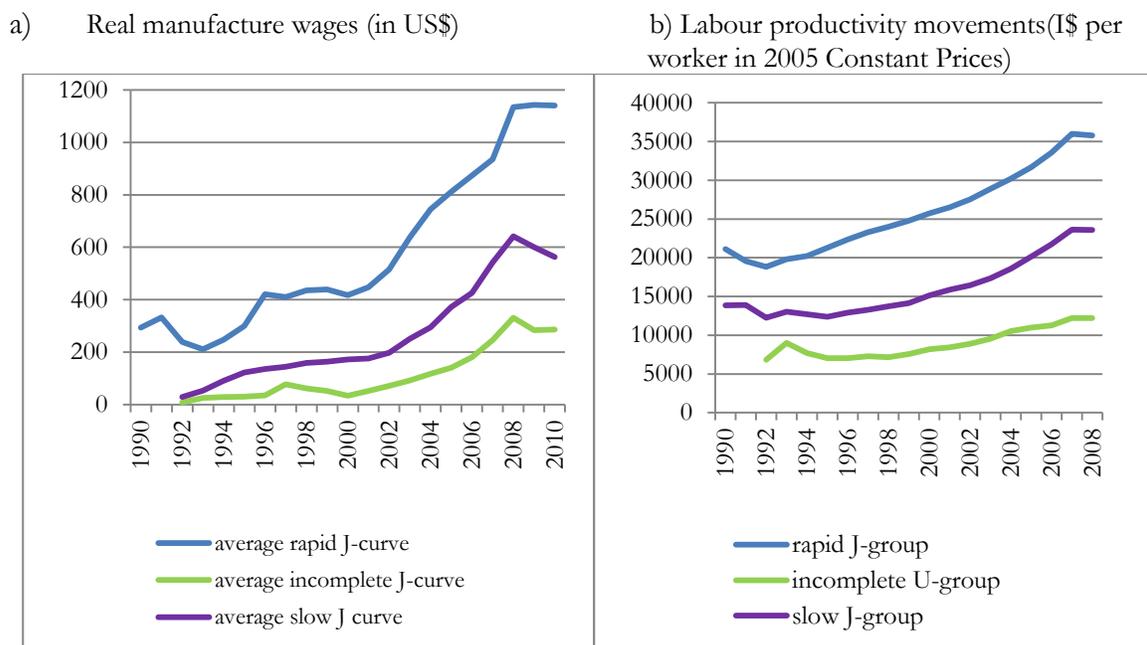
Source: Author's own calculations based on the data source: United Nations Organisation (2012).

The starting year on manufacturing salaries data is 1990 for the rapid -J group and 1992 for the slow - J and incomplete-U group of countries. Although the data for the onset of transition are missing, it can be noticed by 1992 real manufacturing wages were comparably the lowest in the incomplete-U group of countries, followed by the slow-J group; while the rapid-J group of countries is characterized by the highest manufacturing wages, which reflects probably higher productivity in this group. The phase of falling wages ends by 1993 and 1992 in the rapid - J and in the slow-J countries (when averages are observed); however, within the incomplete-U group

³³The long definition of the indicator used is given in the Notes of the United Nations *Manual*. Gross average monthly earnings in cash are defined as the total remuneration, before any deduction from income tax and before social security contributions. They include direct wages and salaries, remuneration for time not worked, bonuses and gratuities paid by the employer directly to the employee. Data reflects earnings of full-time employees in the total economy. Wages common currency (US\$) estimates are computed by using the nominal exchange rates.

wages record unstable movements with some reversals in the course of the whole mid-transition. If Figure 3.2-3 is compared with Figure 3.4-1 on page 107 the resemblance between the manufacturing wages' movements and productivity movements (measured as real GDP per worker) in various groups becomes even more obvious. The combined figure is given below.

Figure 3.2-4 Combined figure for real manufacturing wages movements and labour productivity movements (unweighted averages for groups)

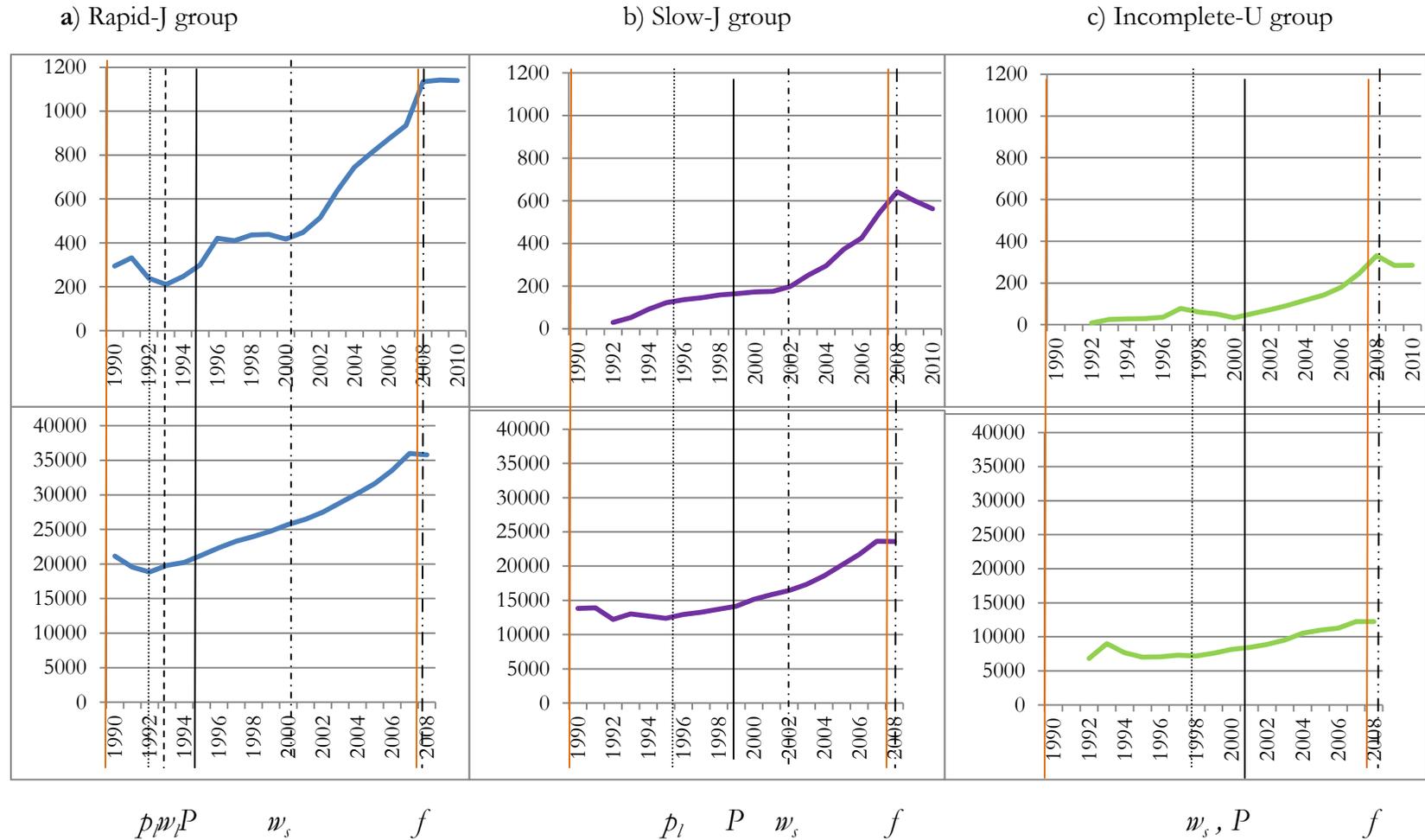


Note: Although the units of measurement are different in both graphs, the purpose of the graph is to give a general depiction. In addition, the right graph includes the available data until 2008. More importantly, it is worth noting that the graph a) gives the movements of the wages in the manufacturing sector only, while the graph b) shows the labour productivity movements for the whole economy, aggregated for the three groups.

Source: This combined figure is based on Figure 3.2-3 and Figure 3.4-1. Data source: For real manufacture wages: UNECE Statistical Division Database, compiled from national and international (CIS, EUROSTAT, IMF, OECD) official sources; and, for real GDP per worker: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011.

The similarity between the labour productivity and wages patterns for the separate groups is evident, with the rapid-J group being characterized by both the highest productivity and wages for the whole transition in contrast to the incomplete-U group of countries at the opposite extreme. Individual combined figures are presented in Figure 3.2-5. Upper set of graphs gives real manufacture wages (in US\$), while the lower set shows Labour productivity movements (I\$ per worker in 2005 Constant Prices). For accuracy reasons years 1990 and 2008 are marked in red colour. When individual figures are observed more detailed picture emerges.

Figure 3.2-5 Real manufacturing wages (top) and labour productivity (low) (unweighted averages for separate groups)



- Namely, in the rapid-J group, the wages show some extent of rigidity at the beginning of transition. As productivity falls and bottoms out (point p) average wages fall with a small delay. Hence, after the bottom, the rise of productivity is accompanied with even further decrease of wages. Only after a year do they touch the bottom point (w). Recovery of initial productivity (point P) is parallel with the wages increase, which is interrupted in middle transition, i.e. middle 1996, when wages stagnate for 4 years (till point w), while productivity continues to rise. This rigidity of wages as compared to productivity movement is obvious in this period. After this, i.e. after 2001, wages raise parallel with productivity. All this ends with the shock of the Global Financial Crisis, marked by point f .
- For the slow-J group, data on wages movements start from 1992; hence, it is impossible to follow their starting adjustment. However, what is obvious for this group is that the productivity fall lasts longer, i.e. until beginning of 1995(p), which is accompanied by increase in average wages. Recovery of average productivity is achieved in late 1999(point P), accompanied by only slight increase of average wages. Afterwards until 2002 the increase in productivity is accompanied by lesser increase in wages, again reflecting rigidity in wage adjustments (till point w). Only after 2002 do wages and productivity show significant increase.
- For the incomplete-U group, wages show increase or steadiness in spite of the falling productivity until middle 1998 (till point w). After this, fall in wages is accompanied by the rise of productivity. After middle 2001(point P) rise in average productivity is accompanied by stronger increase in wages in this group of countries.

All the above descriptions must be taken with great caution, since the figures are created using limited and incomplete data series. However, it can be concluded that wages show some degree of rigidity when adjusting with the movements of productivity in all groups of countries. Namely at the beginning, wages either fall slower (as in the rapid-J group) or show increase despite the fall in productivity (in the slow-J or incomplete-U group). Interestingly, the starting increase in

productivity is accompanied by fall in wages in all transition countries with the lowest wages point following the lowest productivity point (w_s point following p_l point). In middle transition, wages again show some extent of rigidity observable in all groups of countries: i.e. in the rapid-J group ending with w_s in 2000; in the slow-J group ending in 2002; and in the incomplete-U group ending in middle 2001.

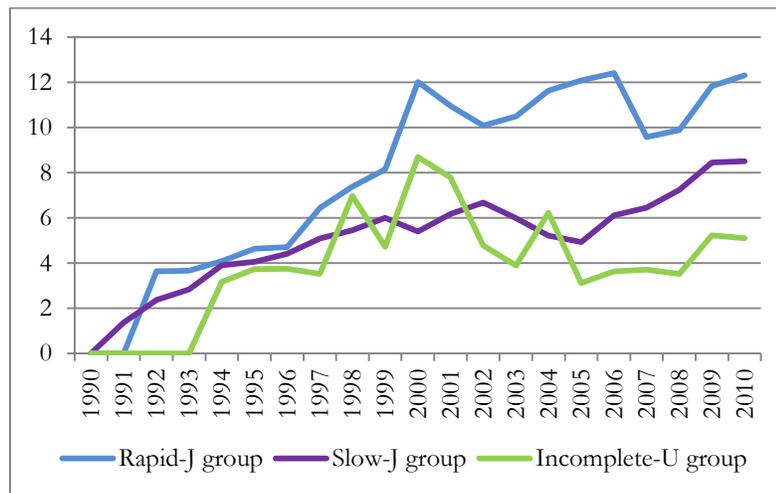
3.2.3 Technical progress – implicit indicators

One important criticism for socialist economies was related to the weaknesses of technology development policies. Instead of favouring TFP growth and innovations, these policies supported and built fast industrialization based on extensive growth at the expense of agriculture and large investments in fixed capital as discussed in chapter 2, section 2.2. These sources of growth eventually ran their course by the middle-seventies as most transition countries experienced lower growth under the weight of successive external shocks (Rider and Knell, 1992). By the eve of transition, inefficiencies and shortages had become obvious. Lack of TFP growth inevitably led to exhaustion of growth, under the governing rule of diminishing returns to scale as Solow (1956) predicted. The mainstream theoretical consensus is that technical change and innovations are the key factors for growth in industrial countries, as emphasized in neoclassical theory and extensively explained in endogenous growth theories.

It is difficult to measure technical change in countries, in transition countries in particular, due to the lack of data. Hence, any conclusions on technology development efforts of the countries need to be indirect and based on proxied indicators. One of the indicators that can be used is prevalence of high-technology exports in total manufacturing. Although this indicator might capture the impact of some other factors such as change in the production structure, impact of liberalization and so on, still it is the closest one that in the absence of other data can offer

comparative and historical perspective on technical changes in the country groups. Unfortunately, even this indicator is missing for some transition countries, and for some countries data series are incomplete. Hence, conclusions based on the figure below should be taken as suggestive only.

**Figure 3.2-6 High-technology exports (% of manufactured exports)³⁴,
as unweighted averages for country groups³⁵**



Source: United Nations *Common Database*, ESDS International, University of Manchester (April, 2012)

As Figure 3.2-5 shows, the beginning of transition is marked on average by very low high-tech exports as a percentage of all manufactured exports for transition groups. However, this percentage increase in the middle transition, with the highest increase recorded by the rapid-J

³⁴United Nations gives long definition of the indicator used. High-technology exports are products with high R&D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. Aggregation method: Weighted average.

³⁵This figure has very limited descriptive power, especially for the beginning of transition due to the fact that it is based only on the available data for certain countries, however not complete for all of them for each year. In addition data for B&H, Kosovo, Montenegro, Tajikistan and Uzbekistan are missing. Yet the figure can be used in order to get some historical perspective of changes during the transition period in the high tech exports of the country groups.

group of countries, and less increase in the other two group of countries. Additionally, in middle transition, this indicator is relatively stable for the rapid-J and slow-J groups, while for the incomplete-U group it shows decreasing trend. In later transition, the rapid-J group achieve a remarkable raise in this indicator, while unusually the indicator shows a decrease for the incomplete-U group, suggesting that this group of countries on average was losing markets for high-tech exports in the international market during this period. Nevertheless, even in later transition, all transition groups, including the most successful rapid-J group, are below the high-income or EU, and even the middle-income country averages as Table 3.2-2 below presents giving the same indicator for 2008 for the individual countries together with the group means.

Table 3.2-2 High-technology exports (% of manufactured exports, 2008)

Country/ Group(mean)	High-technology exports (% of manufactured)	Country/ Group(mean)	High-technology exports (% of manufactured)
Slow-J group	7.56	Rapid-J group	9.89
Armenia	2.49	Albania	3.67
Azerbaijan	0.9	Czech Republic	14.3
Belarus	2.35	Estonia	10.5
Croatia	9.14	Hungary	24.2
Latvia	7.14	Poland	5.24
Lithuania	11.4	Slovak Rep.	5.27
Kazakhstan	21.9	Slovenia	6.1
Russia	6.52	Incomplete-U group	3.31
Uzbekistan	n/a	Georgia	2.68
Bulgaria	6.56	Kyrgyzstan	3.11
Macedonia	n/a	Moldova	4.24
Romania	7.24	Ukraine	3.22
EU	14.35	Serbia	n/a
High income countries	18.65	Uncategorized countries	3.89
Middle income countries	16.9	Montenegro	n/a
Low income countries	n/a	B&H*	3.89

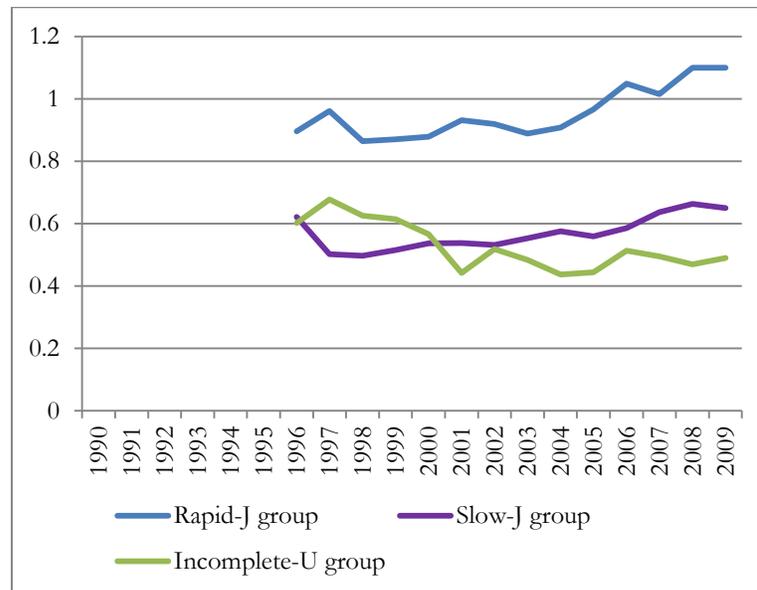
Note: Year 2008 is taken in order to avoid possible changes caused from Global Financial Crisis. Source: United Nations *Common Database*, ESDS International, University of Manchester (April, 2012)

According to this indicator, none of the transition group could reach the mean value for EU countries of 14.35 per cent by 2008. In fact, only five countries - Hungary, Czech Republic, Estonia, Lithuania and Kazakhstan (the first 3 rapid- J and the last 2 slow-J group) -manage above 10 per cent of high-tech export goods in their total manufactured exports, with Hungary exporting the most, i.e. above 24 per cent of its total manufactured exports. This situation suggests weak competitiveness of most transition economies in high-tech products on the international markets, where mostly developed industrial economies are dominant. Namely, this indicator on average for middle- and high- income countries is 16.9 % and 18.65%, respectively, of their total manufactured exports for the same year (United Nations *Common Database*, ESDS International, University of Manchester, 2012).

An additional indicator that indirectly can shed some additional light on technical efforts of the countries is research and development intensity measured by the expenditures for research and development (both public and private) as a percentage of GDP.³⁶ Although it is incomplete for the beginning of transition, this indicator again reveals a similar story as given above. Namely, all transition groups in the course of the whole transition are close to the level of this indicator for the middle-income countries, with the EU being far above with an average of above 1.75 per cent of GDP expenditures for R&D for 2008.

³⁶The long definition of the indicator used is given by United Nations Educational, Scientific, and Cultural Organization (UNESCO) *Institute for Statistics*. Expenditures for research and development are current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development. Aggregation method: Weighted average.

Figure 3.2-7 Research and development expenditure (% of GDP) for various groups of countries (in unweighted averages for transition groups)



Source: United Nations Educational, Scientific, and Cultural Organization (UNESCO) *Institute for Statistics* ESDS International, University of Manchester (April, 2012).

In historical perspective,

- Among the transition country groups, the rapid –J group shows the highest percentage of GDP invested in R&D, which slightly increases in later transition, i.e. after 2005, reaching above 1% of GDP on average for the group.
- The slow-J group also shows similar movement and increase in later transition as the rapid-J group, however on the much lower level of 0.5% on average.
- In contrast, the incomplete-U group is the only group characterized by a decreasing trend in R&D expenditures (as a percentage of GDP), which in later transition falls even further - below 0.5%.

It should be noted here that data for the research and development structure, in terms of private and public expenditures, are not available for transition countries. This differentiation might have been useful in order to see how comes from economic agents that are in the private sector, hence responding to market-based incentives, and how much is related to fundamental research, which is mostly publicly funded.

As for concluding this brief discussion, it is interesting to relate the technology efforts in terms of expenditures as a percentage of GDP and the success of the country in high - technology exports. It seems that higher expenditures result in higher success in high-tech export in the transition countries; with, in this case, the rapid-J group being the most successful, especially in later transition, and the incomplete-U group being the least successful.

This part mainly focuses on indicators of technology development, which as admitted involve many critical issues regarding measurement problems of technical change and measures of skills, especially in the context of transition (Autor et al., 2003). If technical progress is to be observed over time, these problems are even more pronounced, since data on the indicators presented above are mostly missing for the beginning of transition. Yet, several general notes drawn from the transition literature and a glance at the figures presented can be summed up regarding technical progress in transition countries. Namely, during the starting transitional period research and technical progress are minimal, due to the inherited obsolete structure and low investments; later in the course of transition the research incentive increases, which is reflected in the increase in high-tech exports. It is worth noting that high-tech exports are mainly related to FDI, which in turn would suggest that the source of technical change is mainly exogenous (Campos and Kinoshita, 2008). However, as the tables and data in this section show, on the eve of transition, technical progress becomes more fundamental, especially in the more successful transition countries i.e. in the rapid-J group (Drahokoupil and Myant, 2012).

3.2.4 Institutions and social capital

3.2.4.1 Formal and informal order in transition

It becomes widely recognized that development of institutions plays a specific role in a country's growth. The state's institutional capacities are important indicators of government power to enforce the formal order, its rules and regulations (Castanheira and Popov, 2000). Furthermore, institutional development is an important component for a country's growth, as it ensures greater legal protection, enforcement of contracts, enforceable property rights and a climate hospitable to business (Easterly et al., 2006; Efendic et al., 2011).

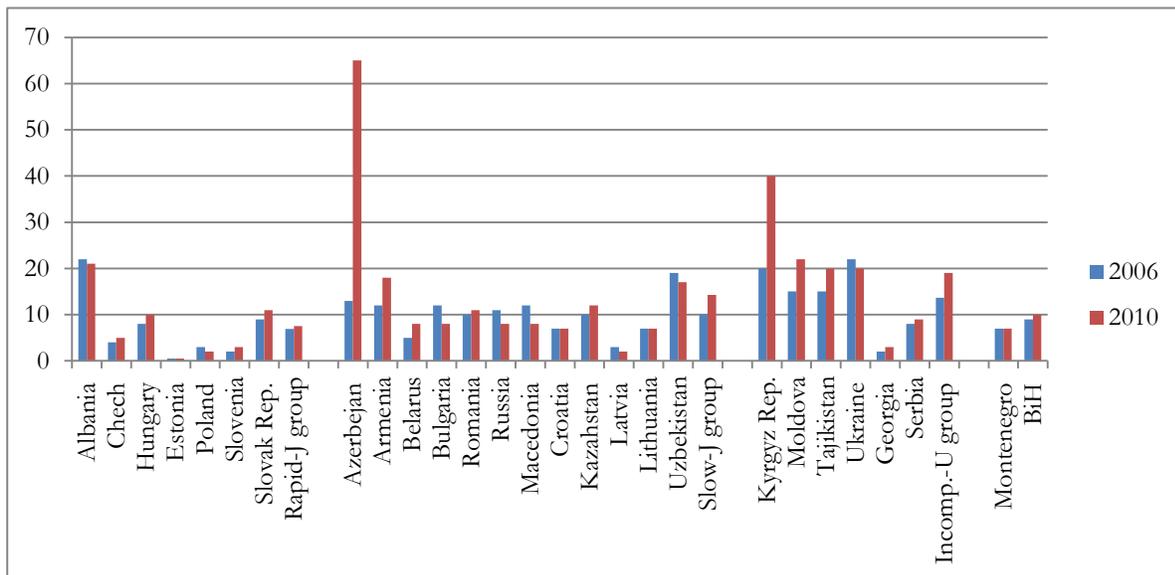
Dabrowski et al. (2000, p. 18) give a wide definition of institutions specifying them as "formal rules and institutions (legal codes, court systems), and also rules of behaviour, expected even from those with unknown reputation". In general, institutions create the economic environment in which economic agents function that in turn makes them an important ingredient for growth (Hall and Jones, 1999). Better institutions with less weaknesses and limitations are an important precondition for growth (Dollar and Kraay, 2002).

Evidently, transition countries that had to build new institutions, laws and social norms in such a short period were prone to more institutional shortcomings, some far more serious than the institutional weaknesses identified in developed countries. In that context, Stiglitz (1999) suggested that new institutions should have been built on old inherited institutions in a gradual transition process, as China managed to do so. He stated that only gradual introduction of laws that correspond to existing norms are likely to succeed. Conversely, Dabrowski et al. (2000) disagreed suggesting that old social norms relating to economic activity, which had existed under socialism, expired even before the collapse of communism. In that situation,

governments were faced with a peculiar situation of absence of appropriate norms and urgent need for introduction of new laws and institutions.

Indeed, introduction of laws, institutions and norms in many transition countries proved to have incoherent and uncoordinated paces. Clearly, under these circumstances many deviant processes developed in transition countries, in some countries in particular, such as corruption, weak rule of law, increased number of economic crimes, which in transition literature are taken to be measures of the degree to which institutions are not suited to the needs of a market economy (Roland and Verdier, 2003; Anderson and Gray, 2006, Michailova and Melnykovska, 2009, Friedman, 2002). For example, a survey conducted by the European Bank for Reconstruction and Development in 2010 revealed that a huge percentage of the people in transition countries perceived a necessity for unofficial payments or gifts to public servants. The figures by countries and different groups are given in Figure 3.2-8 below.

Figure 3.2-8 Average level of perceived necessity of unofficial payments and gifts for public servants in separate countries and in averages for the country groups (% of respondents) (for 2006 and 2010)



Source: European Bank for Restructuring and Development (2011). *Life in Transition*, Surveys conducted in 2006 and 2010.

As the figure shows, the rapid-J group countries have the lowest average indicator revealing the highest confidence in public service in opposite to that of the slow-J or, worse, of that of the incomplete-U group. Additionally, for the last two groups the indicator shows substantial increase instead of the “desired” decrease. In addition, the figure reveals strong divergence within the groups, with Albania, Azerbaijan and Kyrgyz Republic being negative outliers in the respective groups, especially in 2010.

In general, the above figure also suggests a low level of trust within these societies. The conventional wisdom is that trust is an important ingredient of social capital that facilitates the functioning of the economy. The *Life in Transition* (European Bank for Restructuring and Development, 2011) provides insights into this issue categorizing trust measures into “generalized trust”,³⁷ “group trust” and “institutional” trust. Interestingly, the general trust which in 2006 in transition countries on average as a group was 30% of respondents having some or complete trust did not change significantly. It rose only to 34 % of respondents, while at the same time for developed countries this percentage was 42%. The situation is pretty much similar across all transition countries showing modest levels of trust. With respect to “group” trust, the results are much higher (around 60% of people showing trust in their families, relatives, neighbours and so on.). With respect to the country groups, the highest trust is measured in the rapid-J group in contrast to the incomplete-U group with the lowest trust. Yet most interesting for this research is the “institutional” trust. This analysis confirms the correlation between institutional trust and corruption. Higher corruption reflects a low level of trust in the economy. In particular, across the transition world belief in courts is low, with this emphasized in slow-J and incomplete-U group.

³⁷Generalised trust is measured by asking the respondents to answer to the question: Would you say that most people can be trusted, or that you cannot be too careful with people? The answers are scaled using five-point scale: completely trusted, some trust, neither trusts neither distrust, some distrust, complete distrust.

Having indirect and heterogeneous indicators for the countries in each group, it is difficult to draw any convincing conclusions. However, the general impression is that the business environment is more stable and better formally ruled in the successful transition countries (mainly the rapid-J group, Albania excluded) compared to the lagging transition countries (mainly the incomplete-U group); with the slow-J countries being in between the extremes (European Bank for Restructuring and Development, 2011).³⁸

Having malfunctioning formal institutions, many countries created specific informal institutions or private order that acted in place of the inadequate legal system (Efendic et al., 2011a). In general, private order exists in every country, developed market economies included, and it is a complement to the legal system, articulated through norms, values and reputation assessment (McMillan and Woodruff, 2000). However, in the case of transition countries, private order, which consist of “social networks and informal gossip that substituted for the formal legal system”, gained the primary role to rule social life, the economy included (McMillan and Woodruff, 2000). As McMillan and Woodruff (2000) show, to some extent, private order had played a positive role in the course of transition, creating side-mechanisms that supported the economy in the absence of institutions, such as: trustworthiness of bilateral relationships; communal norms; and trade associations and market intermediaries. However, in some transition countries private order overtook the whole control power, overflowing into criminal violence; hence, deterring overall productivity by excluding new entrants in sectors or by expropriation of profits. Additionally, it is argued that private order is strongly involved with “ethnic” discrimination, which is especially relevant for transition countries that experienced fragmentation, war or conflicts (McMillan and Woodruff, 2000).

³⁸EBRD and World Bank surveys were conducted for transition countries in 2002, 2005 and 2009. The data for the beginning of transition are missing.

3.2.4.2 Organizational capital and emergence of vested interests in the course of transition

One particular form of social capital is so called “organizational capital” that Dabrowski et al. (2000) define as the value of a productive organization over and above the value of its assets that is due to existence of habits, formal rules and trust. In short, organizational capital is a name for maximal efficiency that enables elimination of the inefficiencies within the firm or broader system (Coase, 1937).

Having in mind the definitions, it becomes clear that it is difficult to assess organizational capital formation during transition. Various authors take different stands towards this issue. According to Stiglitz (1999), organizational capital existed in socialism and it should be preserved as very valuable under conditions of transition because, once dissipated, it cannot be easily reassembled, particularly in environments with little entrepreneurial experience. Havrylyshyn et al. (1999) agreed, partly stating that organizational capital started to deteriorate before transition that is at the eve of socialist period when huge inefficiencies in firms were recorded. In their view, transition was supposed to eliminate those inefficiencies and create appropriate organizational capital. However, Dabrowski et al. (2000, p.10) strongly rejected the hypothesis that old inherited organizational capital can be put to use during transition, by specifying several reasons:

Much of the organizational structure of the state owned enterprises (SOEs) is unsuited to operation in a market – e.g. the almost complete absence of sales and marketing function and the considerable attention paid by management to purchasing. The capital structure and the labour skills structure of SOEs are usually unsuited to producing goods profitably at the relative prices that obtain after the liberalization of prices, entry and international trade.

Instead, the authors suggest development of a new private sector that is flexible and fast reactive towards the changes in the environment. The evidence for the former proposition is the fact that, in transition economies, *de novo* private firms have been found to be far more efficient than all other categories of firm – both privatized and state owned – with the exception of firms run by foreign direct investors (McMillan and Woodruff, 2000, Havrylyshyn and Gettigan, 1999).

In the transition literature, organizational capital formation in the course of transition is also related to the emergence of vested interests. The first and simplest economic task to liberalize the economy in a situation where the need was for dramatically changing rules actually meant benefits for some groups of people, mainly the so called “old nomenclature”, and more corruption for the government (Ronnås, 1997, Beck and Laeven, 2006; Michailova and Melnykovska, 2009). In the absence of overt privatization, the old elite made their money through asset stripping manufacturing firms, through their preferential access to cheap credits from the banks, the preferential privatization to them of natural resource based (not manufacturing) firms, and their ability to benefit from monopolized domestic prices (Hamma et al., 2012). Holding their power in the course of transition, the old elite became also a main political threat to sound economic policy, especially noticeable in “lagging transition countries” as Havrylyshyn (2001) suggests.

3.3 Growth determinants in the specific context of transition

3.3.1 The role of government in the course of transition

Systems determinants, such as national policies and institutional settings shape the macro environment in which firms operate (De Melo et al, 1996). Better government and stable institutions have proved to be conducive to growth according to the growth literature, not only

in the case of developed but also in the case of developing and transition economies (Michailova and Melnykovska, 2009). Thus, the main goal of each government is to create a well-functioning and predictable institutional and macroeconomic environment as a necessary though not sufficient condition for sustainable growth (Fischer, 1993). According to Burki and Perry (1998), the macroeconomic situation is stable and sustainable when inflation is low and predictable, real interest rates are appropriate, fiscal policy is stable and sustainable, the real exchange rate is competitive and predictable, and the balance of payments situation is perceived as viable (at least, sustainable). Additionally, the institutional environment is stable when there are effective “formal and informal rules and appropriate enforcement mechanisms that shape the behaviour of individuals and organizations in society” (Burki and Perry, 1998, p.11). The promotion of the overall institutional and macroeconomic stability was particularly demanding for the transition economies where strong destabilization forces had to be countered with poorly developed instruments and little relevant experience with respect to implementation (Havrylyshyn and Rooden, 2000; Beck and Laeven, 2006).

The real macroeconomic framework created in transition countries drifted significantly from the above definition especially at the outset of transition. Gligorov and Mojsovska, (2005) suggest that this government behaviour was rather expected, because significant political and economic changes led to losses in production and employment, which induced higher social spending and public expenditures accompanied by fiscal deficits. Monetarisation of the deficits and liberalization of prices resulted in higher inflation rates in the first stage of transition. However, while the governments in successful transition countries managed to achieve macroeconomic stabilization and institutional reform in a short period of time, governments in lagging transition countries were characterized by lower dedication to reform, often justified by more complicated political, social and economic situations (Havrylyshyn and Rooden, 2000, Beck and Laeven, 2006).

The onset of transition imposed several changes regarding government behaviour: reduced size of the former planning system; reduced interference into the economy accompanied by increased government expenditures for social purposes; higher transparency for tax collecting and government expenses; and increased fiscal discipline (Gomulka, 2000, Popov, 2004). Faced with such huge challenges, several unconstructive processes developed: inability of institutions to adapt to new roles and to give up their prior power; unwillingness of public servants to practice new rules of work; resistance of people towards fiscal duties, accompanied by high expectations inherited from the previous system and reinforced by expectations aroused by transition ³⁹(Gomulka, 2000; Easterly et al., 2006). As a result, budget balance indicators showed negative trends. Most of the incomplete-U countries and slow-J countries have in a number of years had annual budget deficits in excess of 5 per cent of GDP (Svejnar, 2002). These countries contained their budget deficits in later years despite the deepening of the recession and low tax revenues. The weaknesses of fiscal institutions in collecting taxes as well as the problem of tax evasion additionally contributed to the deficits recorded. Regarding price stability, transition economies recorded two phases. While, in the first phase, consumer price inflation in most of the transition countries revealed high or hyperinflation, in the following period they managed to reduce their inflation rates to single digits (Svejnar, 2002). For comparison, Poland, Slovenia, Albania, Bulgaria and Romania all experienced at least one year from 1990 to 1993 when consumer price inflation exceeded 200 per cent; Estonia, Latvia and Lithuania all had one year with inflation around 1000 per cent; and Russia, Ukraine, and Kazakhstan experienced at least one year when inflation was above 2000 per cent.

An additional key component of macroeconomic stability is a well-functioning financial sector. While a weak financial sector can undermine growth, because resources are misallocated, a

³⁹The unrealistic expectations increased the propensity for Ponzi – i.e. pyramidal - schemes that collapsed shortly in financial crisis in many transition countries – for example: Albania, Macedonia, Serbia, and B&H.

strong and developed financial sector can play a vital role in fostering economic growth (Fischer and Sahay, 2000). By providing credit to those investments that offer the highest risk-adjusted rates of return, banks, alongside the services of other financial intermediaries, contribute to a higher growth rate for the economy as a whole. Transition countries abolished the monobank system or system of tightly related commercial banks and allowed the creation of new and independent banks and financial institutions in the early stages of transition (Svejnar, 2002). However, these changes in the absence of regulatory and supervisory regimes led to the collapse of many small banks and the emergence of pyramidal schemes that shattered the trust in financial institutions in some of the transition countries. In the SEECs, these examples of failures in the financial sector were the most numerous. On the other side, large banks that inherited a sizable portfolio of non-performing loans continued their practice of accumulating bad loans during transition. In the later stages of transition, their restructuring was supported by governments and by the privatization and entrance of foreign banks.

As discussed in chapter 2, section 2.3, one of the features of transition was the liberalization of markets that led to freeing of prices for most goods. European Bank for Restructuring and Development data for transition countries show that most transition countries experienced a similar pace of price liberalization, with some countries from the CIS group lagging behind in this process. By 1993 the European Bank for Restructuring and Development index of price liberalization reached 3.7 points⁴⁰ for most transition countries, indicating that markets for most

⁴⁰The European Bank for Restructuring and Development assesses progress in transition through a set of transition indicators. These have been used to track reform developments in all countries of operations since the beginning of transition. Progress is measured against the standards of industrialized market economies, while recognizing that there is neither a “pure” market economy nor a unique end-point for transition. The measurement scale for the indicators ranges from 1 to 4+, where 1 represents little or no change from a rigid centrally planned economy and 4+ represents the standards of an industrialized market economy.

goods were highly liberalized (European Bank for Restructuring and Development, 2008).⁴¹ By 2010 this indicator for most transition countries stood at 4.33 (or 4.00), except for Uzbekistan, which recorded a reversal after 1997 reaching an index of 2.6 (European Bank for Restructuring and Development, 2011).

In addition to price liberalization, transition countries undertook trade liberalization, introducing world prices on the domestic markets. From the nineties, trade between transition countries was based on hard currencies, direct negotiation among enterprises, and payments mostly through bank arrangements (Fischer et al., 1996a and b). On the import side, direct state controls were replaced by indirect trade instrument such as tariffs and quotas (Svejnar, 2002). Within this framework, the advantages of national trade within the same states, as for example within the former Yugoslavia and the former Soviet Union, or of socialist negotiated trade disappeared. Generally, in all transitional countries, progress was made in the trade liberalization process, although with restrictions especially at the beginning of transition. The main arguments for increased tariff levels and import taxes at the onset of transition were the high adjustment costs that enterprises had to bear and their loss of export markets. By 2010, several countries such as: Uzbekistan, Turkmenistan and Belarus still recorded an index around 2, while this indicator was slightly above 3 for Tajikistan and the Russian Federation. (European Bank for Restructuring and Development, 2011).

In general, price and trade liberalization were policy reforms that were supposed to enable enterprises to reallocate resources in accordance with prices signals determined by demand and supply changes (Svejnar, 2002). Yet, the consequences of market and trade liberalization in terms

41 Data assessable on internet - <http://www.ebrd.com/search/query.html?charset=iso-8859-1&qt=structural+indicators>. Explanations for the definitions can be found from: <http://www.ebrd.com/country/sector/econo/stats/sibmeth.htm>

of effects on reallocation and restructuring differed in transition countries, depending on the differing pace of the reforms in these countries; and also depending on countries' peculiar characteristics. While initial decline in output, due to both supply adjustments and sharp demand falls, was common for all transition countries, the later reallocation and restructuring differed, generating various growth patterns. Thus, the following part of this section reviews the evidence on how much reallocation and restructuring occurred in transition countries.

3.3.2 Restructuring and reallocation in different transitional groups depicted in figures and tables

Transformation is an essential characteristic of every economy. It is usually described by the changes in the economic structure, i.e. by the changes in the shares of industry, agriculture and services in total GDP, by corresponding changes in the structure of employment, by the changes in organizational structure, changes in commodity structure and exports and so on (Eschenbach and Hoekman, 2006). The alterations in the economic structure usually are a good indicator of a country's economic position relative to economic structure of the leading developed industrial economies (Mitckiewicz and Zalewska, 2001; Eschenbach and Hoekman, 2006).

However, it is hard to incorporate the dramatic reallocation and restructuring characteristic of transition into the picture of the more steady systemic alterations observed in the developed industrial countries. Transition was rather characterized as a “deeper transformation” or as a “creative destruction” process, accompanied by several additional structural dimensions, such as change of the dominant ownership identity and corresponding changes in the form or legality of conducting economic activities (De Melo et al., 1997). These additional alterations, peculiar for transition countries' growth paths, have realized their impact through labour market adjustments and, hence, on overall productivity (Eschenbach and Hoekman, 2006). Nevertheless, in this

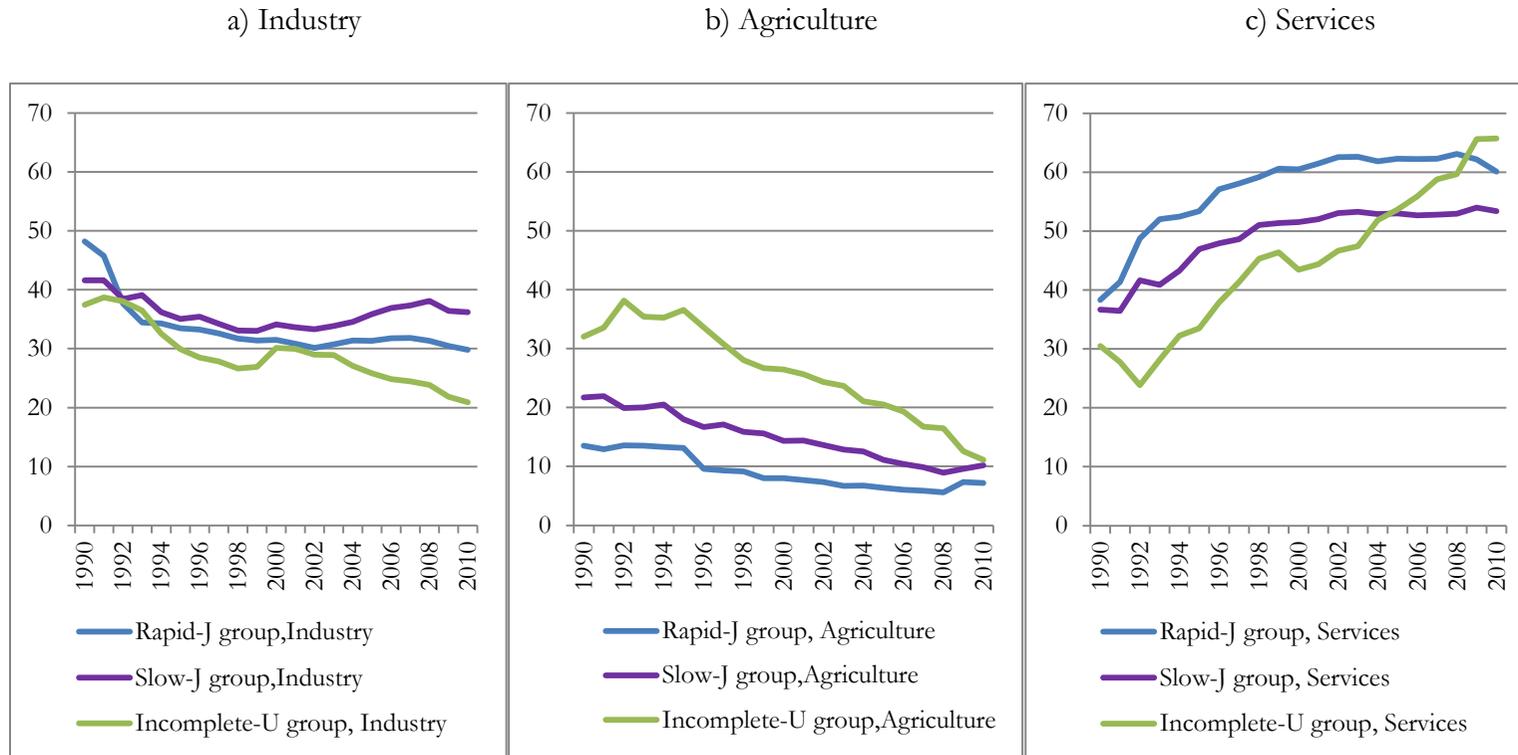
section the focus will be on the broad economic restructuring, i.e. changes in the respective shares of industry, services and agriculture in GDP.

Structural change has been repeatedly pointed out as a major force driving growth in transition, as resources were expected to move from low productivity activities to high productivity ones in the course of transition (Berg et al.,1999; Eschenbach and Hoekman, 2006). In addition, it was also expected that the structure of output would change rapidly in the course of transition. This analysis found that this did not happen equally fast in all transition groups. Additionally, one group, i.e. the incomplete-U group, recorded specific adjustment at the beginning of transition not similar to the ones observed in the other two groups.

From the structural point of view, all transition countries inherited an economic structure biased towards industry's share in GDP (Mitkiewicz and Zalewska, 2001). At the beginning of transition, the share of industry in GDP and the corresponding share of employment in industry in total employment in all transition countries were relatively high as compared to market economies with a similar level of income per capita.⁴² This inherited anomaly also meant distorted shares of agriculture and services in GDP that were supposed to be corrected in the course of transition (Eschenbach and Hoekman, 2006). Figure 3.3-1 below shows the structural changes in the main three groups of transition countries, measured by the averages of each respective sector's value added as a percentage of GDP.

⁴² For example, in 1990, EU the share of industry in GDP was 33.2%, the share of agriculture was 3.6% and the share of services was 63.2%.

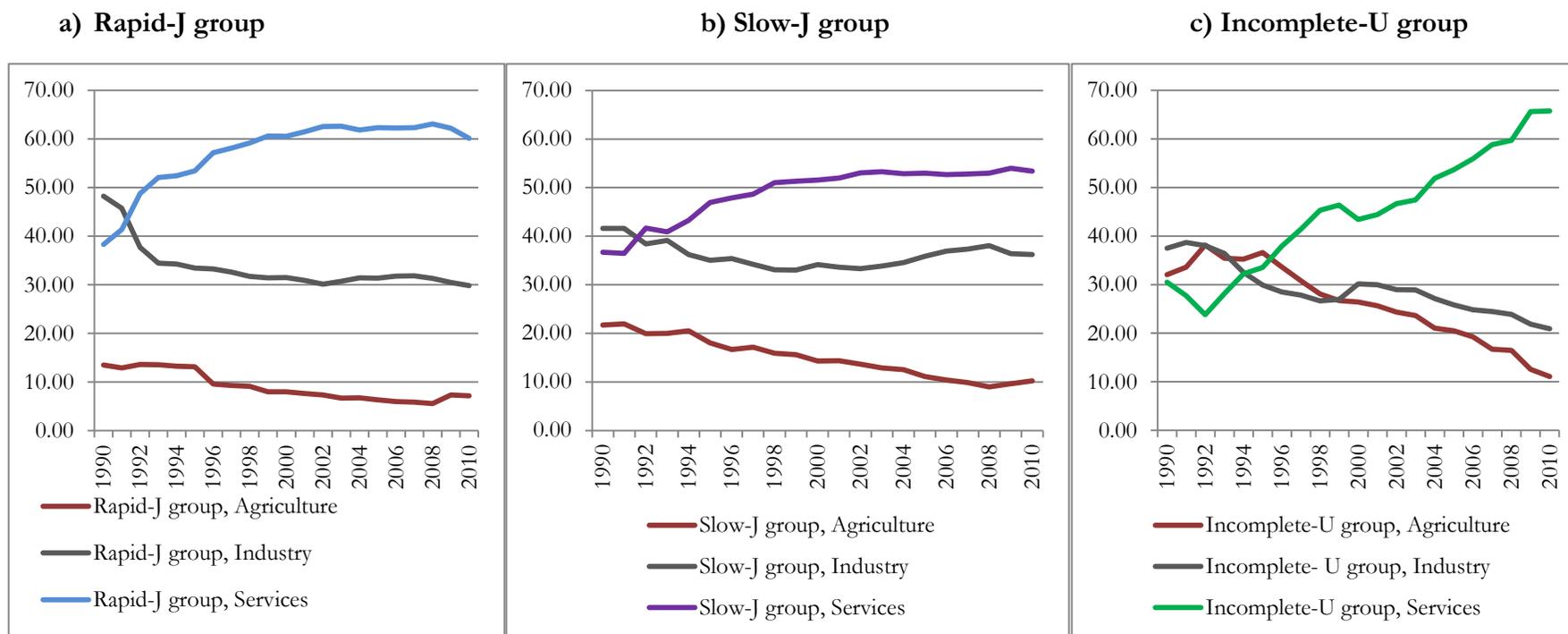
Figure 3.3-1 GDP shares of industry, services and agriculture sector in various groups of transition countries (1990-2010)
 (Measured by their value added as a percentage of GDP, respectively; averages for the three groups of countries)



Source: Author's Own Calculations based on data source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

- In general, industry was the largest sector at the beginning of transition in all countries. It accounted for close to half of GDP in all groups, with the rapid-J group having the highest, and the incomplete-U group the lowest share of industry in GDP (Figure 3.3-1.a.). By 2000, the share of value added in GDP by industry had changed drastically moving down to around a third of GDP (or around 33%), with the incomplete-U group experiencing the sharpest decline and the slow-J group the least change. By 2010, incomplete-U group has the smallest share of industry of around 20% and incomplete-U group highest share of industry of above 37%, while rapid-J group has around 30% share of industry in GDP value added. For comparison, in EU, the share of industry in GDP in 2010 was 23.8%.
- The opposite happened to the share of services: from around one third in 1990, it increased to 50-70% of GDP (Figure 3.3-1. c.) (Eschenbach and Hoekman, 2006). Comparison of the shares of value added by the service sector between country groups reveals that in the rapid-J group and incomplete-U group the services share in value added in GDP increased by more than 50% relative to the share at the onset of transition, while in the slow-J group its rise was the least. In the EU, the share of services in GDP was 74.6% in 2010, while in incomplete-U, slow-J and rapid-J countries it was above 67%, 52% and around 60%.
- It can be seen from Figure 3.3-1.b) that the agriculture share was relatively low in all transition countries, except for the incomplete-U group, at the outset of transition. However, agriculture development paths differed in the course of transition, with the rapid-J and slow-J-group recording gradual decrease; while the incomplete-U group records, instead, increase of the agriculture share in value added in GDP till 1994 and, thereafter, relatively steep decrease of the agricultural share in value added in GDP. Yet by 2010, all transition countries groups are still far away from approaching the EU or industrial countries that record a very low 1.5% share of agriculture in value added in GDP. In general, structural change paths were similar across transition groups with the incomplete-U group being the most different.

Figure 3.3-2 Structural adjustment in transition groups (industry, services and agriculture percentage share in GDP)



Source: Author's Own calculations based on data source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

1. As Figure 3.3-2 shows, the incomplete-U group is the only group that have experienced on average an increasing share of value added of agriculture in GDP at the outset of transition accompanied by the decreasing share of services in GDP as opposed to the movements observed in these two sectors in the other two groups. This peculiar movement probably resulted from the closure of the anyway small number of services firms, and the labour force absorption that the agriculture sector had at the outset of transition, reflecting the under-employment and resulting in a fall in agricultural productivity (Lerman, 2001). However, the services sector shows fast recovery. In parallel, the dissolution and closure of the previous big combined agricultural and processing enterprises and slow processes of privatization and denationalization of state land in this group of countries marked the agriculture sector development, transforming it into a subsistence-type inefficient sector in later transition (Boeri, 2000). It is interesting to note that consolidation of these changes delayed the restructuring in the beginning years of transition. Afterwards, this group experienced profound change in their economic structure, characterized by the largest changes in the form of decreased industry share in GDP (around 20%), accompanied by maintaining a relatively high share for agriculture (12%) and greatly increased services share in GDP (65%).⁴³ This kind of restructuring eventually led to an economic structure similar to middle-income countries, however with a much lower share of industry in GDP. In comparison, in middle-income countries the average industry share is 35% (in value added in GDP), and in low-income countries it is 24%, while in the incomplete-U group it is only slightly above 20%. In fact, the industry share in incomplete-U group countries is even below the low-income countries' share, which suggests possible deindustrialization on account of preserving a high agricultural share in the GDP value added (Lerman, 2001).

⁴³The internal structure of each sector and its change over time might also help in determining the productivity changes in various sectors in different transition countries. However, that analysis is not the focus of this research programme. Additionally, it cannot be performed fully due to the lack of data for some transition countries and to the different categorisations adopted and changed through time in various countries.

2. The slow-J group, which involves the countries with the least change in their economic structures, is marked by the flattest lines of changes in the shares of industry, services and agriculture in value added in GDP. Relatively slow increase in the service sector is accompanied by slower decrease in industry and slower decrease in agriculture. By 2010, the shares of agriculture, industry and services in GDP were around 10%, 30% and above 55%, respectively, which is somewhat similar to the structure of middle-income countries. As can be noticed, most of the reallocation took place during the whole first decade of transition.

3. Lastly, the rapid-J curve countries followed a path of reallocation characterized by a lower decrease in the industry share compared to the incomplete-U countries, yet a greater change than in the slow-J group. With respect to agriculture and service sector changes, it is evident that this group managed not only to decrease the agriculture share but also to increase substantially the share of services in GDP value added. Additionally, it is worth noting that most reallocation took place in the first 5 years of transition, when the service sector managed to increase its share in GDP by around 50% and industry decreased significantly. By 2010, the structure in the rapid-J group resembles the structure of middle income countries with 8%, 30% and 62% of value added in GDP produced by agriculture, industry and services respectively.

In order to complete the picture about reallocation in transition countries, one more indicator - structural employment - calls for special attention (Boeri, 2000). Structural employment data in comparison with the data about the share of value added of various sectors in GDP can help in tracking the changes among groups in order to discern possible influences on sectorial productivity growth in various groups of transition countries. However, data for structural employment exist only for some of the transition countries and, even in those cases, are incomplete. Hence, this analysis cannot be performed and conclusive

assertion about the overall impact on the labour productivity developments in the various sectors cannot be made.

In addition, the analysis concerning the aggregate productivity should take into account the internal structure of each sector: industry, services and agriculture with respect to the balance and the changes over time between highly productive segments and the low-productive ones. The studies that analyse industrial competitiveness in transition countries offer such detailed analysis but mostly for the cases of CEECs for which data are available. Even in those studies, there is a severe problem of incomparability of sector classifications or lack of data for certain periods for some countries. As the focus of this research is on a broad restructuring, the internal structural changes will not be further analysed.

3.3.3 Peculiar labour market adjustments

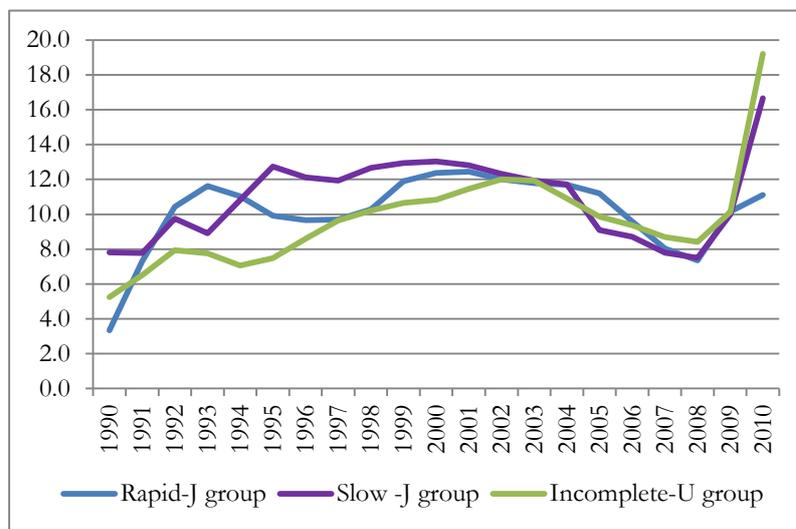
Having the background of the reallocation given in the previous section, one important question emerges - how much of the labour force did not manage to adapt to these structural changes and was reallocated into unemployment?

As is frequently observed, the change in the structure of employment was accompanied by the emergence of open unemployment. However, the experience gained from the transition economies reveals a time lag before the disruption of the economic system and decline in output was reflected in falling levels of employment (Hoff and Stiglitz, 2004). Put differently, the growth in unemployment was generally slower than the pace of adjustment that would have happened in developed industrial countries (Lehmann and Muravyev, 2011).⁴⁴

⁴⁴ Indeed, Lehmann and Muravyev (2011) findings suggest that there are considerable heterogeneity in the evolution of labor markets in transition countries over the last two decades. The differences are not found only in the size and dynamics of the adjustment mechanisms such as

However, as Appendix 3.2, p.464 shows, the pace of unemployment adjustment was different across various groups of transition countries. In the figure below, the unemployment movements in the three country groups are presented, with the y-axis presenting the unemployment rate (as a percentage of the labour force). Again, due to missing data, the averages are presented based only on the available data; hence, the findings should be treated with caution.

Figure 3.3-3 Unemployment rate (as a percentage of the labour force) in groups of transition countries (unweighted averages)⁴⁵



Source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

falling employment rates, rising unemployment, reduction in working hours, and decreasing real wages, but they are also detected in the characteristics of the TEs labour markets in general, with: *the more developed transition economies resembling labour markets in developed European economies , in both positive (for example, productivity growth) and negative aspects (for example, high and stagnant unemployment). In contrast, labor markets in low-income CIS countries seem to become similar to those in other low-income countries, with typical characteristics such as the dominant informal sector, underemployment, and low productivity employment (emphasized by Rutkowski and Scarpetta (2005) in Lehmann and Muravyev (2011, p.5)*

⁴⁵Due to lack of data, some countries are not included in the figures (B&H, Kosovo), or for some countries the figures capture only the available data (ex. Romania).

The most interesting result of this comparison appears to be that all transition groups get to much the same level of unemployment by 2002. However, the difference between groups is in the length of the period in which most of this adjustment takes place.

As can be noticed, in the rapid-J group most of the adjustment, i.e. increase in unemployment is achieved relatively fast in around 3 years, with reversal in middle transition; while in the slow-J group the adjustment takes 5 years and persists at the same high level thereafter. In the incomplete-U group, adjustment is the most sluggish. These movements in unemployment seem to be consistent with more and less rapid restructuring recorded in the various groups. Namely, as shown in Figure 3.3-2 in the rapid-J group the main restructuring was achieved in the first 4-5 years of transition, accompanied by the highest increase in unemployment rate in that period. In contrast, the restructuring in the other two groups lasted longer and equally as long lasted the adjustment in unemployment.⁴⁶ In general, it can be said that a slower rate of restructuring, accompanied by slower adjustment on the labour market is consistent with slower growth and, hence, delayed recovery. This assertion will be further developed and justified in section 0, where the whole evidence base will be brought together.

Labour market adjustments as described above are not the whole of the story, taking into account that, alongside rising unemployment, labour markets in transition countries experienced other specific adjustment mechanisms, such as increase in the non-participation rate, emigration and informal employment (Svejnar 1999, Nikoloski, 2009). According to Mitkiewicz and Bell (2000), in the cases where the sharp decline in employment at the beginning of transition did not translate into increases in unemployment, this reflects an

⁴⁶In fact, in some countries, such as: Uzbekistan, Belarus and Tajikistan, the unemployment rates did not change drastically for the whole period of transition (see Appendix 3. 2). One of the reasons is that continued soft budget constraints and lack of effective competition enabled enterprises to retain surplus labour, often accumulating huge and potential destabilizing enterprise debts in the process (Herr and Tober, 1998). Work sharing, reduced work hours and temporary lay-off are often resorted in those countries (Boeri and Terrell, 2002)

expanding inactive sector; i.e. people withdrew from the labour force. For example, inactivity rates⁴⁷ all across the region moved upwards in the course of transition reaching 45% in SEEC and 38% in the Baltic States by 2005, due to the increased share of discouraged workers (International Labour Organisation, 2011).⁴⁸

As far as the informal sector and, hence, employment in this sector are concerned, Schneider (2002, 2005) documented significant increase in the informal sector as a percentage in GDP in the course of middle transition. His estimates show that by 2003 it was mainly countries in our rapid-J group that had managed to decrease significantly the informal sector share in GDP to below 30 per cent, while countries in the slow-J and incomplete-U groups preserved a relatively high share of GDP in the informal sector, as well as of employment in the informal sector. Again, the ranking of the aggregates is consistent with the established categorization of the countries. However, there are two rapid-J group countries, Estonia and Albania that overlap more with the countries from the other groups. In the slow-J group the only outlier is Lithuania with probably a better position and less employed labour in the shadow economy in 2000/01 than the countries from the respective group. Unfortunately, the indicators for most of the countries for 2010 are not available; hence, the historical perspective cannot be captured.

⁴⁷The inactivity rate is the proportion of the working-age population that is not in the labour force. When added together, the inactivity rate and the labour force participation rate (see KILM 1) will add up to 100 per cent. (International Labour Organisation (ILO), *Key Indicators of the Labour Market*, Labour force participation rates, ESDS International, (Mimas) University of Manchester).

⁴⁸ Data assessable on Internet - (International Labour Organisation (ILO), *Key Indicators of the Labour Market*, Labour force participation rates, ESDS International, (Mimas) University of Manchester.

Table 3.3-1 Size of the Shadow Economy in Transition Countries

Transition countries	Shadow Economy (in % of GDP) ⁴⁹		Shadow Economy Labour Force in % of (Working Age)2000/01	Persons in informal sector (%of non-agricultural employment) ⁵⁰	Transition countries	Shadow Economy (in % of GDP)		Shadow Economy Labour Force in % of (Working Age) 2000/01	Persons in informal sector (%of non-agricultural employment2010)
	Average 00/01	Average 02/03				Average 00/01	Average 02/03		
					Albania	34.6	35.3		
					Czech R.	19.6	20.1	12.6	
Armenia	47.8	49.1	40.3	19.8	Estonia	39.2	40.1	33.4	
Azerbaijan	61.1	61.3	50.7	26.5	Hungary	25.7	26.2	20.9	
Belarus	49.3	50.4	40.9		Poland	28.2	28.9	20.9	
Croatia	34.2	35.1	27.4		Slovak R.	19.3	20.2	16.3	7.4
Latvia	40.7	41.3	29.6		Slovenia	28.3	29.4	21.6	
Lithuania	31.4	32.6	20.3		Rapid-J group	27.5	28.6	20.9	
Kazakhsta	44.1	45.2	33.6		Georgia	67.6	68.0	53.2	
Russia	47.5	48.7	40.9		Kyrgyzsta	40.4	41.2	29.4	
Uzbekistan	35.7	37.2	33.2		Moldova	47.3	49.4	35.1	15.9
Bulgaria	37.1	38.3	30.4		S&M	37.3	39.1		6.1
Macedonia	35.1	36.3	35.1	12.6	Ukraine	53.6	54.7	41.2	
Romania	36.1	37.4	28.3		B&H	35.4	36.7		
Slow-J group	41.7	42.7	34.2		Incompl.-U group	46.9	45.4	35.9	

Source: Schneider (2002, 2005); and for the indicator: Persons in informal sector (percentage of non-agricultural employment) the data are taken from *The Statistical Update on Employment in the Informal Economy* (2011). ILO Department of Statistics.

Schneider (2002, 2005) attributes the increase in the informal sector mainly to two factors: increase of tax and social security contribution burdens; and intensity and enforcement of

⁴⁹Schneider (2002) uses two methods for estimating the informal sector and employment in this sector. We present only the data related to DYMIMIC (dynamic multiple-indicators multiple-causes) model developed in his analysis on the basis of earlier studies on the informal sector (for more, see: Schneider, 2002, p. 41)

⁵⁰ The data in his column are taken for ILO latest survey on the Employment in the Informal Economy, which was conducted only for 46 medium and low-income countries. Due to its limited scope, not all countries in transition are included in this analysis.

regulations, similarly like Popov (2004). In addition, he argues that not the overall extent of regulation but mostly its non-enforcement drives firms into the shadow economy, which is especially relevant for transition countries and the lagging transition countries in particular.

In addition, emigration became a prominent way to escape unemployment in some transition countries. The data given by Dumont et al. (2010) suggests that most transition countries recorded negative net migration⁵¹ in the course of the whole transition, with it being high in some countries; especially from countries in our incomplete-U and slow-J groups (Appendix 3.3, p.466).⁵² These migrations had different sizes and origins in the case of the more successful and of the lagging transition countries. Namely, as identified by Nikoloski (2009), while for SEEC and CIS countries long-term and permanent migration is more characteristic, for CEEC and Baltic countries more prominent is short-term migration.

3.3.4 Reallocation of labour amongst private and public sector

Privatization has been a key policy in the transition from plan to market. Rapid privatization early in transition aimed to get the state out of enterprise management and to create a broad support for reforms (Hamma et al., 2012). Privatization was a way of imposing hard budget constraints and promoting restructuring and productivity growth by transfer of property and also transfer of the labour force into the more productive private sector. In consequence, the

⁵¹Definition of net migration as given by Organisation for Economic Cooperation and Development definitions: Net migration is the net total of migrants during the period, that is, the total number of immigrants less the annual number of emigrants, including both citizens and non-citizens. Data in the *International Migration Outlook* (Organization for Economic Cooperation and Development, 2007) are given as five-year estimates.

⁵² The data in the table presents the total emigration rate including foreign-born persons in the population of the country of origin

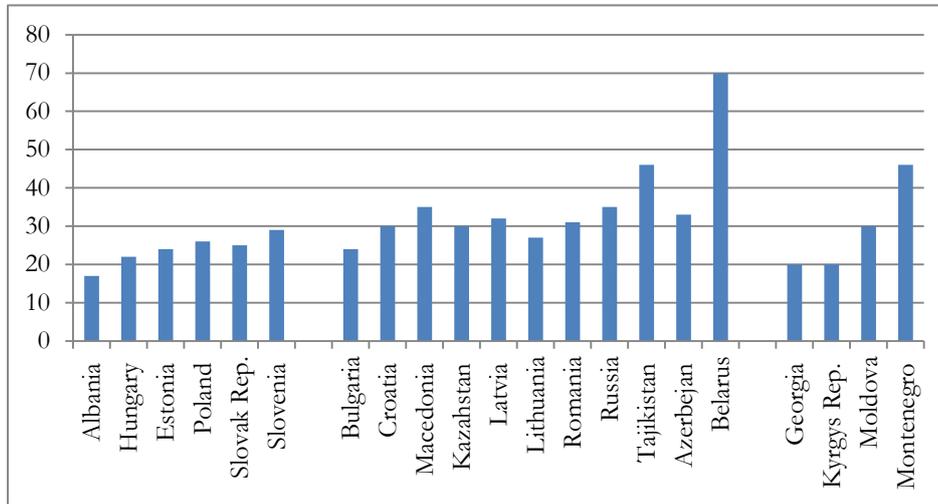
“old” public sector⁵³ was supposed to decrease its share in GDP⁵⁴ coupled with a sharp decrease in the public employment share in total employment (Rodrik, 2000).

As a result of differences in the privatization policies adopted, transition countries considerably differed in their privatization outcomes in terms of the speed of privatization, reallocation of labour amongst private and public sector and overall effects on productivity (Hamma et al., 2012). For instance, while some of the transition countries managed to decrease the employment share in the public sector considerably, some retained a huge share of the total employed labour force in it (European Bank for Reconstruction and Development, 2009). Figure 3.3-4 below presents the public sector employment share in total employment in selected countries in 2009 on the y-axis. Each bar represents one country, with the first block giving the rapid-J group, the second block the slow-J group and, last, and the incomplete-U group. This indicator is approximate and it is estimated from the indicator on private sector employment given by the European Bank for Restructuring and Development in its *Structural change indicators*.⁵⁵

⁵³Here term public sector refers to the old public or state enterprises that did not have activity of public interest and hence needed to be privatised.

⁵⁴ Paradoxically, the share of public sector as contemporary understood, measured as government expenditures that include government consumption and transfer payments is relatively high for OECD countries, approximately around 42% of GDP.

⁵⁵Since in the *Methodology of Structural change indicators*, the indicator of employment in the private sector includes employment in the informal sector, where data are available, the employment in the public sector is calculated by deducting private sector employment from 100.

Figure 3.3-4 Public sector employment share in total employment (2010)

Note: For some of the countries the data are missing. Source: Author's Own Calculations. Data Source: European Bank for Restructuring and Development, appropriate *Structural Indicators* (2011) on Private sector share in GDP.

On average, the successful rapid-J group has the smallest share of public employment in total employment, while the other two groups have considerably higher shares, with Belarus, Tajikistan, and Montenegro being in the “worst” position with the highest share of public employment. The *Survey Report* identified that high public sector employment usually reflects “excessive number of ministries, duplications of functions, or the existence of ghost workers” in transition countries, which results in outlay on wages and salaries that are the major source of excessive public spending (International Monetary Fund, 1997).

Many scholars have suggested that the above given situation in the public sector in transition countries resulted from the fact that the public sector was used as an “employer of last resort” to absorb the released labour force, which in turn affected productivity developments in the transition countries and hindered their restructuring (Boeri and Terrell, 2002, IMF, 1997). Namely, the governments have used the public sector as a tool for generating and redistributing rents, which in the conditions of pervasive rent-seeking behaviour often have

gained a political dimension (Gelb et al., 1991). Alongside with that argument, Rodrik (2000) suggests that the relatively safe state jobs are partial insurance against the undiversifiable risks faced by the domestic economy. He argues that governments counteract the income and consumption risk especially in small open economies by providing a larger number of secure jobs in the public sector, which eventually spreads the relative insurance throughout the whole economy through informal risk-sharing arrangements within families. Nevertheless, whatever the government motives are, he confirmed the finding that there is a negative relationship between levels of the public sector, measured by government consumption or employment and long-run growth (Rodrik, 2000; International Monetary Fund, 1997).

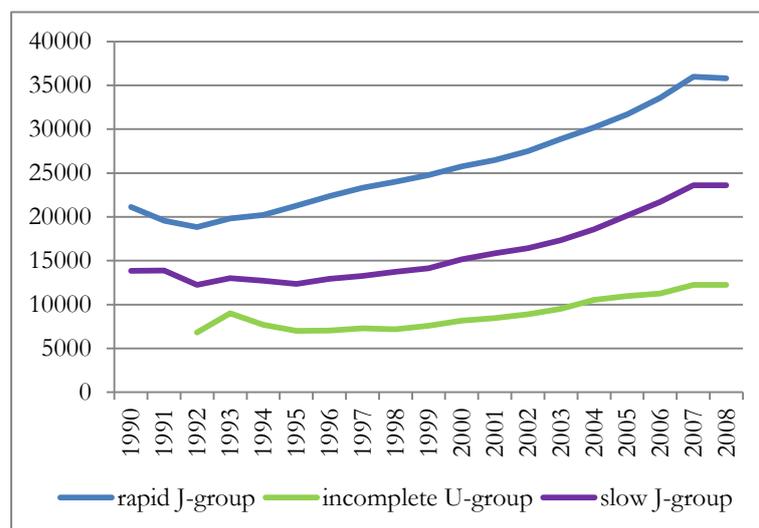
Although similar in nature, processes of reallocation and restructuring differed across transition countries. The differences can be observed not only in the restructuring among the main sectors in the economy, but also in the reallocations between the private and public sectors, and between the legitimate and the shadow economy. As the depictions offered here are broad, only a very general conclusion can be made. Namely, that lagging GDP growth can be related in part to negative effects and productivity losses, which in turn resulted from a slow and inadequate reallocation process, from slow adjustment in the labour market, and from slow privatization (Ham et al., 1998, Boeri, 2000, Hamma et al., 2012).

3.4 Overall productivity developments in various transition regions

Having outlined the background on adjustments and restructuring, the question to address is how efficient/or inefficient was the restructuring in various transition groups; and what were the consequences for productivity? In the absence of accurate data on productivity, in order to gauge the aggregate productivity changes in various groups of transition countries the relatively crude measure of productivity adopted in the *Penn World Tables* - GDP per worker -

will be used in this section.⁵⁶ Figure 3.4-1 plots productivity movements in various groups of transition countries, with the y-axis presenting the GDP per worker indicator.

Figure 3.4-1 Real GDP per worker (chain series, International \$ per worker in 2005 Constant Prices, unweighted averages for groups of countries),⁵⁷



Note: The data set contains data until 2008. Source: Author's own Calculations based on the data source: Alan Heston, Robert Summers and Bettina Aten, *Penn World Table Version 7.0*, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, May 2011.

The data presented above seems appealing with respect to the ranking of our three country groups, although it must be emphasized that the presented trajectories disguise different productivity developments in different sectors within and between the various country

⁵⁶Data for Serbia starts in 2005, while data on Montenegro and Kosovo are completely missing; hence, these countries are excluded from the analysis. Additionally, for most of the incomplete-U countries data are available only from 1992, hence for these groups the analysis is conducted only after that period.

⁵⁷ In the *Penn World Tables* Appendix, long definitions of the variables used are given. Real Gross Domestic Product per worker is calculated in PPP. Purchasing power parity is the number of currency units required to buy goods equivalent to what can be bought with one unit of the base country. They calculated PPP over GDP. That is, PPP is the national currency value of GDP divided by the real value of GDP in international dollars. The international dollar has the same purchasing power over total U.S. GDP as the U.S. dollar in a given base year (1996 in PWT 6.1). The definition for the workers variable is usually a census definition based on the economically active population. The underlying data are from the International Labour Organization, and have been interpolated for other years.

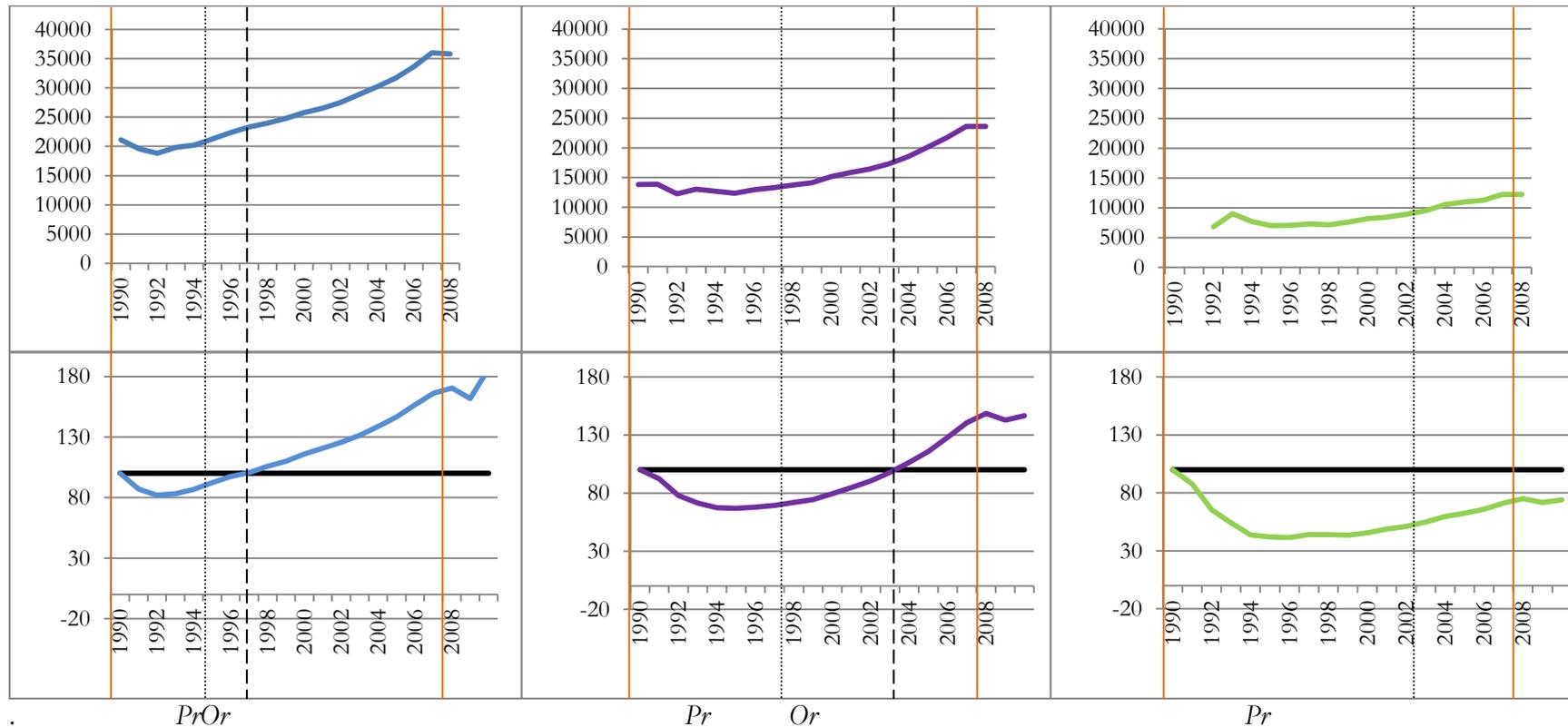
groups. Broadly, albeit starting from different positions, various groups of countries preformed differently in the course of transition in terms of productivity changes.

- Rapid-J countries had the highest productivity level at the beginning of transition and this situation remains throughout the whole course of transition. Namely, the rapid-J group managed to restore their productivity level fast by 1995 and subsequently managed to almost double their labour productivity level by 2007, which was impeded by productivity stagnation in 2008.
- On the other hand, the slow-J group managed to restore its initial productivity level by 1998, recording moderate increase in productivity thereafter, yet on a lower altitude than the rapid-J countries.
- The incomplete-U group is in the most unfavourable position, regaining the initial productivity level only by 2002 and with only minor positive changes in productivity level thereafter.

The above data of productivity changes (i.e. Figure 3.4-1) are jointly presented with the real GDP paths in various transition countries (Chapter 2, Figure 2.5-1) in Figure 3.4-2. For accuracy, in the figure years 1990 and 2008 are marked by bold red lines. In the figure, the productivity recovery point is marked for each country group with line (*Pr*), while the output recovery point is marked with line (*Or*). From the figure can be concluded that productivity recovery precedes output recovery in both groups: rapid-J and slow-J group of countries. In addition, this suggests that productivity movements are reflected in output movements. As far as the incomplete-U countries are concerned, although productivity managed to recover the output remains yet to recover.

Having presented most of the evidence in this chapter, now it is of interest to bring together all investigated indicators and to relate them to the output movements. That is the goal of the next section.

Figure 3.4-2 Real GDP per worker, i.e. productivity movements (upper block, I\$ per worker in 2005 Constant Prices, 1990-2008) and Real GDP (lower block) (on average for transition groups, in indexes, 1990=100)



Data source: Alan Heston, Robert Summers and Bettina Aten, *Penn World Tables Version 7.0*, Center for International Comparisons of Production, Income and Prices, University of Pennsylvania, May 2011; World Bank, *World Development Indicators* (April 2012), ESDS International, University of Mancheste

3.5 Joint picture: evidence brought together

In order to be able to create a broader but more unified picture in this section the whole evidence presented previously in the chapter is summarized in two main manners: through a joint figure and a joint summary table, where all variables of interest are presented. This double-presentation enables better tracking and discussion of the patterns, related processes (co-movements) and relationships between the variables, common or specific for each group of countries.

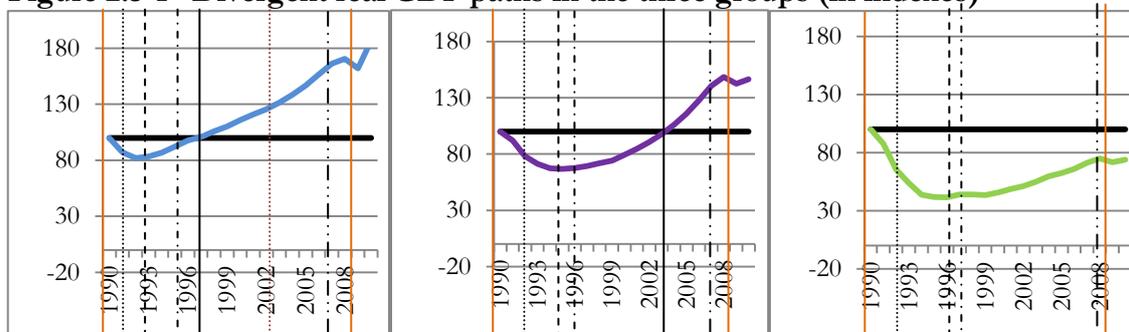
Firstly, the joint figures are presented in Figure 3.5-1 for each group of countries. The main division into separate points and stages of transition is based on the argument in section 2.5.3, chapter 2. As mentioned, every point marks a specific turning or extreme spot in the course of transition. Briefly,

- point 1 marked the start of transition (red line);
- point i marked the lowest negative growth rate (full line —);
- point 2 marked the start of the recovery of real GDP and zero growth rate (dashed line - - - - -);
- point 3a marked the first highest positive growth rate in early transition (- · - · -);
- point 3 marked the recovery point of real GDP (full thick line —);
- point 4 marked the end of the relatively volatile growth rates period and of the lowest growth rate in later transition (red line ······);
- point 5 marked the highest growth rate in later transition and the end of the period of steady growth in growth rates (- · - · -); and, finally,
- point f marked the shift caused by the Great Financial Crisis (red line).

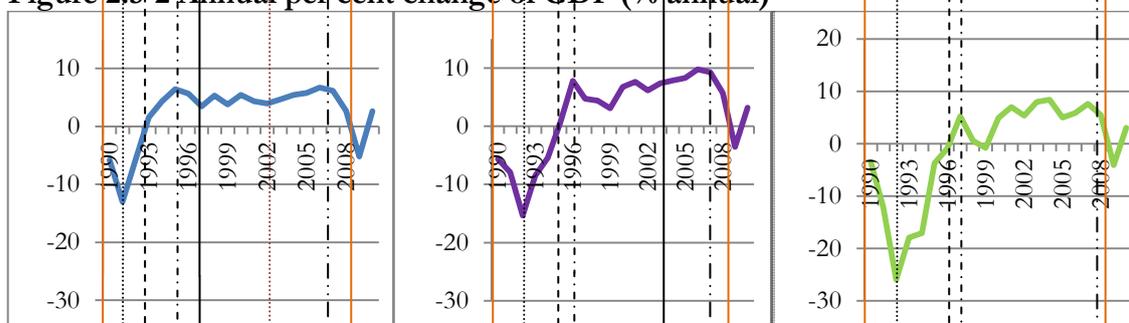
The periods between different points are the different stages of transition, characterized by specific processes and variables. In addition, the y-axes in each figure preserve the same representation as in the original figures.

Figure 3.5-1 A) Joint picture, evidence brought together (in averages for groups)

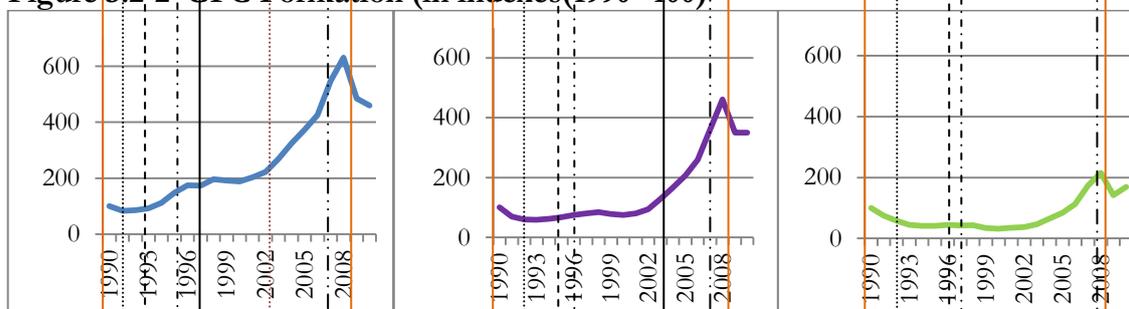
1. Figure 2.5-1 Divergent real GDP paths in the three groups (in indexes)



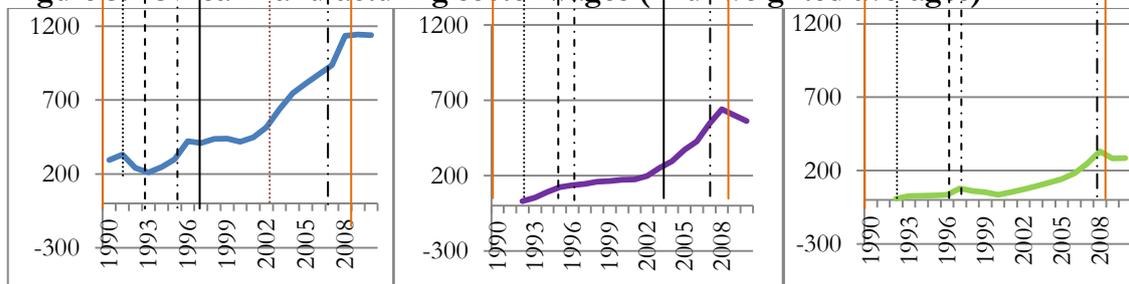
2. Figure 2.5-2 Annual per cent change of GDP (% annual)



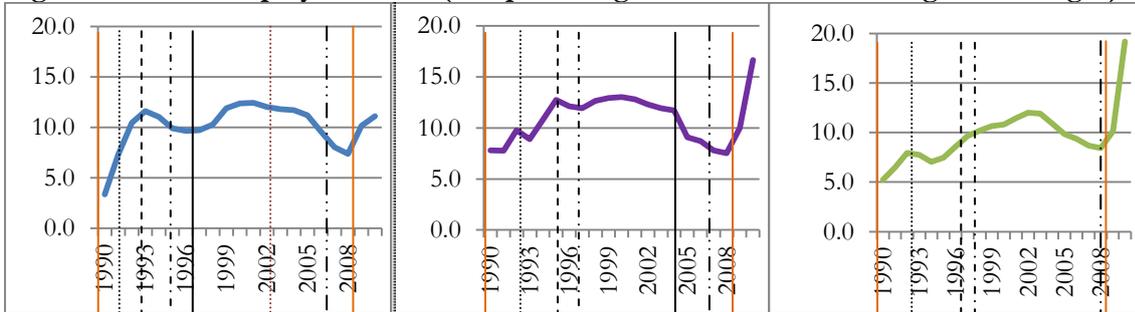
3. Figure 3.2-2 GFC Formation (in indexes (1990=100))



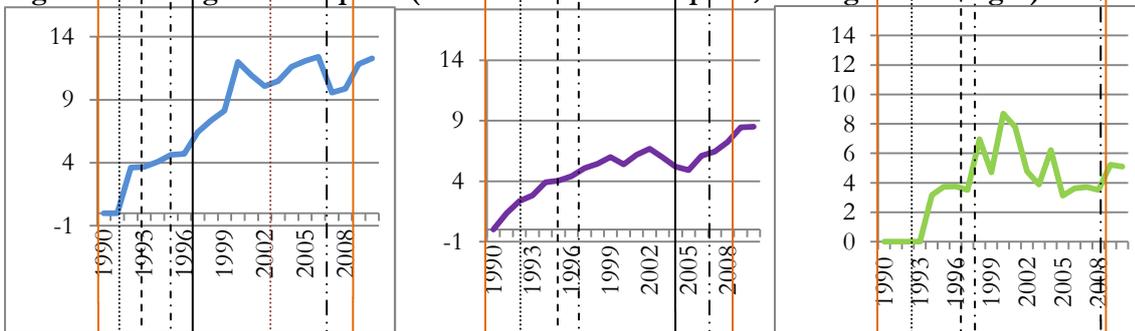
4. Figure 3.2-3 Real manufacturing sector wages (in unweighted averages)



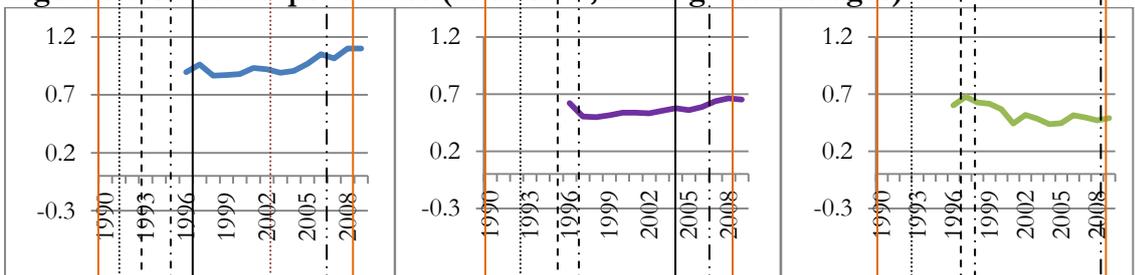
5. Figure 3.3-3 Unemployment rate (as a percentage of labour force, unweighted averages)



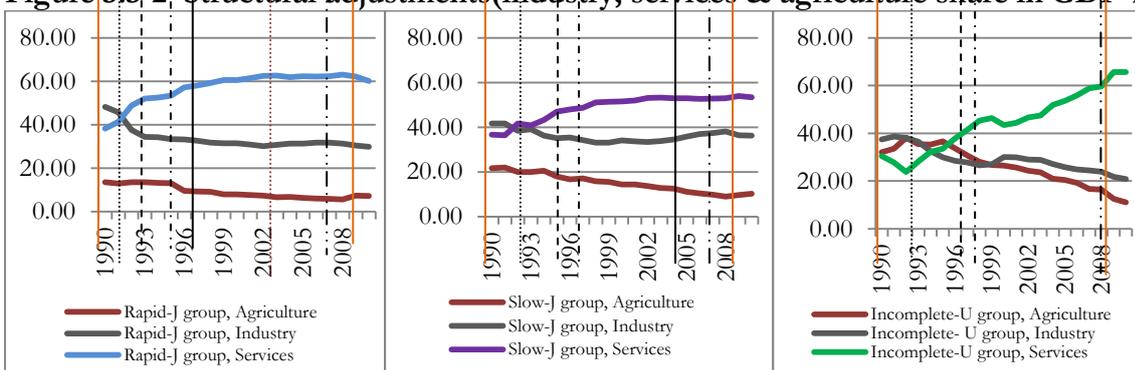
6. Figure 3.2-6 High-tech exports (% of manufactures exports, unweighted averages)



7. Figure 3.2-7 R&D expenditures (% of GDP, unweighted averages)



8. Figure 3.3-2 Structural adjustments (industry, services & agriculture share in GDP %)



Several points are worth noting here:

Firstly, not all indicators discussed in this chapter are presented in the figure. Some variables such as for example institutional development, privatization, corruption, the role of government and many others were analysed in more of a narrative manner, mainly due to the lack of data or due to the need for extensive analysis beyond the main focus of this research.

Secondly, as it can be noticed the periodization is not quite the same for each group. Namely, the periodization was made by the strategic points established in the text above the figure. However, it can be noticed that while rapid-J group managed to pass through all stages, the incomplete-U group managed to pass only until point 3a. In addition, the rapid-J and slow-J group periodisations differ greatly with respect to two aspects:

- In the rapid-J group, 3a point is followed by point 3 meaning that the highest positive growth rate was achieved before the recovery of the real GDP to its initial level. In slow-J group, the process was opposite, after the recovery, the highest positive growth rate was experienced.
- The second difference is that points 3 and 4 could not be differentiation in slow-J group, while in rapid-J group there is a difference.

The figures give an appealing story, however, and inform some general conclusion. The data portrayed in the figures is further organized into Table 3.5-1, where each column represents one group of countries, and the rows are organized in sections. Each section represents one stage of transition, i.e. a period between two points on the figure (for example from point 2 to point 3). In addition, in each section, the variables are presented in the following order: real GDP, Growth rates, GFC, Real Wages, Unemployment, Real GDP per worker, High-tech exports, R&D expenditures and Structural changes. Finally, each cell notes the change in the variable, i.e. what is happening to the variable in a particular stage for a particular group, compared to other groups or sometimes compared within different stages in the same group.

Table 3.5-1 Summarizing the evidence (Table is based on Figure 3.4-2 and Figure 3.5-1)

Countries group		Rapid-J group	Slow-J group	Incomplete-U group
From point 1 to point <i>i</i>	Real GDP	Fall	Fall	Fall
	GDP growth rate	Fall, touching the lowest level, higher than in the other groups	Fall, touching the lowest level, comparably middle	Fall, touching the lowest level, comparably lower than the other groups
	GFC	Fall to lowest level	Fall to lowest level	Fall
	Real Wages	Stable or even increase in wages	No data	No data
	Unemployment	Sharp Increase	Moderate increase	Moderate increase
	Real GDP per worker	Fall	Fall	No data available
	High tech* export	No data	Slight increase	No data
	R&D	No data available for this period		
	Structural Change**	Start of changes, comparably most intensive and fast	Start of changes, comparably less intensive and fast	Start of changes, with specific direction of restructuring
From point <i>i</i> to point 2	Real GDP	Further fall till lowest level	Further fall	Further fall
	GDP growth rate	Steep increase until zero growth rates	Less steep Increase until zero growth rates	The least steep Increase until zero growth rates
	GFC	Recovery	Lowest negative level for this group	Further fall
	Wages	Drop to lowest level		
	Unemployment	Further Increase	Further increase	Stable , even decrease
	Productivity	Start of the recovery	Lowest level	
	High tech export	All groups approach similar level of high tech exports in this stage, which comparably is similar to low income countries in these years		
R&D	No data available for this period			

	Structural change		Sharpest and deepest	Moderate and slower	Delayed and least pronounced
From point 2 to point 3***	Real GDP		Sharp Increase - regained the initial position	Moderate Increase – regaining the initial position	Slow increase but still in negative zone
	Growth rate	3a	Sharp Increase, highest point	Increase, highest point	Increase, positive growth rate. After fall into negative and very volatile growth rates
		3	Small decrease, still positive	Positive but volatile	
	GFC		After the recovery at the beginning positive increase	Struggling to recover. Recovering by the end of the stage	Negative GFC index for almost 15 years. Recovery only after 2006.
	Wages		Increase in wages	Stable wages, slightly increasing at the end	Stable wages, slightly increasing after 2003
	Unemployment		Sharp drop in unemployment	Relatively stable and high unemployment	Significant but gradual increase in unemployment until 2002, drop afterwards
	Productivity		Recover and further steepest increase	Recover and moderate increase	Recover of productivity in later transition and slight increase
	High-tech exports		Relatively stable exports at allow level	Steady increase in exports	Very volatile but low
	R&D		No data available	Slightly decreasing	Decreasing considerably
	Structural Change		Further deepening	Further change but less pronounced	Intensified change
From point 3 to point 4	Real GDP		Increasing slightly		
	Growth Rates		Positive, but volatile		
	GFC		Positive but Stable		
	Wages		Stable		
	Unemployment		Increase and stabilize on highest level		
	Productivity		Rising		
	High-tech exports		Very sharp increase		
	R&D		Volatile and slightly decreasing		

	Structural change	Continuing and finishing		
From point 4 to 5	Real GDP	Remarkable increase	Short increase	
	Growth Rates	Steady increase	Steady increase	
	GFC	Remarkable highest increase	Increase	
	Wages	Sharp increase	Increase	
	Unemployment	Sharp drop	Drop	
	Productivity	Rising	Rising	
	High-tech exports	Volatile, on average at a high level	Fall	
	R&D	Increase pronounced in later transition	Slight increase	
	Structural change	Very small changes	Further change	

Note: * -It should be noted that the increase in high-tech exports in this period is in fact an increase that reflects inclusion of additional data and countries for which data become available. After a period of non-availability of data, the more countries are included in the average aggregates the more reliable data become. However, by the end of this period, when averages are more reliable, the indicator actually shows a relatively low level of high-tech exports, which is slightly higher than in low-income countries.

** -The descriptive attribute is made based on the form of the figures. However, it should be noted that while in rapid-J and slow-J group the main change comes from switch between increased share of services and decreased share of industry in these countries; in the incomplete-U group, an odd restructuring is observed with fall in services, increase in agriculture and fall in industry.

*** -For the incomplete-U group the cells will explain what happens after point 2. However, it should be kept in mind that point 3 in this group was never achieved. In addition, this group stage is not comparable to the characteristics of the stage from point 2 to point 3 for the rapid-J group and the slow-J group.

In general, when different stages of transition are observed some common features within each stage can be identified, alongside differences that emerged between particular groups.

1. In the first period – from point 1 to point i , there are several common features for all transition groups: drop in the real GDP accompanied by a sharp fall in growth rates; sharp fall in GFC formation; and fall in productivity. On labour markets, there is an interesting co-movement of two variables – wages and unemployment. Interestingly, wages show some rigidity, being stable in the rapid-J group (data are available only for this group). As expected, relatively stable wages are accompanied by increase in unemployment; however, not equally sharp in all groups. The steepest increase in unemployment is recorded in the rapid-J group, followed by slightly increased unemployment in the slow-J and incomplete-U groups.⁵⁸ In terms of technology efforts in this period, no conclusive observations can be made as the data are lacking. However, from the comparative analysis presented from section 3.2.3, it can be said that probably in this period all technology efforts are based on inherited technology and knowledge from the socialist period, which as mentioned in chapter 2 was very low and uncompetitive in the international environment.
 - a. What differentiates countries in this period is not the nature of changes, nor even the length of this period (1 and a half, 2 and a half, or 3 years in the respective groups) or the co-movement of variables, which is similar, but is rather located in the starting level of changes and in the sharpness of changes.
 - b. In general, the rapid-J group started with the highest level and recorded less sharp falls in real GDP, GFC, and productivity in contrast to the incomplete-U group with the lowest levels and the most pronounced drops.
 - c. Alongside that, emphasized further characteristic that distinguished groups in this period is unequal rise in unemployment. In this case with the rapid-J group recording most adjustment as compared to the other two groups.

⁵⁸Wages data are missing for the slow-J and incomplete-U groups.

- d. Another striking difference is related to the structural changes in this period. Namely, while the rapid-J and the slow-J groups both record a fall in the industry share and a rise in the services share in GDP, the incomplete-U group records increase in the agriculture share, accompanied by a fall in the industry and in the services share in GDP. This rather odd restructuring indicates possible problems related to creation of *de novo* firms and possible deindustrialization, as most pronounced in this group of countries.
2. The second period –from point *i* to point 2 - reveals further differences among the country groups. The common features are that this period is characterized by: fall of real GDP to its lowest level in all country groups; and corresponding increase in growth rates in this period until zero growth rates are attained. The bottom is deepest in the incomplete-U group as measured by real GDP. However, the other indicators seem to be different between the country groups.
 - a. Firstly, the length of this period is only a year and a half for the rapid-J group, while for both the slow-J and incomplete –U groups it is three and half years.
 - b. Secondly, in the rapid-J group this period is characterized by recovery of GFC, while in the other two groups GFC continues to be negative, or even decreasing in the incomplete-U group.
 - c. Additionally, the adjustments on the labour market are different and most striking. Namely, in the rapid-J group there is significant increase in unemployment accompanied by fall in wages. In the slow-J group there is an increase in unemployment, however accompanied with relatively stable or even increasing wages. In the incomplete–U group, the relatively stable wages and unemployment reveal very strong rigidities on the labour markets in this period.⁵⁹

⁵⁹The evidence on labour market rigidities is found even later in the course of transition. The latest EBRD (2011) *Transition Report* suggested that labour market rigidities cushioned the fall in

- d. The differences among groups with respect to gross fixed capital formation and labour market adjustment are reflected in differences in productivity movements: productivity in the rapid-J group starts to recover within this period, while for the other groups productivity touches bottom only at point 2.
 - e. With respect to technology efforts in the countries, the conclusions are vague due to the lack of reliable data. Based on the indicator of the high-tech exports share in GDP, in this period all transition countries can be compared to the low-income countries. Probably this indicator is insufficient to make statements, because the export of the countries in this period reflected also other trade-related problems such as: losing the markets, constant wars or conflicts in some countries, political changes and so on (Kandogan, 2003).
 - f. With respect to the structural changes, again the most deepest and pronounced changes are observed in the rapid-J group, followed by lesser changes in the slow-J group. Only after 5 years of transition does the incomplete-U group record restructuring, with an increasing share of services and a decreasing agriculture share in GDP.
3. The following period from point 2 to point 3 reveals even more divergent features among the country groups.
 - a. Firstly, only two groups managed to achieve point 3, with the incomplete-U group not managing to recover its initial real GDP at all. This group will be discussed at the end of this section. Although the two other groups, the rapid-J and slow-J groups managed to regain their initial GDP position, there are substantial differences in their growth patterns. In terms of growth rates, this period for the rapid-J group is characterized by remarkable increase at the beginning (point 3a) and slight decrease

employment during the Global Financial Crisis, but they have since delayed the recovery in employment growth.

until point 3, while for the slow-J group after the first increase (point 3a) the period until point 3 is characterized by strong volatility and decreasing, though still positive tendencies.

b. Secondly, point 3 is achieved after different lengths of time: with the rapid-J group reaching its initial real GDP only 3 years after reaching its lowest level; and the slow-J group achieving its initial real GDP 8 years after reaching its lowest level. This different speed of recovery can be attributed to several factors, notably differences GFC formation and labour market adjustment:

i. GFC formation shows positive initial increase in the rapid-J group at the beginning of this stage, while in the incomplete-U group for a prolonged period (over 7 years) there was no recovery. Interestingly, after a small recovery in GFC the recovery in real GDP follows.

ii. With respect to labour market adjustments, the rapid-J group records decrease in unemployment and as light increase in wages, while the slow-J group shows evidence of a relatively rigid market with stable or slightly increasing wages and high but not changing unemployment.

c. Productivity in this period recovers and continues to rise in both groups.

d. With respect to technology efforts, high-tech exports reveal slight improvement, i.e. increase of 2 per cent only in the rapid-J group, which on the other side is still low and incomparable to the same indicator in middle-, high- or EU- countries (Kandogan, 2003). With respect to structural changes, this is an important period, although further structural change is more pronounced in the rapid-J group and less so in the slow-J group.

4. The next period (between point 3 and 4) can be only identified for the rapid-J group. As mentioned before, point 4 in the slow-J group overlaps with point 3. Namely, real GDP increases further above its initial position in that period. However, with respect to other variables descriptions, this period of the rapid-J group transition shares some common

features with the slow-J group in the recovery process. Namely, this is a prolonged period over which growth rates are positive but very volatile, accompanied by positive but relatively low and stable GFC formation, stable wages and increasing unemployment. Productivity shows further increase, and more importantly, technology efforts measured indirectly through high-tech exports show remarkable increase (Kandogan, 2003). Interestingly, the R&D expenditure as a percentage of GDP records a decrease for this group of countries, although it is the highest in comparison with the other groups, although still much lower than in the high-income or EU-countries (as discussed in section 3.2.3).

5. From point 4 to point 5 there is a short period that is marked by a rise in real GDP and a steady rise in growth rates, accompanied by a notable increase in GFC formation and productivity. Labour markets are characterized by significant increase in wages and drop in unemployment. Interestingly, in this period there is one peculiar difference between the slow- and rapid-J groups, with the former recording a fall in high tech exports, while the latter records volatile, and high - although without an increasing tendency - high-tech exports. Nevertheless, in both groups the R&D expenditures show increase, for the first time in the whole transition period. In terms of structural changes it is interesting to note that the changes in the rapid-J group are already finished, while in the slow-J group there is further change, now increasing the industry share and by further decreasing the agricultural share in GDP.

The incomplete-U group seems to be specific group altogether. In particular, this group never managed to regain its initial real GDP. In terms of growth rates, after the initial positive growth rate (point 3a), this group recorded growth rates reversal into the negative zone in middle transition. Later the recovered positive growth rates are highly volatile until the end of this analysis. With respect to gross fixed capital formation, this group records a negative index for more than 15 years. This is accompanied by gradual increase in unemployment, in conditions of relatively stable wages. Structural changes continue throughout. For this group productivity records increase only in late transition, which is

accompanied by increase in GFC formation, fall in unemployment and increase in real wages. Interestingly towards the end, the incomplete-U group recorded volatile, low and decreasing high-tech exports, accompanied by decreasing R&D expenses in GDP, which would suggest even less technology efforts in these countries.

Before drawing general conclusions regarding overall productivity movements in transition countries, it should be emphasized once more that most investigations conducted in this chapter should be considered as descriptive and narrative. Lack of data and altogether missing data, especially for the beginning of transition, do not allow for more consistent inquiry and reliable findings on the issues discussed in this chapter. Additionally, industry statistics are not fully trustworthy, especially for the period of privatization. During this period, efforts of the former socialist managers to devalue enterprise prices resulted in undervaluation of industrial production in official records (Hamma et al., 2012). Furthermore, as mentioned in section 3.3.3, the large unofficial economy contributed to the problem of non-recorded production and unrecorded employment too. These problems also affected the reliability of the data on wage and profit movements in the course of transition, as discussed in sections 3.2.1.3 and 3.2.2.2. In addition, highly atomized agricultural activity was not completely recorded in official statistics (Lerman, 2001). Therefore, most of the analyses in this chapter have the aim to capture only stylized facts for the main growth indicators and determinants, their changes and their interrelationships. Having the above caveats in mind, several conditional conclusions regarding the growth patterns in the various groups of transition countries can be made.

3.6 Conclusion

This chapter summarized the evidence describing differing trajectories of growth in the three previously identified groups of transition countries. It offered “descriptive analysis”, which is a broad picture of the main variables and their changes in the course of transition. Based on

that, the main stylized facts of transition can be identified to set the scene for formal theoretical and econometric analysis.

In general, no theory can be applied if the theory's assumptions do not accommodate the main stylized facts of the reality that needs to be analysed. Hence, what is actually needed in the next chapter is a theoretical explanation that will account for the main features of the countries' economic performance during transition. Such an explanation must take into account the following "stylized" facts.

First, at the outset of transition, the countries differed in their initial conditions with the rapid-J group recording the highest productivity and real GDP in contrast to the incomplete-U group with the lowest productivity and real GDP. Discrepancies in terms of starting inherited positions can be noticed within other indicators too, such as: different inherited production structures; different trade relations; different technology bases; and so on. Nevertheless, in theoretical model developed in the next chapter, the starting point hypothetically is taken to be the same for all transition countries, since they all as a group are similar as compared to the developed market economies. However, the different initial conditions will have some impact on the empirical results as final chapters reveal.

Second, transition economies had an abundance of human capital relative to the physical capital stock at the outset of transition. As shown in section 3.2.1.2, obsolescence of physical capital was severe across the whole transitional world which, coupled with the available labour force,⁶⁰ was supposed to create conditions for economic take-off, in the sense that the latent return to capital was supposed to be high in accordance with neoclassical theory;⁶¹ i.e. within the neoclassical theory, diminishing returns to capital assumption implies higher

⁶⁰ Although, as shown above in chapter 3, some authors have disputed the supposing skill-level of the labour force in the countries of transition, such as: Ronnås, 1997, Campos and Corriceli, 2000.

⁶¹ This theory is elaborated further in this chapter.

returns as the capital stock declines ⁶²(Solow, 1956). The severe obsolescence at the onset of transition is modelled within the model in chapter 4. However, at the macro level, high returns to capital were not actual but potential,⁶³ i.e. latent at the onset of transition as was shown in this chapter and will be further argued in the next chapter. The difference is associated with various blockage mechanisms emerging in the course of transition, including: weak government policies; macroeconomic destabilization; corruption; weak rule of law; weak institutions; and so on (Michailova and Melnykovska, 2009; Beck and Laeven, 2006, Hamma et al.2012). The countries that managed to overcome problems faster and better indeed managed to create an environment in which the returns to capital can be closer to the potential.

Third, in the course of transition adjustment on the labour markets played a role characterized by a certain co-movement between wages and unemployment. In general, relatively rigid wages at the onset of transition are accompanied by increase in unemployment; though not equally sharp in all countries. Similar rigidity of wages can be observed in later transition, though accompanied by relatively stable unemployment. These peculiarities of the labour market are also modelled in the model in chapter 4.

Fourth, as shown in section 3.2.1.1, investment measured by Gross Fixed Capital formation in the different transition groups of countries displays different growth paths and volatility. Notably, the incomplete-U countries experienced greater volatility relative to other transition economies, with respect to the sharpest slump in the recession and much slower recover only after 15 years of transition (Figure 3.2-2). In addition, the increase in investments preceded

⁶²The implication of high return to capital in the neoclassical framework presumes several important conditions: perfect factor and goods markets; closed economy; and constant growth rates of savings, labour force and depreciation (s , n and δ). Relaxation of these assumptions in accordance with transition reality facts is an important departure from the neoclassical framework to better fit the stylized facts about transition countries, as shown in chapters 2 and 3.

⁶³At the onset of transition some, firms managed to realize those high profits as discussed in chapter 3, section 3.2.1.3 (McMillan and Woodruff, 2002). However, their number was small, hence, on a macro level high profits will be considered as potential.

the recovery of real GDP as the analysis showed, showing that factor's growth to be important for that stage of transition. In middle transition, investments stabilized, and afterwards only in later transition did they record a remarkable increase. This movement of the investments is modelled within the theoretical model with it assuming to be lower in the middle, and higher in the later transition.

Fifth, governments in all transition countries undertook a set of various measures starting after 1991 to stabilize the economy and to support further growth. Yet, the pace and character of reforms varied across the transitional world producing various results, leaving some of the countries as a lagging transitional group (Kornai, 2006). It seems that government and institutions' roles contributed to the failure that blocked the growth process in incomplete-U curve countries in particular (Michailova and Melnykovska, 2009). As shown, government interventions in these countries were implemented in a less effective manner as compared to other transition groups. In addition, institutional development in some of the countries was characterized as less successful and problematic, accompanied by delayed reforms and emergence of deviant processes such as corruption (Havrylyshyn and Rooden, 2000; Michailova and Melnykovska, 2009). As a consequence, private entrepreneurs, institutions, and the labour force responded to increased instability and uncertainty, creating extremely negative results not only in financial terms but also in terms of diminished social capital as shown in section 3.2.4. Creating vested interests in society reinforces preference for the status quo rather than for changes and growth (Havrylyshyn et al., 1999, Dabrowski et al., 2000, Easterly, 2008, Beck and Laeven, 2006, Michailova and Melnykovska, 2009, Hamma et al., 2012).

Sixth, the analysis showed that the main drivers of growth were changing in the course of transition. While at the onset of transition, the speed of adjustments on factors' markets played out the main role, in middle transition the weight is rather on reconsolidation of the economy i.e. structural changes in the economy, the recovery of GFC formation and creation of the positive economic environment that will enable adoption of foreign know-how and

best practices. In later transition, significant increase in investments accompanied by appropriate technology efforts becomes an important ingredient of growth. This set of changes is also taken into account when modelling growth theoretically in the next chapter.

The depiction from this chapter does not amount to an explanation. Theory is needed to explain why the observed features had such an influence on the growth patterns in transition countries. In order to do that, model developed in the next chapter alters the neoclassical growth framework in order to take into account the stylized facts presented in this chapter.

Chapter Four

4 The application of the neoclassical theory in assessing the different growth paths of transition countries

All theory depends on assumptions which are not quite true. That is what makes it theory. The art of successful theorizing is to make the inevitable simplifying assumptions in such a way that the final results are not very sensitive. A "crucial" assumption is one on which the conclusions do depend sensitively, and it is important that crucial assumptions be reasonably realistic.

When the results of a theory seem to flow specifically from a special crucial assumption, then if the assumption is dubious, the results are suspect (Solow, 1956, p.65).

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4.1 Introduction

The synthesized features of transition summarized in the previous chapter imply that the explanation of the process of economic growth in the transitional context can be very complex and empirically difficult to analyse. Many factors summarized in the stylized facts, coupled with their consequences, such as lagged reallocation of resources, changes in social capital and external shocks have influenced growth during transition as discussed in chapters 2 and 3 (Ronnås, 1997, Havrylyshyn, 2001, Stiglitz, 1999). The variety of determinants also indicates that proper understanding of growth in transition may require consideration of more than one growth model. Not a “toy growth model”, but rather a “toy collection” is needed in order to explore the processes more deliberately (Pritchett, 2000).

In that context, in the case of transition countries both “old” neoclassical and “new” endogenous theories can find their application. First, the Solow (1956) model seems to suit transition reality in that it attributes a great role to changes in basic factors such as labour and physical capital, rather than to technical progress, which is considered as exogenous. These assumptions seem to be appropriate for the transition reality, especially at the onset of transition when growth was primarily driven by the adjustments in the factors’ markets, i.e. recovery and increase of physical capital and labour and less by technical progress. On the other hand, new growth theories can also be applied for explaining growth in the course of transition as they relate growth to a “broader” concept of technical progress, i.e. with education, investments, government role, institutions; all determinants of growth that proved to be very important for growth in the course of transition as shown in chapter 3⁶⁴ (Mankiw

⁶⁴In general, the focus of the endogenous theories is technology and its creation as a main driver of long-run growth in countries. By inter-relating physical capital with human capital and with research and development (R&D), these theories consider technology as endogenously created within the system and they propose a number of mechanisms that could overcome diminishing returns to capital, which eventually creates conditions for achieving constant or increasing returns to “broad” capital (Rebelo, 1990; Lucas, 1988; Romer, 1990; Schumpeter, 1943). Therefore, focused on technical progress and the way it is created, endogenous theories are mainly suitable for explaining growth processes in *developed market economies*. However, in the context of *developing or transition economies*, the

et al., 1992). Both relevant to some extent, these two main growth theoretical branches can be used to create a “model collection” for explaining transition growth patterns, though very carefully, since the use of different and inconsistent theories may lead to incoherent theorizing and hence modelling. Thus, in the risky attempt to apply growth theories to transition episodes of growth, three broad routes will be followed here.

- Firstly, the oldest growth model, the Solow model and its augmented versions and their associated set of determinants will be used in order to see how much of transition countries experience can be explained by their application.
- Secondly, the transition countries experience will be critically observed as a real current process with the main intention and focus to capture its peculiar features -instability and volatility⁶⁵ that, to our knowledge, has not yet been considered and assessed in the transition studies.
- Thirdly, the model will be developed in the neoclassical fashion for the reasons explained further in this chapter. However, the insight from the endogenous growth theories will be incorporated only indirectly, suggesting that the switches among various stages of transition do not happen automatically⁶⁶ but depend on the main determinants pointed out by the theorists of endogenous growth. However, the model will not develop the detailed analysis of the main determinants suggested by the endogenous growth theories, but it will rather be focused on the two main neoclassical factors, such as physical and

new growth theories application gained different perspectives, discussing mainly the conditions needed for adoption of new technology (Pritchett, 2001; Abramovitz and David, 1994; Parente and Prescott, 1994; Howitt and Mayer-Foulkes, 2002; Barro, 1996b; Easterly, 2004).

⁶⁵The concepts of instability and volatility of growth will be defined in more details in Chapter 5. However, in the neoclassical theory context *instability* of growth can be defined as shift of the country between two transitory lines or balanced growth paths, while *volatility* can be defined as variations of growth along one transitory line.

⁶⁶The model developed in this chapter introduces the concept of switches that happen as a result of adoption of free or non-free technology.

human capital that together with the endogenous factors contributed to the switch to higher growth pattern.

In summary, this chapter reviews the main theoretical background and introduces the key concepts that will be used, modified and applied as a basis for the model of the growth during transition developed in the remainder of the thesis. This chapter is strongly related to and supplemented by the following chapter 5.

The chapter is structured as follows. In section 4.2 a wide synthesis of the neoclassical model is presented as one of the most widely used theories in growth economics. In this context, issues such as the definition of the growth pattern, steady states, transition path⁶⁷ (balanced growth path), growth determinants as well as the possible implications are covered. Additionally, section 4.3 discusses both, the adopted and also the modified assumptions of the Solow model, with the emphasis on the theoretical justification of the amendments. This section also includes an explicit critique of the applicability of the neoclassical model to transition economies. Building upon the empirical regularities presented in chapters 2 and 3, the development of the model begins in section 4.4 and continues in section 4.5 by providing intuitive and diagrammatic explanations followed by algebraic derivations of the results. In this section, transition is divided into three different stages or regimes and the changes and consequences in each regime are discussed with respect to changes in growth rates, labour productivity and output level changes. The more detailed technical explanation of the Solow model is provided in Appendices 4 to this chapter. Finally, in section 4.6 main conclusions are presented.

⁶⁷In the growth literature, the balanced growth path is also called the transition path. However, in this research the term “transitory path” or “transitory states” is used instead in order to make a distinction with the term transition, which describes the full transition process from planned to market economy as it was defined in chapters 1 and 2.

4.2 A Synthesis of the neoclassical theoretical framework

4.2.1 The Solow model as a broad framework for the research

4.2.1.1 The basic Solow model

Major development in neoclassical growth theory started in 1956 with the “Solow growth model”. This model explains aggregate growth by increase in factor endowments and technological progress that is exogenously given (Solow, 1956). The usual version supposes a Cobb-Douglas production function such that

Equation 4.2-1
$$Y = AK^\alpha L^\beta$$

where Y is output, A is level of technology, K refers to physical capital, L refers to labour, and α and β denote shares of factors in national income and $\alpha + \beta = 1$ in accordance with the constant returns to scale and diminishing returns assumptions⁶⁸ (Appendix 4. 1, p.468). Under these restrictive assumptions, the model shows how capital accumulation and output growth are realized through savings and depreciation rates⁶⁹ together with the population growth rate (Appendix 4. 2, p. 470). After mathematical manipulation using the Cobb – Douglas production function, Solow derives his key equation to explain the capital per worker growth rate (the extended algebraic derivation is given in Appendix 4.3, p. 472 to this chapter).

Equation 4.2-2
$$\frac{\Delta k}{k} = s\left(\frac{Af(k)}{k}\right) - s\delta - n$$

⁶⁸ Constant returns to scale mean that doubling the inputs would double the output, while diminishing returns to factors indicates that increase in only one factor while all other factors are constant would result in diminishing marginal productivity of that factor.

⁶⁹Capital itself is created from the existing resources in the economy. Capital earns a return i.e. profit or rent and also depreciates, becoming less and less productive eventually becoming obsolete.

Or, after gathering the last two terms:

Equation 4.2-3
$$\frac{\Delta k}{k} = s\left(\frac{Af(k)}{k}\right) - (s\delta + n)$$

Where k –capital per worker ($\frac{K}{L}$), s – saving rate, δ - the rate of depreciation, n – population growth rate (which is equal to the labour growth rate in the Solow framework), A - exogenously given technology level⁷⁰, $\frac{\Delta k}{k}$ - capital per worker growth rate or $(\dot{k})^*$ ⁷¹, and $f(k)$ - is a function of capital per worker. The first term on the right-hand side of Equation 4.2-3 includes the production function (Equation 4.2-1) transformed into a relationship between labour productivity (i.e., output per worker, $\frac{Y}{L} \equiv y$) and the capital-labour ratio k (see Appendix 4.1, p.468): $y = Af(k)$, which implies that for a given technology level (A), labour productivity is a function of capital per worker. Moreover, this function embodies the diminishing returns assumption. Algebraically, if the first derivative of the function,⁷² i.e. the marginal product of the capital is positive $f(k)' > 0$, while the second derivative $f(k)'' < 0$ is negative, reflecting diminishing returns to capital. The intuition is that each additional unit

⁷⁰The technological progress growth rate in A would be $\frac{\Delta A}{A} = g$, which in the basic Solow framework is equal to zero.

⁷¹Throughout this research work sometimes the dot notation is used for growth rates as well. To be more precise, the growth rate of capital per worker $(\dot{k})^*$ is the rate of change in output per worker between period t and $t+1$, which is abbreviated as $\frac{\Delta k}{k_t}$ over k_t defined in some discrete time, i.e.

$$(\dot{k})^* = \frac{k_{t+1} - k_t}{k_t} = \frac{\Delta k}{k_t}$$

⁷² Marginal product of capital is the first derivative of the production function with respect to capital, while the second derivative of the function with respect of capital presents its changes or movement.

Starting with the basic production function $\frac{Y}{L} = F\left(\frac{K}{L}, 1\right)$ and let $\left(\frac{K}{L}\right)^\alpha = k^\alpha$ the first derivative is calculated as:

$f'(k) = \alpha k^{\alpha-1}$, which is positive, while the second derivative is:

$f''(k) = -(1-\alpha)\alpha k^{\alpha-2}$, which is negative.

of capital results in positive marginal product, which is decreasing as capital per worker increases. The shape of the downward sloping curve $s\left(\frac{Af(k)}{k}\right)$ in Figure 4.2-1 below presents the properties of the function $f(k)$, by allowing for positive but diminishing marginal product of capital as the capital-labour ratio increases.

Equation 4.2-3 shows that the capital per worker growth rate is positively incremental in the savings rate (see Box 4.1 below) and in the technology level but negatively incremental in labour force growth and the depreciation rate. Treating the technological level as given and as exogenous and s, δ, n also as exogenous and constant, the only endogenous variable is k , indicating that the Solow model ascribes the dominant role to capital accumulation in the determination of growth on the transitory path or balanced growth path.

Box 4.1 Changes in the capital per worker growth rate and its main determinants (Appendix 4.3, p. 472)

Since growth rates s, n, δ are constant in the Solow model, and A is not changing i.e. $\Delta s, \Delta n$ and $\Delta \delta$ all approach zero, we can use the derivative concept to relate the instantaneous change in capital per worker growth rate $\frac{\Delta k}{k}$ to its main determinants. Thus, if the Equation 4.2-2 is differentiated with respect to s :

Equation 1-a
$$\lim_{\Delta s \rightarrow 0} \frac{\Delta k}{\Delta s} = \frac{d \frac{\Delta k}{k}}{ds}$$

Equation 1-b
$$\frac{d k}{ds} = \frac{Af(k)}{k} - \delta$$

where the function $f(k)$ expresses diminishing returns to increases in the capital-labour ratio (see footnote 72).

For constant A and δ :

- For low levels of capital per worker, increments to capital cause high increments to output per worker y (recalling that $y = Af(k)$) relative to the increments to k

(recalling that $k = \frac{K}{L}$), hence most likely is that $\frac{Af(k)}{k} > \delta$ and, by a symmetrical argument,

- for high levels of capital per worker $\frac{Af(k)}{k} < \delta$.

Moreover, at some point where $\frac{Af(k)}{k} = \delta$, capital accumulation stops, which determines the steady state point in the model.

For rising A , i.e. ΔA : $\frac{Af(k)}{k} > \delta$, i.e. new technology enables permanent accumulation as the productivity effect of technological progress more than offsets the effects of diminishing returns to capital.

Focused on capital accumulation, Solow further explains its mechanism. Following Solow's arguments, the capital per worker growth rate can be decomposed into **two functions**: $s(\frac{Af(k)}{k})$, and $-(s\delta + n)$ given in Equation 4.2-3. In addition, those functions will be presented in the "alternative" Solow diagram, enabling better explanation of the main categories.

- Taking s and level of technology (A) as constants, Solow suggests that every increase of capital per worker level leads to a decrease in returns, i.e. to a decreasing capital per worker growth rate, as a result of the diminishing returns to capital assumption. Thus, the $s(\frac{Af(k)}{k})$ line is diminishing with respect to capital per worker, which is the crucial assumption of the model.
- On the other hand $-(s\delta + n)$ is a horizontal line, because s, δ, n - which are all rates, measured in percentage terms - are constant with respect to capital per worker changes (see: next sub-section 4.2.1.2).

Once capital per worker is given, Solow determines the output per worker ($y = \frac{Y}{L}$) growth rate as (see Appendix 4. 2, p. 470):

Equation 4.2-4
$$\frac{\Delta y}{y} = \alpha \frac{\Delta k}{k}$$

Where y – output per worker, $\frac{\Delta y}{y}$ – output per worker growth rate, α – capital share coefficient, which is fixed in Solow’s framework. The key result is that the growth rate of output per worker depends only on the capital per worker growth rate. Hence, via Equation 4.2-4, the labour productivity growth rate can be derived from Equation 4.2-3.

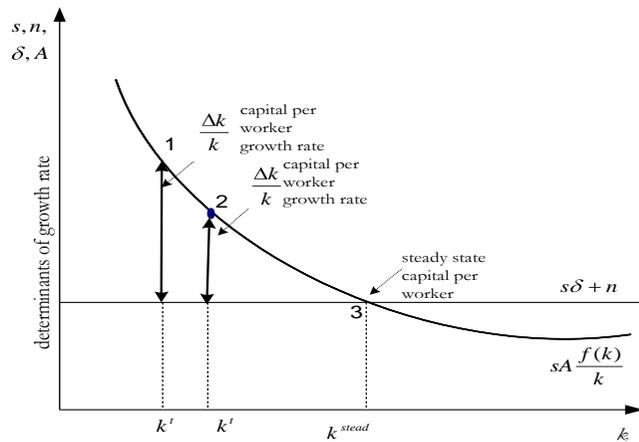
In the following section, the Solow growth model is considered in two stages: first with a constant level of technology (as in the original Solow model, A is normalized to unity); and, second, with increase in the technology level (i.e. A rising over time⁷³).

4.2.1.2 The Solow model with constant technology

The presentation of the two component functions from Equation 4.2-3 in Figure 4.2-1 enables graphical interpretation of the Solow model. Here, the alternative Solow diagram is presented.

⁷³Given the formula, the effects of change in A on the capital per worker level and growth rate will be analysed later in the chapter. It should be that the **change of level of technology** here is of interest $\Delta A \Rightarrow A_1 \rightarrow A_2$, where $A_2 > A_1$ similar to the exercise undertaken by Barro (2008, p.72)

Figure 4.2-1 Determination of the capital per worker growth rate in the Solow model



Source: (Barro, 1990)

Note: The changes in growth rates in s , n , δ can be: one time changes or permanent cumulative changes in rates. Still, the effects in terms of contemporary capital per worker level will be as explained. The difference will emerge with respect to steady state k level or short-run growth rates, which is explained extensively in the chapter.

x-axis - k , capital per worker level is presented $k = \frac{K}{L}$

where K - capital stock and L -labour force,

y-axis, presents growth rates - in depreciation, savings, population (all measured from the origin) for a given level of technology A

k^{stead} - steady state capital per worker level

k' - transitory capital per worker level

s - exogenously given constant savings rate , the effect of change of s depend on the capital per worker level. For a constant technology A :

and $A \frac{f(k)}{k} > \delta$, raising s increases k .

When $A \frac{f(k)}{k} = \delta$, raising s doesn't affect k

n - exogenously given constant population growth
(increase in n , lowers capital per worker level, i.e. $n \uparrow \Rightarrow \frac{K}{L} \downarrow$ or $n \uparrow \Rightarrow k \downarrow$)

δ - constant depreciation rate
increase in δ , lowers the capital per worker level, i.e. $\delta \uparrow \Rightarrow \frac{K}{L} \downarrow$ or $\delta \uparrow \Rightarrow k \downarrow$

A - exogenously given constant level of technology,
according to the model change in A enables permanently increase in the capital per worker level in the long run $A \frac{f(k)}{k} > \delta$

$\frac{\Delta k}{k}$ - the only endogenous variable, is the capital per worker growth rate - or k^*

it is a vertical distance between $sA \frac{f(k)}{k}$ and $s\delta + n$

$sA \frac{f(k)}{k}$ - transitory path of a country towards steady state

point 1 -assumed starting position, characterised with k - capital per worker, and capital per worker growth rate (transitory state)

point 2 - transitory state

point 3 - steady state with zero capital per worker growth rate

Solow assumes that a country away from its steady state – say, starting from position 1 in Figure 4.2-1 – is characterized by a certain level of capital per worker (k) and a certain short-run capital per worker growth rate $\frac{\Delta k}{k}$, given by the vertical distance between $s\left(\frac{Af(k)}{k}\right)$ and $-(s\delta + n)$. From this point, the model builds the concepts of steady state, the transitory path (line), transitory state and the corresponding growth dynamics.

- A country in position 1 is in its **transitory state**, characterized by a certain *level* of capital per worker and a certain *short-run capital per worker growth rate*, for a given, constant exogenous A , n , s and δ .
- While other factors are constant, diminishing returns govern capital accumulation, which eventually will push the country down along a **transitory path** $s\left(\frac{Af(k)}{k}\right)$. For low levels of capital per worker $\frac{f(k)}{k} > \delta$ ⁷⁴, there is a positive change of capital intensity, which is diminishing. The transitory path (curve) itself is determined by the constant technology A and capital accumulation process.
- In the long run, the country will approach its **steady state** of zero growth rates with a constant ratio between output and labour, when capital accumulation is just enough to cover depreciation, i.e. $\frac{f(k)}{k} = \delta$. Intersection with the $-(s\delta + n)$ line is inevitable at one point, on the conditions of: the diminishing returns rule; and constant level of technology A , which defines the steady state of the economy.

This model focuses on the long-run growth movement of a country along the transitory curve towards its steady state. It should be noted that every change in capital per worker growth rates along the transitory curve is related to the change of the capital per worker level

⁷⁴See Box 4.1 above.

itself.⁷⁵ Assuming constant and free technology, the Solow model predicts convergence of countries towards the same steady state. This is the concept of absolute convergence. Briefly, the countries that are scarce in capital, i.e. in a transitory state (for example point 1) will record higher short-run growth rates of capital per worker while, on the other hand, countries with a higher capital per worker level (point 2) or close to steady state will record lower growth rates, respectively.

4.2.1.3 Augmented - Solow model with changing level of technology

Mankiw et al. (1992) augmented the Solow model by transforming technical progress into a particular labour-augmenting form, implying that improvements in available technology raise the efficiency of labour only (Mankiw et al., 1992). Thus, still in the same framework of diminishing returns to capital, technological improvements increase the efficiency of every worker, meaning that each worker produces more and more with the improvement of technology.

The introduction of technology and human capital in the Solow model has important implications (Mankiw et al., 1992). Namely, the diminishing returns to “broad capital⁷⁶” in this case will be less severe than to physical capital in the Solow model, and convergence to the steady state will be slower, hence the transitory effects of investment will last for longer.⁷⁷ The augmented Solow model usually is written in production function form as:

Equation 4.2-5
$$Y = AK^\alpha L^\beta H^\gamma$$

⁷⁵ For example, in Figure 4.2-1, movement from point 1 to point 2 means diminishing the capital per worker growth rate, coupled with the change (increase) in the capital per worker level, which is depicted on the x-axis.

⁷⁶ Broad capital includes not only physical capital and labour, but also human capital.

⁷⁷ In the graphical presentations, the technology level of the Augmented Solow model will mean a less steep transitory line $(s \frac{A_2 f(k)}{k})_2$ as compared to the one originally given by Solow - $s \frac{A f(k)}{k}$.

where, γ is the share of human capital H . In this model technology is still considered as exogenous, and $\alpha + \beta + \gamma = 1$.

As Figure 4.2-2 shows a change in technology⁷⁸ shifts $s \frac{Af(k)}{k}$ upward to $(s \frac{A_1 f(k)}{k})_2$ which, if the country is in a transitory state (point 1), away from its steady state, will result in:

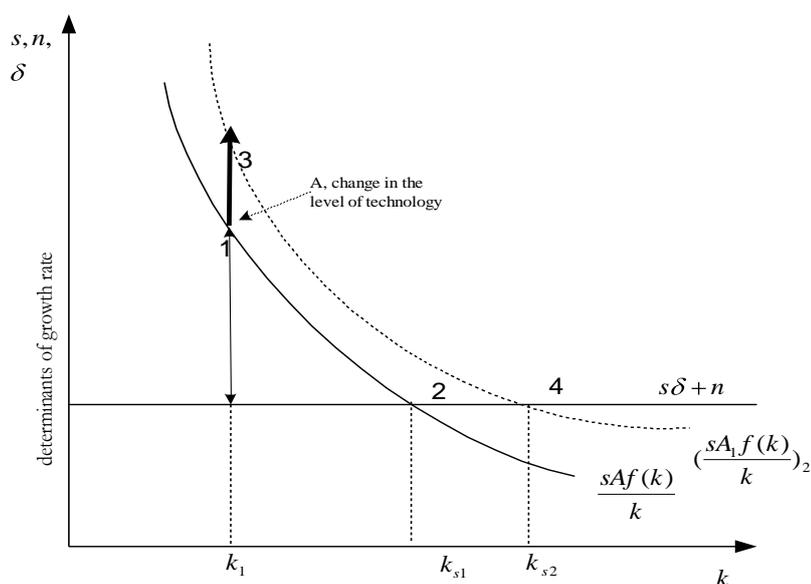
- An increase of short-run growth rates, moving it from point 1 to 3.⁷⁹
- The capital per worker level remains the same at k_1 because technical change is labour-augmenting but does not change the quantity of either capital or labour. Hence, the implication of this is that technical progress is depicted as a parallel upward shift in the whole transitory path – as in Figure 4.2-2.
- In the long run, a country will approach a zero steady-state growth rate at the new higher level of technology and a higher level of capital per worker steady state level (Point 4). This level is higher as compared to point 2 or a steady state level without change in technology. The efficiency of each worker has increased for the change of human capital- H and technology incorporated in it. (Barro, 2008; Sørensen and Whitta-Jacobsen, 2005). Hence, labour is measured in efficiency units, meaning that the amount of labour is magnified by the technology factor. In addition, technical change incorporates determinants that have an independent impact on growth. Namely, in Mankiw et al. (1992) the A term reflects not just technology but resource endowments, climate,

⁷⁸As mentioned the change of technology considered here i.e. ΔA , while the growth rate of technology progress is defined as $g = \frac{\Delta A}{A}$

⁷⁹ Short-run growth rates are measured by the vertical distance between lines $s \frac{Af(k)}{k}$ and $(s \frac{A_1 f(k)}{k})_2$ and $s\delta + n$. As it can be noticed from Figure 4.2-2, the distance in point 3 is bigger for the change in the level of technology.

institutions and so on. It may therefore differ across countries. Namely, $\ln A(0) = a + \varepsilon$, where a is a constant and ε is a country-specific shock. On the other hand, the technical progress rate g primarily reflects the advancement of knowledge, which is not country specific (Mankiw et al, 1992). These assumptions fit well in the modelling later on.

Figure 4.2-2 Augmented Solow Model with changing level of technology



Source: Barro (2007)

In this model, the adjustment of technology level to A_t is accompanied by an increase in the capital per worker growth rate in the short run, which carries with it an important implication. Introducing technology change, the model allows for a shift of the country from one transitory path (curve) $s \frac{Af(k)}{k}$ to another $(s \frac{A_1 f(k)}{k})_2$,⁸⁰ i.e. from one transitory state (point 1) to another (point 3), characterized by the same capital per worker level (k_t), but followed by a new capital per worker steady state level, k_{s2} (Gundlach, 2007). This transfer between various transitory lines can be defined as a **shift movement or regime shift** of the

⁸⁰ The second transitory path characterized by technology level A_1 is marked by a subscript 2.

country producing various effects in both the short and the long run (Barro, 2008; McQuinn and Whelan, 2007; Gundlach, 2007).

It is well known that the model makes strong predictions about the long-run steady-state growth path. However, the model's "out of steady state" dynamics as presented in Figure 4.2-2 seems to be less explored in the literature. McQuinn and Whelan (2007) provide a simple analytical formulation of the Solow model's long-run predictions as well as its short-run dynamics. They state that the capital per worker growth rate tends to converge to zero over time, governed by the diminishing returns to capital, and given the constant rates of n , s and δ . However, once the economy has reached this value, the capital per worker grows according to the change in A , given the labour augmenting technological progress.

4.2.2 Several important implications of the basic Solow model

The Solow model suggests that the long-run growth will be solely determined by the technology change that lead to increases in total factor productivity. Namely through Equation 4.2-1 technical change influences capital per worker which changes output per worker in the long run (Equation 4.2-3). However, neoclassical theory provided no explanation for the sources of technological advances, considering technology as an exogenous factor outside the model (Solow, 1988). Yet, later on Solow (2000) himself relaxed the idea of totally free technology when stating:

The usual presumption is the technology is universal if only because handbooks of science and engineering are easily available everywhere. But that seems superficial to me. Abstract technological knowledge by itself butters no parsnips. For the two countries to have effectively the same technology is very much a matter of workers' skills and attitudes toward work, managerial and administrative habits, interpersonal attitudes, social norms and institutions and no doubts many other hard and soft characteristics of the economic and social environment (emphasized by McQuinn and Whelan, 2007, p.52).

Additionally, the neoclassical model promotes the notion that whatever the sources of growth are, they operate identically in all countries, be they highly advanced or not (Osborne, 2006). This may be misleading, since the model does not take into consideration the possibility that growth determinants are dependent on the stage of economic growth at which a country finds itself. In this context, the growth process is assumed to be the same in the United Kingdom as it is in Macedonia, with only parameter values distinguishing the two. However, Pritchett (1997) argued that economic growth theory should be more sensitive to the peculiarities of growth when the different groups of countries are explored, as for example: mature and stable economic leaders; booming rapidly industrializing countries; countries that fade and lose the momentum of rapid growth; or countries that remain in low growth for very long periods. He emphasizes:

In poor countries there are clearly forces that create the potential for explosive growth, such as those witnessed in some countries in East Asia. But there are also strong forces for stagnation: a quarter of the 60 countries with initial per capita GDP of less than \$1000 in 1960 have had growth rates less than zero, and a third have had growth rates less than 0.05 percent. There are also forces for "implosive" decline, such as that witnessed in some countries in which the fabric of civic society appears to have disintegrated altogether, a point often ignored or acknowledged offhand as these countries fail to gather plausible economic statistics and thus drop out of our samples altogether. Backwardness seems to carry severe disadvantages. For economists and social scientists, a coherent model of how to overcome these disadvantages is a pressing challenge (Pritchett, 1997, p.15).

Even earlier studies, such as Rostow (1960), had pointed out that in different stages of a country's growth different factors determine the growth pattern. He noticed that real economies develop along irregular paths instead of following a smooth exponential curve. In addition, in agreement with neoclassical economic theory and using the conceptual frameworks of economics, sociology and culture, Rostow (1991) supported the idea that capital accumulation determines a country's growth rate. He suggested that growth depends first of all on the shift of income from social redistribution to a high rate of investment in economic activities. The special contribution of Rostow is that he also thought that economic investments had to be supported by other elements: an entrepreneurial attitude;

willingness to accept new ideas and an appreciation of physical capital and its development; the building of an effective national state and its proper institutions; the emergence of a new elite; and an interest in the possibility of increasing human dignity through modernization. In a similar manner, Osborne (2006) argues that the resources available and the choices made have different effects for countries at different levels of the production function. While at lower levels, capital accumulation is the more important driving force of growth, at higher levels total factor productivity gains importance over factor accumulation.

With the limitations of the Solow model in encompassing all the aspects relevant for transition countries in mind, this model is introduced in the following section in order to determine how much of its properties can be used or adapted for explaining growth patterns in transition countries.

4.3 The adopted and modified assumptions of the Solow model

In this section a simple graphical model will be developed by adopting Solow the model and adapting some of its assumptions in order to develop new insights into the different growth path of transition countries.

4.3.1 Adopted assumptions

- Following Solow (1956) **saving** is considered as a constant ratio of income; although this is probably not realistic, in Solow's terminology this is a "non-critical" assumption (i.e., the hypotheses derived from the model do not depend on it). In addition, the assumption related to the **returns to factors equal their marginal value**

products⁸¹ will be preserved at first in accordance with the stylized facts presented in chapter 3, section 3.2.1.3 and 3.2.2.2. Later, this assumption is relaxed.

- **Technological change** is also considered as exogenous to the system. This is a critical assumption but is also reasonable in the context of transition countries, lagging countries⁸² in particular, for three reasons.⁸³
 - First, the rate of indigenous innovation was very low especially at the beginning of transition (whether considered narrowly with respect to R&D intensive production or more broadly in terms of new processes, products and markets⁸⁴)(World Bank, 2007, Kornai, 2012). This was also the case under socialism; so at the beginning of transition, these countries had little knowledge and experience of technology development. In addition, World Bank (2007) key findings suggest that the innovation in transition countries was primarily geared towards improved production and transaction process, e.g. organisational change and improved marketing, rather than the development of new and improved products, especially in the first decade of transition.
 - Secondly, even the current low level of innovation in lagging transition countries in particular is not motivated mainly by domestic business activities, but is rather supported by government and to some extent by foreign investment (World Bank, 2007). Since the innovative change is small and pursued mainly by the government, it can be considered as exogenous reflecting the government willingness to finance R&D in accordance with Shell's model (Shell and Stiglitz, 1967). He introduced public research as an exogenous variable in the neoclassical model, taking into account that it is financed by public funding and contributes technological knowledge to profit motivated agents. In addition, the diminutive

⁸¹ This is an important assumption in the sense that profits and wages should reflect the factors' marginal products in the production process.

⁸² As mentioned in Chapter 2 and 3, lagging countries are TEs which are at a lower level of technological development.

⁸³This subsection is related to the descriptions given in chapter 3, section 3.2.3.

⁸⁴Data on high technology exports in total exports shows an extremely small share of these exports in total exports, comparable to low income countries (World Bank, *World Development Indicators*, 2012).

private sector innovation as does take place is largely associated with foreign direct investment, which is rather small in some groups of countries (EBRD, *Transition Report* 1999, Damijan et al., 2003).

- In addition, it is assumed that, to a certain extent, new technology⁸⁵ is relatively free and available. In fact, to the extent to which technological change does not necessarily require new capital stock, the technology will be considered as relatively not costly and accessible. This might apply to, for example, new management practices, workers' skill and interpersonal attitudes that reduce the "x-inefficiency" in firms (World Bank, 2007). This is the so-called "Harrod-neutral" specification of technology progress, which implies that technological progress takes effect by increasing the productivity of existing capital on a given capital stock (Carlin and Soskice, 2006).⁸⁶ However, all the new technology, which requires substantial investments and hence causes changes in the capital stock, is considered as not free and thus not as easily accessible for the countries in transition. Howitt and Mayer-Foulkes (2002) also distinguish between two types of technological investment, namely "modern R&D" (or simply R&D) and "implementation". The former describes the process in the most technologically advanced countries, while the latter is the process of assimilation and adaptation that takes place in less advanced countries, transition countries included. They suppose that both kinds of technology investment are costly, but R&D draws more heavily on scientific knowledge and its institutions, and thus requires higher skill levels than implementation. In particular, they claim that graduating from

⁸⁵ Here, all the methods that decrease the x-inefficiencies in the firm and are not always related to a huge investment and change in capital per worker are referred to, such as new organization of labour that can be easily copied (World Bank, 2007).

⁸⁶ There are different ways of modifying the production function so as to take into account the technology variable A in addition to capital and labour:

- "Hicks-neutral" or factor-augmenting technological progress, where the technology variable affects both the productivity of labour and capital;
- "Solow-neutral" or capital-augmenting technological progress.

In each case, A changes exogenously and can be considered as something like world technological knowledge (Carlin and Soskice, 2006).

implementation to R&D requires surpassing a threshold skill level that increases with the demands of new, ever advancing, leading technologies.

Unlike the Solow model, in which completely common and free technology enabled each country to approach the same steady state, the augmented Solow model as given by Mankiw et al. (1992) relaxes the assumption of completely free and common technology, relating technological progress to human capital. Thus, still exogenous technological progress in this model allows for divergence across countries related to level of technology A , which is incorporated within the labour force. According to it, each country will approach its own steady state depending on the level of technology (Gundlach, 2007, p.28).

- Likewise, the critical and also realistic, assumptions of Solow's model, namely, the notion of **diminishing returns** and constant returns to scale have been maintained, reflecting the transition countries' economic structure,⁸⁷ which was supposed to restructure from a high share of agriculture and industry in GDP value added to a high share of services in GDP value added (Eschenbach and Hoekman, 2006). This kind of restructuring was observed in some of the transition countries. However, as shown in chapter 3, section 3.3.2, the pace of changes differed among various groups with most of the countries still preserving large labour intensive, low-tech industries characterized by diminishing returns to capital and constant returns to scale (EBRD, *Transition Report*, 2008). Grossman and Helpman (1991) argue that in reality the opportunities for technological progress are not uniform across various sectors and different sectors employ production factors in different combinations, which eventually determine the composition of production and prevailing returns to scale. In their findings, sectors using predominantly unskilled labour exhibit constant returns to scale, whilst the high-technology sectors using high-skilled labour exhibit increasing returns to scale.

⁸⁷At the outset of transition, in the industrial structure in transition economies industries such as extractive industry, textile industry, food industry dominated. (Grigorian and Martinez, 2000).

4.3.2 Modified assumptions

Although adopting the main assumptions of the neoclassical theory, in the following section some of these assumptions will be relaxed in order to develop a theoretical model that might fit the stylized facts of transition better. Additionally theoretical justification for doing so will be offered.

The Solow model made three assumptions (Solow, 1956):

- Firstly, there is no possibility for **shocks** to occur in the economy. Namely, the Solow growth model presumes that a closed market economy would gravitate naturally along the optimal growth path.
- Secondly, there exist **perfect factor markets** that adjust the returns to the marginal productivity of each factor.
- Thirdly, a **totally closed economy**, where the interactions of a country with other countries have no influence on returns to factors and thus have no influence on the short-run or long-run output growth rates (Solow, 1956, 1957). In the closed economy no borrowing from abroad is possible and hence savings are equal to investment.

4.3.2.1 The introduction of shocks in the model

As already mentioned, the Solow model does not allow the actual growth path to be on a lower path than the optimal capital–output ratio in the long run. Since the saving/investment ratio is a constant share of income, a country cannot move out of the equilibrium movement along its transitory line (curve), predetermined by the constant level of technology.⁸⁸ Since the savings and investment rates are always higher than the depreciation and labour growth

⁸⁸This assumption is made in a world of non-freely moving capital, where the investment depends only on the savings in the country.

rates (given by the restrictive presumptions of constant rates) and there is no possibility of shocks. Countries are predestined to follow the line and, additionally, as a result of diminishing returns, subsequent investment will produce progressively smaller impacts on output (as presented in Figure 4.2-1).

In that context, it seems that this model fits the growth pattern of the developed industrial countries, which was also recognized by Solow himself (Solow, 1994). Yet the description of steady growth around a well-defined and stable trend is clearly not a good description of the actual growth experience of most economies in the world, certainly not for transition countries as will be discussed in chapter 5 (Solimano and Gutiérrez, 2006). New evidence is showing that growth fluctuations at frequencies measured in decades are very important for most countries, except probably high per capita income economies (although even this may be in doubt with the global financial crisis and the end of the “Great Moderation”)(Pritchett, 2000). In fact, there is now increasing evidence that growth is an irregular and volatile process in which one country may experience various shifts in growth regimes over a period of decades that can entail growth take-offs, stagnation and/or growth collapses (Hausmann, et al., 2004, Jones and Olken, 2005, Solimano and Soto, 2006). This idea of shocks and volatility and instability of growth will be additionally developed in chapter 5. The reason for dedicating such attention to this is the fact that major shocks can cause growth regime shifts, especially in transition countries.

At this point, two main shocks will be discussed: huge and sudden increase in the depreciation rate due to sudden obsolescence of the physical capital; and sudden drop in the employment rate following the adjustment of the labour market, all of which are discussed in detail in chapter 3, sections 3.2.1.2 and 3.3.3. These rates are constant in the Solow model, not allowing for either one time change or permanent changes.⁸⁹

⁸⁹ Solow (1956) did briefly consider the implications of (Keynesian) unemployment for his model, allowing unemployment to emerge. However, this was not a primary focus of his investigation.

a) Depreciation rate and sudden obsolescence

In the original Solow model, the **depreciation rate** is constant. Constant depreciation rate is one of the drivers that determine the capital accumulation process in the model. Constant depreciation rate of the physical capital is applicable for the case of developed countries, where capital is worn out gradually (Barreca, 1999).⁹⁰ On the other hand, transition countries recorded huge and sudden jumps in depreciation of the physical capital once the economies were opened up as shown in chapter 3, section 3.2.1.2. In practice, the physical capital became obsolete and useless at the onset of transition, a shock that cannot be easily incorporated in the balanced growth path of the Solow model, as it does not allow for the introduction of large sudden changes in rates, the depreciation rate included (Laski and Bhaduri, 1997, Ericson, 1996). Fiaschi and Lavezzi (2006) introduced sudden depreciation of the capital stock caused by the oil shock in their model of growth. They showed that this shock had negative effects on the rate of growth, producing a downward shift in the linear growth path, which additionally increased the dispersion of the world income distribution. Hence they continued by modelling the growth pattern in a non-linear fashion.

b) Employment rate change

In the Solow model the **population growth** is assumed to equal the growth of labour force, under conditions of a high employment rate, a very low/natural rate of unemployment and a flexible wage system.⁹¹ Furthermore, in the traditional Solow model a given amount of labour is spread among the capital continuously so that the output is maximized. The assumption of a non-changing labour force and constant employment rates could be applied - with even

⁹⁰Based on this assumption most growth accounting studies for developed (and developing) countries usually consider the depreciation rate to be 0.05, constant for the whole period of analysis.

⁹¹ However, later on, Solow merely mentions rigidities in wages and explains the way that they impinge on the neoclassical model.

more justification - to socialist countries, where the relationship between population growth and employment growth was strong and coupled with low or no unemployment⁹²(Svejnar, 1999). However, in the course of transition, the relation between population growth and the labour force was broken, because transition countries recorded specific adjustments in labour markets characterized by low rates of employment, coupled with high rates of unemployment, decreased labour participation rate and substantial employment in the informal sector as shown in chapter 3, sections 3.3.2, 3.3.3 and 3.3.4 (Nikoloski 2009; Blanchard,1997).⁹³ On the other hand, the accompanying factor - capital - adjusted more quickly to the new conditions, simply becoming obsolete and useless (Ericson, 1996).

4.3.2.2 Imperfect markets: differences in the adjustments of factors' markets

Partly these differences in factors markets alterations can be explained by the various adjustment properties of labour and capital as factors of production. Namely, discussing structural unemployment in the neoclassical model, Akerlof (1969) noted that the adjustment speeds of labour and capital are significantly different, the former being considerably slower than the latter. He attributed that to two main reasons. Firstly, he emphasized that while physical capital's average age is fairly low, around 17.5 years on average⁹⁴, the labour that is trained and educated in its first twenty years of life has to live with skills little changed for an additional 40 or 50 years. Hence,

- labour has higher sensitivity to possible shocks as compared to capital; and,
- Labour is characterized by reluctance to change wages.

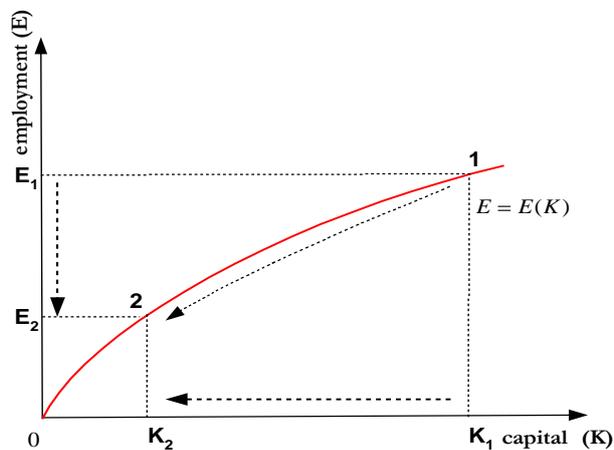
⁹²Presumably, the level of the natural unemployment rate during socialism was fairly low, even if it is assumed that the concept can be applied to planned (socialist) economies.

⁹³In terms of the level of natural unemployment rate, these movements altered it and in fact increase it (Nikoloski, 2009).

⁹⁴The indicator borrowed from Akerlof (1969) involves the average age of equipment and also buildings and structures. However, that is much less true for the equipment itself. In addition, it should be kept in mind that Akerlof's argument was made in the distant 1960s. However, his idea of various life-long spans for labour and capital is still applicable.

As a result, taking into account different ageing properties, Akerlof (1969) allowed for structural unemployment or “labour scrapping” emerging in circumstances when the capital stock shrinks. Given the labour force and a positive wage, he explains how labour scrapping occurs when the capital stock diminishes. On Figure 4.3-1 below, his idea is presented where the x-axis presents the capital stock (K) and the y-axis presents the employment stock (E) in the economy. The function $E(K)$ actually captures the positive relation between the capital and employment.

Figure 4.3-1 Structural unemployment



Source: Akerlof (1969, p.403).

Figure 4.3-1 shows that as capital stock decreases from K_1 to K_2 , labour employed diminishes too, as workers are laid off. In Akerlof’s model, the workers first to leave employment are the ones with lowest productivity per unit of capital and then successively more efficient labour is shed until employment matches the diminished capital stock. The remaining labour, with the highest efficiency, stay employed. He concludes that with a given labour force and given positive and relatively rigid wages, the smaller the capital stock the higher is the number of unemployed.

However, this explanation might be inconsistent with the main assumption in **long-run** macroeconomics, which states that all wages and processes are fully adjusted in the long run, meaning that there are no nominal rigidities in the long run.⁹⁵ Hence, long-run neoclassical macroeconomics assumes equilibrium over a long span of time.⁹⁶ This assumption is quite in accordance with developed countries' growth paths. However, even in 1975, Chenery discussed the need to develop specialized models for analysis of developing countries,⁹⁷ which introduce the possibilities of persistent disequilibrium in commodity or factor markets in the course of their development. He emphasized that several characteristics may prevent a developing country from reaching equilibrium over extended periods or cause economic equilibrium to be politically or institutionally unstable. Further on, he identified that the properties of demand and production functions may lead the economy into disequilibria together with time lags in their interrelated adjustments. If production and demand are characterized by low elasticities of substitution and with delays in their adjustment, then adjustment is more difficult to achieve. Three sets of substitutions are possible and they are alternatives to each other:

- Direct substitution among components of domestic demand;
- Direct substitution among components of supply, i.e. factors of production; and
- Indirect substitution among commodities and factors by way of international trade.

Hence, according to him, less substitution in demand should be offset by more substitution (adjustments) in supply or international trade. The interest here is precisely in the substitution of factors, i.e. the adjustments on the supply side that occurred in the course of

⁹⁵ For the case of developed economies, the identification of the realistic set of circumstances that could cause persistent unemployment of both capital and labour led to the formulation of the Keynesian model of short-run macroeconomic behaviour. This model enables research into the sources of disequilibrium and the differences in economic behaviour and policy responses.

⁹⁶The neoclassical theory is supply-side theory as opposed to the demand – driven growth theory as developed by Kaldor (1960), Thirlwall (1986).

⁹⁷Chenery (1979) is concerned with developing countries at that time: most African countries; Asian countries; South America; and Yugoslavia also. The general framework of his research is in development economics.

transition, although it should be admitted that some interesting aspects of substitution might have occurred by way of international trade.⁹⁸

In similar vein, Easterly et al. (2000) emphasized the asymmetries in the adjustment of real variables. They claimed that much of the standard analysis has neglected some important first order effects, e.g. the *dynamic* consequences of wages and prices falling or sudden depreciation. These may result in long-run adverse effects that appear to be more dominant than are reflected in the comparative static effects. Namely, it is often stated that a lower level of wages may be associated with a higher level of employment. However, to go from one level of wages to another (lower) level, wages need to be falling. If falling wages lead workers to reduce consumption, then the net effect on aggregate demand and employment could even be negative, i.e. falling demand and falling employment. Easterly et al. (2000) claim that this will be the case especially when there are asymmetries in the adjustments of real variables, which is usually the case in developing (or transition) countries where the **factors and goods markets are imperfect** or not fully developed. Hence, the total effect in these groups of countries might be the economy pulled out of equilibrium even further and for a longer period as compared to the predictions in business cycles theories. This suggests that the structural changes in the course of transition have a completely different nature from the changes that happen in the normal business cycle.⁹⁹

Sørensen and Whitta-Jacobsen (2005) also contributed to this debate on the different adjustments in factors markets, agreeing that there may be permanent real rigidities preventing wages and capital prices from adjusting to the values which would prevail under perfect competition, due to the fact that the correlation between real wages and economic activity is quite weak whereas the correlation between output and employment is very strong.

⁹⁸Replacement of the demand for domestic products with the demand for foreign products might be one way of substitution in this context (Thirlwall, 1986). Additionally, immigration can be considered as another way of substitution by way of international cooperation.

⁹⁹The idea of differentiating between business cycle recession and transition recession was introduced in the introductory chapter 1. However, it will be extensively discussed in chapters 5 and 6.

Following an extensive example of workers' union behaviour, they suggest that the degree of real rigidity may be measured by the *level of the natural unemployment rate*¹⁰⁰ that might be changing. Hence, in their argumentation, market rigidity boil down to the labour market. In their modelling, they do allow for some short-run rigidity, which accumulates over time, hence forcing the agents who kept their wages or prices constant even further away from their optimal wages and prices. Nevertheless, eventually, they argue that in the long run wages and prices do adjust. Yet, the remaining effect will be the changed level of the natural rate of unemployment. The idea of short-run and long-run rigidities and their medium-term effects will be extensively used in the following sections.

4.3.2.3 Open economy instead of the assumption of closed economy

As mentioned at the beginning of this section, the Solow model was developed for a completely closed economy, which has no interaction with the rest of the world, hence the goods and factors markets are unaffected by changes in the international economy. However, one imperative of transition in reality was the liberalization of markets and intensification of international exchange as mentioned in chapter 3, section 3.3.1.

Ventura (1997) introduced the openness of goods and capital markets in the neoclassical model. Namely, relating the international goods market to the domestic factor markets, he suggested that for small open economies in particular, the actual return to capital is determined by the world's capital stock, because goods must be sold and exported at the prices given by world conditions. In Ventura's context, the low capital per worker level might potentially mean high returns to capital and high profits, and hence high short-run growth rates, but only if goods produced with that particular level of capital per worker can be sold

¹⁰⁰ According to established tradition in macroeconomics, the long-run equilibrium unemployment rate implied by the economy's real rigidities is called the natural rate. This is the long-run equilibrium rate of unemployment emerging when all relative prices, including wages, have fully adjusted.

on the domestic and international markets at world prices. Otherwise, the potential high returns in reality might turn into low or normal returns to capital (profits) reflecting the low productivity and low technology level in the economy.

4.3.3 Preserved vs. modified assumptions

In Table 4.3-1 below the main Solow assumptions are listed, with differentiation of the assumptions that are preserved in different stages in the modelling procedure from the ones that are relaxed. Since the full model and the different stages have yet to be introduced, the concept of modelling through stages will be introduced briefly at this point. Namely, the modelling is the reflection of the notion of transition itself, which involves big structural changes, grouped in three main steps or regimes: the first stage of “crash” adjustments in which mainly adjustments in physical capital and labour occurs; followed by the “recovery” stage of adoption of relatively free technology, and ending with the “take off” stage when the transition country catches up with western economies.

Table 4.3-1 Assumptions of the neoclassical growth model

Assumption:	Stage One		Stage Two	Stage Three
	Phase 1	Phase 2		
Diminishing returns to each factor (capital)	√	√	√	√
Constant returns to scale	√	√	√	X
Exogenous technical progress	√	√	√	√X
Perfect Markets - Marginal product of factors equal to returns to factors	X	X	X	√
Closed economy	X	X	X	X

√ - the assumption is preserved in the modelling,

X – the assumption is relaxed in the model,

√X – the assumption is relaxed though with some limitations.

Having introduced the notion of stages, the assumptions can be briefly discussed:

- The assumption of eventual diminishing returns to each factor applies for the transitional period. An increase in the physical capital, i.e. every increase in the capital per worker level, is expected to produce diminishing returns and consequently decreasing growth rates as the country is moving along some transitory growth path rather than moving between different transitory growth paths. As Figure 4.5-2 will show, only when new technology is introduced (free or non-free) are there increased returns for the same capital per worker level, as the country moves from one to another transitory line or records a shift in regimes.
- The assumption of constant returns to scale is preserved implying that low-tech industry is dominant in the industrial structure of most of transition countries for the most of the transition period.¹⁰¹
- Exogenous technology is also a preserved assumption, though to some extent relaxed for the final third stage of transition, reflecting the fact that technology shift in transition countries is owing mainly to public research, technology absorption and its import from abroad in the form of foreign direct investments (FDI).
- It was assumed that transition countries become relatively open economies in terms of the export and import of goods and capital, therefore the assumption of closed economy is relaxed (see chapter 3, section 3.3.1).
- Finally, the assumption of perfect markets of goods and factors in which the returns to factors will be equal to its marginal product is relaxed as well. Thus, it is assumed that it takes some time for the markets to be stabilized and to be able to equalize the returns with their marginal product. After achievement of full utilization of all factors in stage 3 of transition, it is assumed that markets will be relatively close to the perfect markets assumption.

¹⁰¹This assumption will be relaxed later in this section. Namely, in the final stage of transition, the industrial structure in some of the more successful transition countries is changed towards relatively higher-skilled based industries mainly related to FDI, which creates conditions for achieving increasing returns to scale (Campos and Kinoshita, 2008)

The main conclusion from the above discussions on modifying some of the Solow assumptions is introducing the sudden increase in the depreciation rate into the model as well as the employment rate and its changes, instead of the labour force growth rate (Jones and Olken, 2005). This will enable the modification of the Solow model in order to identify the effects of employment adjustment on the output level in the course of transition. Thus, n is substituted by e (i.e., the growth of employment). Correspondingly, the growth of unemployment is $u = n - e$.¹⁰² Furthermore, it should be noted that depending on the time span observed, the growth of employment rates would differ significantly. To be precise it is assumed that, in short-run terms, there were sharp changes in the stock of the employed labour force and, hence, large one-time changes in the employment rate. However, in the long run, the employment and correspondingly the unemployment rates stabilize leaving strongly altered changes in levels of employment and unemployment.

At first, it is assumed that the transition country started from some socialist steady state (point 1 in Figure 4.4-1) characterized by full use of factors but with latent deformations, explained previously in chapter 2, section 2.2 (Rider and Knell, 1992). The time point overlaps with the onset of transition, which for most of the countries in the sample is the beginning of the nineties.¹⁰³

¹⁰² For simplifying reasons, the inactive labour force growth rate is not included in the analysis. Additionally, it is assumed that the main adjustments on the labour market were realized by the changes amongst the employment and unemployment.

¹⁰³ The application of the neoclassical growth theory to explain socialist (planned), transition and capitalistic (market) steady states and the growth processes in between those states may be questionable having in mind the huge differences among these economic systems. Yet, the main assumption of this theory - diminishing returns to one factor, which are determined by the level of technology - holds for all three systems.

4.4 Modelling under modified assumptions

Having in mind the importance of technology and stylized features of former socialist countries, at the outset, two steady states can be distinguished in this model:

- one characteristic for planned (socialist) economies (S), characterized by capital per worker (k_s); and,
- one for market (capitalist) economies¹⁰⁴ (C), characterized by higher capital per worker (k_c) presented in Figure 4.4-1.

This corresponds to the assumption that the former neglected investments in technology, especially in the last stages of the old regime, whereas developed industrial countries led by the profit motive invested heavily in technological progress as described in chapter 2 (Deliktas and Balcilar, 2005. Kornai, 2012). This strategy enabled the market economies to move along a different transitory line further to the right as compared to socialist countries. The capitalist economies are in fact characterized by higher productivity for the same capital per worker levels (Rider and Knell, 1992; McQuinn and Whelan, 2007). In addition,

- while planned (socialist) economies move along the $sA_s \frac{f(k)}{k}$ line, which indicates a lower level of technology A_s and capital accumulation function $\frac{f(k)}{k}$,
- the market (capitalist) economies record a capital accumulation function producing higher growth rates, $sA_c \frac{f(k)}{k}$, as a result of a higher technology level, which is

¹⁰⁴Here the advanced industrialized economies are referred to, such as the EU, US, Japan, excluding capitalist countries in Latin America or Africa.

incorporated in human capital¹⁰⁵ (i.e. $A_s < A_c$) (see section 4.2.1.3 on the technologically augmented Solow model) (Kolodko, 2001).

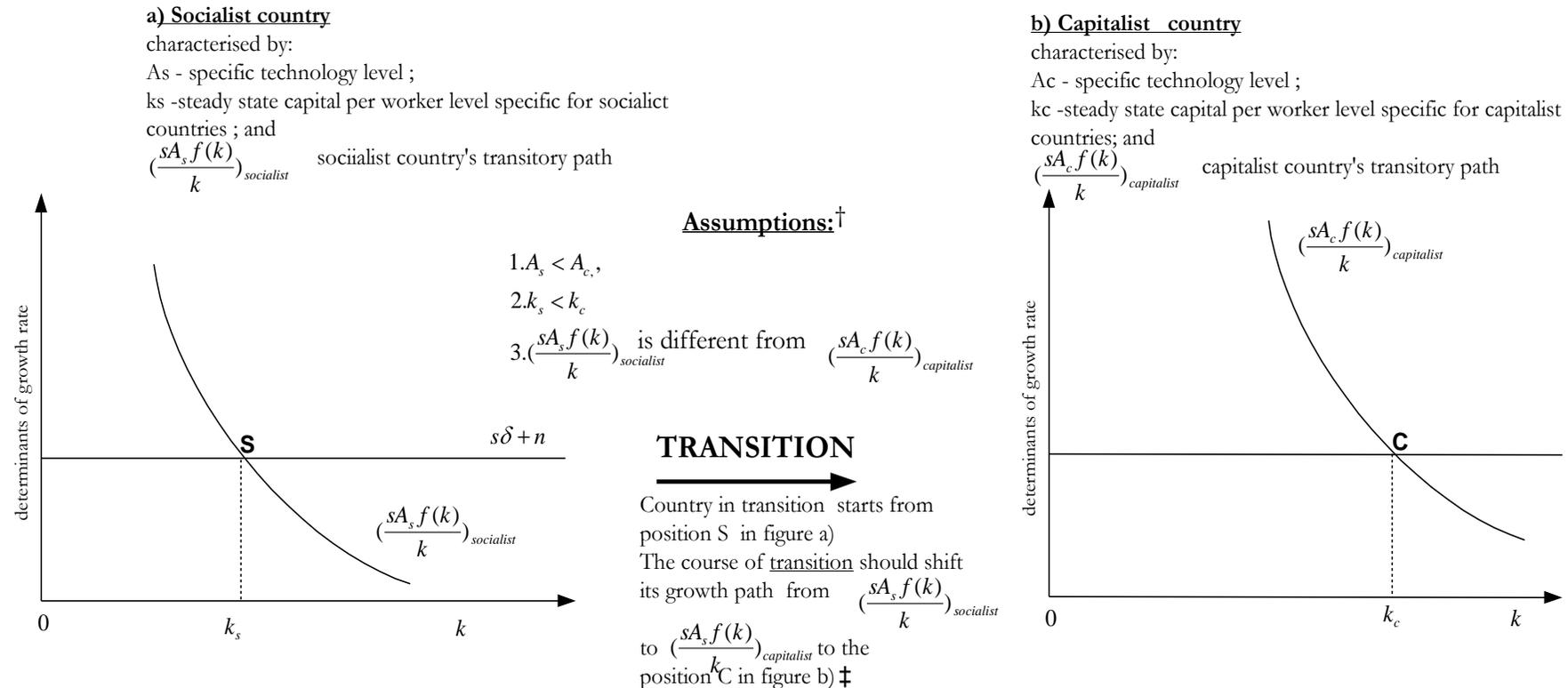
In Figure 4.4-1, these starting assumptions are captured by the distance of the curves from the coordinate system's starting point.

Transition itself (marked by arrow in the figure) was supposed to shift former planned (socialist) economies from the socialist steady state and the $sA_s \frac{f(k)}{k}$ transition line (curve) to a higher (capitalist) economies curve $sA_c \frac{f(k)}{k}$, producing a higher short-run capital per worker growth rate, along a higher transitory path, reflecting technological progress and enabling increase in contemporary capital per worker levels and, finally, increase in the long-run steady state capital per worker level. However, this process was far from straightforward in transition countries. In fact, the difficulties of change, and the way in which various countries responded to them, resulted in huge differences in terms of the processes developed and results achieved.

Having said that, the growth in the past twenty years of transition should have been a part of a sequence of technologically induced traverses, disequilibrium transitions between successive growth paths – each new path being characterized by output per capital levels higher than the one left behind (Abramovitz and David, 1973, Pritchett, 1997). The following section will reveal whether this was, in fact, the case in all transition countries.

¹⁰⁵This assumption is in accordance with the Augmented Solow Model, chapter 4, section 4.2.1.3.

Figure 4.4-1 Determinants of growth – modified assumptions



[†] - the assumptions are drawn from the arguments presented in chapters 2 and 3

[‡] -transition produced changes in the variables captured in the Figures 4.5-1 and 4.5-2. subsequently resulting in an array of adjustments

Figure 4.4-1 depicts an idealized transition – i.e., one happening without sharp discontinuities. In contrast, in the following section we develop a model designed to capture the violent upheavals that occur during transition, i.e. between the “before” and “after” steady states depicted in Figure 4.4-1.

4.5 Transition in three main regimes or stages

Three different stages or regimes of growth in the course of transition can be distinguished.

1. The **first regime** is the “**crash adjustment**” stage in which mainly adjustments in physical capital and labour happened as will be explained below. The extent of these two changes allows for subdivision of this stage into two separate phases:
 - First phase – adjustment in physical capital, which includes the sudden obsolescence of physical capital at the outset of transition as depicted in Figure 4.5-1a), and;
 - Second phase – adjustment in the labour market, which encompasses the consequent labour market adjustment, as depicted in Figure 4.5-1b).

Briefly, this stage can be described as a necessary “adjusting period”, resulting from the inherited conditions and opening of the transition economies. This stage actually draws the downward part of the J- or U- growth path¹⁰⁶ in transition countries, moving the country to the very bottom of the growth curve. However, as shown in chapter 2, the length of this stage differed across transition countries allowing for new shapes of growth patterns to be formed such as: rapid-J curve; slow-J curve; and incomplete-U curve groups of countries (chapter 2, section 2.5).

¹⁰⁶In the literature, the U-shape growth path is usually used to describe the growth in transition countries.

2. The **second regime**, following the crash stage, is the **“recovery stage”**. The preconditions for the upturn in this stage are created in the first stage, by correcting the capital per worker ratio after the crash movements in both factors. This stage is characterized by the adoption of new relatively free technology.¹⁰⁷ The definition of the free technology is borrowed from Abramovitz (1962), namely, free technology is described as “...the effects of the “costless” advances in applied technology such as: managerial efficiency and industrial and labour organization...(p.764)”. This progress moves the country along the upward part of the U-curve ending at the top (in other words, back to the pre-transitional level of output). The length of this period varies across various transition groups from 2 to over 10 years.
3. The **third regime** is the **“take off” or “catch up” stage**, characterized by import and implementation of new technology (equipment, machines) accompanied by the required investments, domestic or foreign. This phase continues after the country has reached the top of the U-curve and inaugurates the J-curve of recovery, i.e. a sustained growth pattern. As mentioned in chapter 2, this stage has not occurred in all TEs groups.

These stages and phases are now analysed further by reference to the three-panel model set out in Figure 4.5-2.

4.5.1 Regime One or “Adjustment Stage”

- From the initial top of the “U” curve to its bottom

Before the main model is introduced in Figure 4.5-2, it is useful to start by describing the changes that happened in the physical capital and labour at the onset of transition. These

¹⁰⁷Carlin and Soskice (2006) considered technological shift (innovation) as a “step-by-step” process in which the firm can only upgrade its technology by one step as a result of its innovation activity: there is no leap-frogging. This assumption will be borrowed and applied in this research, i.e. technology shift due to technology diffusion that occurs when one country absorbs some technology from abroad.

changes actually triggered the later developments in the course of transition and it is worth explaining them at the very beginning.

4.5.1.1 Changes in physical capital and labour at the onset of transition

With the onset of transition, it is assumed that the technological basis of production does not change; hence, the $s\left(\frac{Af(k)}{k}\right)$ curve remains in its final, “socialist” position. In addition, as shown in chapter 3, sections 3.2.1 and 3.2.2 the depreciation rate and employment growth rate¹⁰⁸ each recorded a sharp one time or permanent change, which moved the country back along the existing transitory line, changing the capital per worker level as well as the level of employment (i.e. the number of workers actually employed at a given ratio of capital to labour). These changes were more or less prolonged at the aggregate level but, for simplicity, they are modelled as one-time changes, which do not have a permanent effect on the growth rates thereafter. That is to say, after the sharp adjustments, the depreciation and employment growth rates are stabilised; for simplicity, the $s\delta + e$ line remains in the same position in the course of transition.¹⁰⁹ The changes in growth rates have their counterpart in the changes in the levels of capital per worker.

Following the argument of the various adjusting paces of capital and labour given by Akerlof (1969) in section 4.3.2.1 (see also Sørensen and Whitta-Jacobsen, 2005), in the first **stage** of **“crash” adjustment** two phases can be distinguished.

¹⁰⁸Labour force growth has been replaced with the employment rate in as discussed earlier on in chapter 4, section 4.3.2.

¹⁰⁹ The phrase “for simplicity” means that this feature of the model is not supported as realistic, but, nonetheless, does not affect the analysis in any essential way.

- The **first adjustment phase** (denoted by subscript 1) was marked by a sharp fall in capital as compared to the socialist period, and no change in the labour force, i.e.

$$\frac{K_S}{L_S} \Rightarrow \frac{K_S \downarrow}{L_S} \equiv \frac{K_{T1}}{L_{T1}},$$

where subscript T denotes transition. Thus, at the onset of transition, the capital per worker decreases significantly as compared to the one in the

socialist state $\frac{K_S}{L_S} > \frac{K_{T1}}{L_{T1}}$ or $k_s > k_{t1}$.

- The **second adjustment phase** in the first “crash” stage (denoted by subscript 2) is characterized by a huge fall in employment and no change in the capital level, i.e.

$$\frac{K_{T1}}{L_{T1}} \Rightarrow \frac{K_{T1}}{L_{T1} \downarrow} \equiv \frac{K_{T2}}{L_{T2}}.$$

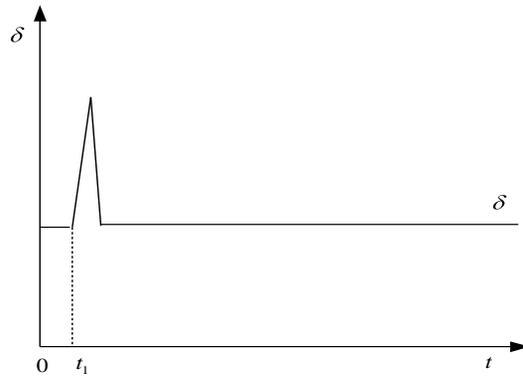
Thus, the capital per worker at T_2 increases as compared to the one at the beginning of transition T_1 , or $\frac{K_{T2}}{L_{T2}} > \frac{K_{T1}}{L_{T1}}$ or $k_{t2} > k_{t1}$.

In Figure 4.5-1, the changes in the rates of depreciation and growth rates of the labour force are presented. The x-axis is the time scale, while the y-axis presents the rate of depreciation and the growth rate of the labour force (Figure 4.5-1, a and b, respectively). The sharp increase of depreciation rate marks the outset of transition, while later on (at point time T_2) it is followed by the sharp decrease in the employment growth rate as discussed in chapter 3, section 3.3.3. After crash adjustments and corresponding spikes, both **growth rates** are stabilized at constant levels; for simplicity, the lines are returned to their previous positions, though leaving **the levels** of the physical capital and employed labour drastically changed. The changes are presented in Figure 4.5-1 below.

Figure 4.5-1 Changes in depreciation and employment growth rates in the course of transition

a) Phase I - Physical capital adjustment

1. one time change - sharp increase in depreciation rate, which triggers instant move upwards (spike)
2. stabilization of the rate afterwards (for simplicity shown at the "pre-crash" level)

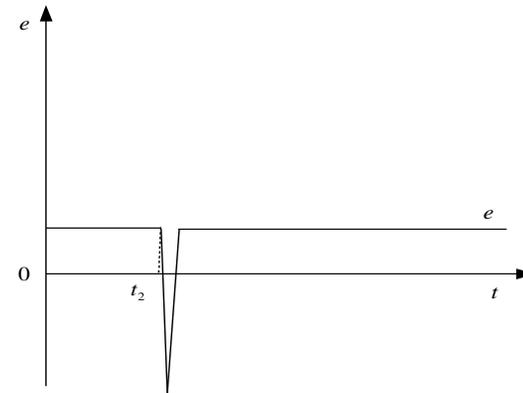


T - transition time where

$$t_1 < t_2$$

b) Phase II - Labour force adjustment

1. one time change - sharp fall in the employment growth rate, which triggers instant movement downwards (spike)
2. stabilization of the rate afterwards (for simplicity shown at the "pre-crash" level)



4.5.1.2 The main model

In the following Figure 4.5-2, a graphical extension of the Solow model is developed to analysis both growth rates and levels changes during transition (i.e. to show what happens between Figure 4.4-1 a) and b). However, it should be noted that in reality the distinction among various phases is difficult, since in the course of transition the changes were interrelated and causally associated.

The model shows:

- Growth rates, presented in Figure 4.5-2. a);
- Changes in labour productivity, shown in Figure 4.5-2.b); and,
- Changes in output level, shown in Figure 4.5-2.c).

In each graph in Figure 4.5-2, the horizontal-axis presents the capital per worker level, $k = \frac{K}{L}$, while the vertical-axes present, respectively, changes in growth rates, labour productivity and output level, respectively. Because the horizontal-axis is in common, the three diagrams are interlocked and so they offer a simultaneous analysis of transition processes in growth rates, the capital-labour ratio, labour productivity, and the level of employment and the level of output. The algebra underlying the graphical relationships is presented in Box 4.2 below.

In general, three main downward sloping curves appear in all figures. These match the three stages or regimes that transition countries should pass in order to reach the capitalist country transitory growth path. They are explained extensively later in this section. At this point, it should be noted that the main distinction, which differentiates them, is the assumed level of technology. To be more precise, one curve is characteristic for planned (socialist) economies A_1 ; one characteristic for developed market (capitalist) economies A_2 ; and one transitory path characterized by the level of technology related

to relatively free technology A_t , i.e. better labour organization and less x-inefficiencies in accordance with the assumptions. The subscripts used in the Figure are extensively explained in Box 4.3.

Box 4. 2 From growth rates to levels (algebraic addition to the diagram)

Algebraically, each curve (function) can be related to the main Solow equations given above and in Appendix 4 (1-3) to this chapter.

Namely, starting in Figure 4.5-2.a) with the main Solow Equation 4.2-3:

Equation 2-a
$$\frac{\Delta k}{k} = s\left(\frac{Af(k)}{k}\right) - (s\delta + n)$$

And by replacing the left-hand side $\frac{\Delta k}{k} = \frac{\Delta K}{K} - \frac{\Delta L}{L}$ (Equation 4-9 from Appendix 4.2, p. 470):

Equation 2-b
$$\frac{\Delta K}{K} - \frac{\Delta L}{L} = s\left(\frac{Af(k)}{k}\right) - (s\delta + n)$$

If on the left side of Equation (2-b) $\frac{\Delta K}{K}$ is replaced with $\frac{\Delta K}{K} = s\frac{Y}{K} - s\delta$ (Equation 4-14 from Appendix 4.3, p. 472), and similarly for $\frac{\Delta L}{L} = n$, and remove the brackets around the second term on the right-hand side:

Equation 2-c
$$s\frac{Y}{K} - s\delta - n = s\left(\frac{Af(k)}{k}\right) - s\delta - n$$

The final two terms in both sides of Equation (2-c) are the same, so that they can be discarded:

Equation 2-d
$$s\frac{Y}{K} = s\left(\frac{Af(k)}{k}\right)$$

By discarding s on both sides and substituting for $k = \frac{K}{L}$:

Equation 2-e
$$\frac{Y}{K} = \frac{Af(k)}{\frac{K}{L}}$$

Or, after cross multiplying by K and then by $\frac{K}{L}$:

Equation 2-f
$$\frac{YK}{L} = KAf(k)$$

K can be discarded in both sides in equation 2-f, which yields the labour productivity equation as given above:

Equation 2-g
$$\frac{Y}{L} = Af(k) \text{ or } y = Af(k)$$

Thus, following the opposite procedure of the Solow algebra the labour productivity equation is derived which is depicted in Figure 4.5-2.b). This equation and figure show changes in capital per worker and their effect on labour productivity. For each level of capital per worker, the labour productivity will depend on the technology level and the function of capital per worker.

Finally, if Equation 2-g is multiplied by L , i.e.:

Equation 2-h
$$y \cdot L = Af(k) \cdot L \text{ or } \frac{Y}{L} \cdot L = Af(k) \cdot L$$

The following equation is obtained:

Equation 2-i
$$Y = Af(k) \cdot L$$

The last equation is depicted in Figure 4.5-2.c), in which the relation between the capital per worker level and the output level is presented. The final equation states that output depends positively on the level of technology (A), the capital intensity or capital – labour ratio (k) and the quantity of the labour employed (L). The height of the function $f(k)$ above the x-axis (k) is determined by both the level of technology (A) and the size of the employed labour force (L).

Box 4. 3 Explanation of the notations used in Figure 4.5-2

n – Labour growth rate

s – Savings growth rate

δ – Depreciation growth rate

s – socialist

c – capitalist

A – Level of technology

K - Physical Capital

L - Labour

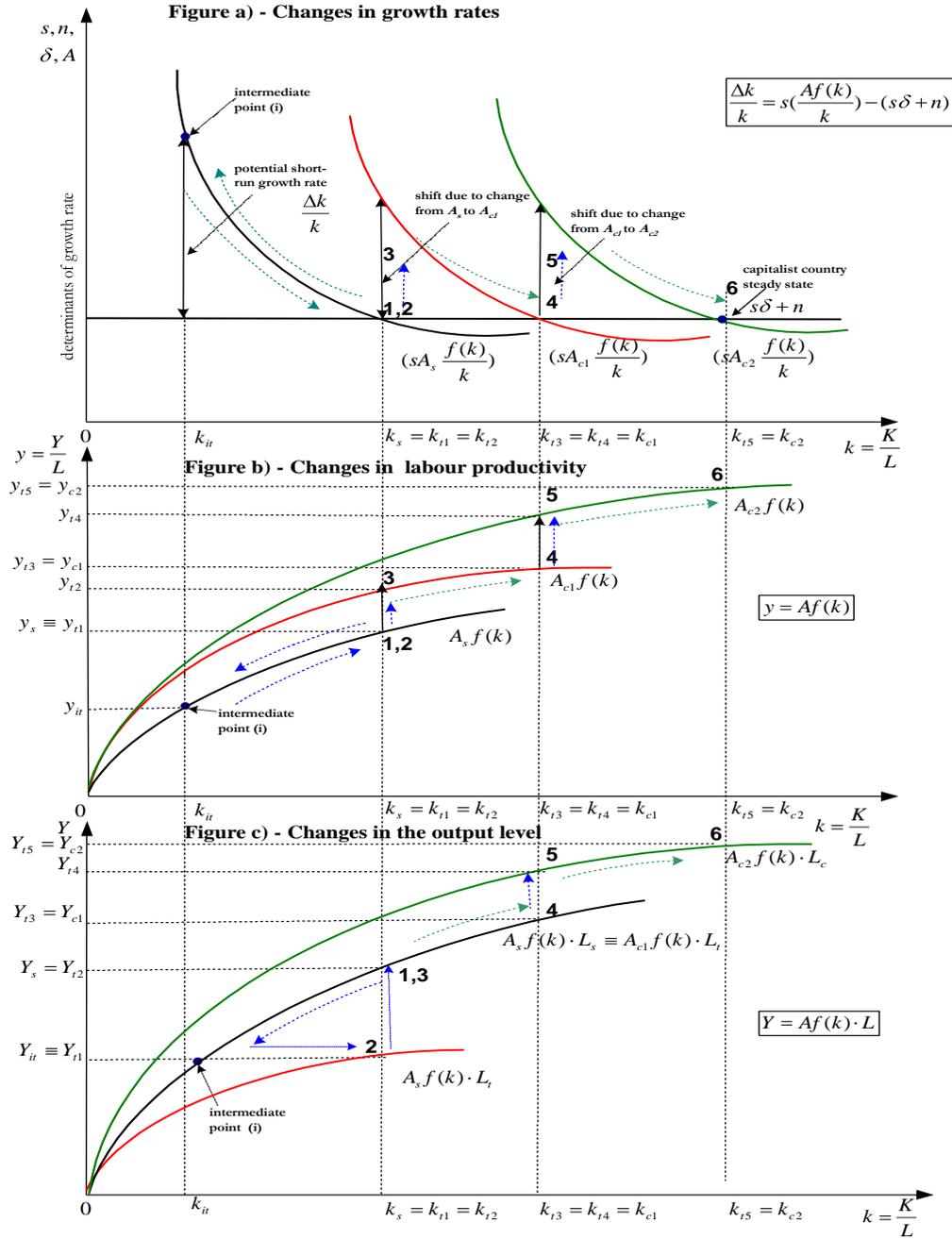
$\frac{\Delta L}{L} = n$ - Growth rate of labour; $\frac{K}{L} = k$ - Physical capital per worker or measure of the

capital-labour ratio; $\frac{\Delta k}{k} = \dot{k}$ - Growth rate of physical capital

In the box below the subscripts for each variable are given in every point of transition. The switch points are marked in grey.

Various points in the course of transition	Capital per labour (k)	Technology level (A)	Output per worker (y)	Output level (Y)	Equilibrium growth pattern
Point 1 - (t1 =s) The starting point of transition (t1) or Socialist state (s)	$k_s = k_{t1}$	A_s	y_s	Y_s	$sA_s \frac{f(k)}{k}$
Intermediate Point - (it) Bottom of U curve	k_{it}		y_{it}	Y_{it}	$sA_s \frac{f(k)}{k}$
Point 2 - (t2) Return point– end of U curve	k_{t2}		y_{t2}	$Y_{t1} = Y_{it}$	$sA_s \frac{f(k)}{k}$
Point 3 Starting adoption of “free” technology (c1)	$k_{t2} = k_{t1} = k_s$	A_{c1}	$y_{t1} = y_s$	$Y_{t2} = Y_s$	Switch to $sA_{c1} \frac{f(k)}{k}$
Point 4 - (t3 = c1) “Free technology” adopted	$k_{t3} = k_{c1}$		$y_{t3} = y_{c1}$	$Y_{t3} = Y_{c1}$	$sA_{c1} \frac{f(k)}{k}$
Point 5 (t4) Starting adoption of “non-free” technology (c2)	k_{t4}	A_{c2}	y_{t4}	Y_{t4}	Switch to $sA_{c2} \frac{f(k)}{k}$
Point 6 (t5=c2) Non-free technology adopted or acquiring developed economy level of technology	$k_{t5} = k_{c2}$		$y_{t5} = y_{c2}$	$Y_{t5} = Y_{c2}$	$sA_{c2} \frac{f(k)}{k}$

Figure 4.5-2 Adjustments in the course of transition



4.5.1.3 First phase – shock obsolescence of physical capital

In the first phase, the **“adjustment” phase**, the capital stock is subject to a shock downwards adjustment associated with obsolescence as discussed in chapter 3, section 3.2.1.2 and presented in Figure 4.5-1.a). The depreciation is accelerated massively in one instantaneous change, rising the depreciation rate because of obsolescence caused by transition to market imperatives. In the model, the obsolescence is instantaneous. However, closure of capacities – an economic and legal act - occurs over time during which employment continues at levels not immediately constrained by the (new) level of capital stock.

- In the figure, this instant change in depreciation rate triggers the movement of the country along the transitory line (Figure 4.5-2.a), from point 1 to some unstable intermediate point (*i*) changing at the same time **the capital per worker level**, which falls from k_s to k_{i^*} . The potential growth rate appears very high at point *i*. However, potential growth - reflecting lack of capital and consequent opportunities for growth generating capital accumulation - could be realized only in the context of socialist economic relations that no longer exist.¹¹⁰ This is why intermediate point *i* must be considered as merely transient. In addition, this movement, ending in the intermediate point, also produces correspondingly transient changes in the level of labour productivity and in output itself.
- As a result of the change of capital per worker (which determines labour productivity through Equation 4.2-4, the **labour productivity** falls from y_s to

¹¹⁰However, as mentioned in section 3.2.1.3, a small number of firms managed to realize high profits at the very onset of transition (McMillan and Woodruff, 2002).

y_{it} . This movement is presented in Figure 4.5-2 b. The country again moves from point 1 to the intermediate point on the same transitory path¹¹¹ $Af(k)$.

- In terms of **output changes** (Figure 4.5-2.c.), the fall in capital per worker that caused the fall in productivity causes a fall in output too, but preserving the same employment rate in the very short run. That is, the country moves from point 1 to the intermediate point, marking a fall in output from Y_s to Y_{it} , on the same transitory path $A_s f(k) \cdot L_s$.¹¹² The transitory path remains unchanged because there is no change in technology level or in employed labour. Yet the effect of early transition is to change radically the mode of movement along this path. Instead of progressing from intermediate point i by means of capital accumulation with constant full employment of labour, the capital-labour ratio (k) increases only because employment collapses in line with the previously shrunken capital stock. In turn, productivity increases (Figure 4.5-2.b, in point 2) but not the output (Figure 4.5-2.c), point 2). These developments are explored further below.

4.5.1.4 Consequences after the first phase

According to the model, after the exogenous shock occurs at t_1 , the growth rate becomes highly negative instantaneously (or, allowing for developments in real time, briefly). As the economy returns relatively rapidly to the new long-run steady state level of capital per worker (point 2 in Figure 4.5-2.a.), the growth rate of output per worker (hence capital per worker) returns to zero. Namely, at point i , sudden change of depreciation rate, the low capital per worker level (k_{it}) creates conditions for **potential high short-**

¹¹¹ The line $Af(k)$ is referred to as the transitory line, because it depicts the diminishing effects of capital accumulation on labour productivity for a certain level of technology.

¹¹² Similarly, the line $Af(k) \cdot L$ is a transitory line because it depicts the diminishing effects of capital accumulation on output level for a certain level of technology and a certain level of the labour force.

run growth rates of capital stock per worker $\left(\frac{\Delta k}{k}\right)$, i.e. the vertical distance of the intermediate point (*i*) and $s\delta+n$ line ¹¹³, marked by the bold arrow line, Figure 4.5-2.a). In the “normal” capitalist conditions envisaged for the Solow model, the presumed growth rate should be relatively high. The neoclassical growth model predicts that such negative shocks are followed by a transitional period of faster growth. Similarly, the model also predicts that the high post-shock growth rates should gradually decline to the long-run rate of growth (Ben-David and Papell, 1997). However, in transition, as noted above, the capital-labour ratio instead of steadily increasing with capital accumulation increases rather dramatically as employment collapses to “catch-up” with the very low capital per worker level k_{it} . In turn, productivity rises from its very low level of y_{it} (Figure 4.5-2.b), but only because of labour shedding. In addition, because rising productivity merely reflects falling employment, the output level does not change (remaining at Y_{it} in Figure 4.5-2.c).

Potentially, in the very short run, the increase from zero to a positive growth rate should reflect increasing returns on a diminished capital stock (a corollary of diminishing returns). The marginal productivity of capital and its returns should increase as a result of low capital per worker level after the first crash adjustment phase (point *i* in Figure 4.5-2.a,b and c). Namely, relatively scarce capital spread on the same amount of labour creates conditions for high marginal product of capital and thus, high returns to capital¹¹⁴, i.e. high profits.¹¹⁵ Complementary to that, abundant labour relatively to capital should result in diminished marginal product and, thus, low returns to labour, i.e. low wages. Yet, for these changes to occur in the factor markets, the Solow model assumed functioning perfect factor markets in a totally closed economy, where the interactions of

¹¹³In part a) of Figure 4.5-2, note, as there are rates of change. However, this is consistent with L, the level changes in part c) of Figure 4.5-2.

¹¹⁴ One of the Solow’s assumptions was the equality between factors’ marginal products and their returns.

¹¹⁵As mentioned in chapter 3, section 3.2.1.3, some very limited number of firms realized high profits.

a country with other countries have no influence on returns to factors and thus have no influence on the short-run or long-run output growth rates (Solow, 1956, 1957).

If these conditions are met, the Solow model predicts that with a low level of capital per worker, such as at k_{it} , high returns to capital will enable new investment, thereby increasing the capital per worker ratio and pushing the transition country from its transitory state (intermediate point i) in Figure 4.5-2 a, b and c automatically along the transitory line to point 2. Transitory increase of capital per worker in conditions of perfectly adjusting returns to factors (profits and wages) will result in diminishing effectiveness of new investment. However, countries will record positive but decreasing growth rates in the short to medium run which, in the absence of technological progress, will lead to a zero growth rate in the long run. In addition, due to perfectly adjusting wages and due to the closed economy conditions, the quantity of employed labour will remain unchanged. In Figure 4.5-2.c) this will mean that the country should move back to point 1 on the same transitory line $A_s f(k) \cdot L_s$, characterized by the same level of technology and the same quantity of labour employed, instead of to point 2 as shown in Figure 4.5-2.c) characterized by the same level of technology but a much lower quantity of both capital and labour employed and, hence, a much lower level of output (Y_{it}), which is even below the socialist level ($Y_{it} < Y_s$).

The question that arises at this point is how the neoclassical model can be modified and applied if the above two conditions are not fulfilled completely. What are the consequences for the model if the opposite is assumed – namely, a small open economy in which, in the short to medium run, wages are relatively rigid (see sections 4.3.2.1 and 3.2.2.2)? And, additionally, what if the returns to capital, such as interest rates and profits do not match the marginal product of capital? As mentioned in section 4.3.2.1 several authors allowed for rigidity in the neoclassical model such as Akerlof (1969), Sørensen and Whitta-Jacobsen (2005), Chenery (1975), and Easterly et al. (2000). In order to

justify this departure from the neoclassical model for the case of transition countries, briefly the stylized facts depicted in chapter 3 will be reprised.

4.5.1.5 Consequences of the modified assumptions

According to the model's assumptions, huge obsolescence causes a decreased capital per worker level coupled with change in returns to factors as explained above.¹¹⁶ However, in the absence of perfect markets, the returns to factors do not adjust appropriately to the changes in their marginal products. Namely, wages are relatively rigid and do not fall as much as productivity, which subsequently causes collapse in employment. As presented in chapter 3, section 3.2.2.2 workers' wages as a return to labour decreases in all transition countries, though characterized by a delay in the adjustment (or rigidity) different for the different groups of workers.¹¹⁷ On the other hand, the returns to capital, i.e. the expected increase in profits was not recorded in most of the transition countries at the outset of transition. Namely, although at the onset of transition the marginal product of capital was probably high due to the low level of capital per worker level for some limited number of firms, profitability was relatively low at the general macro level as discussed in section 3.2.1.3.

These adjustment peculiarities can be attributed to several main factors: the opening of these economies and the associated shock from the sudden increase in depreciation accompanied by the imperfection of markets, notably rigid wages (Akerlof, 1969;

¹¹⁶The Solow (1956) model assumption is that perfect factor markets adjust the returns to the marginal productivity of each factor. Briefly, in the case of decreased level of capital per worker, perfect markets should enable adjustment of the changed marginal product of capital and labour to their respective returns. As the marginal product of capital increases relative to the marginal product of labour, the model supposes increased profits and decreased wages.

¹¹⁷ Presumably, in reality, wages do not fall as much as productivity. The model reflects this as no (immediate) fall. Hence, the subsequent collapse in employment.

Mankiw et al., 1990; Banerjee and Duflo, 2004; Ventura, 1997).¹¹⁸ Thus, after opening of their economies, and with their relatively obsolete technology, transition countries were struggling to preserve their place on an international market. Having the characteristics of a small open economy¹¹⁹ and no positive cost differential with developed countries, transition countries were forced to substantially reduce their commodities' prices in order to preserve their place in the market. These considerations lead to assessment of the economic forces that determined relative wages and profits.

1. **Relative rigidity of wages** inherited as a social dimension from the socialist period, accompanied by the low propensity to accept downward change in nominal wages, as mentioned above, did not allow for fast equalization of the actual marginal product of the abundant labour with wages. However, although with a slight delay and aversely, the wages in transition countries were flexible downwards, especially at the beginning of transition; until reaching the bear minimum wage level which we named as “wage flooring” (Akerlof, 1969). After touching this level or floor, wages did not fall further, as many of the workers decided to leave the wage labour and work in substance agriculture, exercise rent-seeking behaviour, crime, illegal activities or migrate. Namely, as discussed in chapter 3, in many transition economies, a large subsistence agriculture sector (as discussed in section 3.3.2), a large state sector (also discussed in section 3.3.4) and the possibility of migration all tended to prevent wages falling below that certain limit or “floor”. In Solow’s terminology, the returns to

¹¹⁸ All these aspects were explained in the section on the modified assumptions, i.e. the assumptions that differ from the transition reality (see section 4.3.2).

¹¹⁹The usual interpretation of a small open economy is one that does not affect the larger economic environment in which it operates. In the present context this definition has several meanings:

- it faces perfectly elastic demand in world markets and trades at exogenously given prices;
- if the small economy trades in the capital markets, it does so at an exogenously given rate of interest; and,
- R&D activities of small country do not influence the rate of world technical progress, because they are negligible in the world framework (Grossman and Helpman, 1991).

The construct of the small open economy fits most of the transition countries well and also allows us to explore the channels through which world markets affect those countries without considering the reverse relation.

labour did not fall far enough and fast enough to enable increase in returns to capital, i.e. profits, while preserving a high employment level¹²⁰ as discussed in chapter 3. Although analyses of this issue are deficient, the next adjustment recorded in transition reality - i.e. negative growth in employment (i.e. rising unemployment) - is consistent with the above assumption (also see Figure 4.3-1). Namely, since the falling real wages touched the limited “floor” level, the employment level soon adjusted in order to equalize the marginal product of labour with the wage.¹²¹ Lehmann (1995) suggested that capital shortage could manifest itself in either unemployment or in wage adjustment and earnings inequality. He states that in highly regulated economies, the wages adjustments and earnings inequality will be the immediate outcome of capital shortage, while in deregulated economies the result might be rather in unemployment first, and afterwards in wages adjustments and earnings inequality. He explored this issue in the case of OECD countries, as well as some transition countries – Hungary, Russia and Poland. He suggests that if the economies in transition were moving from “complete” regulation under planned economy to “lack” of regulation in course of transition and “less” regulation under market economy, the adjustment shifted from wage adjustments towards unemployment and earning inequalities.

2. As an addition to the arguments for **low profits** in transition countries, Banerjee and Duflo (2004) questioned the neoclassical assumption about the higher returns in the capital scarce countries and their reinvestment. They found that these processes are highly related to the imperfection of factor markets, as well as to the various possible sources of the inefficient use of resources such as government failures, credit constraints, insurance failures, externalities and behavioural issues. They argue that each of these market imperfections can explain why returns are not always highest in

¹²⁰This assumption holds for the economy as a whole, with some exceptions for the small number of mainly *de novo* firms that managed to realize high profits as mentioned in footnote 115.

¹²¹ This is the second phase of the “adjustment” described more extensively later.

capital scarce countries, why investment may not always take place where the rates of returns are the highest and, therefore, why resources may be misallocated within countries. This misallocation, in turn, drives down returns and this may lower the overall investment rate. Jones (1997) found an enormous variability in rates of return, with some countries apparently possessing marginal products of capital greater or smaller than the ones predicted by the neoclassical model, especially for countries below the 30th percentile of the income distribution in 1990. However, they found an amount of uniformity in the marginal products of capital in the countries above the 50th percentile of the income distribution in 1990.

In the transition country case, the intermediate point (*z*) in Figure 4.5-2, in which the country finds itself after the initial crash adjustment, is characterized by very low labour productivity (y_{it} given in Figure 4.5-2.b) and thus a correspondingly very low output level (Y_{it} , Figure 4.5-2. c). This point (*z*) reflects Ventura's (1997) claims that the same capital per worker level can be coupled with different labour productivity and different output levels, depending on the technology level. In similar vein, Mankiw et al. (1992) explored the possibility of capital movements and equalization of profit rates across countries in an open economy context. However, even when allowing for high marginal product in capital scarce countries, they argue that risk of expropriation is one reason why capital does not move. In addition, they conclude, in view of this risk, it was surprising that the profit rates were not at least somewhat higher in developing countries (Mankiw et al. 1992, p 26).

These conclusions bring us back to the augmented Solow model explained above, which implied that a country can be on a different transitory path through time depending on the technology level (Mankiw et al., 1992). Figure 4.5-2 presents different transitory paths determined by different technology levels: one characteristic for socialist countries

A_3 ; one characteristic for developed capitalist countries A_{c2} ¹²²; and one transitory path characterized by the level of technology related to the relatively free technology available during transition, i.e. labour organization, A_{c1} .

In summary, for the country on a lower transitory path $s \frac{A_s f(k)}{k}$, low capital per worker level itself is not a guarantee of high profits and high growth rates. Put on the same playing field with countries on a higher transitory path, such as $s \frac{A_{c2} f(k)}{k}$ characterized by much higher productivity and output at any given level of capital per worker, transition country producers are more likely to encounter very low (or even negative) returns to capital and thus low or even negative growth rates in the short run. Correspondingly, low profits and little capacity to borrow – given the undeveloped financial sectors – ruled out the immediate onset of rapid capital accumulation (Barro, 1991).

4.5.1.6 Second phase – Labour force adjustment, fall in employment rate

As a consequence of disequilibrium and inequality between returns to factors and their marginal products, the intermediate point (\dot{z}) in Figure 4.5-2 a), b) and c) is unstable. Thus, the transition country records a second adjustment phase in the **“crash adjustment” stage**. The labour force, i.e. the employment rate, undergoes an adjustment process analogous to that of the capital stock in the previous phase. The employment rate falls as firms shed labour as was explained in chapter 3, section 3.3.3. The depreciation rate is stabilized, because the phase of very rapid depreciation or obsolescence is passed.

¹²² From the graphs, it can be seen that the same capital per worker level will determine different growth rates, different labour productivity and different output for various level of technology A_s , A_{c1} and A_{c2} .

- Correspondingly, **capital per worker** increases from k_{it} to $k_{it} = k_s$, because the same - much depreciated (partially obsolete) - capital stock is allocated to fewer workers. The country moves along the transitory line from intermediate point (i) to point 2, which is the same as point 1 in Figure 4.5-2.a). It is assumed that point 2 overlaps with point 1, i.e. the country returns back to its previous capital per worker steady state level. This point is not just a choice of convenience (i.e., is not for simplicity only).
- Namely, in terms of **labour productivity** (Figure 4.5-2.b.), the point 1, 2 means that the country, has moved back to the $y_{it} \equiv y_s$, i.e. the labour productivity is restored to the highest steady-state level for the given level of technology. Further adjustment in employment would not contribute to higher productivity for the given level of technology. Although, technically it is possible to raise productivity, it is not economically viable to do so because, at higher levels of the capital-labour ratio, right from point 1, 2, the transitory path $s \frac{A_s f(k)}{k}$ is lower than $s\delta + n$, meaning that capital accumulation (given by its function, reflecting diminishing returns to capital) is not sufficient to cover both the depreciation rate on a larger capital stock and the labour force growth rate, for that level of technology.
- In terms of **output** (Figure 4.5-2.c.), the country has moved from the intermediate point (i) to point 2, which here is not overlapping with point 1 as in Figure 4.5-2.a) and b). Namely, as a result of wage rigidities, i.e. “**wage flooring**”, the country experienced negative movement in the employment growth rate, i.e. a sudden sharp fall in employment (employed labour), which through equation $Y = A_s(k) \cdot L$ can be translated into the movement of the transitory line $A_s(k) \cdot L_s$ (i.e., output with socialist technology and the socialist labour force) downwards to the new line $A_s(k) \cdot L_t$ (i.e., output with inherited socialist technology but the much reduced transition labour force), characterized by the much lower level of employed labour $L_s < L_t$ and correspondingly huge unemployment. It is assumed that the level of technology remains the same, while the adjustment happens only in the labour force.

In other words, the output level remains at the same unchanged low level $Y_{it} = Y_{i1}$, Figure 4.5-2.c), but the increase in labour productivity $y_{i2} > y_{i1}$, Figure 4.5-2.b), reflects the decreased employed labour force ($L_t < L_s$).

In summary, the country's movement from point 1 to intermediate point (i) is caused by the huge obsolescence in physical capital. Movement from the intermediate point (i) to point 2 is caused by the subsequent adjustment in employment. What differentiates this movement from the one predicted by the Solow model is the nature of the movement along the transitory path. Namely, instead of a "natural movement" caused by capital accumulation in the conditions of perfect markets and closed economy, country movement along the transitory path $s \frac{A_s f(k)}{k}$ in Figure 6.5-2.a) is rather a sudden "forced adjustment" caused by the rigidities of wages and open economy conditions that condition the employment adjustment.

4.5.1.7 Consequences after the second phase

After the adjustment, at point 2, the potential capital per worker short-run growth rate falls to zero, but the capital per worker level increases significantly from k_{it} to $k_{i1} = k_s$, as employment falls. This is shown on the x-axis Figure 4.5-2.a), b) and c). Accordingly, productivity increases from y_{it} to y_{i1} (via Equation 4.2-4, Figure 4.5-2.b). However, this process is achieved with a hugely diminished capital stock and under the emergence of correspondingly huge unemployment. The sharp one time change in employment rate results in fall in the employment level greatly below the socialist labour force level (i.e. $L_t < L_s$), which is due to wage rigidities as we explained above in relation to Figure 4.5-2.c). In addition, this change in employment level was not followed by the increase

of the output level, which remains unchanged ¹²³($Y_{it} = Y_{t1}$), Figure 4.5-2.c). Further adjustment (i.e. further decrease in the employment rate or further capital accumulation) to the right of point 1, 2 for the same level of technology (A) is not realistic, simply because it would not contribute to increase in productivity, because returns have diminished to the extent that, further on, the marginal product (MP) of investment would be lower than its marginal cost (MC). To the right of point 1,2 the combined impact of depreciation and population growth cause a decline in the capital-labour ratio until steady state equilibrium is restored at point 1,2 where the marginal cost will equal the marginal product of capital ($MP=MC$).

All the above-described adjustments give rise to the downward movement of the transition countries on the famous U-curve of growth rates. Point 2 marked by the capital per worker level ($k_{t2}=k_s$), labour productivity ($y_{it}=y_s$) and output level ($Y_{it}<Y_s$) actually shows the adjustments that occurred in physical capital and labour markets, ended up with the restoring of labour productivity but at the expense of mass unemployment. This is also the bottom line of the U-shaped growth curve which ended by creating conditions for recovery in the presence of huge potential free labour but deficient physical capital and low technology level.

4.5.2 Regime Two or “Recovery Stage”: Adoption of free technology, from the bottom of the “U” curve to its top

In the conditions of huge potential increases in the labour force but deficient capital, the only way to increase the productivity level in the early recovery phase of transition was

¹²³This is a relatively arbitrary assumption. The movements of the $Af(k) \cdot L$ line in the Figure 4.5-2.c) depends largely on the changes in the labour force and technology level and their interrelation. In this case, the downward movement is due to the change in L , whereas A remains constant.

adoption of new technology (Abramovitz, 1962; Abramovitz and David, 1994). To a certain extent, it is assumed that new technology is relatively free and available, for example, through the introduction of new management practices, in particular those related to the organization of labour and employment practices (The World Bank, 2007). Thus, transition countries adopt the easily transferable parts of available capitalist technology, which enabled their movement from point 1, 2 to point 3 in Figure 4.5-2.

- **Capital per worker** remains on the same level $k_{t2}=k_s=k_{t1}$, because the adoption of new technology is not related to big new investments. The country moves to the higher transitory line, from $sA_s \frac{f(k)}{k}$ to $sA_{c1} \frac{f(k)}{k}$, reflecting the introduction of capitalist work organization (Figure 4.5-2 .a) (where A_{c1} denotes relatively free technology).
- In terms of **labour productivity** (Figure 4.5-2.b), point 3 marks higher labour productivity $y_{t2} > y_{t1}$ for the same capital per worker level, k_{t2} , given the higher level of technology A_{c1} .
- In terms of **output** (Figure 4.5-2.c), the country moved from point 2 to point 3, i.e. Y_{t2} , which is equal to the socialist level Y_s . Namely, as a result of the change in technology level, the transition economy experiences increase of output and attains the starting socialist output level (assumed for simplicity). The change moves the country from one transitory path $A_s(k) \cdot L_t$ onto a different transitory path $A_{c1}(k) \cdot L_t$. It is assumed that any change in employment level is negligible so that the same notation on L_t is preserved. (In this phase, changes are made mainly in the organization of labour rather in the level of employment; hence abstract from employment changes at this point in our analysis.) The change of technology with respect to labour organization shifts the transitory path upwards. In short, Point 3 marks the return point in the famous output U-curve.

4.5.2.1 Consequences of the second regime

The beginning of recovery is characterized by the rise in the potential capital per worker short-run growth rate (the vertical distance between points (1, 2) and 3 in Figure 4.5-2.a). In the long run the country would still approach zero growth rates, but at a higher capital per worker steady state level at point 4, i.e. capital per worker steady state level (k_{cl}).

In the very short run, the increase from zero to a positive growth rate should reflect the increased returns to the capital stock as a result of adoption of the new technology level A_{cl} . The marginal productivity of capital and its returns increase as a result of adopted new technology (labour practices, A_{cl}).

Following the instantaneous changes so far (movement from 1, 2 to point 3), the marginal product of a rising capital per worker level should decrease as a corollary of diminishing returns to capital, pushing the country towards the transition steady state (movement from point 3 to 4, along the new transitory path $s \frac{A_{cl} f(k)}{k}$ in Figure 4.5-2.a).

In fact, attaining point 4 for the transition country would mean a higher technology level with respect to labour organization (A_{cl}), higher productivity ($y_{cl}=y_{cl}$ in Figure 4.5-2.b), and higher output ($Y_{cl}=Y_{cl}$ in Figure 4.5-2.c) but still at a relatively low employment level (L_{cl}). However, it should be noted that the adoption of the free technology, although it is free, doesnot happen automatically. It is related to creating certain preconditions or capabilities to do so (Abramovitz and David, 1994).

4.5.2.2 Is the adoption of new technology automatic even when it is free?

In general, disembodied technical know-how flows from the technologically advanced countries to their followers and augments their total factor productivity (Howitt and Mayer-Foulkes, 2002). Again, in those cases, technology can be considered as exogenous for the following countries as they do not have the capabilities to develop it by

themselves (Parente and Prescott, 1994; Howitt and Mayer-Foulkes, 2002). Therefore, while the growth of the technology frontier reflects the rate at which new discoveries are made, the growth of total factor productivity (TFP) in adopting countries depends on the implementation of these discoveries, and varies positively with the distance between the technology frontier and the level of current productivity (Howitt and Mayer-Foulkes, 2002; Kydland and Prescott, 1991). The rate at which the gap between the technology frontier and the current level of productivity in the country “follower” is closed, and thus the rate of economic growth, depends on two groups of factors:

- social factors - including macroeconomic stability; organization; market structure; trade; government policies and the legal system - that subsequently determine
- the outcomes from the individual factors, such as economic agents’ investment and innovative or adoptive behaviour (Easterly, 2004).

The two groups of factors are strongly related. If the firms face social barriers in the wider social environment, such as instability and/or a malfunctioning legal system, then they will need to make greater investments to adopt more advanced technology (Parente and Prescott, 1994). In general the barriers that hinder growth can take different forms such as regulatory and legal constraints, inadequate government policies, weak institutions, bribes that must be paid, violence or threat of violence, worker strikes and so on (Parente and Prescott, 1994).

All these determinants and their relationships to growth are already identified in the new growth theories. However, in this thesis they will not be further analysed as primarily the accent is placed on the application of the neoclassical theory to explain growth switches between various stages. Within that framework, the importance of the residual that captures all these factors will be scrutinized and its size and sign will be identified too.

4.5.3 Regime Three or “Take off Stage”

– Import and implementation of new technology coupled with new investment (from the “U” curve into the “J” curve)

However, most likely, the economy will not reach steady state at point 4. As accumulation proceeds between point 3 and steady state at point 4, reflecting a high marginal product of capital and profit opportunities, productivity is also likely to rise (in Figure 4.5-2.b from point y_{t2} to $y_{t3} \equiv y_{cl}$), with a corresponding rise in output (in Figure 4.5-2.c from Y_{t2} to $Y_{t3} \equiv Y_{cl}$). Mass unemployment and/or over employment in the subsistence agriculture sector and state employment prevent real wages from rising; correspondingly, this “reserve army” enables new workers to be employed at existing wage rates creating the so-called **“wage ceiling”** effect on transition labour markets. The widely varying employment levels are compatible with the unchanged wage levels, which is consistent with the analyses given in chapter 3, sections 3.2.2.2 and 3.4. Consequently, the existing labour force has little or no bargaining power, so that the productivity benefits of capital accumulation (movement from point 3 towards steady state at point 4 in Figure 4.5-2.a) are entirely appropriated by capital (Duczynski, 2003). In turn, the correspondingly high profits give the potential for domestic investment and FDI (foreign direct investment), hence for rapid capital accumulation and technical progress, which should create preconditions for moving the country onto a higher transitory line, i.e. if the steady state at point 4 has been attained then upward to point 5. Parente and Prescott (1994) show that for the firm to move from one level to another level of technology, it has to undertake some investment. The amount of investment needed depends on two factors: the level of general and scientific knowledge in the world; and the size of the barriers to adoption in the firm’s country. General knowledge is created in the world and it is exogenous. Its growth and availability decreases the investment needed by the firm, so up to some point the adoption can be costless or

relatively low cost. However, after some threshold, the firms will need to make considerable investments in order to acquire the new technology.

If realized, this potential technical progress shifts the transitory path right from point 4 to point 5 in Figure 4.5-2 (from $s \frac{A_{c1}f(k)}{k}$, where A_{c1} represents capitalist work organization, to $s \frac{A_{c2}f(k)}{k}$, where A_{c2} represents exogenous technical progress such that $A_{c2} > A_{c1}$). This final transitory line $s \frac{A_{c2}f(k)}{k}$ in fact depicts the growth path of a capitalist country, which was the final goal of the transition countries.

4.5.3.1 Consequences of the third regime

According to the model assumptions, an improvement in technology level actually moves the country again further onto a higher transitory line, coupled with the opposite change in returns to factors. Namely, in this stage, workers' wages remain relatively flat in transition economies (especially in some countries as discussed in section 3.2.2.2), posing a **wage ceiling**¹²⁴, analogous to the wage flooring mentioned above (see Figure 3.2-3 in chapter 3). Thus, it can be argued that after Point 4, the returns to capital, i.e. increase in profits, recorded in all transition countries exceeded the marginal product of capital due to the relative rigidity of workers' wages (in this case upward rigidity).

1. **Relative rigidity of wages**, i.e. wage ceiling in later transition, was the result of the huge 'reserve army' of labour that did not allow the equalization of wages with the actual marginal product of labour. Because returns to labour did not rise

¹²⁴As it can be noticed from Figure 3.2-3, wages in most transition countries remained relatively flat in the first decade of transition, and although time-wise this does not overlap completely with the model predictions, it still introduces and can be related to the increase in profits in later transition.

as the country was moving along the transitory path $s \frac{A_{c1} f(k)}{k}$, the benefits of rising productivity are entirely appropriated by capital, thereby offsetting the fall in returns to capital caused by diminishing returns. In fact, non-decreasing profits created conditions for domestic investment and attraction of foreign investment.

2. The second determinant that affected returns to production factors, i.e. profits and wages in particular, was the **liberalization of capital markets** in the course of transition. Attracted by the relatively high returns to capital, i.e. profits, and social capability for adopting new technology (as the country had already adopted the A_{c1} level of technology), foreign capital entered transition countries, and successful ones in particular. Figure 3.2-2 in chapter 3 shows that in the later stage of transition a huge increase in GFC can be noticed especially in the rapid-J curve countries. However, this infusion of additional capital per worker does more than merely push the country further along the transitory line, from point 3 to point 4 in Figure 4.5-2.a). At the same time, inward transfer of capitalist technology raises the technical level from A_{c1} to A_{c2} and thus brings about a new higher growth path, namely $s \frac{A_{c2} f(k)}{k}$. For simplicity, the effect of this exogenous technical progress is shown as a shift from Point 4 to point 5 in Figure 4.5-2.a). Correspondingly, productivity should rise from $y_{t3} = y_{c1}$ to y_{t4} in Figure 4.5-2.b), and output should rise from $Y_{t3} = Y_{c1}$ to Y_{t4} .

After managing to achieve some high level of productivity y_{t4} , comparable to world standards, the country becomes economically and financially capable of importing high technology (A_{c2}).¹²⁵ In the model, the presence of a “reserve army” of labour, coupled with rigid wages, enables further rapid accumulation of capital (from point 5 to point 6

¹²⁵In general, the technology level even in the most successful transition countries cannot be considered as comparable to the highly developed countries, which develop their own technology (Duczynski, 2003).

in Figure 4.5-2.c). This process will continue up to the achieving of the full employment of factors of production, i.e. until the domestic and foreign capital enable full use of the labour force, or the natural rate of unemployment at point 6 in Figure 4.5-2.c). In terms of the model, the labour force, i.e. the employment rate undergoes an adjustment process analogous to that of the capital stock in the previous phase. The employment rate should increase (as firms employ labour). As the transition country approaches point 6, this means that it is approaching a “normal” steady state rate of growth given by the prevailing world rate of technical progress.

4.6 Conclusion

The model presented in this chapter aimed to explain the process of economic growth in countries in transition. Together, technology changes, which are central to this analysis of regime shifts; transitory dynamics, steady states and associated concepts of labour and capital market adjustments and returns rigidities provide a way of identifying the existence of the factors that drove and hindered the movement of these economies between and along different transitory paths in transition. In addition, this model sheds some light onto the discontinuities – switches - among various transitory paths, suggesting that they do not happen automatically. The model implies that there exist necessary conditions for **switch** to happen at each stage; i.e., mechanisms that actually enable the realization of the potential growth rates. Accordingly, there are factors that hinder or promote technical progress and corresponding shifts to successively higher transitory growth paths. All these factors and determinants of growth are encompassed and explained extensively in other strands of growth theory, notably in the endogenous and institutional theories. Because the model presented here is in the neoclassical tradition, its explanatory power is limited as it does not identify and disentangle these various factors. It points towards their existence and importance, but not to their content. To identify these “driving” and “hindering” factors we appeal to insights from other strands of growth theory.

Chapter Five

5 The instability and volatility of growth in the course of transition: Initial assessment

“Instead of variations of growth around a single trend...some countries experience episodes of peculiar acceleration or decelerations...and growth paths among various countries differ even when average growth rates do not..”

(Pritchett, 2000, p.1, p.56)

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5.1 Introduction

Pritchett (2000) claimed that nothing that is true about GDP for the developed countries is true for developing (or transition) countries. Namely, there are many ways in which the behaviour of the GDP of poorer countries looks very different to that of rich countries Durlauf et al. (2004). For example, while growth in the United States “...displays as a modestly sloping, only slightly bumpy hill..”, per capita GDP in most developing countries does not follow a single time trend according to Pritchett (2000, p.1).

In fact, growth in developing countries is characterized by two peculiar characteristics - instability and volatility, much higher and different from the ones observed in developed countries (Ben-David and Papell, 1997, Pritchett, 2000, Durlauf et al., 2004). In general, instability of growth can be explained as sudden turns from positive to negative average growth rates (or vice versa) after a certain point in time i.e. “turnarounds” or “growth meltdowns”, while volatility of growth can be defined as deviations from the specific trend line of growth¹²⁶ (Ben-David and Papell, 1997, Pritchett, 2000). These two peculiarities of growth and their combinations, especially evident and interesting in the case of developing and transition countries, have drawn researchers’ interest towards deeper analysis of the dynamic of output in the wake of collapses and sharp rises, because it differs greatly from its dynamics at other “rather steady” times (Durlauf et al., 2004).

As a result, the observed stylized facts about variations in growth patterns among developed and developing countries have occasioned new approaches to growth theory. Before, mostly, studies on developed countries discussed steady-state growth and

¹²⁶ Instability and volatility of growth are defined and measured differently in various studies and they will be more closely defined in the next section.

considered whether all countries in the "convergence club" will reach the same happy level in the end (Pritchett, 2000). Following this example, studies of developing countries adopted similar approaches, thereby underestimating the importance - and ignoring the implications - of the instability or volatility of growth rates, which are more relevant not only for the case of developing countries, but also for the case of those in transition. When taken into account, instability and volatility of growth change the whole conception of the linear growth steady-state path, as established in neoclassical theory, and put forward the idea of growth interrupted by break points and turns that can be described as transitions between different growth regimes (Pritchett, 2000). This conception is consistent with the model framework developed in chapter 4, where transition was depicted through shifts between various growth slopes (see Figure 4.5-2). Hence, in this chapter the goal is to assess critically the newest breakthroughs in growth literature on volatility and shifts in growth regimes in order to then apply it in the context of transition countries (Easterly et al., 1993; Ben-David and Papell, 1997; Pritchett, 2000; Hausmann et al., 2004; Aquiar and Gopinath, 2004; Easterly, 2009c; Jerzmanowski, 2006; Durlauf et al., 2004).

This chapter proceeds as follows. Section 5.2 reviews the very recent literature on shifts in growth regimes, paying particular attention to the empirical methods and findings used to identify shifts and volatility in growth regimes. Section 5.3 defines more closely the regime component of growth, and discusses the importance of short-run dynamic effects in determining long-run outcomes, as well as the persistence of the determinants of growth; all these discussions offer interesting insights for the following modelling rationale. Section 5.4 focuses on the assessment of the instability and volatility of the growth in transition countries by use of the standard tests and methods. Section 5.5 sets out the conclusions and further steps.

5.2 Instability and volatility of growth in growth literature: emergence, definitions, empirics and findings

5.2.1 The impact of various shocks on growth - motivating the debate on instability and volatility of growth

The debate over the instability and volatility of growth started in the early nineties, possibly motivated by the seminal work of Perron (1989) who challenged the conventional understanding of the data generating processes (DGP) of macroeconomic data series. Namely, the conventional perception of most macroeconomic data series was based on the findings of Nelson and Plosser (1982), who argued that almost all macroeconomic time series have a unit root. They suggested that random shocks have permanent effects on the long-run level of macroeconomic variables; that is, that the fluctuations are not transitory. As a result, these non-stationary series follow a random walk and have no tendency to return to a long-run deterministic path and their variance is time dependent. As mentioned, later, Nelson and Plosser's findings were challenged by Perron (1989), who claimed that most macroeconomic series are not necessarily characterized by a unit root but, rather, by:

- Structural breaks due to large and infrequent shocks, which characterise a country's long-run development; and,
- Deterministic trends between the breaks, which are characterized by small and frequent shocks after which the economy returns to the trend.

Hence, Perron's (1989) proposal was to allow for huge structural breaks when analysing macroeconomic data series¹²⁷, suggesting that:

¹²⁷ Perron (1989) asserted that in the presence of a structural break, caused by a big shock, the standard unit root test such as Dickey-Fuller test is biased towards non-rejection of the null hypothesis of a unit root.

Most macroeconomic time series are not characterized by the presence of a unit root. Fluctuations are indeed stationary around a deterministic trend function. The only 'shocks' which have had persistent effects are the 1929 crash and the 1973 oil price shock (Perron, 1989, p.1361).

In summary, from the growth literature perspective, Perron's (1989) study, although mainly empirically based, allowed for development of new perception of growth, different from the one established in the neoclassical theory. It showed that distinction of the types of shocks that hit a particular country can be very important for understanding the whole process of growth. Namely, according to Perron (1989) in some cases when the shocks hitting an economy are sufficiently big they can move a country from one deterministic trend to another. Later this idea enabled definition of the instability of growth as a peculiar characteristic of the growth process. On the other hand, small shocks that cause only fluctuations around a deterministic trend generate the volatility of growth. These ideas motivated the emergence of the conception of growth as transitions between various trend lines or regimes, characterized by specific volatility within each trend, instead of simply a linear process characterized by business cycle fluctuations. Additionally, it spurred further investigation of shocks that hit one economy and their impact on growth and real GDP data series.

Easterly et al. (1993) discussed the sudden shocks and their underlying relation with the instability of growth, which they believed are ignored in growth theoretical and empirical literature. They found that the country specific shocks are hugely important for the medium-term growth of each country and, hence, they proposed growth studies to be focused on the analysis of growth within individual countries. Namely, Easterly et al. (1993) showed that correlation of growth across decades (1960-70 and 1970-80) within countries is very low – averaging from 0.1 to 0.3 in a worldwide sample of 115

countries.¹²⁸ The possible explanation for the low persistence of growth rates is *the role of shocks* in growth shifts, such as the terms of trade, external transfers, the change of number of war related causalities and the presence of a debt crisis. More precisely, they argued that shocks are important over decade-long periods, since they influence “policy” variables and thus estimates of the impact of policies. The main implication of their study was that most of the variation in growth is *within* individual countries, rather than across countries. In the later analyses, Easterly et al. (2000) focused rather on the developing countries, claiming that the economic crises gained in frequency and severity in developing countries, especially in the past quarter century. They claimed that the causes and nature of these crises have differed vastly among developed and developing countries, especially hitting the less developed economies.

In similar manner, emphasizing the impact of the shocks in the economy, Ben-David and Papell (1997) identify a statistically significant single structural break in the growth series for 54 countries out of set of 74 countries from 1955 to 1990. Beginning with the scan of output (in levels), defined as the logarithm of real GDP per capita, they used Perron’s (1989) testing procedure to identify structural breaks in the data series. The algorithm actually identified structural breaks on purely statistical grounds and the unit root null was rejected for 20 countries in their sample. Additionally, they applied the test in first differences for the series in which a unit root could not be rejected. Finally, they found 54 countries in total in which a structural break was statistically significant either in levels or rates analysis. In general, the reasons behind the big shocks were different: for the developed countries, the breaks were associated with the collapse of the Bretton-Woods system and the first oil embargo; while the meltdowns, i.e. the growth slowdowns in developing countries, commenced with the second oil shock and the start of debt crisis.

¹²⁸Only with few exceptions - like Botswana (whose success story is attributed to extensive diamond mines and democratic government), the East Asian foursome and the small OECD group for a short period - the data on growth revealed low persistence in their analysis.

In general, these studies supported the initial idea of Perron (1989), suggesting that the macroeconomic data series on GDP have recorded breaks due to big shocks in the economies, the idea especially confirmed in the case of developing countries. The breaks actually capture and portray the persistence effects of shocks as they lead to regime change¹²⁹ – i.e. permanent effects on the level and/or rate of growth. This idea motivated further close investigation and definition of two peculiar characteristics of growth in growth studies – instability and volatility, features especially pronounced in developing countries.

5.2.2 Defining the instability and volatility of growth

Motivated by the similar idea, i.e. the variation of growth among countries, later on, Pritchett (2000) developed further the idea of *changes in growth regimes*, which are experienced mainly by developing economies¹³⁰ due to big shocks recorded in these countries, as oppose to a consistent convergence process, characteristic for developed countries. In order to examine the differentiation among growth in developed and developing countries, firstly he tested how much of the country's time-series behaviour is just a trend, interpreting the R^2 of the simple regression line as an indicator of fit, i.e. fitting a single time trend through y for the whole period in the case of 111 developed and developing countries. The estimated regression is:

Equation 5.2-1
$$\ln(y_t) = a + b_t + e_t$$

¹²⁹ The persistent effect of shocks is captured by a stochastic trend (e.g., a random walk with drift) but not by a deterministic trend. However, a deterministic trend with breaks may also be able to capture such persistence effects (where shocks lead to regime change – i.e., permanent effects on the level and/or rate of growth). This is the distinction explored by Perron (1989).

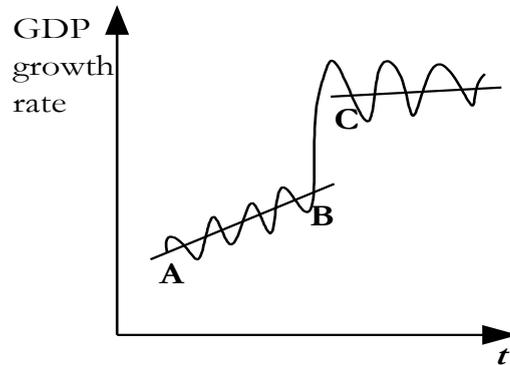
¹³⁰The countries belonging to the OECD are developed countries in his study, while all the rest are developing countries.

Where y is real GDP, b is the trend coefficient, or calculated Least squares growth rate, e_t is the error term and t is the time subscript. The time horizon is 1960-92, and the frequency of data is quarterly in Pritchett's analysis (2000). His findings are appealing. In the developed-country sample the median R^2 is 0.95, with standard deviation of only 0.03; while for the developing-country sample the median R^2 is only 0.67, with a standard deviation of 0.32. Hence, for nearly all industrial countries the total variance of the time series is almost completely summarized in a single number – the average growth rate, while in contrast in developing countries the R^2 values are distributed over the entire (0,1) range. After summarizing the results into two groups, developed and developing countries, he concluded that OECD countries have business cycle fluctuations, but these are not the dominant features of the evolution of their GDP. In contrast, for the developing countries, "growth" is not just the trend, but it is characterized by *sudden changes*, which cause shifts in growth. In the long run, even small shifts in growth turn into huge shifts in living standards and even more sustained large differences into seismic shifts. Hence, he deepened the analysis into two more dimensions of growth, which are more visible in the case of developing countries:

- Instability of growth defined as shifts in the growth trend; and
- Volatility of growth defined by the deviations from the trend.

Instability refers mainly to the shifts of bigger size, which lead to change of regime, while volatility refers to the frequency of the shifts but still within the same trend line. Presented graphically in Figure 5.2-1 below, volatility encompasses the period between points A and B, while instability refers to the shift in the GDP growth rate between points B and C (see Figure 5.2-1 below, in which the y-axis represents GDP growth rates).

Figure 5.2-1 Stylized depiction of instability and volatility of the GDP growth rate



5.2.2.1 Instability of growth

Assessing the instability, Pritchett (2000) firstly tested structural breaks and shifts in the growth rates data¹³¹ for the industrial and developing countries, related to the Crisis of 1973. In order to test the instability he calculated and depicted in graphs the mean growth rates for the periods 1960-73 (before the Crisis), 1973-82, and 1982-92. His graphs of mean growth rates for certain periods confirmed that growth in some of the countries was indeed localized in episodes of discrete trends separated by shifts in growth rates. Hence, in the second step he used a specific calculation in order to determine the growth differences based on the best single breakpoint in trend (t^*) from the data. Namely, if

$$\text{Equation 5.2-2} \quad y_t = a_I I_I(t \leq t^*) + b_I t^* I_I(t \leq t^*) + a_{II} I_{II}(t > t^*) + b_{II} t^* I_{II}(t > t^*) + e$$

where $I(\cdot)$ is an indicator function and t^* is chosen to minimize the sum of squared errors

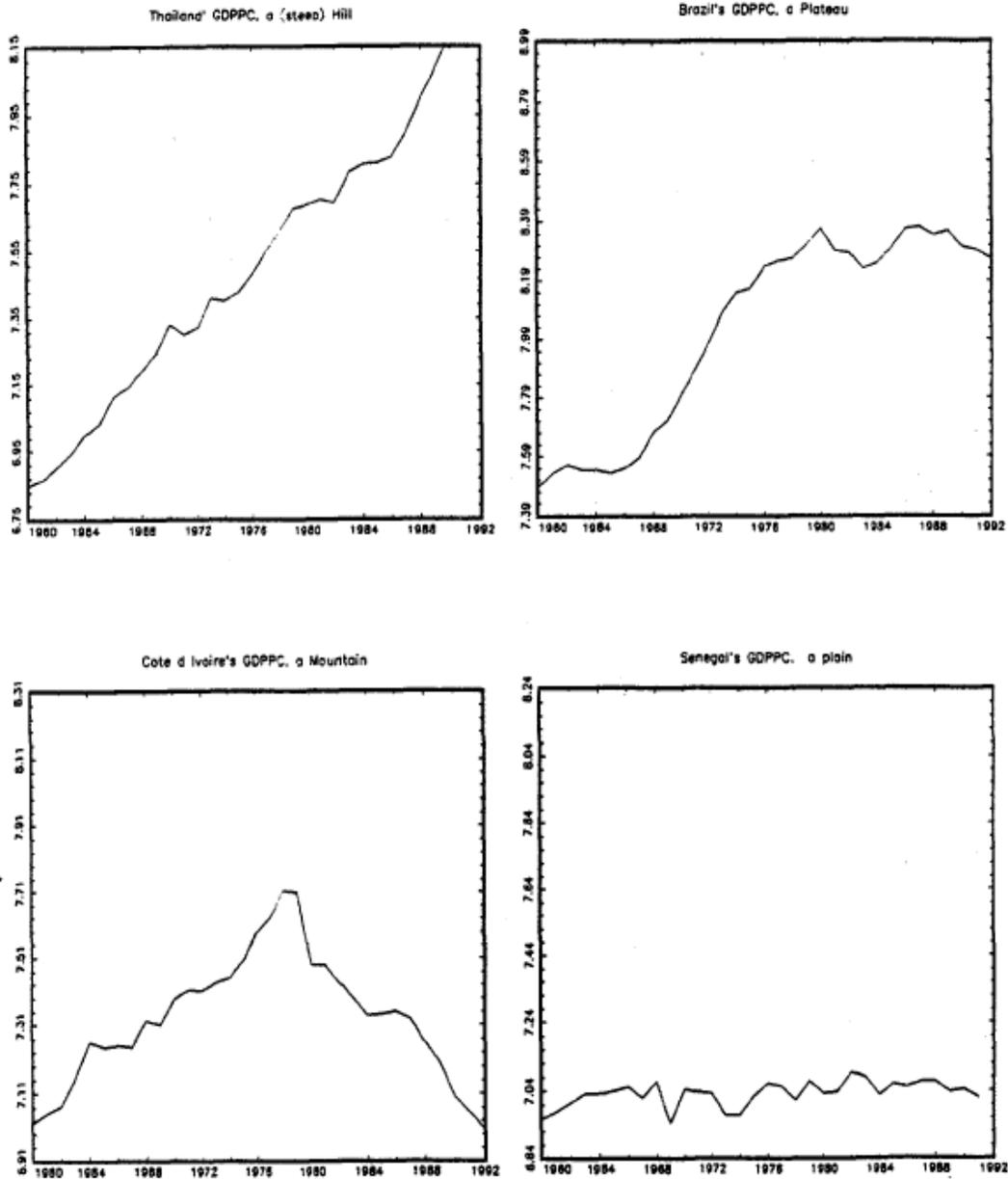
¹³¹Growth rates are calculated as first differences of log real GDP data series.

over all t , such that $t^* - t_0 \geq 6$ and $T - t \geq 6$; the year of breakpoint is t^* ; and growth before the break is g_b , while growth after the break is g_a and the difference in growth rates is $(g_b - g_a)$. The estimations confirmed the idea of shifts in growth rates, with different points in time identified by the algorithm for each country depending on the economic conditions within the country. These shifts are especially emphasized and much larger in developing or less developed countries as compared to the size of shift for developed countries. Namely, among the developing countries the average group shift (i.e. difference in growth rates $(g_b - g_a)$) is 3.85 percentage points, while the average shift in developed countries is only 1.46 percentage points. Big shifts are mainly deceleration of growth in both groups of countries; in the developed countries these are related to the impact of the oil shocks, while in the developing countries shifts are mainly country specific. The shifts in growth observed in various countries created distinct growth patterns Pritchett (2000, p.2):

Some countries have had steady growth (hills and steep hills); others have had rapid growth followed by stagnation (plateaus); others have had rapid growth followed by declines (cliffs) still others have experienced continuous stagnation (plains) or even steady decline (valleys) (see Figure 5.2-2 below).

Figure 5.2-2 Depiction of the different patterns of economic growth:

Hills, Plateaus, Mountains, and Plains



Note: Since the figures are copied from the original paper, for better visibility here the text above each graph is re-given. In addition, in each case the x-axis presents the period from 1960-92, while the y-axis gives growth rates starting from above 6.75 per cent.

Up-left: Thailand's GDPPC A (steep) hill

Up-right: Brazil's GDPPC A Plateau

Down-left: Cote d'Ivoire's GDPPC A Mountain

Down-right: Senegal's GDPPC A Plain

Source: Pritchett (2000, p. 4)

According to Pritchett (2000), the standard growth theory and empirics fits well hills of different slopes but has difficulty accounting for other topographic formations, such as the ones recorded for developing or transition countries. Evidently, transition countries' growth patterns as described in chapter 2, Figure 2.5-2 do not resemble the hill growth pattern characteristic for developed countries. Using Pritchett's terminology, these countries' growth patterns can be described rather as a combination of subsequent formations: sharp cliffs at the beginning of transition, followed by steep hills, then periods of stagnation (plains in the rapid-J group), or valleys in the slow-J group of countries or even repeating cliffs in the incomplete-U group (see Figure 2.5-2, p. 40), which turn again into cliffs in all groups with the start of the Great Financial Crisis in 2008. Although differentiated by eye, different topographic formations remain to be further identified and classified by statistical means. In this line of research, Pritchett (2000) suggested that an empirical method that will be able to depict individual countries' growth patterns through their breaks and changes will be useful for deeper understanding of growth process, especially in developing (or transition) countries.. Conversely, *"...the use of "panel" data to investigate the effects of long-term growth in developing countries - especially with 'fixed effects" estimates – is potentially more problematic than helpful* (Pritchett, 2000, p.1).

5.2.2.2 Volatility of growth

Volatility of growth is a familiar concept within growth studies. As mentioned, volatility is defined as fluctuations of real GDP around its trend line; hence, usually it is measured by standard deviation from trend (Easterly et al., 2000). However, lately, as the concept of instability was introduced in growth studies, it became more difficult to measure the *pure* volatility as it could be easily confused with possible shifts in the data series, i.e. with instability (Pritchett, 2000). Hence, Pritchett introduced three methods for measuring the volatility of growth:

1. Firstly, the standard measure usually used in volatility studies - i.e. deviations from trend¹³²; and, then the two additional measures:
2. The variability of first differences measured using the equation:

Equation 5.2-3
$$fd = \ln(y_t) - \ln(y_{t-1})$$

where he reports the *Standard Deviation, Coefficient of Variation and Mean*. The first difference of the log GDP actually gives the growth rates; and,

3. The magnitude of second differences using the equation:

Equation 5.2-4
$$sd = \ln(y_t) - \ln(y_{t-2})$$

where he reports the median of the absolute value.

While the former two measures measure the volatility in data series, though not separating it from instability, the last measure (second difference) enables identification of stability (or instability) around a trend with a single shift. Namely, the last measure is convenient in the cases when data series are stable within periods, but record a shift between periods. In that case, the standard deviation of first differences would still be high; however, the standard deviation of second differences will reflect only the size of the shift (that is the changes in the growth rate would be zero except for the shift).

However measured, studies find that the volatility of growth is much higher in developing countries as compared to the developed economies (Aquiar and Gopinath, 2004, Pritchett, 2000). For example, Pritchett's (2000) study shows that the standard deviation of the log GDP deviation from trend is twice as high in developing countries (median for the group) as in the developed countries (.10 versus .05); while, the

¹³²Here Pritchett (2000) used the above given trend regression: $e_t = a + b \ln(yt)$, where y is real GDP and b is the trend coefficient, and e_t is the error term. He reports: the Standard Deviation of e_t , and the *R-squared* of the trend regression.

coefficient of variation of the (natural) log of first differences of GDP per capita is four times as high in the median developing country as in the median industrial country (4.3 compared with 1.04).

Provoked by the previous findings on instability and volatility of growth rates Easterly et al. (2000) tried to explain growth volatility, especially in the relation to the financial system in the countries. On a very large sample of countries they found that mean growth is lower in developing countries (163) than in OECD economies (23 economies), and the volatility of growth¹³³ is much higher, confirming the claim of negative correlation between growth and volatility of growth. Moreover, they also showed that employment is much more volatile in developing than in developed economies, accompanied by greater volatility in real wages than in OECD economies. This paradox of volatile employment along with unstable real wages certainly cannot be explained in terms of purely nominal wage rigidities, since in this case the relationship should be the opposite – stable wages and volatile employment. Hence they claim that wage rigidities play little role in the volatility of growth. By contrast, they found that financial variables¹³⁴ consistently turn up significant both in explaining variability and in the likelihood of a downturn. Additionally, they claimed that the volatility of an economy will also differ across countries according to the nature of the shocks they face, the structure of the economy, and the policy regime of the government. In this regard, the roles of openness and of policy were also found to be significant determinants of growth volatility.

Reporting the figures on the standard deviation of annual growth rates between 1960 and 2000, Durlauf et al. (2004) offer additional evidence on long-run output volatility.

¹³³ Growth volatility is measured as standard deviation of the per capita growth rate.

¹³⁴ Easterly et al. (2000) tested various variables as indicators of financial system development, such as: Change in private credit/Gross Domestic Investment; Standard deviation of M3/GDP; Stock market value traded/GDP; Credit to private sector/GDP; Long-term private debt issues/GDP; Private bond market/GDP and Public bond market/GDP.

They conclude that the industrialized countries are relatively stable, while sub-Saharan Africa is by far the most volatile region, followed by South and Central America. In their view, growth varies substantially over time, and countries experience distinct events that contribute to this variation, such as changes in government and in economic policy. However, they find that the volatility is not uniformly higher in developing countries, hence, they suggest "...the most natural way to understand growth would be to examine time series data for each country in isolation" (Durlauf et al., 2004, p.99).

In summary, until recently, the macro phenomenon of the growth path was divided only into "trend" and "cycle" movements (Pritchett, 2000). On the one hand are the business cycle studies exploring business cycle fluctuations, which involve reallocations of factors, including labour supply that have little or no welfare consequences in the long run¹³⁵; on the other, are growth studies focused on the long-run growth trend displaying itself as gradual changes and adjustments in the economy with major implications for standards of living in the long run. Only lately has growth literature started to look in between those two components, searching for explanations that are more appropriate and methods of investigation for the real growth patterns observed in developing and transition economies. In particular, when developing/transition countries growth paths are observed several questions arise— what happens if an economy is hit by huge shocks, different from the ones occurring in a business cycle, that eventually change not only the growth rate but also its steady-state level, and move it from one transitional path to another? Are these transitional shocks significant? It appears that once the world of highly developed countries is left, these shocks are more the rule than the exception. The

¹³⁵ Lately, there is theory and evidence to suggest that business cycle shocks may have a persistent effect (e.g., via the "scarring" effects of unemployment, deterioration of skills and so on). The general idea in these studies suggests that beside short-term unemployment effects in the form of direct income loss, there are severe long-term consequences as the unemployment period deteriorates future labour market possibilities (characterised as "scarring" effects) (Nilsen and Reiso, 2011).

following sections have as their main objective to assess whether these shocks can be detected in growth in the course of transition.

5.3 Underpinning of the modelling procedure

In order to organize discussion of growth as shifts in the growth regime, it is useful to start with the focus on the components of growth of interest.

5.3.1 Explanation of the regime shift component of growth

The new branch in growth literature that addressed the inexplicability of growth fluctuations introduced the closer description and definition of a “third” component of growth, beside the trend and the cycle.

Pritchett (2000) was the first researcher who articulated the idea of three dimensions of growth based on the notion of the steady-state output per capita level:

- The *steady-state* growth rate, which refers to the growth rate of the steady-state level of output per capita.
- The *business cycle*, which refers to the dynamics in actual output per capita without shifts in either the level or the growth rate of the steady state in the long run.
- The *shift in growth pattern*, which refers to movements of output as it adapts to *changes in the steady-state level* or *steady-state growth rate*. In fact, this movement is emphasized and developed in the model in chapter 4, as it is considered to be the most prominent and important to characterize growth under transition.

Noticeably, in Pritchett’s concept of growth regime shifts, the output per capita level and growth rate at some point of time t has a steady-state, a regime shift and also a cyclical component. If the *shift in growth path* is of interest, the turning point t has a specific

meaning as the growth dynamic and its determinants might differ significantly before and after that turning point.

In a similar manner, Easterly (2008b, 2009c) claimed that there are “time-varying” shocks that affect the time-varying element in growth, which he defined as the “transitory” or “shifting” component of growth. In his understanding, transitory is:

... not necessary mechanically “random” in the sense of coin-flipping; but it could be one-off movements caused by human action, as for example a smart policy move in the right place at the right time or maybe a bubble caused by an information cascade, or it can be dramatic mistake by a policy maker or entrepreneur and so on... Still in this understanding transitory can be as well random in the sense that it cannot be explained or replicated (Easterly, 2009c, p.8).

In similar vein, Aquiar and Gopinath (2004) claimed that cycle movements in emerging markets can be considered as trend breaks. In addition, they argued that frequent regime shifts, due to changes in economic policy are completely different from the transitory fluctuations around the trend characteristic of developed markets, which eventually changes the perception of trend and cycle. Hence, they claim that growth patterns in emerging markets are to be assessed by a different research strategy, which will take into account more profoundly the permanent and shifting shocks.

All these studies convey the idea that growth might have another dimension or component, which is not extensively discussed in the literature and which is mostly related to the stylized facts of growth observed in developing/emerging/or transition countries. There are some peculiar growth characteristics in these countries, which cannot be explained in the framework of the modestly sloping hilly pattern given in the original Solow model, nor in the linear increasing research and development motivated growth path described in new, endogenous theories. Easterly (2009a, b) goes even further, arguing that apparent “randomness” in economic success makes it difficult in

economic science to draw conclusions about the determinants of growth as well as the possible policy recommendations. According to him, the conditional probability that success stories can be replicated in another country is really small, although growth researchers tended to offer many, in total around “145” answers for how to raise growth. His suggestion is to focus on the instability and unpredictability of growth and the determinants that obstruct growth, rather than the ones that promote it.

Responding to these hints, close attention in the next sections will be paid to the instability and volatility of growth observed in transition countries. Following that intuition, the argument in this section will relate to the issues of the time span of the data available for analysis, the persistence and/or change in determinants of growth, as well as to the modelling rationale pursued in the sections to follow.

5.3.2 Persistence of the determinants of growth and the importance of shocks

In the literature, the issue of growth fluctuations and shift regimes in growth is closely related to the characteristics of the variables affecting growth (Easterly et al., 1993). Common logic is that relatively volatile and/or unstable determinates of growth result in volatility in growth rates and possible shifts in growth regime.

In general, the variables affecting growth identified in the literature can be categorized into three groups with respect to their persistence as stable, medium persistent and volatile. Some studies found that the variables are relatively stable in the context of developed countries (Easterly et al., 1993; Pritchett, 2000). Testing the persistence of the determinants affecting growth Easterly et al. (1993) found that the variables correlation among decades is 0.6 to 0.9, with some variables being completely constant like geography and language. However, although the variables are relatively persistent, he

also claimed that a large part of growth fluctuations are transitory, caused by huge shocks, which in many cases are absent from growth regressions.

In a similar manner, Pritchett (2000) categorized variables introduced in the growth regressions according to their persistence and endogeneity:

- Stable and either exogenous or low endogenous variables are: structural: geographic¹³⁶, climatic, resource endowments, and: institutional, such as: ethnic diversity, political system, language, legal system;
- Medium persistent and medium endogenous variables are: policies and their intermediate outcomes: trade ratio, inflation, budget deficit, financial depth;
- Volatile and high endogenous variables are: shocks to the terms of trade, spillovers from financial crisis and their intermediate outcomes - FDI, export growth, budget deficit¹³⁷, and black market premium.

Although these categorizations are useful, it should be noted that in transition countries most of the variables, even though characterized as stable or medium stable, changed drastically, along with the unstable ones. For example, in some countries, mainly the former Yugoslav, Soviet or Czechoslovakian Republics, the geographical description changed for the new born states in terms of newly established borders, access to sea and so on, as well as their ethnicity, political system, and legal system. In addition, as shown

¹³⁶ Some of these variables are typically regarded as completely exogenous such as geography that is not determined – either jointly or mutually – by economic development.

¹³⁷ Obviously, the budget deficit is a variable (or outcome) that is used in two categorizations, as medium and also as a high volatile and endogenous variable. Pritchett (2000) used it to describe the possible problems of dynamic misspecification and endogeneity that may occur in growth panel modelling due to wrong interpretations of one such variable in terms of its magnitude and endogeneity. He gives an example where depending on the model rationale used in the analysis, high budget deficits can be in one country the result of countercyclical fiscal policy; in others, it can be the result of temporary shocks, such as war. In such cases, the effects and the relation to growth will differ (for more extensive explanation, see Pritchett 2000, p.243).

in the chapters 2 and 3, all transition countries experienced many policy shifts and many shocks, which additionally affected growth. Clearly, the output (and employment) fluctuations inevitably relate to shocks and to the manner in which the economy copes with those shocks as shown in chapter 4. The shocks change the individually rational actions of firms and households, and the policy interventions of governments, which eventually add up to collective behaviour that either brings the economy quickly back to full employment and efficient resource utilization or does not (Easterly et al., 1993, 2000). Studying the impact of shocks, Easterly et al. (2000) emphasized that shocks are important over decade-long periods, since they influence “policy” variables and thus estimates of the impact of policies. They argue that developing countries are far more vulnerable to shocks and far more likely to experience growth downturns than are industrial economies, controlling for other variables.¹³⁸ However, as mentioned before, Perron (1989) draws attention to the size of shocks which hit an economy. In his view, not all shocks in the economy are relevant for the growth shifts and only huge shocks can have a permanent influence on macroeconomic variables. Hence, the question is whether these shocks, in the case of transition countries, were big enough to be significant and to cause shifts in growth regimes.

¹³⁸In the probit analysis (downturn takes value 1 and positive growth equals zero) Easterly et al. (2000) test the probability of growth downturn in a data set of 54 countries for the period 1960-97. They control for several determinants of growth, including a dummy for developing country, years since last downturn, 5-years moving average growth, credit to private sector/GDP (with abbreviation GSP/GDP), GSP/GDP squared to control for a non-linear relationship, private capital flows/GDP, Log change in real wages, Capital restrictions, (M+X)/GDP, Stock Market value traded / GDP. They find that more open economies, while they have greater output variability due to a higher incidence of shocks, seem less likely to go into a growth downturn. Their analysis confirms the central role that financial institutions play in economic volatility and downturns, namely that financial depth (as measured by private credit to GDP) reduces volatility up to a point, but too much private credit can increase volatility. The financial sector can also exacerbate periods of downturns, particularly if debt increases relative to equity.

5.3.3 Short-run versus long-run analysis

The idea that the study of long-run growth should not be completely separated from the study of short-run macroeconomic phenomena has been stressed by several authors (Temple, 1999, Easterly et al., 2000, Ramey and Ramey, 1995). Namely, the average growth over a long period is typically not a good description of that country's experience at any particular point in time when the possible instability or volatility is taken into account. That is to say, the combination of instability and volatility makes it difficult to separate "long-run" growth from exogenous shocks, business cycles, or transitory shifts in growth as discussed above. Jones and Olken (2005) suggested that long-run averages within countries mask patterns of extreme success and extreme failure in the same way that cross-country comparisons do not capture a substantial part of growth variations. In particular, they showed that growth "miracles" and "failures" over ten year periods (and longer) appear within the historical experiences of most countries. They characterize this growth pattern within countries as a "start-stop" process, whose variation should offer specific insights for theory and policy. Similarly, Pritchett (2000) found that the enormous volatility of growth around its trend (with or without a break point) means that even over periods as long as a decade growth can be determined by shocks and recovery. Hence, he adds that compressing the entire time series of output into one regression can conceal many important features of growth. Easterly et al. (1993) stressed that correlation of growth across periods as long as two decades – a period comparable to those used in cross-section empirical literature - are similarly low. With a few exceptions, the same countries do not do well period after period; countries are "success stories" in one period and disappointments in the next. Hence, Easterly (2009c, p.123) suggested special research attention to the so called "transitory, shifting" effects, arguing: *"...We falsely draw conclusions about how to achieve superior long-run performance ... without allowing for the large role of transitory factors in a small sample."*

Evidently, the empirical modelling procedure in the following sections will be largely based on the concept of instability and volatility of growth in transition economies,

having in the background the drastic changes in growth determinants in the course of transition in concert with the relatively short annual data series at our disposal.

- The use of relatively short span of annual data may raise objections on the grounds that studies of economic growth should be based on longer horizons. Even so, the data series on transition are relatively short due to the objective reason of the relatively new date of transition itself. In addition, the introduction of transition also meant the introduction of new methodologies on data collection in the countries, which also makes data series on an indicator before and after transition incomparable. The dissolutions of countries also add to the problem of incomparability of data in many cases as, for example, in the case of Serbia and Kosovo.
- A further objection may be that expansions and recessions rather than changes in the long-run growth regime will be identified. In general, the annual data contain a business cycle component, which may dominate the long-run tendencies. This is certainly important in the studies of developed countries where one tries to find a link between country characteristics like institutions, legal framework, physical and human capital and growth. In developed countries' cases, all those variables are characterized by relatively low variability at annual frequency and, hence, short-run fluctuations may dominate the long-run relationship between these variables and growth (Pritchett, 2000). However, in the case of transition, as mentioned in section 5.3.2, all those variables were characterized by significant instability similar to output. Hence, the possibility of capturing business cycle effects is negligible compared to the possibility of capturing the big shifts in the analysis. In other words, in the countries in transition, growth performances recorded shifts big enough to dominate the difference between expansion and recession.

As shown in chapter 2, over substantial periods – fifteen years or more – the transition countries have proven capable of widely varying growth patterns - rapid collapse and rapid expansion, rapid collapse and slow expansion, reversals in the growth process, and stagnation. If the long run is the summation of medium-run experiences, then the

difference between a country that converges towards capitalist developed market economies and one that stagnates (or worse) in the course of transition may be a single break in the growth process or may be a huge volatility in the output growth. Hence, the main goal in the next section is to offer initial empirical evidence on the instability and volatility of growth in each transition country.

5.4 Preliminary assessment of instability and volatility of growth in transition countries

This section provides a set of non-standard statistics characterizing the evolution of GDP for transition countries, with particular emphasis on going beyond average growth rates to instability in growth rates and the volatility of output.

- The definitions of instability and volatility are borrowed from Pritchett (2000) where *instability* is defined as shifts in growth trend; and *volatility* of growth is defined by the deviations from the trend within the same trend or regime (as presented in Figure 5.2-1 and defined in section 5.2).
- The annual data on GDP growth rates¹³⁹ or GDP (in constant 2000 U.S. dollars)¹⁴⁰ used in the analyses are taken from the World Bank (2012) data series. The former is

¹³⁹*World Development Indicators* give long definition of the data. Namely, annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2000 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Source: World Bank national accounts data, and OECD National Accounts data files. Aggregation method: Weighted average.

¹⁴⁰*World Development Indicators* give the long definition of the data used, namely GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2000 U.S. dollars. Dollar figures for GDP are converted from domestic currencies using 2000 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign

used in the equations given in sections 1 and 3 in Table 5.4-1, while the latter data series are used for the test given in section 2 in Table 5.4-1.

- The procedures for each aspect of growth analysed are described in Table 5.4-1, accompanied by the main equation used and the appropriate appendices and tables for the statistics computed.

Table 5.4-1 Description of the calculated statistics on growth rates

	The equation used (each equation used is in detail explained in the following text)	Appendix
1. Descriptive statistics		
Testing for a single time trend through GDP Growth Rate	$y_t = \alpha_0 + \beta T + e_t$ Equation 5.4-1	Appendix 5.4
2. Instability of growth		
Identifying the possible shifts in growth rates (Perron's version of the augmented ADF test)	$\Delta y_t = \hat{u} + \hat{\theta}DU_t + \hat{\beta}t + \hat{\gamma}DT_t + \hat{d}D(TB)_t + \hat{\beta}_1 y_{t-1} + \sum_{i=1}^k \hat{c}_i \Delta y_{t-i} + \hat{e}_t$ Equation 5.4-2	Appendix 5.2 and 5.3
3. Volatility of growth		
Deviations from the single trend	$e_t = y_t - (\alpha_0 + \beta T)^{141}$ Equation 5.4-3	Appendix 5.4

1. Section 1 of the table above gives the first set of the basic statistics on growth rates across countries. The main goal of this section is to test how much of the series behaviour of the growth rates in transition countries is “just a trend”. In Equation 5.4 -1 in section 1, y is the dependent variable (GDP growth rate), α_0 is the constant, β is the coefficient to be estimated on the deterministic time trend t and e_t is the error term. In economic terms, the variables from the equation take different meanings: a significant constant in this model indicates the average growth rate at the beginning of transition, while a significant positive trend

exchange transactions, an alternative conversion factor is used. Source: World Bank national accounts data, and OECD National Accounts data files. Aggregation method: Gap-filled total.

¹⁴¹The estimated equation and variables description is the same as the one in section 1 of this Table, though here the focus is on the deviations from the trend line.

indicates a continuous increase in the growth rate. In this case, the data used for the dependent variable is the GDP growth rate from World Bank (2012).

2. Section 2 gives the statistics on the instability of growth, i.e. on shift changes in level of the growth rates within a country. The idea in this section is to identify if there are some structural breaks in the data series. Perron's version of the Augmented Dickey Fuller test was used in order to assess the break in trend. The interpretation of the equation and explanation of the method itself will be given extensively in the following section 5.4.2.1.
3. The third set of statistics on the volatility of growth rates is given in section 3 of the table above. Here the procedure is based on the deviations from a single trend, i.e. the variability of the growth rates (section 3). In this case again the Equation 5.4-3 (or Equation 5.4-1) is used, however with a focus on closer investigation of deviations from trend line.

5.4.1 Basic growth statistics

To motivate the use of the univariate analysis of structural breaks, firstly the simple test for fitting a single time trend through the GDP annual growth rates over the period 1990-2010 is performed as explained in section 1 of Table 5.4-1. The full regression results on every individual country are given in Appendix 5.4.

The appendix to this section is consisting of:

- country by country results for the statistics computed;
- graphs representing the variable of interest: GDP growth rates (Appendix 5.2); with the vertical axis presenting the variable of interest; and
- a final graph that gives the estimated residuals for each regression for each country.

As mentioned, the idea is to see how much of the behaviour of the growth rates fits the trend line.

The following Table 5.4-2 summarizes the results of each individual country, together with the aggregated averaged results for the three identified groups of transition countries: the rapid-J; slow-J; and incomplete-U curve groups of countries. In the columns various estimated coefficient are presented: column (1) gives the constant term and its p-value in parentheses, column (2) presents the trend term and its p-value. While a significant constant coefficient presents the growth rate at the beginning of transition, a significant trend coefficient should represent a constant change in the growth rate. Columns (3) and (4) give the mean value of the growth rate in each country and its standard error, while column (5) gives the R-squared i.e. the measure of goodness of fit of the regression.

Table 5.4-2 Fitting a single trend through GDP growth rates
(Results from Equation 5.4-1)

Country	Constant term (in percent, α_0) (p-value) (1)	Coefficient on trend t (in percent, β) (p-value) (2)	Mean (in percent) * (y_t) (3)	SE(Y) (in percent) (4)	R ² (5)
Albania	-8.67(0.2347)	0.59(0.0998)***	3.03	9.84	0.14
Czech Rep.	-4.70(0.1980)	0.32 (0.0728)***	1.77	4.33	0.18
Estonia	-4.70(0.5190)	0.28(0.4260)	0.87	9.42	0.03
Hungary	-2.84(0.3803)	0.20(0.2011)	1.17	4.28	0.08
Poland	0.79(0.7877)	0.15(0.2836)	3.89	3.30	0.07
Slovak Rep.	-4.90(0.2938)	0.35(0.1255)	2.06	6.26	0.12
Slovenia	-0.35(0.8893)	0.16(0.4364)	1.37	5.42	0.03
Average rapid-J group	-3.62	0.29	2.02	6.12	0.09
Azerbaijan	-35.08(0.0001)*	2.15(0.0001)*	4.70	15.79	0.65
Armenia	-9.20(0.1969)	1.07(0.0712)***	2.60	14.28	0.18
Belarus	-7.49(0.0199)**	0.97(0.0008)*	3.18	7.76	0.50
Bulgaria	-11.98(0.0041)*	0.65(0.0019)*	0.77	5.94	0.42
Croatia	-5.34(0.1529)	0.57(0.0665)***	0.93	7.47	0.18
Kazakhstan	-22.00(0.0007)*	1.10(0.0002)*	2.24	8.27	0.56
Latvia	-14.12(0.1075)	0.76(0.0815)***	0.63	11.22	0.16
Lithuania	-8.33(0.3396)	0.40(0.3296)	-0.14	10.29	0.05
Romania	-9.65(0.0445)**	0.55(0.0219)**	1.10	6.41	0.26
Russian Fed.	-17.25(0.0039)*	0.82(0.0027)*	0.28	7.61	0.40
Macedonia	-9.70(0.0026)*	0.52(0.0011)*	0.69	4.25	0.47
Uzbekistan	-4.35(0.0066)*	0.71(0.0000)*	3.09	5.14	0.67
Turkmenistan	-9.18(0.0374)**	1.38(0.0008)*	5.26	11.81	0.47
Average slow-J group	-12.59	0.9	1.95	8.94	0.38
Georgia	-33.73(0.0023)*	1.65(0.0024)*	-1.57	15.26	0.41
Moldova	-25.05(0.0029)*	1.16(0.0044)*	-2.39	11.30	0.37
Kyrgyz	-15.23(0.0180)**	0.81(0.0112)**	0.64	8.68	0.31
Ukraine	-13.81(0.0074)*	0.93(0.0121)**	-2.21	9.99	0.30
Tajikistan	-29.12(0.0005)*	1.46(0.0004)*	-0.58	12.11	0.51
Serbia	-11.32(0.0242)**	1.01(0.0167)**	-0.68	11.35	0.28
Average incomplete-U group	-21.38	1.17	-1.13	11.45	0.36

Notes: * - indicates significant at 1% level, ** - indicates significant at 5% level, and ***- indicates significant at 10% level of significance.

- The first column (1) of Table 5.4-2 gives the coefficients on the constant term, i.e. the estimated annual growth rate in various transition countries at the beginning of transition. Evidently, all the coefficients are negative, except that of Poland, although insignificant. In addition, statistically significant constant coefficients can be found predominantly in slow-J and incomplete-U group countries, excluding all rapid-J group countries and Latvia, Lithuania, Croatia and Armenia. The observation of the rates across countries shows that the lowest average annual growth rate (-21.4 per cent) at the beginning of study period was recorded in the incomplete-U group, followed by the slow-J group of countries (-12.6 per cent), suggesting that the drop was the most pronounced in the former group. For the rapid-J group these coefficients are insignificant, although the average shows an initial drop to only -3.26 per cent. This would suggest that the sharpest drop was recorded in the incomplete-U group of countries, followed by the slow-J group; and the rapid-J group of countries recorded the least sharp drop.
- The second column (2) presents the estimated trend coefficients accompanied by their statistical significance. Evidently, all countries recorded a positive trend, i.e. positive increase in growth rates over the observed period, though the slopes are moderate varying from among 0.15 and 1.50 per cent, with only one country - Azerbaijan having a larger trend coefficient (of 2.15 per cent). All trend coefficients are significant except those of: Lithuania and most of the rapid-J group countries, such as Estonia, Hungary, Poland, Slovak Republic and Slovenia. The highest trend coefficients are recorded for the incomplete-U group, with an average of 1.17 per cent; for the slow-J group, the average trend coefficient is 0.9 per cent; and for the rapid-J group only 0.29 per cent, though mainly insignificant. This would suggest that on average the incomplete-U group countries recorded the highest continuous increase in growth rates, while the rapid-J group countries the lowest increase, which is consistent with the “catch-up” hypothesis, with less developed transition countries recording higher increase of growth rates.
- Turning to the average growth rates shown in column (3) and the accompanying standard errors (column 4), it becomes obvious that only one group of countries, the

incomplete-U group, recorded a negative average annual growth rate (of -1.13 per cent), which additionally is accompanied by the highest deviation from the trend (11.45 per cent); followed by the slow-J group with an average annual growth rate of 1.95 per cent, accompanied by standard error of 8.94 per cent; and, lastly, the rapid-J group, recording the highest average annual growth rates of 2.02 per cent and the least variation (6.12 per cent). However, it should be noted that this estimation does not take into account possible breaks in the data series.

- Column (5) shows the R-squared of fitting a single time trend through growth rates (y_t^*) or how much of the time series behaviour of GDP growth rates is "just the trend". For most of the countries, the R-squared is very low. In fact, only two countries - Azerbaijan and Uzbekistan - have an R-squared above 0.65¹⁴², suggesting that for transition countries, "growth" is not just the trend. However, the interpretation of the low R-squared is complicated, as it involves both the deviations from the trend and their magnitude and possible structural breaks in the data. Hence, the possible instability in the series is mixed with the potential volatility of the data series.
- Finally, a glance at the results in Table 5.4-2 (with all the rapid J-curve countries recording the lowest R-squared), indicates that "successful" countries with rather stable growth rates in latter transition tend to record a bad fit onto the trend line. In addition, the constant and trend coefficients in the case of rapid-J group countries mainly are not statistically significant (except for trend coefficients for Albania and Czech Republic) suggesting that this regression is a weak representation of the data generating process of GDP growth of these countries.

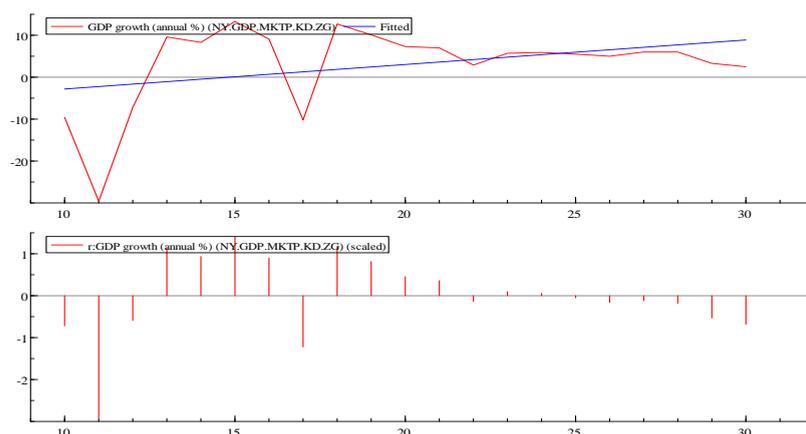
In general, the results offered in Table 5.4-2 give a descriptive analysis but are inconclusive. The interpretations of the R-squared indicate a poor fit, suggesting that this

¹⁴² Even this value of R- squared of 0.65 that is taken arbitrary means relatively low fit of the trend line.

basic starting regression trial has weak statistical relevance. Also, the hypothesis testing relies on the assumption of normality. In addition, the estimated regressions do not allow for differentiating between the possible instability and volatility in the growth rate series, which on the other hand are rather visible characteristics of growth shown in the graphs.

For example, in the following graph (top one) annual GDP growth rate dynamics for Albania is presented. On y-axis GDP growth rates are given for the whole course of transition. It can be easily observed that there is a break in the data series in middle transition, along with the one at the beginning of transition. This situation is observable for most of the countries.

Figure 5.4-1 Annual GDP growth rate dynamics for Albania



Note: Since the graphs are from the original software printouts, the second graph that gives the scaled residuals could not be excluded.

For example, Albania's *average* annual growth rate from 1990-2008¹⁴³ is 3.03 per cent; which includes both its high and rising annual growth rate from 1993 to 2008 as well as the sudden drop from 1990 to 1992. Is Albania's experience similar to that of Slovenia for example, that also recorded a sudden drop to -7.14 per cent annually at the start of transition till 1993 and afterwards experienced a more modest average annual growth of

¹⁴³The ending point of descriptive analysis in this paragraph is 2008, the year in which the effects of Global Financial Crisis started to materialize in the transition countries' GDP growth rates.

4.11 per cent as compared to 6.56 per cent in Albania? Ignoring this break, the average annual growth rate of Slovenia for the whole period was only 1.37 per cent, lower than the average annual growth rate of Albania of 3.03 per cent. Additionally, Slovenia recorded much lower variability in the growth rates of 5.42 per cent while Albania's standard error is 9.84 per cent.

All these comparisons suggest that the average annual growth rates can mask the real processes in the course of transition and so disguise the instability and volatility recorded in each country. Hence, in the following sections, the focus will be on the appraisal of the instability and volatility of growth rates.

5.4.2 Assessing Instability in Transition Countries

The assessment of the instability of growth is initiated by testing for the existence of shifts in growth rates within transition countries. Therefore, the strategy is firstly to conduct univariate analysis and test for the presence or absence of unit roots in macroeconomic time series, conditional on the presence of a deterministic trend and trend breaks, which should help to identify some features of the underlying data-generating process of each series.

5.4.2.1 Method used – Perron's modified augmented Dickey-Fuller Unit Root Test

As mentioned in section 5.2.1 the theme of univariate analysis of time series has gained an increasing amount of attention in terms of theoretical and applied research over the last three decades, starting with the seminal works by Perron (1989) and Perron (1990). By applying a testing procedure that is an extension of the Dickey-Fuller methodology, Perron (1990) tries to separate “outlying” exogenous events, which happens on a known date, from the noise function and to model it into the deterministic part of the general

time series model. In general, he develops two types of models for testing the unit root in a time series, which are:

- characterised by a structural change in its mean level; and,
- time series which are characterised by a presence of a one-time change in the level or/and in the slope of the trend function.

For both cases, he develops sets of models and corresponding regressions as given in the following table, with the last rows adding explanations.

In the table below the two types of models developed in the two papers (Perron, 1989) and Perron (1990) are given in the two columns. In addition, another classification is made by setting out the additive and innovative outlier models in two main rows. The brief explanations for each of the models and notation are given:

- for the additive outlier models in row 6; and
- for the innovative outlier models in row 7.

Table 5.4-3 Main models developed by Perron (1989, 1990) for testing for a unit root in a time series with intercept or/and trend breaks

	I) Structural change in mean level of the series (Perron, 1990, p. 14) (1)	II) Structural change in the level or in the slope of the trend function (Perron, 1989, p.1373, 1380) (2)
Additive outlier models	1. Extension of Phillips procedure (1987)(for details see p.13)	1. Extension of Phillips procedure (1987)(for details see p.1378)
	2. $y_t = \alpha y_{t-1} + \sum_{j=1}^k c_j \Delta y_{t-j} + v_t$ where $(t=k+1, \dots, T)$ and $\Delta y_t = y_t - y_{t-1}$ (Perron, 1990, p.12)	2. 1. $y_t^i = \alpha^i y_{t-1}^i + \sum_{j=1}^k c_i \Delta y_{t-1}^i + e_t$ where $(i=A,B,C)$ and $\Delta y_t^i = y_t^i - y_{t-1}^i$
Innovation outlier models	3. Model AM (“crash mean hypothesis”) $y_t = \mu + \gamma DU_t + dD(TB)_t + \alpha y_{t-1} + \sum_{j=1}^k c_j \Delta y_{t-1} + v_t$	3. Model A (“crash hypothesis”) $y_t = \mu^A + \theta^A DU_t + \beta^A t + d^A D(TB)_t + \alpha^A y_{t-1} + \sum_{i=1}^k c_i \Delta y_{t-1} + e_t$
	4.	4. 1. Model B (“breaking slope with no crash”) $y_t = \mu^B + \theta^B DU_t + \beta^B t + \gamma^B DT^*_t + \alpha^B y_{t-1} + \sum_{i=1}^k c_i \Delta y_{t-1} + e_t$
	5.	5. 2. Model C (both hypotheses are allowed) $y_t = \mu^C + \theta^C DU_t + \beta^C t + \gamma^C DT^*_t + d^C D(TB)_t + \alpha^C y_{t-1} + \sum_{i=1}^k c_i \Delta y_{t-1} + e_t$
	6. Explanation and notation of the additive outlier model (row 2):	6. Explanation and notation of the additive outlier model (row 2):
	Perron 1990, p.7 sets out this additive outlier test as a two steps regression procedure in which the first step - detrending – is to subtract the mean from the raw series (y_t) by allowing a change at time T_b . The two steps are: 1. a regression of y_t on a constant and DU_t (defined in Row	Perron (1990, p. 1373) suggest that this additive outlier test is a two steps regression procedure whereby: <ul style="list-style-type: none"> • Firstly, the raw series (y_t) are detrended according to either model A, B or C. • In the second-stage regression, the residuals (y_t) from a

		<p>7); and</p> <p>2. the residuals from the first step regression are denoted y_t; and α is the least squares estimator of α in the following regression: $y_t = \alpha y_{t-1} + e_t$.</p> <p>This approach adopts the procedure suggested by Dickey and Fuller (1979) and Said and Dickey (1984) which adds extra lags of the first differences of the data as regressors in the equation: $y_t = \alpha y_{t-1} + e_t$, resulting in the equation given above in row 2.</p>		<p>regression of y_t on (1) $i=A$: a constant, a time trend, and DU_i; (2) $i=B$: a constant, a time trend and DT_t^*; (3) $i=C$: a constant, a time trend, DU_i and DT_i; and α is the least squares estimator of α in the following regression: $y_t^i = \alpha^i y_{t-1}^i + e_t$.</p> <p>This approach adopts the procedure suggested by Dickey and Fuller (1979) and Said and Dickey (1984) which adds extra lags of the first differences of the data as regressors in the equation: $y_t^i = \alpha^i y_{t-1}^i + e_t$ resulting in the equation given above in row 2.</p>
	7	Explanation and notation of the innovative outlier model (row 3):	7	Explanation and notation of the innovative outlier models A, B and C (rows 3, 4 and 5):
		<p>This approach involves only a one-step regression. $\hat{\mu}$ is the constant term, y_{t-1} the first lag of the level of the left-hand side variable and Δy_{t-1} lagged differences to ensure that the residual e_t is free of autocorrelation. The equation takes into account the existence of two possible kinds of structural breaks, where TB is the break date: a “crash” effect, which allows for a break in the mean of the series, such that the crash dummy $D(TB) = 1$ if $t = TB + 1$, and zero otherwise; the intercept shift dummy DU_i allows for a once-and-for-all change in the mean such that $DU_i = 1$ if $(t > TB)$ and zero otherwise. The model has a unit root with a break under the null hypothesis, as the deterministic components are incorporated in the regression under the null. The alternative hypothesis is a broken mean stationary process.</p>		<p>This approach involves only a one-step regression. $\hat{\mu}$ is the constant or estimated drift term, $\hat{\beta}$ is the coefficient to be estimated on the deterministic time trend t, y_{t-1} the first lag of the level of the left-hand side variable and Δy_{t-1} lagged differences to ensure that the residual e_t is free of autocorrelation. Model C takes into account the existence of three possible kinds of structural breaks, where TB is the break date: a “crash” effect, which allows for a break in the level (or intercept) of the series, such that the crash dummy $D(TB) = 1$ if $t = TB + 1$, and zero otherwise; the intercept shift dummy DU_i allows for a once-and-for-all change in the level, such that $DU_i = 1$ if $t > TB$ and zero otherwise; the slope dummy DT_i represents a trend “shift”, which allows for a once-and-for-all break in the slope (or the rate of growth) of the trend function, such that $DT = t - TB$ if $t > TB$ and zero otherwise. Other models (A and B) take into account fewer breaks; however the notation is the same. The model has a unit root in the presence of breaks under the null hypothesis, as the deterministic components are incorporated in the regression under the null. The alternative hypothesis is a broken trend stationary process.</p>

According to Perron (1989, p.1380), these models fall into two main groups: the so called “additive outlier model”; and the “innovation outlier model”. While the former model is a two-steps regression, whereby the residuals from the first regression are used as a dependant variable in the second regression, the latter involves only a one-step regression, estimating the trend function and the dynamics of the process simultaneously. In addition, the former imply that the change in the mean/or trend function of the data series occurs instantaneously, while the later model allows for a gradual change in the mean and/or the trend function. In general, Perron (1989, p.1380) suggests that this distinction is a “possible drawback” of the former models, given for instance that it is more realistical to assume that the economy reacts over time to some shock. In addition, he derives the critical values which are the same for both the additive and innovation outlier models, thereby allowing for hypothesis testing.

When comparing the two groups of innovation outlier models, that is the Model AM (row 3, column 1) with the models A, B and C (rows 3,4 and 5, column 2), it is noticeable that the latter ones include a deterministic time trend t with $\hat{\beta}$ as the coefficient to be estimated. In addition, the most extensive Model C includes a slope dummy DT_t that represents a trend “shift”, which allows for a once-and-for-all break in the slope (or the rate of growth) of the trend function. In sum, Model C is an encompassing model.¹⁴⁴ Having the most extensive specification, Model C permits testing for the presence of a unit root in a “quite general time series process which allows for a one-time break in the mean of the series or its rate of growth (or both)” (Perron,1989, p.1381).

Following Perron’s argument, we have two reasons to use innovative outlier models, and Model C in particular, for our testing procedure.

¹⁴⁴ Perron uses the Model AM (row 3, column 1) to apply his testing procedure to three types of series: interest rate series; unemployment rate series; and terms of trade index series. The Models A,B and C (rows 3,4 and 5, column 2) are used to test the post-war quarterly real GDP series and the other 14 macroeconomic variables sampled annually by Nelson and Plosser.

1. Firstly, we believe that it is more realistic to model changes in the real economy as occurring over time, even when they are initiated by some sudden or shock event.
2. Secondly, as mentioned, Model C is an encompassing model, which allows for a one-time break in the mean of the series or its rate of growth (or both). In our analysis of regime switches, we want to allow for intercept shift and trend shifts.

In summary, following Perron's argument that most macroeconomic time series are characterized by deterministic trends broken by large shocks that determine a particular country's long-run growth, this section aims to identify similar structural breaks in data series in transition countries by using the most extensive – encompassing - Model C. In addition, this strategy is adopted, because – as previously argued in section 5.2.1 - there is an affinity between Perron's innovations in the analysis of univariate time series and the later growth literature emphasizing regime changes.

5.4.2.2 Several caveats to the testing procedure

Before applying the testing procedure, several caveats should be mentioned at this instance:

- Firstly, this test is derived from asymptotic principles and so requires a large sample for implementation; hence, the results in our analysis should be considered as suggestive only.
- Secondly, the break points are assumed in advance, based on visual inspection of the data, as Perron (1990, p17) suggests, and informed by the historical knowledge, which may not fully represent reality.

This second caveat deserves additional consideration. A prerequisite for applying this procedure is that the test can be conducted conditional on a change occurring at a fixed known date. However, in the case of transition countries, there are often easily

identifiable turning points after which growth behaves differently, mostly related to the wars, conflicts or to recent historical facts, which are well known. Particularly important examples for each of the 26 transition economies are detailed in Box 5.1, Appendix 5. 1. These inform the choice of structural break points to be investigated. However, issues of concern may still arise over the choice of the break point. In this case, Perron (1990, p.17) suggests that “usually visual inspection is sufficient since the method is better suited for sudden changes”. However, in a subsequent paper, Perron (1990) further discusses this issue suggesting that the general idea of these tests is not to provide an unconditional representation of the time series properties of the variables, but to remove from the noise function the events that occurred at specific dates when shocks happened and by modelling them by means of the trend function. In our analysis, in order to reduce the possibility of data mining, the events tested are the ones that can be considered – following Perron (1989 and 1990) - as exogenous and major. Table 5.4-3 below gives the possible turning points to be investigated for the various countries, based on the details given in Box 5.1, Appendix 5. 1. Reported are the tests for the points that were regarded as exogenous and major such as wars, conflicts and dissolutions that were given priority. These “major” visual events are taken to be the breaking points for which the results are presented. The question to investigate is whether the shocks observed in historical facts can be classified as major, in the sense that they thereby affect subsequent growth in transition countries.

Table 5.4-4 Possible turning points of growth in various transition countries

Country	Albania	Armenia	Azerbaijan	Belarus	B&H	Bulgaria	Czech Rep.	Croatia
Turning point (year)	1997	1994	1995	1996	Short data	1997	1997	1995
Country	Estonia	Hungary	Georgia	Kazakhstan	Kyrgyz Rep.	Kosovo	Latvia	Lithuania
Turning point (year)	1999	1994	1995	2000	1995	Short data Series	1994	1994
Country	Poland	Romania	Russia	Serbia	Slovenia	Slovak Rep.	Macedonia	Moldova
Turning point (year)	1993	1999	1998	Short data series	1993	1998	2001	1993
Country	Montenegro	Turkmenistan	Tajikistan	Ukraine	Uzbekistan			
Turning point (year)	Short data series	1997	1997	1995	1995			

5.4.2.1 Initial estimation on instability

Perron's modified ADF test is used in order to locate and test for structural breaks within each time series. Beginning with the scan of output (in levels), defined as the logarithm of real GDP per capita, and after applying the test in first differences – i.e. growth rates - for the series for which the unit root could not be rejected, we test whether the structural breaks were statistically significant.

The equation tested here is:

$$\text{Equation 5.4-2 } \Delta y_t = \hat{u} + \hat{\theta}DU_t + \hat{\beta}t + \hat{\gamma}DT_t + \hat{d}D(TB)_t + \hat{\beta}_1 y_{t-1} + \sum_{i=1}^k \hat{c}_i \Delta y_{t-i} + \hat{e}_t,$$

where \hat{u} is the constant or estimated drift term, $\hat{\beta}$ is a coefficient to be estimated on the deterministic time trend t , y_{t-1} the first lag of the level of the left-hand side variable and Δy_{t-1} lagged differences to ensure that the residual e_t is free of autocorrelation. The coefficient of interest is $\hat{\beta}_1$ and we test the unit root null hypothesis according to whether it is not statistically different from zero (unit root rejected). Due to the standard Dickey- Fuller reparametrisation this is the same as we were to test whether $\alpha=1$. As mentioned, the equation takes into account the existence of three kinds of structural breaks, as explained in row 7, column 2 in Table 5.4-3 above. The model has a unit root in the presence of breaks under the null hypothesis, as the deterministic components are incorporated in the regression under the null. The alternative hypothesis is a broken trend stationary process. The order of Perron's modified ADF test – i.e. the number of lags of the differenced variable to include on the left-hand side of the testing equation – was decided by examining model diagnostics and choosing the testing equation with the minimum number of lagged differences consistent with ensuring a white noise error term (hence free from autocorrelation). This minimises loss of degrees of freedom in context of already short time series.

The results with respect to testing for the presence of unit root in the natural logarithm of GDP for each country are given in and the estimates in full are given in Appendix 5.2. The coefficients are estimated by OLS regression using Microfit. For the coefficient β_1 (column 7 in the table), for which the T-Ratio and p-value are reported, the t-statistic is compared to the critical values given in Perron's tables (Perron, 1989, p.1377), having deciding first the size of the test, which is taken to be the 10% level of significance, and the time break relative to the total sample size. If t-statistic < critical value, the unit root can be rejected. In the table the coefficients for the cases where the unit root was not rejected are not marked for significance at all (in those cases the countries are highlighted in light grey). Given that critical values are non-standard in the presence of a unit root, these countries and their results are not discussed. However, in cases where the unit root null is rejected, then the usual (standard) critical values are used. Hence, in these cases the estimated coefficients and their appropriate p-values in parentheses are presented for further comment. In addition, for the countries for which the unit root could not be rejected, we conducted further testing.

In Table 5.4-5 each row presents one country. Each country is grouped in the appropriate group. The columns (2-7) give the appropriate estimated coefficients with the p-values in parentheses, with the first column (1) giving the turning points tested, column (8) the R-squared of the estimated regression, column (9) the diagnostic test brief description, and the final column (10) the judgment as to whether the assumption of a unit root is/or is not rejected.

**Table 5.4-5 Testing the unit root hypothesis for the lnGDP
Rapid-J group of transition countries**

Country	$\Delta y_t = \hat{u} + \hat{\theta}DU_t + \hat{\beta}t + \hat{\gamma}DT_t + \hat{d}D(TB)_t + \hat{\beta}_1 y_{t-1} + \sum_{i=1}^k \hat{c}_i \Delta y_{t-i} + \hat{e}_t$ <p>The dependant variable is the first difference of ln GDP</p>									
	Turning point tested (1)	Constant (2)	Trend (3)	$\hat{\theta}DU_t$ level effect (4)	$\hat{\gamma}DT_t$ trend effect (5)	$\hat{d}(D(TB)_t)$ crash effect (6)	$\hat{\beta}_1 y_{t-1}$ (T-ratio, p-value) (7)	R ² (8)	Diag. tests (9)	Unit root rejected/not rejected (10)
Albania	1997	5.03[.000]*	.07[.000]*	.26 [.000]*	-.04[.000]*	-.14[.000]*	-15.55[.000]	.98	All fine.	Unit root can be rejected
Czech Rep.	1997	4.65[.000]*	.03[.000]*	-.05[.179]	-.004[.380]	.03[.098]**	-5.56[.000]	.93	All fine.	Unit root can be rejected
Estonia	1999	1.39[.757]	.033[.008]	.48[.079]	-.046[.079]	-.142[.113]	-3.6545[.422]	.73	Func. form	Unit root can NOT be rejected
Hungary (2 lags)	1994	6.25[.005]*	-.06[.073]***	-.39[.037]**	.08[.037]**	.04[.053]***	-3.5464[.005]	.83	Func. form	Unit root can be rejected
Poland	1993	6.22[.000]*	.039[.000]*	-.05 [.061]***	-.001[.361]	.031[.018]**	-11.7351[.000]	.95	All fine	Unit root can be rejected
Slovak Rep.	1998	3.67[.000]*	.030[.000]*	-.09 [.072]***	-.50[.914]	.023[.307]	-6.5435[.000]	.95	All fine	Unit root can be rejected
Slovenia	1993	4.84[.078]	-.006[.808]	-.036[.787]	.027[.474]	.003[.759]	-1.99[.069]	.96	All fine	Unit root can NOT be rejected

Notes: * - indicates significant at the 1% level, ** - indicates significant at the 5% level, and ***-indicates significant at the 10% level of significance. Estonia and Slovenia are the two countries from this group for which the unit root null was not rejected. In addition, column 9 in each table gives a short assessment of the diagnostic tests: “All fine” is used to mark estimations for which all diagnostic tests were acceptable, while “Func. form” marks the cases where problems with Functional form test were identified.

The coefficients are estimated by OLS regression using Microfit. For the coefficient β_1 (column 7 in the table), for which the T-Ratio and p-value are reported, the t-statistic is compared to the critical values given in Perron’s tables (Perron, 1989, p.1377), having deciding first the size of the test, which is taken to be the 10% level of significance, and the time break relative to the total sample size. If t-statistic < critical value, the unit root can be rejected. Due to this, this coefficient is not marked for significance. In the table the “unit root non-rejecting” cases are marked in grey.

Slow- J group of countries

Country	Turning point tested (1)	$\Delta y_t = \hat{\alpha} + \hat{\theta}DU_t + \hat{\beta}t + \hat{\gamma}DT_t + \hat{d}D(TB)_t + \hat{\beta}_1 y_{t-1} + \sum_{i=1}^k \hat{c}_i \Delta y_{t-i} + \hat{e}_t$ The dependant variable is the first difference of ln GDP								
		Constant (2)	Trend (3)	$\hat{\theta}(DU_t)$ level effect (4)	$\hat{\gamma}(DT_t)$ trend effect (5)	$\hat{d}(D(TB)_t)$ crash effect (6)	$\hat{\beta}_1 y_{t-1}$ (T-ratio, p-value) (7)	R ² (8)	Diag. tests (9)	Unit root rejected/not rejected (10)
Armenia	1994	1.58[.131]	-.42[.000]	-.81 [.002]	.43[.000]	-.11 [.025]	-.90728[.382]	.98	Fun. form	Unit root can NOT be rejected
Azerbaijan	1995	2.12[.114]	-.11[.016]	-.65 [.087]	.15 [.013]	-.05[.617]	-1.6925[.116]	.89	All fine	Unit root can NOT be rejected
Belarus	1996	2.43[.211]	-.049[.019]	-.30[.230]	.072[.040]	-.10[.072]	-1.3064[.216]	.93	Fun. form	Unit root can NOT be rejected
Bulgaria	1997	4.73[.000]*	.013[.030]**	-.29[.002]*	.02 [.035]**	.02[.318]	-5.7109[.000]	.96	Fun. form	Unit root can be rejected
Croatia	1995	3.12[.003]*	.03[.000]*	.10[.207]	-.02[.078]***	-.054[.178]	-3.9549[.002]	.88	All fine	Unit root can be rejected
Kazakhstan	2000	5.79[.044]	-.035[.201]	-.738[.127]	.087[.103]	-.018[.798]	-2.3476[.039]	.89	All fine	Unit root can NOT be rejected
Latvia	1993	5.05[.017]	-.31[.000]	-.94 [.005]	.35[.000]	.018[.751]	-2.59[.024]	.94	All fine	Unit root can NOT be rejected
Lithuania	1994	5.11[.024]	-.13[.004]	-.67[.034]	.17[.005]	-.035[.540]	-2.57[.025]	.92	Func. form	Unit root can NOT be rejected
Macedonia	2001	0.60[.293]	.013[.000]	-.01[.854]	-.003[.400]	-.049[.014]	-1.30[.217]	.91	Fun. form	Unit root can NOT be rejected
Romania	1999	2.49[.004]*	-.007[.459]	-.24[.005]*	.024[.045]*	-.037[.115]	-3.76[.004]	.85	All fine	Unit root can be rejected
Russian Federation	1998	2.86[.013]	-.05 [.059]	-.35 [.020]	.07[.017]	-.003[.939]	-2.9691[.012]	.91	All fine	Unit root can NOT be rejected
Turkmenistan	1997	1.66[.018]	.004[.793]	-.06[.735]	.016[.428]	-.163[.007]	-3.3212[.008]	.96	All fine	Unit root can NOT be rejected
Uzbekistan	1995 (2lags)	-3.246[.012]	.06[.001]	.53[.002]	-.07[.002]	-.0[.036]	2.56[.026]	.95	All fine	Unit root can NOT be rejected

Notes: * - indicates significant at the 1% level, ** - indicates significant at the 5% level, and ***-indicates significant at the 10% level of significance.

Incomplete-U group of transition countries

Country	$\Delta y_t = \hat{u} + \hat{\theta}DU_t + \hat{\beta}t + \hat{\gamma}DT_t + \hat{d}D(TB)_t + \hat{\beta}_1 y_{t-1} + \sum_{i=1}^k \hat{c}_i \Delta y_{t-i} + \hat{e}_t$ The dependant variable is the first difference of ln GDP									
	Turning point tested (1)	Constant (2)	Trend (3)	$\hat{\theta}DU_t$ level effect (4)	$\hat{\gamma}DT_t$ trend effect (5)	$\hat{d}D(TB)_t$ crash effect (6)	$\hat{\beta}_1 y_{t-1}$ (T-ratio, p-value) (7)	R ² (8)	Diag. tests (9)	Unit root rejected/not rejected (10)
Georgia	1995	2.12[.232]	.17[.021]	.53[.265]	-.14[.069]	.033[.742]	-2.07[.062]	.98	All fine	Unit root can NOT be rejected
Kyrgyz Rep.	1995	6.80[.013]	-.16[.003]	-.96[.018]	.18[.004]	-.047[.178]	-2.93[.013]	.95	All fine	Unit root can NOT be rejected
Moldova	1993	3.96[.000]*	-.25[.005]*	-.99[.001]*	.27[.002]*	.32[.000]*	-5.56[.000]	.91	Func. form	Unit root can be rejected
Tajikistan	1997	9.38[.002]*	-.25[.002]*	-2.43[.004]*	.33[.002]*	.068[.250]	-4.012[.002]	.98	All fine	Unit root can be rejected
Ukraine	1995	6.06[.075]	-.07[.161]	-1.09[.163]	.12[.130]	.004[.955]	-2.05[.065]	.94	All fine	Unit root can NOT be rejected

Notes: * - indicates significant at the 1% level, ** - indicates significant at the 5% level, and ***-indicates significant at the 10% level of significance.

Before interpreting the results, it should be noted again that the results are only indicative, for the reasons given above. Several main conclusions can be made:

- Namely, when implementing Perron's modified augmented Dickey-Fuller Test on the lnGDP series, there are 10 series for which the unit root null can be rejected but which yield significant intercept break and/or trend break terms (respectively, nine and seven from 10).
- In general, examination of the test results for the countries for which the unit root was rejected reveals various types of shifts in GDP. We can gain insight into real GDP effects after the respective break points for those 10 countries for which the unit root null was rejected. The estimated coefficients measuring the level (constant) and the trend are combined with the corresponding interaction terms, respectively the level break dummy and the trend break dummy. While the summation of the estimated coefficient on the constant plus the level break dummy represents the combined level change effect after the break, the summation of the estimated coefficient on the trend plus the trend break dummy represents the combined trend change effect after the break in the data series. Depending on the sign and size of the estimated coefficients and their appropriate interactive terms, the combined effects in level and trend after the break can be described as mainly positive or negative.

As expected, for those countries for which the unit root hypothesis was not rejected for the levels of lnGDP, unit root testing of the first differences of the lnGDP series revealed that for most of these countries the unit root hypothesis could not be rejected. We proceed by testing the first differences of lnGDP for a unit root. The idea is to investigate whether the growth rates in the various countries are stationary and also whether they have experienced structural breaks. The estimations are given in Appendix 5. 3., while the results with respect to testing for the presence of unit root in the first difference of the natural logarithm of GDP for each country are summarized in following Table 5.4-6. Each first-differenced series is tested for the presence of a unit root using the same procedure as was applied to the levels of lnGDP; however, in each case the trend and trend-break terms were excluded from the

testing equations on the grounds that the implied quadratic effects in the levels have no sensible economic interpretation (certainly not for real economic series like GDP) and therefore played no part in testing the levels series. The crash term was also excluded on the grounds that a one-period crash effect in the $\ln\text{GDP}$ series is self-cancelling in successive periods of the differenced $\ln\text{GDP}$ – i.e. growth rate – series (so that it has no permanent effect on the growth rate).

Table 5.4-6 Testing the unit root hypothesis for the first-differences of lnGDP

Country	The dependant variable is the second difference of ln GDP						
	Turning point tested (1)	Constant (2)	$\hat{\theta}(DU_t)$ level effect (4)	$\hat{\beta}_1 y_{t-1}$ (T-ratio, p-value) (7)	R ² (8)	Diag. tests (9)	Unit root rejected/not rejected (10)
Estonia	1999	4.62[.025]**	.58[.268]	-3.45[.005]	.53	Func.form	Unit root can be rejected
Slovenia	1993	-.06[.072]***	.103[032]**	-3.51[.004]	.88	All fine	Unit root can be rejected
Armenia	1993	-.49[.000]*	.56[.000]*	-15.89[.000]	.97	All fine	Unit root can be rejected
Azerbaijan	1995	-.16[.002]*	.21[.001]*	-3.88[.002]	.59	Func.form	Unit root can be rejected
Belarus	1996	-.066[.012]**	.10[.002]*	-3.48[.004]	.53	Func.form	Unit root can be rejected
Kazakhstan (2 lags)	2000	-.035[.098]***	.08[.031]**	-3.033[.010]	.41	All fine	Unit root can NOT be rejected
Latvia	1993	-.345[.000]*	.39[.000]*	-8.644[.000]	.89	All fine	Unit root can be rejected
Lithuania	1994	-.21[.000]*	.27[.000]*	-7.21[.000]	.83	All fine	Unit root can be rejected
Macedonia	2001	.004[.739]	.005[.765]	-1.60[.131]	.18	All fine	Unit root can NOT be rejected
Russia	1998	-.05[.015]**	.12[.003]*	-4.027[.001]	.54	All fine	Unit root can be rejected
Turkmenistan	1997	-.095[.001]*	.19[.000]*	-5.79[.000]	.71	All fine	Unit root can be rejected
Uzbekistan	1995	-.067[.012]**	.105[.004]*	-3.86[.002]	.52	All fine	Unit root can be rejected
Georgia	1995	-.402[.007]*	.49[.005]*	-3.95[.001]	.53	Func. form	Unit root can be rejected
Kyrgyz Rep.	1995	-.14227[.000]*	.17[.000]*	-5.88[.000]	.75	All fine	Unit root can be rejected
Ukraine	1995	-.054[.169]	.092[.113]	-2.11[.052]	.24	All fine	Unit root can NOT be rejected

Notes: * - indicates significant at 1% level, ** - indicates significant at 5% level, and ***-indicates significant at 10% level of significance. In addition, column 9 in each table gives short description of diagnostic tests: “All fine” is used to mark estimations for which all diagnostic tests were fine, while “Func. form” marks the cases where problems with Functional form test were identified.

When implementing Perron's modified augmented Dickey-Fuller Test on the first differences of the lnGDP series, the unit root was rejected for the rest of the countries, except for three, such as Macedonia, Kazakhstan and Ukraine. This indicates that the first differences of lnGDP, or growth rates of GDP, in most of these cases are stationary variables. However, the results of unit root testing are often ambiguous and conclusions involve judgements that take into account a range of evidence, including formal unit root tests and examining the plots of times series. This would seem to be the implication of the conclusion of Harris and Sollis (2003, p.77) to their exposition of "testing for unit roots":

Clearly, the most important problem faced when applying unit root tests is their probable poor size and power properties (i.e. the tendency to over-reject the null when it is true and under-reject the null when it is false, respectively). This problem occurs because of the near equivalence of non-stationary and stationary processes in finite samples, which makes it difficult to distinguish between trend-stationary and difference-stationary processes. It is not really possible to make definitive statements like 'real GDP is non-stationary'; rather, unit root tests are more useful for indicating whether the finite sample data used exhibit stationary or non-stationary attributes.

The variety of results regarding rejection/non-rejection of the unit root hypothesis and of break points suggested by the deterministic components in the testing equations makes it difficult to draw general conclusions. In addition, for some of the countries the unit root hypothesis was not rejected for ln GDP, while for some it was rejected even for the first differences, which additionally complicates attempts to draw general conclusions. However, in general, it can be confirmed that economic development in these transition countries was often interrupted sufficiently severely to give rise to a detectable break. Moreover, it can also be confirmed that upon differencing the data series generally exhibit stationary attributes, although with the caveat of the small sample size problem. With respect to the in lnGDP levels, while in some cases these breaks are characterised by long-lasting "level" and "trend" effects. Similarly, most of the differenced lnGDP series exhibit breaks in the level of growth (shown by significant intercept shift terms in Table 5.4-7.

The procedure itself has limitations in several aspects:

- Firstly, it identifies breaks that are presumed from previous knowledge.¹⁴⁵
- Additionally, it allows for only one break in the data series that is not on the tails of the data series.
- It does not separate the instability from the volatility of growth; and,
- Finally, it is suggestive rather than definitive in a small sample.

However, beside limitations, the testing procedure was useful in the sense that it does reveal evidence of structural breaks in economic development under transition and, thereby, directs attention towards further search for more effective and appropriate methods of analysis. In particular, we need an approach to take into account both the instability and the volatility of the growth process.

5.4.3 Assessing volatility of growth in course of transition

Pritchett (2000) argued that the volatility can be relatively easily evaluated and measured if the time series under analysis are well represented by a single stable growth rate. In those cases, volatility is usually measured by the standard deviation of output growth from a single trend. However, in the cases where the data series exhibits strong structural shifts, the estimation of volatility can be complicated, since the measurement method might capture the shifts or so called instability, hence overstating the actual volatility in the data. The previous section has shown that nearly every transition country exhibits at least one large shift in the level or trend of growth, which encumbers the extraction of the pure volatility of output from its instability.

¹⁴⁵ Although it could be argued that this feature might be the strength of the procedure, since it determines the breaking points based on historical knowledge and theory. The alternative is to identify “turning points” using a statistical algorithm, which of course is a completely a-theoretical approach.

Having this difficulty in background, in this section as a starting step in volatility analysis a relatively simple approach that combines the instability and volatility will be used i.e. the standard deviation of output growth from a single trend, using Equation 5.4-3 or Equation 5.4-1. Results are summarized and averaged in the three groups of countries from Table 5.4-2 into the following Table 5.4-6. In the table column (1) gives the three groups mean values of the estimated trend coefficients for each country accompanied by its p-value (in column 2), column (3) gives the groups mean values of the estimated mean of GDP growth rates for the countries, column (4) the group mean value of the standard error, column (5) the mean groups value of the R-squared of the regressions. In fact, this table copies the average values for groups from Table 5.4-2; however, the interest here is focused on the standard error (column 5) which should give some indication on the volatility of growth.

Table 5.4-7 Summarized results of the fitting a single trend into a GDP growth rates (averages for the groups from Table 5.4-2 and using Equation 5.4-3 or Equation 5.4-1

Country group	Trend (in percent) (1)	p-value (2)	Mean (in percent) (4)	SE (in percent) (5)	R ² (6)
Average rapid-J group	0.29	0.24	2.02	6.12	0.09
Average slow-J group	0.9	0.04	1.95	8.94	0.38
Average incomplete-U group	1.17	0.007	-1.13	11.45	0.36

Table 5.4-7 shows that the standard deviation in growth rates is much larger among the incomplete-U and slow-J group of countries (11.45 per cent and 8.94 per cent on average, respectively), while for the rapid J –group it is much less at 6.12 per cent. This difference in the variability of growth rates between the groups favours the assumption of the different volatility of growth among transition groups. It also suggests that countries with less volatility recorded higher success in the period of transition.

5.5 Conclusion

The univariate data series analyses for individual transition countries undertaken in this chapter suggest that GDP growth rate paths cannot be well described by a single rising trend. Additionally, the tests partially confirm the ideas of instability and volatility of growth in the course of transition. The evidence indicating substantial breaks in data series, as well as evidence on the volatility of growth was offered in sections 5.4.2 and 5.4.3 of this chapter and it can be qualitatively summarized in Table 5.5-1 below.

In column (1) main theoretical concepts that are explored in this chapter are given, in column (2) the corresponding empirical measures are presented, while the rest three columns present the three groups of countries, accompanied by the general qualitative results, i.e. by using ticks and crosses and country group descriptive comparison for volatility. Each tick presents dominance of the effect in each group of countries as identified by the estimation techniques in this chapter.

Table 5.5-1 Summarized outcome from the analysis

Main theoretical concepts of growth (1)	Corresponding empirical measures (2)	Groups of countries (3)		
		Rapid-J group	Slow-J group	Incomplete-J group
Instability of growth is defined as breaks or shifts in growth trend	Level-break	√	√	√
	Trend-break	x	√	√
	Crash-break	√	x	x
Volatility of growth is defined by the deviations from trend	Standard deviation around detrended series	lowest	high	highest

Note: √ - marks dominance of the significant coefficients for that effect in the respective group of countries, x – marks lack of significant coefficients in that group.

In summary, on average, the rapid-J group countries recorded mainly level and crash break adjustments in the GDP growth data series, accompanied by comparably lower volatility. The incomplete-U curve group on the other hand, experienced a GDP growth pattern characterized by level and trend break adjustments, accompanied by the highest group volatility. In the middle, the slow-J group countries resembled the incomplete-U

group countries with respect to the instability adjustments mainly realized through level and trend break adjustments, although accompanied by lower volatility.

Although indicative, the assessment at this stage is still not complete for several reasons:

- The univariate analysis conducted in this chapter captures *only one* big change in each series and, moreover, only in the case when the null hypothesis of a unit root is rejected. As such, it is unable to reflect the idea of *more than one regime* switch in a country, as developed in the theoretical model in chapter 4.
- Additionally, as already mentioned, the turning point was a priori assumed for different countries, which in some cases might not best accommodate reality.
- Finally, the volatility of growth when structural shifts characterize the data series could not be captured by using the standard univariate analysis. Namely, as discussed in section 5.4.3 the volatility estimation is mixed with the instability, which leads to inconclusive results. As pointed out by Lamoureux and Lastrapes (1990), failure to allow for regime shifts or structural changes leads to an overstatement of the persistence of the variance of a series.

Hence, an approach that can model jointly both structural shifts and volatility in data series is needed to allow for better identification of both instability and volatility in the course of transition. Statistically, such a model will give the possibility of replacing the familiar picture of long-run growth now and then impacted by business cycle fluctuations with a growth concept allowing for shifts or breaks in trend and characterized by varying degrees of volatility around each new trend line. Hence, in these cases, the analysis of economic growth must be matched with a non-linear modelling approach that will allow the parameters to adjust to reflect structural changes, but will be also informative on the dynamics around each particular trend line. As Durlauf et al. (2004) suggest many of the difficulties that face growth researchers could be addressed in ways that are now standard in the macro econometrics literature or business cycle literature. This can be done using interaction terms, nonlinearities or semi parametric

methods, so that the marginal effect of a given explanatory variable can differ across countries or over time. Accordingly, in the next chapter, a Markov Switching framework, which is borrowed from the business cycle literature, is proposed as an appropriate framework that will enable assessment of the instability and volatility of growth more fully.

Chapter Six

6 Empirical analysis of the instability and volatility of growth in the course of transition

...Traditional separation of the medium-run assessment of the business cycle and long-term economic growth perspective is not a promising research strategy for economies subject to structural change... (Krolzig, 2000, p.18)

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6.1 Introduction

Macroeconomic analysis, both theoretical and empirical, has generally maintained a primary distinction between the long-run growth path of the economy and short-run fluctuations, usually described as business cycles. Namely, theories of economic growth, stressing real human capital and physical capital accumulation and productivity, and theories of business fluctuations, often emphasizing nominal rigidities, have been typically developed without reference to one another (Diebold and Rudebusch, 2001). In general, this division between economic growth and business cycle analyses might be relevant in cases when the countries under analysis follow the “Solow” balanced growth pattern, characterized by no significant fluctuations in the macroeconomic data series in the long run and familiar business cycle fluctuations in the data in the short run.

However, as discussed in chapter 5 this sharp distinction between the economic growth and business cycle analyses seems implausible when the countries under analysis experience peculiar processes such as huge structural changes in the economy as well as varying rates of factor accumulation and technical progress, which cannot be easily explained either within growth theories or within business cycle theories (Krolzig, 1998). Certainly, transition countries belong to the group of countries to which Krolzig (1998), Durlauf et al. (2004) and Pritchett (2000) referred. As mentioned in chapter 5, instability and volatility were dominant characteristics of growth patterns in the course of transition. Instead of a smooth growth path, the growth process in the course of transition may be characterized by a series of switches among various regimes as described in chapter 4, which seeks for possible reconciliation or transcendence of the growth and business cycle approaches.

On the theoretical side, settlement has started with the work of Pritchett (2000), Hendry and Krolzig (2004), Easterly (2009c,d), Aquiar and Gopinath (2004), Hausmann et al. (2004), as explained in chapter 5. Nevertheless, in the original empirical approach the

dichotomy among growth and business cycle studies is still preserved in terms that business cycle researchers usually use a non-linear modelling approach to describe the stylized facts of business cycles, while growth researchers assume that the long-run growth of the economy follows a simple linear deterministic trend and hence use predominantly linear modelling (Krolzig, 1998). Having in mind this division, the question arises as to whether these two concepts can be brought together for the purposes of describing volatile, non-linear growth patterns in developing or transition countries and, if so, under which circumstances? More precisely, will the concept of non-linearity borrowed from business cycle analyses be equally applicable in growth theory analyses, having the capability to capture huge shifts in macroeconomic growth paths in the course of transition.

The aspiration to address the above questions shaped this chapter. Hence, it is organized as follows. Section 6.2 gives the main intuition behind non-linear modelling and the rationale for use of this approach in this research programme, setting out the main characteristics of Markov switching models and explaining various extensions. Briefly, this section discusses the use of Markov Switching Models in business cycle analyses. The methodology is presented in section 6.3. This section also discusses the particular departures needed to be made in order to make the Markov Switching framework applicable in this research. Section 6.4 presents the estimation results and interpretation from the univariate analysis, accompanied by the revision of the discussion on instability and volatility of growth in the course of transition given in section 6.5. The last section 6.6 concludes.

6.2 Non – linear modelling

The inspiration of non-linear econometric modelling stems from the possibility that linear approximations to “possibly” nonlinear economic phenomena might conceal important information present in the data (Hamilton, 2005, Neftçi, 1984). Namely, the

data might not be characterized by parameters constant through time but, rather, by structural shifts dividing series into periods and distinct regimes with different parameter values (Durlauf et al., 2004). In those cases, the performance of structural macroeconomic models incorporating a dynamic system in a deterministic fashion can be degraded, due to the regime shifts (Krolzig, 1998). Although this possibility was recognized long ago, originating with the work of Goldfeld and Quandt (1973), only after the introduction of Hamilton's model (1989) did the number of studies that apply non-linear models, Markov switching models in particular, increase significantly. An important appeal of these models is their ability to account for the accumulating evidence on business cycle characteristics (as discussed in business cycles theory) as well as for the evidence on assets returns and financial data. However, having in mind their properties, Kim and Nelson (1999, p.4) suggested that:

...the most exciting prospect that these models hold is for dealing with evolution and change of economic systems.

Nevertheless, although transition by definition is a perfect model of transformation of the economic system, in this case from socialism to capitalism as discussed in chapter 2, to our knowledge it has never been empirically explored by using a non-linear approach. On the contrary, as Krolzig (1998) noted, dramatic changes such as German reunification, transition in the Eastern European Economies and many other major structural changes - including oil price shocks and the European Monetary Union – are often incorporated into a dynamic system in a deterministic fashion, which he argues poses problems for estimation and forecasting when a shift in parameters occurs.

The examination of the non-linear elements in the economic relationships can be performed using several (relatively) newly developed techniques, among which are: switching models; smooth transition models; and Markov-switching models. (Teräsvirta, 2005). All these models belong to one of two main categories of non-linear modelling, which are: piecewise linear models; and disequilibrium models.

- Piecewise linear models restrict the process to be linear in each regime and only a discrete number of regimes are feasible (Krolzig, 1998). In other words, before and after the switch (es) or transition(s)¹⁴⁶, the assumption of linearity is preserved. These models, Markov Switching Models in particular, will be extensively discussed in section 6.2.2, accompanied by the validation of their use in this thesis.
- Disequilibrium models consist of models that do not nest a linear model as a special case. These models are complicated and are not part of this research.

In general, the research strategy of applying non-linear models usually starts with a linear model and then considers the non-linear extensions should they turn out to be necessary or important.¹⁴⁷

6.2.1 Non-linear nested models – applicability in the context of transition

As mentioned, Markov Switching models are specific non-linear models extensively employed in the analyses of the volatility, persistence and stylized facts of business cycles.¹⁴⁸ Their limited use in growth analyses raises the question as to whether they can be appropriate for the analysis of growth in a particular context; namely, growth in the course of transition. This section offers several arguments in favour of their application in transition research, and in this research in particular.

¹⁴⁶Switching models and smooth transition regression models are non-linear models that do allow for one switch or turning point. While in switching models the change is drastic, the smooth transition models allow for gradual change in the data generating process. In some extensions, they do allow for a reverse movement back to the previous regime (Teräsvirta, 2005). On the other hand, Markov-switching models allow for more than one turning point, more switching regimes and do not necessarily assume return to the previous state, which accommodates the assumptions of the model developed in Chapter 4 (Clements and Krolzig, 1997).

¹⁴⁷The statistical software packages also apply the same initial strategy, offering tests and choice between linear and non-linear approaches (as in, for example: JMulti and Ox Metrics).

¹⁴⁸Extensive discussion on the econometrics of the General Equilibrium Approach to Business Cycles is given in Kydland and Prescott (1991).

1. Firstly, the capability to incorporate the *dynamics and uncertainty* characteristic of business cycles is crucial for non-linear models' extensive use in business cycles context (Kydland and Prescott, 1991). Although this study is based in growth theory, nevertheless a simple non-linear regime switching approach might be useful to capture the stylized facts of transition, a process that was also characterized by dynamism and huge uncertainty.
2. Secondly, Markov Switching Models do conceptually accommodate the *dynamics of the transition process* as explained in chapter 4. Namely, in chapter 4 the equilibrium neoclassical supply-side framework was exploited to develop the understanding of growth in transition. As presented in the model (section 4.4, Figure 4.5-2), the final equilibrium in the course of transition should be reached only after a sequence of transitional equilibriums. Hence, it seems that this movement can be appropriately gauged by non-linear models that nest the linear model within their structure, i.e. piecewise linear models. Additionally, it is important to note that the goal is not to examine the deviations of real activity from some linear trend. Rather the idea is to assess whether or not the real activity changes before and after some regime shift occurs, when the specific combination of factors of production rather than their long-run tendency to grow governs economic dynamics (Hamilton, 1989, 2005). This contrasts with much recent work in transition growth literature where a linear approach to modelling is used (De Melo et al., 1996 and 2001; Harvrylyshyn and Roden, 2000; Fischer and Sahay, 2000); and, associates much more with the business cycles literature. Although relatively new, this modelling strategy probably is more appropriate when transition is to be scrutinized.
3. Finally and thirdly, the validity of the selected model depends primarily on the adequacy of the empirical model as *an approximation to the data generating process* (DGP). In turn, there is the assumption of the constancy of the parameters across

the observations and homogeneity of the sample (Hendry and Krolzig, 2004). This assumption is open to legitimate doubt in the growth regression context, in transition country cases especially. This is for two reasons.

- Initially, as discussed in chapters 2, 3 and 4, transition was marked by severe shifts in the main economic parameters, which questions the constancy of the parameters in the empirical modelling.
- Additionally, as discussed in chapter 2, transition countries do not form one homogenous group, but differ greatly with respect to several criteria, such as: the starting dates of recovery; the sustainability of achieved reforms and growth; and so on. This implies that pooling all the cross-country observations together in a panel might decrease the explanatory power of the model. To put this differently, current panel data methods treat the individual effects as nuisance parameters, which is clearly inappropriate in the growth context (Durlauf and Quah, 1999). The individual effects are of fundamental interest to growth economists, because they appear to be a key source of persistent income differences. This suggests that more attention should be given to modelling the heterogeneity rather than finding ways to eliminate its effects.

Hence, to capture non-linearity and non-regularity of growth in various countries, a within country non-linear modelling approach will be used in the following econometric analyses, in order to achieve richer specifications for examining individual countries' experiences in contrast to recent traditional linear or panel approaches.

6.2.2 Markov Switching Models

6.2.2.1 Intuitive brief explanation

At first, a brief intuitive description of the Markov Switching framework is helpful to establish the concepts and terminology.

The main objective of a regime switching model is to allow for multiple structural breaks in a given time series, i.e. to allow for different behaviour of the dependent variable y in “different states of nature”, while at the same time estimating the timing of the transition from one state to another. In other words, regime switching models do not only jointly estimate the probable number (if any) and timing of regimes in the data, but they are particularly well suited to investigate whether or not different regimes posited in theory, or suggested by observation-guided or by less sophisticated forms of analysis, exist in reality and in the data generating process (DGP). This advantage makes them especially suitable for the analysis of transition as presented in the model in chapter 4, whereas techniques that a priori assume different regimes and a corresponding switch in some particular period(s) are not, by definition, as chapter 5 concluded. In addition, Markov switching models do allow for distinctive parts of the model to depend on the state of the economy (the “regime”), potentially relaxing some or all of the restrictive assumptions of linear modelling with respect to the constant (intercept) (α_0), mean (μ), autoregressive elements (α_p), variances (σ) and included exogenous variables (X) throughout the sample period. Once again, this option is convenient for the particular research of transition, because it allows for closer qualitative description of the various regimes in the empirical model of transition.

Noticeably, the tasks that Markov Switching models have in detecting regimes are highly complex and entail considerable complexity of the estimation techniques required to deal with time series data. The intuition behind the estimation technique suggests that through filtering and smoothing of the observable data y_t , numerous probabilistic inferences with respect to regime change are computed at different points throughout the sample and, lastly, the filter and smoother recursions reconstruct the time path of the regimes. In general, the procedure for calculating the probabilities is rather complex,

which requires repeated iterations and numerical techniques until some convergence criterion is satisfied.¹⁴⁹

6.2.2.2 General framework: main characteristics and definitions

Following the non-technical introduction to the Markov Switching framework, in this section the MS models will be presented in a more technical manner in three steps, starting with the explanation of the time series y_t in the first step. Then, the second step offers a closer look into the switching property, which incorporates the characteristics of the switching hidden variable or process s_t . Lastly, the third step gives the description of the dependency between the switching hidden variable s_t and the time series y_t . The following explanation follows closely those of Hamilton (1994), Krolzig (2000) and Frühwirth-Schnatter (2006).

Step One. The properties of the time series y_t , or named as Y_t conditions.

To begin with, time series data usually reflects the dynamic consequences of events over time (Hamilton, 1994). In some cases, the events might be influenced by the events in the past. In the simplest manner, in mean adjusted form, the standard model to capture the corresponding autocorrelation is the AR(p) model relating the value of the variable y at date t to the value that y took in the previous periods $t-1, \dots, t-p$:

$$\text{Equation 6.2-1} \quad y_t - \mu = \alpha_1(y_{t-1} - \mu) + \dots + \alpha_p(y_{t-p} - \mu) + u_t, \quad u_t \sim N(0, \sigma^2)$$

where y_t is the variable of interest, μ is the mean of the series, t indexes time (periods), p the number of lags and u_t is the usual error term. For the standard AR model, the Equation 6.2-1 is completely equivalent to the model given in the following familiar Equation 6.2-2,

¹⁴⁹Full technical explanation of the estimation techniques and of the corresponding software programmes is given in Bruce and Watkins (1998), Krolzig (2000).

Equation 6.2-2 $y_t = \alpha_0 + \alpha_1(y_{t-1}) + \dots + \alpha_p(y_{t-p}) + u_t$ $u_t \sim N(0, \sigma^2)$

with the constant term $\alpha_0 = \mu(1 - \alpha_1 - \dots - \alpha_p)$. Since the mean is the same for the whole series in the standard AR model, the constant is capturing the effects of the autoregressive parameters multiplied by the mean.¹⁵⁰

Now, Markov Switching Models (MS) start with the assumption that y_t switches regimes according to the unobserved variable s_p . The s_p variable can be considered as a hidden stochastic process that determines the distribution of another observable stochastic process y_t . As is common in time series analysis, the y_t variable can be considered as the realization of a stochastic process. The s_p variable also. Hence, the modelling is based on a doubly stochastic time series model and the dependence between the two series.

Step Two. The properties of the hidden process s_p , or named as S_t conditions.

The variable s_p is a latent random process that can be observable only indirectly through the impact it has on the observable stochastic process y_t (Frühwirth-Schnatter, 2006). Additionally, it is assumed that the unobserved variable's movements (s_p) between regimes are governed by an irreducible, aperiodic, ergodic Markov Chain, defined by transition probabilities between N states or regimes (Krolzig, 2000).

If all the regimes have a positive unconditional probability, the process is called irreducible (Krolzig, 1998). Irreducible means that the system can equally move from any state to any state or it can remain in the same state. Aperiodicity means that the system can return to any state at irregular times. A finite Markov Chain is ergodic if exactly one of the eigenvalues of the transition matrix is unity and all other eigenvalues are inside the unit circle (Equation 6.2-4) (Krolzig, 1998). Under this condition there exists stationarity

¹⁵⁰These two equations (Equation 6.2-1 and Equation 6.2-2) will present completely different models in the cases when the switch in the regimes is assumed (Frühwirth-Schnatter, 2006). The switching models are explained in the next section where different model types are presented (6.2.2).

or an unconditional probability distribution of the regimes; i.e. transition probabilities cannot be trended.

In simple words, based on the observable data y_p the MS estimator determines: the number of regimes; their timing; and the probability of each possible transition of the system from one regime to another. For example, the transition from regime i to regime j when the number of states is two ($N=2$) is given by the equation:

Equation 6.2-3 $p_{ij} = pr(s_t = j | s_{t-1} = i), \quad \forall i, j \in \{1, \dots, N\}$

which means the probability of currently being in state j ($s_t = j$) conditional on having been in state i in the previous period ($s_{t-1} = i$). Hence, as can be seen from the equation, the probability distribution of the state at any time t depends only on the state at the time $t-1$ and not on the previous states, such as $t-2, t-3, \dots$ etc.¹⁵¹ That is, the basic Markov process is not “path dependent” (Brooks, 2002).¹⁵² This is the basic condition **S4** that defines the properties of the basic Markov Switching Model (Frühwirth – Schnatter, 2006) (see Box 6.1, Appendix 6. 1, p. 546).

Because the system has to be in one of the N states at a certain time t , it will follow:

Equation 6.2-4 $\sum_{j=1}^N p_{ji} = 1$

¹⁵¹In order for the hidden process to be fully specified, the initial distribution of the s_t variable should be specified. As mentioned, the Basic Markov Switching Model starts with the ergodic transition matrix. However, this assumption can also be relaxed by allowing the initial distribution to be arbitrary – uniform or unknown (estimated), needed to be estimated from the data. In Ox Metrics, these options are available.

¹⁵²However, it should be noted that the Basic Markov Switching model has been extended with the aim of formulating even more flexible models for a wide range of time series data. These models do allow for containing the history property of the regimes condensed in the “memory” of the state variable (Mizrach and Watkins, 1999; Frühwirth – Schnatter, 2006). A brief explanation of the main definitions and the extensions of Markov Switching Models are presented in Box 6.1, Appendix 6. 1, p. 489).

The sum of the probabilities of being in state j , conditional on being in previous regime i equals 1.¹⁵³

Step Three. Finally, the last step establishes the dependence of the distribution of y_t on s_t . In each moment in time, the distribution of y_t depends on the state s_t , but this dependency can vary, based on the various assumptions that are fulfilled in different models (further explanation of possible variations is given in Box 6.1, Appendix 6. 1, p.546).

6.2.2.3 Different Markov Switching Regression Models

The rather general formulation of the Markov Switching Model allows for a great variety of particular Markov switching regression specifications, which have different notation depending on the parameters conditioned on the state s_t in each model. The most appealing notation of the various MS models is due to Krolzig (1998) where: I denotes the Markov switching intercept term, M stands for Markov switching mean, A – Markov switching auto-regression parameters and H - Markov Switching heteroscedasticity.

¹⁵³ For example, since the state variable is unobservable, it is necessary to form probabilistic inferences of its value, governed by a Markov chain. If two states are assumed $s=1, s=2$, i.e. $N=2$ regimes, then there are four probabilistic inferences: a) the system to be in regime one and to remain in the same regime $p^{(11)} = p(s_t = 1 | s_{t-1} = 1)$ where $p^{(11)}$ is the probability that the system will remain in the same regime; b) the system to move from regime 1 to regime 2, i.e. $p^{(12)} = p(s_t = 2 | s_{t-1} = 1)$ where $p^{(12)}$ is the probability that the system will move from state 1 to state 2; c) the system to move from regime 2 to regime 1, i.e. $p^{(21)} = p(s_t = 1 | s_{t-1} = 2)$ where $p^{(21)}$ is the probability that the system will move from state 2 to state 1; d) the system to be in regime 2 and to remain in the same regime, i.e. $p^{(22)} = p(s_t = 2 | s_{t-1} = 2)$ where $p^{(22)}$ is the probability that the system will remain in state 2. These transition probabilities are restricted so that $p^{(11)} + p^{(12)} = p^{(21)} + p^{(22)} = 1$.

- The most famous MS - Autoregressive model (MS-AR) is the model defined by Hamilton (1989) which allows for a random shift in the mean level of the process through a two-state hidden Markov chain. Hence, Equation 6.2-1 takes the following form:

Equation 6.2-5 $y_t - \mu(s_t) = \alpha_1(y_{t-1} - \mu(s_{t-1})) + \dots + (\alpha_p(y_{t-p} - \mu(s_{t-p}))) + u_t,$

$$u_t \sim N(0, \sigma^2)$$

where the terms $\mu(s_t)$ denotes the mean of the series (dependent on the specific regime (s_t)), α_p denote the autoregressive parameters and p is the lag.

Frühwirth - Schnatter (2006) suggests that in Equation 6.2-5 there is an immediate one-time jump in the process mean moving from one regime to another. Hence, this model is the MSM (Markov Switching Mean) Model. As noticeable from the equation, the present value of (s_t) as well as a limited number of past values s_{t-1}, \dots, s_{t-p} influence the observation density of y_t throughout the means in various regimes, which relaxes the assumption S4 (see Box 6.1, Appendix 6. 1).

- McCulloch and Tsay (1994) proposed an alternative model by introducing the hidden Markov chain into Equation 6.2-2, assuming that the intercept is driven by the hidden Markov Chain rather than the mean level. Given this, the specification can be expressed as:

Equation 6.2-6 $y_t = \alpha_0(s_t) + \alpha_1 y_{t-1} + \dots + \alpha_p y_{t-p} + u_t$ ¹⁵⁴, $u_t \sim N(0, \sigma^2)$

In this model, the intercept α_0 is the parameter that experiences a sudden jump in different regimes (s_t) , which changes the mean level of the series rather indirectly, approaching the new value smoothly over different regimes.¹⁵⁵ In this case, only the

¹⁵⁴ All parameters are the same as in Equation 6.2-5.

¹⁵⁵ Full proof of the difference between mean and intercept MS models is given in Chapter 3 in Krolzig (1998, p. 47-64). In contrast to the linear AR model, the intercept and the mean form of the switching models imply different adjustments of the observed variables after the change in

present value of (s_t) influences the observation density of y_t , which satisfies the assumption S4. In Krolzig's (2000) terminology, this is the MS Intercept (MSI) model.

Additionally, Krolzig (1998) notes that if the order of autoregression is zero, then the MSI (Intercept) and MSM (Mean) specifications are equivalent. In Equation 6.2-5 and Equation 6.2-6 if all a_p terms are equal to zero, then $y_t - \mu(s_t) = u_t$ (from Equation 6.2-5) will equal $y_t = \alpha_0(s_t) + u_t$ (from Equation 6.2-6). Hence, the regime specific intercept term will present the regime specific mean of the series $\mu(s_t) = \alpha_0(s_t)$.

The equality of the intercept term and the mean of the series is one technical advantage of this simple Markov Switching specification (without autoregressive parameters) that will be of interest for this research, because it allows tracking the switches and volatility in the mean level of the growth series.

Additionally, one supplementary advantage of this simple specification with no autoregression is related to the fact that the observation density of y_t is only influenced by the present value of (s_t) . In other words, history is not allowed to be "memorized" in the regime variable, which is an appropriate assumption for the analysis of transition for two main reasons: firstly, the regime shifts evidenced in the course of transition were very dramatic and big; and, secondly, they were recorded in relatively short periods. Hence, capturing the events as they happened might be more appropriate.

- In more general form, MSAR also allows for the autoregressive parameters to be governed by the s_t , switching between the states and introducing different dynamic patterns in various states, such as fast fall and slow recovery in business cycles (Bruce and Watkins, 1998).

Equation 6.2-7
$$y_t = \alpha_0(s_t) + \alpha(s_{t,1})y_{t-1} + \dots + \alpha(s_{t,p})y_{t-p} + u_t, \quad u_t \sim N(0, \sigma^2)$$

regime (Krolzig, 1998). Namely, as Krolzig (1998, p.12) argues, while the shift in the mean (μ) causes an immediate jump of the observed time series onto its new level, the shift in the intercept term causes dynamic response of the time series similar to a shock in the white noise series u_t . due to the fact that the constant term in AR process accumulate over time.

All parameters are the same as in Equation 6.2-6, only in this equation, the autoregressive parameters $\alpha(s_{t,p})$ have the switching dimension.

- Diebold et al. (1994) proposed a class of MS models in which the regimes switch with underlying (economic) fundamentals. In order to capture the fundamentals, different models include various explanatory variables within different MS specifications. One general specification can be derived from Equation 6.2-4 as an extension of the MSI model:

Equation 6.2-8
$$y_t = \alpha_0(s_t) + \alpha_1 y_{t-1} + \dots + \alpha_p y_{t-p} + \beta x_t + u_t, \quad u_t \sim N(0, \sigma^2)$$

where β represent the coefficients on the exogenous x_t variables, which can depend/or not on (s_t) and the rest of the parameters are the same.

- The MS -VAR and MS -VECM applications analyse the co-movement between several mutually dependent variables and the tendency of some variable(s) to move before others in a system (Hamilton, 2005, Krolzig, 1998). The mean adjusted form of the MS-VAR is given by the formula:

Equation 6.2-9
$$y_t - \mu(s_t) = A_1(s_t)((y_{t-1} - \mu(s_{t-1}))) + \dots + A_p(s_t)((y_{t-1} - \mu(s_{t-p}))) + u_{Kt},$$

$$u_t \sim N(0, \sigma^2)$$

where $y_t = (y_{1t}, \dots, y_{Kt})'$ is a set of K time series variables, A_1 is a $\langle K \times K \rangle$ coefficient matrix, one for each lag (p) of the variables (dependent on s_t) and $u_t = (u_{1t}, \dots, u_{Kt})'$ are the unobservable error terms (Krolzig, 2000).

- In any of the above models, the variance may be assumed constant, or it might be possible to assume a shift in the variance, such that $u_t \sim N(0, \sigma_{u,s_t}^2)$.

In practice, modelling a time series by a Markov Switching Model requires some specification or hint on the number of expected states of the hidden chain. Then, the state specific parameters and transition matrix are estimated from the data (such as the variances of the error term σ^2 , the autoregressive coefficients α_1 , the intercepts α_0 and the state probabilities p_{ij} for different regimes). Results from estimation are accompanied by measures of the persistence of regimes and the expected number of periods (years, quarters, months) for each regime.

6.2.3 Use of the regime switching models in business cycles analyses

Deriving from the work of Neftçi (1984) and Hamilton (1989), a large literature has developed based on the Markov process to describe the underlying state of the economy. Although most of this literature is in the business cycles framework, offering explanations for the characteristics of business cycle changes, yet, some modelling ideas can be useful in modelling transition as well; hence, here only briefly the relevant papers will be reviewed.

The pioneering work in this area began with Neftçi (1984), who examined the idea that the unemployment rate displays asymmetric behaviour over various phases of the business cycle. Using a Markov process he implemented statistical tests to see if the behaviour of the quarterly unemployment rate is characterized by sudden jumps and slower drops. His findings suggested that the probabilistic structure of the unemployment rate might indeed be different during upswings and downswings. These implications launched the introduction of the nonlinear approach to major economic time series analyses.

Later on, Hamilton (1989) proposed a Markov switching model with an unobserved state to describe the phases of a business cycle. He decomposed and modelled the series into finite sequences of distinctive stochastic processes or regimes: contractions and expansions. The regimes are associated with different conditional distributions of the growth rate of real GDP where, in this case, the mean is positive in the first regime

(expansion) and negative in the second regime (contraction). He started with the mean adjusted form of the MS AR, allowing for switches between two states or regimes (s_1 =expansion, s_2 =contraction).

Equation 6.2-10
$$\mu(s_t) = \begin{cases} \mu_1 > 0 \\ \mu_2 < 0 \end{cases} \text{ if } \begin{cases} s_1 = 1 \\ s_2 = 2 \end{cases}$$

The variance of the disturbance term $u_t \approx NID(0, \sigma^2)$ is assumed to be the same in both regimes. This model when the mean switches and the variance is equal for both regimes is referred in the literature as MS Mean (2) – AR (4) to denote 2 regimes and 4 lags. The choice of the final model and number of lags is usually based on the Akaike Information Criterion (AIC) and the Hannan-Quinn criterion (HQ) as in standard time series data techniques. Additionally, he assumes that the regime shifts are exogenous with respect to all realizations of the regression disturbance.¹⁵⁶ Hamilton (1989) concludes that once the law is specified for the states s_t , the evolution of the regimes can be inferred from the data.

Along similar lines, Morley and Piger (2005) considered the ability of simulated data from linear and nonlinear time-series models to reproduce features in U.S. real GDP quarterly growth data (1948 -2003) related to business cycle phases. Focusing the analysis on a number of linear Autoregressive Moving Average Models (ARMA) and nonlinear Markov-switching models, they found that both linear and Markov-switching models are able to reproduce business cycle features such as the average growth rate in recessions, the average length of recessions, and the total number of recessions. However, they found that Markov-switching models perform better than linear models at reproducing the variability of growth rates in different business cycle phases, concluding that the

¹⁵⁶Lately, some extension of the MS models have been introduced to relax the assumption of exogeneity of the regime unobserved variable (Kim, 2004). Kim (2004) develops a model in which the latent state variable controlling the regime shifts is endogenously determined. Based on probit specification for the realization of the latent state, the model parameters are estimated via maximum likelihood with relatively minor modifications to the recursive filter in Hamilton (1989).

nonlinearity of the data is important in reproducing business cycles features. One interesting point in their study is the division of the business cycles into recession and expansion, with the latter divided once more into two phases: recovery phase and a mature expansion phase. They conclude that usually high-growth recoveries follow recessions and there is a strong correlation between the severity of a recession and the strength of the subsequent recovery. Although recent experience suggests that this finding does not hold for recessions following asset price deflation and financial crisis.

This class of models has been extended to a multivariate setting by Krolzig (1998, 2000). Krolzig (2000) has applied the Markov switching approach to advanced analysis of time series data within the vector autoregression framework (called MS VAR) and Vector Equilibrium Correction Mechanism (named MS VECM). These extensions enabled reflection of the idea of a co-movement among time series, which was not possible in the univariate Hamilton framework. However, they have one important drawback, they are highly data consuming techniques, which in turn, limits their use for our research. Using the three-regime Markov switching vector autoregression, Krolzig (2000) models the changes in the long-run growth rate of real GDP and employment for the US, Japan and developed countries in Europe over the last four decades. Using quarterly data sets, the regime identification in this paper distinguishes recession, growth and high growth; the last one associated with shifts not only in the underlying growth rate of the economy, but also in labour productivity, which reflects structural changes in the economies in Krolzig's (1998) opinion. For example, in the case of the United States, the long expansions of recent years (i.e., before the global financial crisis and its aftermath) instead of rapid, but volatile economic recovery after recessions signify basic changes in the business cycle pattern. In the case of Japan, he identifies long episodes of rapid economic expansions (observed until the mid-1970s) in addition to the cycle of economic expansions and relatively long economic recessions (as in the 1990s). In Europe, the third regime of high growth corresponds, essentially, to the behaviour of the Southern European economies at the beginning of the sample period and the process of catching up in the 1970s in Europe. As a result, he draws an important inference from these models:

These economies have been subject to structural change manifested in the form of structural breaks, i.e. permanent large shifts in the long-run mean growth rate of the economies, and persistent changes in the volatility of the growth process. The study of these phenomena, which are distinctively different from a reoccurring cycle of expansions and recessions constituting the business cycle, requires allowing for ... a multi-regime, possibly integrated-cointegrated multiple time series model, in which the empirical evidence can be established for the presence of common nonlinear business cycles and structural change. The significance drawn from the empirical evidence leads to a critique of traditional separation of the assessment of the business cycle and economic growth (Krolzig, 2000, p.2).

Following the suggestions from the literature as discussed in chapter 5 and the arguments offered in this chapter, the Markov Switching modelling will be applied in the following analyses. However, it should be mentioned that the empirical strategy will develop gradually building from the simplest univariate Markov switching model, that is at the same time the least data consuming model. Next modelling steps and development of the more advanced and more data consuming switching models will depend greatly from the data available for analysis. The main idea is to focus the empirical analysis on the identification of the shifts and structural changes in the course of transition and to describe them more closely; indeed, within the limits imposed by the reconciliation between the relatively short data series available and the data requirements of the advanced Markov Switching models.

6.3 Univariate Markov Switching Model

In the following section, the model specification will be explained, motivating the use of regime switching models by discussion of the linear model first. Afterwards the approach introduced by Hamilton (1989) is used to analyse regime shifts in economic growth in transition countries over the two decades of transition.

6.3.1 Why not a linear approach?

Usually in growth and business cycle studies the typical historical behaviour of GDP is described by a first-order autoregression¹⁵⁷,

$$\text{Equation 6.3-1} \quad y_t = c_1 + \phi y_{t-1} + u_t$$

with $u_t \sim N(0, \sigma^2)$ to describe the observed data for some observed period $t = 1, 2, \dots, t_0$. However, in the theoretical model of transition in chapter 4 it was assumed that at a certain date of transition t_0 there was a significant change in the average levels of the series in the countries' GDP, caused by some force such as huge and sudden capital obsolescence at the onset of transition (section 4.3.2.1, chapter 4). Consequently, it seems that the data altered by the crash might be better described by a different specification, such as by complementing Equation 6.3-1 with Equation 6.3-2:

$$\text{Equation 6.3-2} \quad y_t = c_2 + \phi y_{t-1} + u_t$$

for $t = t_0 + 1, t_0 + 2, \dots, t_0 + t_n$ and $c_1 \neq c_2$. In this case, the big crash in the average level of series is presented through the change of the intercept term from c_1 to c_2 . Additionally, if a subsequent change is observed (for example, change in employment in phase two according to the model given in Figure 4.5-2 in chapter 4), then this can be modelled by the further addition of the following Equation 6.3-3 :

$$\text{Equation 6.3-3} \quad y_t = c_3 + \phi y_{t-1} + u_t$$

For $t = t_0 + 1, t_0 + t_n + 2, \dots, t_0 + t_n + t_i$ and $c_1 \neq c_2 \neq c_3$; and, so on, for each structural change.

¹⁵⁷The lag order usually depends on the frequency of the data. In the business cycles studies where quarterly data are used, usually the lag is 4; while in annual data analysis the lag is first order.

The changes in the series are captured by the changes in the intercept terms in this case. This way of creation of the model with changing values of the intercept from c_1 to c_2 and then to c_3 and so on presumes that the changes at certain times in the course of transition were deterministic events. Yet, in reality, the changes in the course of transition were characterized by huge uncertainty and huge unpredictability of the forces governing them, as presented in chapters 2 and 3 and in the model in chapter 4. Hence, rather than the claim that Equation 6.3-1 governed the process up to date t_0 , Equation 6.3-2 up to date $t_0 + t_n$ and Equation 6.3-3 up to date $t_0 + t_n + t_t$, a more developed model is needed that will encompass all three stages of transition as well as the uncertainties of the transition process.

In summary, the design of a larger model seems reasonable because of several remarkable features of transition: such as the *uncertainty* of the changes, the *different timings* of the changes; as well as the *unpredictable forces* governing the processes. Exactly that - the capturing of uncertainty and unpredictability through the probability and dating of the regimes are the main features of Markov switching models - which make them especially suitable and applicable in this research. Hence, in the next section 6.3.2, Hamilton's (1989) regime switching model is applied in order to describe the evolution of countries' specific GDP growth patterns.

6.3.2 Initial model

To link the economic model presented in chapter 4 and the properties of the Markov Switching Models explained in this chapter with the primary objective of the research, to discover if and how GDP growth regimes have changed in the course of transition within countries, the following general and estimable form of the model is specified:

$$\text{Equation 6.3-4} \quad y_t = \alpha_0(s_t) + \sum_{j=1}^p \alpha_j(s_{t-j})y_{t-j} + u_t(s_t) , \quad u_t \sim N(0, \sigma^2)$$

where j is the lag and p is the number of lags introduced, y_t is the observable variable, $\alpha_0(s_t)$ is the regime specific intercept, $\alpha_j(s_{t-j})$ is the autoregressive parameter and $u_t(s_t)$ is the regime specific variance. Although usually an autoregressive model, Krolzig (1998) introduces y_t as an MSI (2)¹⁵⁸ – AR(0) process, meaning that the whole autoregressive term is dropped from the Equation 6.3-4. As mentioned in section 6.2.2.3, p. 257, in this case, all relevant information about the future of the Markovian process is included in the present state, where the past and additional variables such as y_t reveal no relevant information beyond that of the actual state (Krolzig, 1998). Additionally, in this model the intercept also represents the mean of the series under analysis. Hence,

$$\text{Equation 6.3-5} \quad y_t = \alpha_0(s_t) + u_t(s_t) \text{ }^{159}$$

where the white noise process can be either homoscedastic, that is $u_t \sim N(0, \sigma^2)$ or it can be heteroskedastic (the variance of the error term being regime dependent), that is $u_t \sim N(0, \sigma^2(s_t))$.

As y_t denotes the growth rate of GDP¹⁶⁰, and it is assumed that the process for y_t is a univariate dynamic regression with regime switches, the model may be written as follows:

$$\text{Equation 6.3-6} \quad \% \Delta GDP_t = \alpha_0(s_t) + u_t(s_t) , \quad u_t \sim N(0, \sigma_{s_t}^2)$$

¹⁵⁸ In Krolzig's terminology, the abbreviation MSIH stands for Markov Switching Intercept Heteroscedastic model.

¹⁵⁹ Krolzig (1998) notes that the MSI and MSM specifications are equivalent if the order of autoregression is zero. Hence, in the example in Krolzig (1998), equation (7) is given in the following form: $y_t = \mu(s_t) + u_t(s_t)$. The switching autoregressive parameters given in Equation 6.3-4 are missing in Equation 6.3-5, which is used for estimation. This can be considered as a significant departure from the business cycles empirical methodology. Hence, its further consideration and justification will be given in section 6.3.3 of this chapter.

¹⁶⁰ In most studies, the data used in the analysis are the log levels of GDP transformed into first differences (Hamilton, 1989, Altuğ and Bildirici, 2010).

In Equation 6.3-6 the intercept term α_0 and the error term u_t depend on s_t . The switching variance in Equation 6.3-6 is supposed to capture the changing volatility in various regimes.

The presented modelling strategy departs from the standard business cycles application of Markov Switching Models. Namely, the omission of the autoregressive elements in the regression, together with allowing for more regimes than are usual in business cycles studies, marks a difference between the present research approach and most business cycles studies.

6.3.3 The departures from the business cycles analysis

In general, the departures in the empirical strategy applied here from the approach used in business cycle analyses reflect differences in the processes under examination – namely, recurring business cycles on one side and the subject of interest in this research project - transition - on the other. While transition means many structural changes manifested in the form of structural breaks, i.e. permanent large shifts in the long-run growth rate and persistent changes in the volatility of the growth process, the business cycle refers to short-run fluctuations in production or economic activity, which do not have permanent impact on the long-run growth trend (Kornai, 2006, Krolzig, 2000).

Hence, the study of these phenomena, i.e. the transformations and reforms within transition, which are distinctively different from the reoccurring business cycles, requires several particular considerations related to:

1. the number of lags introduced;
2. the number of regimes; and,
3. the possibility of switching variance.

We consider each of these in turn.

6.3.3.1 The number of lags

The first proposal regarding the applied modelling strategy is related to the use of lags in the Markov Switching models. In general, Markov switching univariate models incorporate the idea of self-path dependency and persistence within business cycle analyses. Namely, they allow the value of the y variable at date t to depend on p of its own lags; i.e. the value of GDP growth rate to depend on its past values in previous quarters allowing for self-dependence of the GDP growth rates in the short term.¹⁶¹ In the original contribution, the regime switching models are presented in mean adjusted autoregressive form, introducing up to four lags for quarterly data in most studies (Hamilton, 1989).

Applied in this analysis with annual data, the use of lags (one lag or more) posed several dilemmas.

Firstly, conceptually, the main motivation in this thesis is to capture structural breaks rather than the persistence in GDP growth in the course of transition, as explained in chapters 4 and 5. For this reason, the autoregressive model, which has persistence as a main feature, might not be appropriate. Attaching the temporary value of GDP per capita growth rates to its past values in previous years might disguise changes that were dramatic and that took place over a very selection procedure, the introduction of one (or more) lags caused problems reflected in the diagnostics of the models or, in some cases, with the significance of the estimated autoregressive parameters and intercepts. In addition, the introduction of lags weakened the ability of the regime switching models to capture the crash effects at the beginning of transition. The changes of above 25 percentage points for the first consecutive years (in some cases only for a period of 2 or

¹⁶¹The intuition behind this preposition is that GDP growth in one period (usually quarter) determines the GDP growth rate in the next period within the business cycles analysis.

three years), recorded at the start of transition could not be captured due to loss of the starting observation (the consequence of including autoregressive terms). The remaining extreme observation(s) of the model were treated as one or more outliers, hence, were smoothed by the estimator rather than treated as a specific regime.

In conclusion, the autoregressive terms can be misleading if measured across large negative or large positive changes. Hence, the model, which does not include autoregressive parameters, is used. Given the fact that the theoretical model is in growth rates, the regime analysis is taking into account the changes in the levels of growth rates.

6.3.3.2 The number of regimes

The second suggestion, which differentiates the present work from business cycle analysis, is that this approach requires allowing for more than *two regimes*, which might not be recurring, as depicted in the model in chapter 4, Figure 5.2-2. In many early applications of Markov switching models, researchers adopted the two-regime model with the fourth-order autoregressive lag¹⁶² structure that Hamilton (1989) had initially used. The idea of two business regimes – expansion and contraction was very much in line with business cycle theory and, consequently, was hugely exploited in many subsequent analyses. Goodwin (1983) used this specification for dating business cycles based on the behaviour of GDP growth in eight developed economies, including the US, the UK, Germany, Japan, Canada, Switzerland, France and Italy in the post-war era. However, even within the business cycles framework, many subsequent studies also considered the implications of a three-regime model. Following Sichel (1993), Clements and Krolzig (1997) argue that the three regime Markov switching models allow for richer business cycle dynamics, in which a contraction may be followed by a rapid recovery phase, to be succeeded by a normal growth phase. Additionally, the three-regime

¹⁶²The number of lags reflects the type of data, for example for quarterly data four lags are used in the studies.

specification may also be useful for capturing outliers or unusual growth episodes in GDP growth in particular countries (Hamilton and Susmel, 1994).

Having in mind the conceptual differences between business cycles and the transition process, and also having set up the theoretical model of transition in chapter 4, an adequate description of the transition growth process requires the introduction of more than two regimes. Namely, the model developed in chapter 4 assumes three stages: crash; recovery; and take off (see Figure 4.5-2, p.171). In brief, in the *first stage*, GDP per capita level and growth rate recorded as sharp collapses, as a result of adjustments in the capital and labour markets (points 1 and 2 in the model, p.171). This stage is supposed to be followed by the recovery in the *second stage*, achieved with different speeds in various countries due to different approaches to reform and various speeds of adoption of free technology (from point 2 to point 4 in the model, p.171). Finally, in the *third stage* of “catching up” (from point 4 to 6, p.171) the import of technology was assumed, accompanied by the increased use of the available labour. This final step should bring transition countries close to the Western European economies and should mark sustainable competitive efforts in international markets (“take-off”).

Although simplified to a large extent, this framework emphasizes the importance of consecutive structural changes in the course of transition. Hence, the regimes expected to be identified in the empirical model should overlap with the above-described three stages in the theoretical model: crash; recovery; and take off. However, it should be kept in mind that the clear division of the stages, which was assumed in our theoretical model, was not exactly and equally pronounced in the reality of each transition country. Namely, as presented in chapters 2, 3 and 4, in the course of transition, the change in stages included several parallel processes: adjustments on the factors markets; opening and liberalization of the economy; introduction of new policies; strengthening the rule of law; lowering the level of corruption; along with the adoption of new technology and efforts to import embodied technology within countries. While some of these changes,

such as introduction of new policies or sudden obsolescence, for example, can be easily dated¹⁶³, some of the restructuring consequences of market-induced reforms, such as adoption of free technology, are less easily traceable in terms of their timing and developments. Hence, it is expected that while the first stage of “crash” can be relatively clearly identified, the following stages are expected to be more intermingled in terms of the processes involved and also in terms of identifiable growth rates changes.

6.3.3.3 Switching variance in the models

The third departure is the introduction of the switching variance in the models. Variance in business cycle studies is usually used in order to capture the different volatility of the growth rate in the different business cycle phases, expansion or contraction (Sichel, 1993; Balke and Wynne, 1995; Clements and Krolzig, 1997). For example, Sichel (1993) especially contributed to this line of research, comparing the periods of increase to periods of decrease for three US quarterly time series from 1949-1989: employment; real GDP; and industrial production. His findings suggest that industrial production and employment are much more volatile and fall faster than real GDP in the course of downturns as compared to their association in expansions, which means that the production sector and employment suffer the most in recessions. In this analysis, the role of the variance will be twofold. Firstly, switching volatility should enable better detection of instability, i.e. of the switches of the regimes in growth in transition; and, secondly, volatility itself should serve as an indicator for better identification of the various regimes. Having the model developed in chapter 4 in the background, it is anticipated that the variance will be especially high in the first “crash” stage of transition, and lower in the second and third stages of recovery and take off.

¹⁶³However even the reforms that can be related to an exact date cannot be exactly traced in time, due to lagged effects in their implementation and real impact.

6.4 Testing down procedure and the choice of the preferred model

6.4.1 Brief introduction of the main peculiar criteria in Markov Switching Modelling

- In practice, modelling a time series by a Markov Switching Model requires some hint or guidance on the number of expected states or regimes, accompanied by some indications on the possible switches of other parameters in the regressions. Depending on the theoretical background and the goals of the research, as well as on the features of the data generating process, different regimes, their switching points, and parameter heterogeneity can all be investigated and tested, as discussed in section 6.3.3. However, even then the modelling is a difficult enterprise, because the conventional tests are not applicable due to the presence of unidentified nuisance parameters under the null of linearity (Krolzig, 1998). Hence, in this research a rather conservative testing down procedure is used, beginning by testing the expected extensive three-regime model with short span of time in the course of transition.
- Secondly, as well as being suspected on a priori theoretical ground, the use of lags caused several problems in the empirical modelling. Namely, in the model all parameters allowed to switch (intercepts, autoregressive parameters¹⁶⁴ and variance) for each country and then narrowing down the choice, combined with some classical specification testing procedures (Krolzig, 1998). In addition, in order to test the choice of model further, the model alternatives with four and more regimes and the introduction of more lags were explored.¹⁶⁵ In each case, the preferred model was chosen using several criteria in order of importance:

¹⁶⁴ The autoregressive parameters are excluded from the model for the reasons explained earlier. However, they were taken into account in the empirical testing in order to observe how these models perform.

¹⁶⁵ Due to lack of space, these tests are not presented in the accompanying Appendix 6. However, it should be noted that in vast majority of the cases the regressions with 4 or more regimes could not achieve the convergence criteria and did not perform at all. In addition, when lags were introduced, there were severe problems with the model diagnostics. Hence, Appendix 6. 1 gives only the two estimable and competing models: 3- and 2-regime models for each country.

- the test for linearity,
- the diagnostic test results; accompanied by
- the AIC criterion, ,
- the indicators of the probabilities (persistence) of the regimes, and
- the significance of the estimated coefficients.

The above criteria are quite familiar in econometric analysis, such as diagnostic tests for normality, heteroscedasticity and autocorrelation, for example; however, there are some criteria that distinguish this analysis from the others. At this instance, the peculiar criteria will be only briefly introduced; however, their detailed explanation is given in the following section where the testing down procedure is explained.

1. Firstly, the Likelihood Ratio (LR) test for linearity is the starting test that rejects or confirms the idea of pursuing non-linear modelling. Hence, together with the diagnostics tests, LR-test should be always considered at the very beginning of the modelling strategy.
2. Secondly, the persistence of the regime is an important criterion in Markov switching modelling as it enables distinction of stable regimes within countries from outliers or instable regimes that are characterised by a length of only one period (year) and probability of retaining the same regime that is very low and statistically insignificant.

Comparison between stable and unstable regimes is more obvious when presented graphically (see Figure 6.4-1). In the following examples, on the x-axis time is given and on the y-axis growth rates are presented. Graphs¹⁶⁶ are grouped in two columns for two tested countries: 1.Slovenia and 2.Bulgaria:

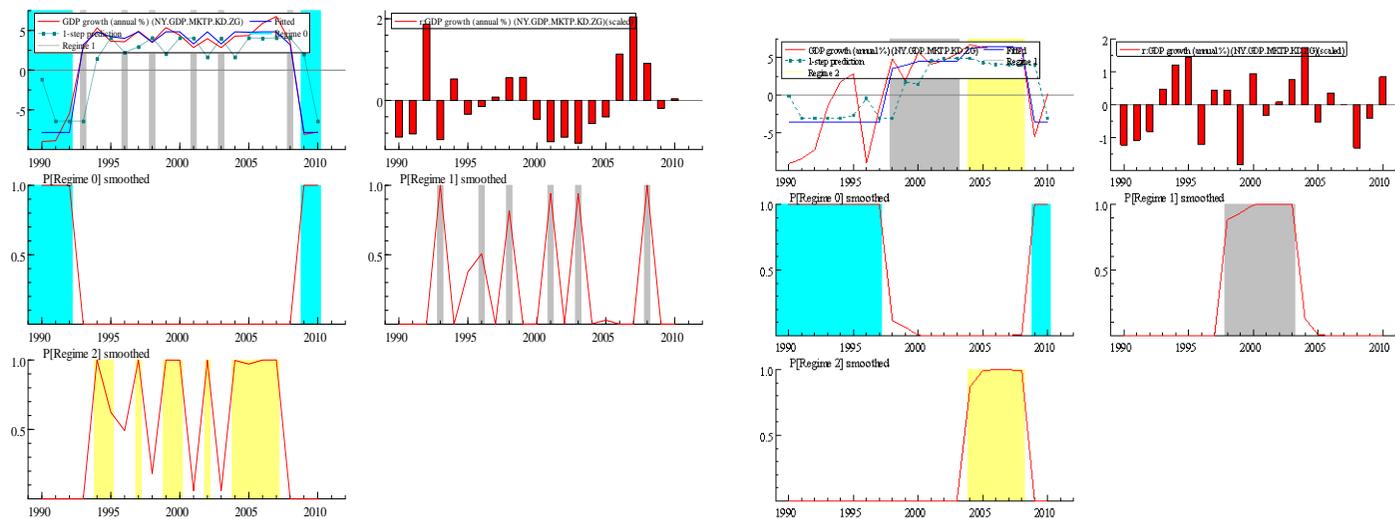
¹⁶⁶Graphs are taken from the original estimation printout and hence they include the residual distribution graph (second one) which is not of interest here.

- The first graph in both groups shows the movement of the GDP growth rate on the y-axis;
- the second graph gives the residual distribution on the y-axis; and,
- the third graph gives the timing of the first regime marked in blue, the fourth shows the second regime marked in grey and the fifth graph shows the third regime marked in yellow for each respective country.

Figure 6.4-1 Comparison of regime identification in two countries

1. Slovenia, 3-regime model

2. Bulgaria, 3-regime model



Note: The graphs reveal an appealing depiction. Namely, in the case of Slovenia the switches of the regimes among instable regimes – the second and the third regime - are between relatively similar regimes in terms of mean GDP growth rate (3.18 per cent and 4.25 per cent); while in the case of Bulgaria the switch among the second and the third regime is easily identifiable and the regimes are much more stable and dissimilar in terms of mean GDP growth rate (4.55 per cent and 6.45 per cent) Interestingly, the third regime in the case of Bulgaria starts in 2004, the year of accession in the EU (see Appendix 6. 1, p.561. and p.577).

Slovenia is characterised by much lower persistence of the second and third regime, which is confirmed by a transition probability indicator of staying in the same regime of 0.000 for the second regime (see Appendix 6. 1 p.561). In contrast, Bulgaria is characterised by stable regimes, which is not only confirmed by the graphs, but also by the high transition probability indicators of staying in the same regime of above 0.76 for each identified regime (see Appendix 6. 1 p.577).

In addition, this research is interested in identifying regimes that are relatively stable and continuous, in which there was enough time for reforms and structural changes to take place as explained in the model in chapter 4, and not in business cycle fluctuations or short-term changes. Hence, the focus is on stable and relatively continuous regime identification. However, as it will be shown later this criterion is not always enough reason to discriminate in favour of one over another model.

3. Thirdly, similarly to the standard statistical analysis, the Akaike Information Criterion (AIC) is also used in order to help in the model selection procedure. Although the AIC can tell nothing about how well a model fits the data in an absolute sense, it can be used as a relative means for model selection, offering a relative measure of the information lost and describing the trade-off between the accuracy and complexity of the congruent models such as 2- and 3-regime models in this case.
4. Fourthly, the regime describing parameters such as the constant term and standard deviation are calculated for each regime separately in the MS modelling approach, representing the peculiarities of that specific regime. Alongside that, one particular advantage of MS analysis is that it gives not only the length of each regime but also the graphical presentation of each regime whether continuous or interrupted, with specific periods when each regime occurred or reoccurred.

In order to describe the testing down procedure better and to explain how the preferred model for each country was chosen based on the above criteria in the following sections couple of steps are followed:

- Firstly, in section 6.4.2 the one country case is presented explaining more deeply each of the criteria used to choose its preferred model. This procedure was followed in the case of each of the 26¹⁶⁷ countries in the analysis as given in Appendix 6. 1, p.545- 649.
- Secondly, based on each country separate analyses Table 6.4-1 was populated. Namely, this table in a qualitative manner explains the choice of the preferred model for each transition country based on the joint consideration of all criteria;
- Thirdly, the results for each country's preferred model are presented in Table 6.4-2 in various sections for each criterion and further explained in section 6.4.4; and
- Finally, individual results are grouped and summarized in the following section 6.5 in order to shed some additional light on the instability and volatility of growth in the course of transition.

6.4.2 Testing down model selection procedure illustrated for one country

As mentioned above some tests within MS analysis are familiar from standard econometric analysis, but some tests are quite novel and particular for Markov Switching analysis. Brief clarification of the testing down procedure and the criteria used is given in

¹⁶⁷ Montenegro, Kosovo, and Bosnia and Herzegovina were not included in the analysis due to lack of data.

the following Box 6.1, where an example of the Markov Switching testing down procedure for one country is presented.

Box 6.1 Example of Markov Switching testing down procedure for Georgia
(Appendix 6. 3, p.649- 655 is attached to this particular box)

The purpose of this box is to explain more thoroughly the testing down procedure for one country -Georgia. This country is chosen because it involves several testing stages, which enable us to explain the testing down procedure.

Step One: The model we start with is a three-regime model with switching constant term, variance and non-switching autoregressive parameter (see Appendix 6. 3, Step 1, p.649). However, this model could not converge at all.

Step Two: The next model to be tested was a three-regime model with switching constant term and variance, but without any autoregressive parameters. This is the first model that gives estimable results and it is shown in Appendix 6. 3, p.649. Several criteria were considered to check for its statistical relevance.

- The first criterion considered was the Linearity LR-test, which is based on the likelihood-ratio statistic between the estimated model and the derived linear model under the null hypothesis assessing the difference that the linear model is preferred (Doornik and Hendry, 2009). The first p-value is based on the conventional Chi-squared distribution, while the second is derived by Davies (1987). As can be seen, the linearity test suggests that the linear model assumption can be rejected (small box labelled 1 on p.649). Consequently, this event is marked with a tick (✓) in the following Table 6.4-1 (column 1 in section A) suggesting that LR-test justifies non-linearity in the data series.
- The second criterion was the inspection of the diagnostic tests (see box labelled 2 on p.650). These tests are standard tests used in statistical analysis. As can be seen, the null hypotheses of normality of error terms, of no-heterescedasticity and no-autocorrelation of error terms cannot be rejected, suggesting that the error terms are normally distributed, homoscedastic and not autocorelated. Again, the success of the model to comply with the diagnostic tests is marked with a tick in Table 6.4-1 (column 2, section A). (It should be noted however, that the normality test is a large sample test.)
- Thirdly, the transition probabilities given in box labelled 3 on page 650 are considered.
 - The transition probability indicators show the probability of the system to transfer to regime i at one point of time $t+1$ conditionally on being in regime j at some previous point of time t .
 - In addition, the transition probability that presents the transfer of the system to regime i at one point of time $t+1$ conditional on being in the same regime i at some previous point of time t explains the so called persistence of the

regimes, i.e. the probability of the system to stay within the same regime (For example, in our case (p. 650. box 3), the probability of the system to stay within the second regime is 0.47, whilst the probability of the system to move from regime 0 to regime 2 is very small i.e. 0.0000).

As mentioned above, depending on the research goals this indicator can be helpful in the case when the stable and relatively continuous regimes are to be identified. In our case persistence of the first regime is relatively high – 0.78, while the second and third regimes are characterised by lower persistence of 0.47 and 0.48 respectively. The graph (see p.650) confirms this lower persistence by showing the interchangeability between these two regimes, with the first regime repeating in 2009. In Table 6.4-1, column 3, section A this situation is marked by $\hat{\hat{}}$ suggesting lower than 0.50 probability of staying within the same regime of two regimes - second and third regime. The limit probability of 0.50 is arbitrary.

- Fourthly, the regime classification is presented based on smoothed probabilities (see box labelled 4 on page 650, Appendix 6. 3). This estimation result accompanying the transition probabilities has no particular influence on model selection though it gives valuable information on the particular period in which the regime took place, the length of the regime and average probabilities in each identified period.
- Finally, the regime classification is better visible in the graphs that follow each country estimation results (graphs in Appendix 6. 3). The group of graphs representing the GDP growth rate movement of Georgia (first graph), error terms distribution (second graph), the first regime marked in blue or drop in growth rates (third graph), second regime in grey or moderate growth (fourth graph) and third regime marked in yellow or high growth (fifth graph). As can be seen from the regime graphs the second and third regimes are less stable and continuous and they interchange starting from 1994 until 2010.

Step Three: The next step was to try a two-regime model with switching constant and variance, and non-switching autoregressive parameter. The relatively low persistence of two regimes in the three- regime model lead to testing the congruent model with two switching regimes. Again, in this case, the same diagnostics were checked and the model was evaluated in similar manner, while at the same time populating Table 6.4-1, **section B**). As can be noticed, the test for linearity is much weaker in this case (p.652), suggesting that the linearity assumption cannot be rejected as strongly as in the previous model. Namely, there is a 1% or 3% chance of making a Type I error. In addition, this model shows possible problems with autocorrelation of the error terms, with Chi squared result being rejected only at the 10% level of significance. Hence, this model is not included in Table 6.4-1.

Step Four. The next model to consider was a two-regime model with switching constant and variance, without any autoregressive parameters. This model performed equally as well as the three-regime model with switching constant and variance, with respect to the linearity test (small box 1, p. 653), diagnostics (small box 2, p.654), regime transition probability and regime persistence (small box 3, p. 653). Hence, this model was also included in populating Table 6.4-1, Section B. In all cases in the representative boxes, the tick symbol was placed.

However, as it can be seen from the table, two main indicators favoured this model as the preferred one as compared to the 3-regime model explained above:

- Namely, in the 2-regime model, the regime probabilities and persistence indicator for both identified regimes is high, 0.91 and 0.95 respectably for the first and second regimes, suggesting continuity and stability of these regimes (small box 3, p.653). This is marked by a tick in section B in contrast to the symbol (\wedge) marking instability of two regimes in the 3-regime model for Georgia.
- Secondly, according to the AIC, this model is a better representation of the data series (152.33) as compared to AIC for three-regime model (153.34), which lead to acceptance of this model as the preferred one in the case of Georgia. This situation is marked by (+) in Table 6.4-1 for 2-regime model and (-) for 3-regime model.
- The fifth criterion, the AIC indicator, was used to discriminate among congruent models indicating the model, which is more accurate at a lower loss of information. In Table 6.4-1 in both sections A and B, columns 4 the preferred model by this criterion is marked by +, the non-preferred model by (-) for each individual country.
- Finally, the significance of the coefficients was considered, using standard statistical inference. In Table 6.4-1, in columns 5 in both sections A and B the statistical significance of one/or more of the coefficients is marked with one/or more asterisk(s).

The testing down procedure explained in the box above is repeated for each of the twenty-six transition countries included in the analysis. In general, the preferred model offering the economically most meaningful results proved to be the basic regime-switching model with a hidden Markov chain including only switching intercepts and variances as given in Equation 6.3-6 and discussed in the following section. Although this model does not model GDP growth through its autoregressive parameters for the reasons explained in section 6.3.3.1, it does capture both:

1. the change in the mean of growth rates by introducing a regime dependant intercept; and,
2. regime-specific volatility by introducing a regime dependant error variance (σ).

Due to lack of space, the estimation results of each consequent test for each country are not presented in this thesis, and only the two competing models (2- and 3-regime

models) are presented in Appendix 6. 2¹⁶⁸ accompanied by two summary tables in the following sections:

- Table 6.4-1 that condenses results of the testing down procedure performed on the competing 2- and 3-regime models; however, it should be noted that this table summarizes results in a qualitative manner, by using ticks and crosses for each checked criteria as explained in the box; and, afterwards,
- Table 6.4-2 that shows individually the estimated results of the preferred model for each country.

6.4.3 Model selection based on joint consideration of the various criteria for all transition countries

In order to determine the best model for each country, joint consideration of all the above criteria is used and presented in Table 6.4-1 below. Each country is presented in a separate row, while the various criteria are given in the columns grouped for the two main groups: respectively, three-regime (section A) and two-regime models (section B). As explained in the box above, for each country the table has been populated following the results of each test in the testing down procedure (see Appendix 6. 2). The judgment on the preferred model for each country (shaded grey in the table) is based on the joint reflection of the various criteria and it is explained in more detail in the text following the table.

¹⁶⁸ In Appendix 6. 2, for each country two estimations printouts is given: firstly three-regime model and then two- regime model. The preferred one is named as preferred, while the indicators of interest in the following discussion for each country are shaded in grey for better visibility.

Table 6.4-1 Model selection based on joint consideration of several criteria

Country group	Country	(section A) 3-regime model					(section B) 2-regime model				
		LR-test (1)	Diagnostic tests (2)	ACI(3)	Persistence of regimes (4)	Significance of coefficients(5)	LR-test (1)	Diagnostic tests (2)	ACI(3)	Persistence of regimes (4)	Significance of coefficients (5)
		Criterion									
Rapid-J group	Slovak Rep.	√	√	-	√	√	√	√	+	√	√
	Poland	X√	√	√	√	*	Not converging				
	Czech Rep.	X√	√	+	√	*	Not converging				
	Hungary	√	√	+	√	√	√	√	-	√	*
	Slovenia	√	√	+	√	√	√	√	-	√	√
	Estonia	√	√	+	√	*	√	√	-	√	√
	Albania	√	√	+	√	√	√	X	-	√	√
Slow-J group of countries	Latvia	√	√	-	√	√	√	√	+	√	√
	Bulgaria	√	√	+	√	√	√	√	-	√	√
	Croatia	√	√	+	√	√	√	√	-	√	√
	Lithuania	√	√	+	√	√	√	√	-	√	√
	Armenia	√	√	+	√	√	√	√	-	√	√
	Belarus	√	√	-	√	√	√	√	+	√	√
	Kazakhstan	√	√	+	√	√	√	√	-	√	√
	Russ. Fed	√	√	-	√	√	√	√	+	√	√
	Macedonia	√	√	+	√	√	√	√	-	√	√
	Romania	√	√	+	√	√	√	√	-	√	√
	Turkmenistan	√	√	+	√	√	√	√	-	√	√
	Uzbekistan	√	√	+	√	*	√	√	-	√	*
Azerbaijan	√	√	+	√	√	√	√	-	√	√	
Incomplete-U group	Ukraine	√	√	+	√	√	√	√	-	√	√
	Tajikistan	√	√	+	√	√	√	√	-	√	√
	Moldova	√	√	+	√	√	√	√	-	√	√
	Kyrgyz Rep.	√	√	-	√	√	√	√	+	√	√
	Georgia	√	√	-	√	√	√	√	+	√	√
	Serbia	√	√	-	√	√	√	√	+	√	√

Note: √ - the criterion is satisfied, X - the criterion is not satisfied, X√ - the criterion is on the borderline; * - marks problem with statistical significance of each problematic coefficient, ^ - marks low persistence of each problematic regime. For the AIC the signs are comparative between the two model options: (+) - the criterion favours the model, (-) - the criterion disfavours the model.

Based on the table, several general conclusions can be made:

- The values given in Appendix 6. 2 and then in Table 6.4-2 by the approximate upper bound for LR-tests show that linear specifications rejected for most countries. Exceptions are the three-regime model for the Czech Republic and Poland, for which the linearity assumption rejection was slightly weaker, although still within the rejection region of the 5% level of significance (see Appendix 6. 2, p.551 and 554). In all other cases, the LR test results justify strongly the anticipation of non-linear data generating processes, though not revealing whether the 2- or 3- regime model is the better fit in each case.
 - Diagnostic tests in most cases are good, though in some rare cases with weaker rejections, implying that the error terms are normally distributed, homoscedastic and not autocorrelated.
 - Coefficient significance and regime persistence indicators differ across countries; hence, general conclusion cannot be made with respect to those indicators. However, one general note is that the low persistence of the regimes in the 3-regime model improves by reducing the number of regimes to a 2-regime model. However, even in those cases, for most of the countries the preferred model remained to be the 3-regime model according to the AIC. This will be discussed more when separate groups of countries are observed.
 - With respect to the AIC, it can be noticed that this indicator mostly favours the three-regime model with some exceptions: the Slovak Republic, Belarus, Latvia, Russian Federation, Kyrgyz Republic, Serbia and Georgia. We shall return to the last two notes more profoundly when discussing various country groups.

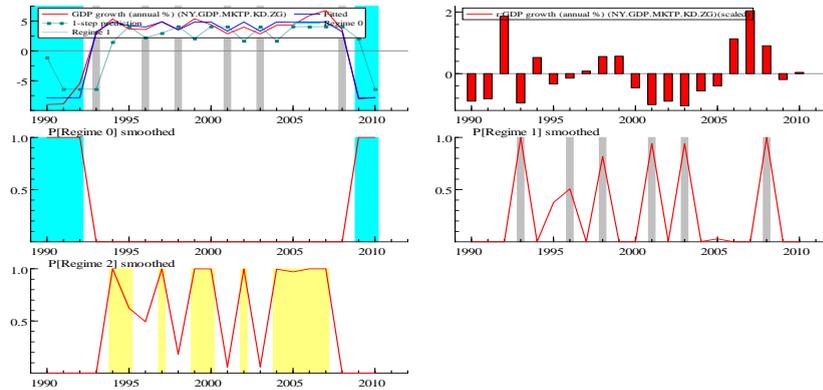
In summary, the results confirm the hypothesis suspicion that growth in transition countries can be observed through various regimes; however, the number of regimes identified will be discussed in more detail below where the separate groups are observed.

When country groups are observed, more detailed representations and insights can be made:

1. *Rapid-J group of countries.* As Table 6.4-1 suggests three regime models fit best for most of the rapid-J group countries. Namely, the AIC criterion favours three-regime hypotheses in the cases of Albania, Hungary, Estonia and Slovenia, while only for the Slovak Republic it does clearly favour the two-regime model. For Poland and Czech Republic, the two-regime model could not perform at all and three-regime model proved to be a good representation of the data series in those two cases. In addition, several peculiarities arising from the testing down procedure for a couple of counties from this group are worth mentioning.

- Namely, the only country from this group for which two-regime model fitted the data series better is the Slovak Republic; though this outcome was not expected on the theoretical grounds. The decision in this case was based on the AIC criterion as well as the fact that the non-normality assumption of the error terms in three-regime was characterised with weaker rejection (see Appendix 6. 2, p.547 - 549).
- For Slovenia the evidence is mainly supportive of the 3-regime hypothesis (AIC criterion), albeit a little less than uniformly with zero persistence of the second regime of 0.000 (see Appendix 6. 2, p.561). In addition, in the case of the 3-regime model for Slovenia, as mentioned above, the second and third regime vary continuously and interchangeably with no stable continuity as it is shown in Figure 6.4-2 below.

Figure 6.4-2 GDP growth rate and regime identification of Slovenia



Note: The printout is from the original software and it shows: GDP growth rates in first graph; the second graph gives the scaled residuals distribution; and the third, fourth and fifth graphs show the first, second and third regimes marked in blue, grey and yellow respectively.

In the specific case of Slovenia, if the respective intercept coefficients for the third regimes in the 3-regime model are compared to the same parameters for the second regime in a 2-regime model, it can be noticed that they are similar (4.26 per cent for the second regime of a 2-regime model of Slovenia compared to the third-regime intercept coefficient from the 3-regime model of Slovenia of 4.83 per cent), which might suggest that this country possibly switched into the third regime immediately after the first stage of transition if the 2-regime model is adopted as a preferred one (see Appendix 6.2, pages 561 and 563). This peculiarity is found only for this one country and no other country in the whole sample. However, yet, the three-regime model is chosen, due to the favourable AIC, though with the mentioned caution.

In summary, the results in this group of the rapid-J countries are in line with the previous expectations. Namely, the empirical exercise confirmed the identification of 3 regimes of transition in most of the countries in this group, which was expected from the theoretical model postulations suggesting that these countries have passed all three

stages of transition. Only for one country in this group – Slovak Republic- did the two-regime model prove to be a better fit, which may be due to the high volatility of the GDP growth rates series; notably it is the highest compared to the volatility observed in the other countries from this group, which eventually resulted in identification of only two regimes (i.e. high volatility can disguise regime shifts as argued in chapter 5, section 5.4.3).

2. *Slow-J group of countries.* In the group of *slow-J countries*, according to the favourable AIC indicator, the three-regime model fits best six countries' GDP growth data series: Bulgaria, Croatia, Azerbaijan, Uzbekistan, Turkmenistan and Kazakhstan. As can be seen from the table, this indicator also favours the 3-regime model for Armenia, Romania, Macedonia and Lithuania, although in all these cases this indicator is accompanied by lower persistence of one of the regimes.

- For example, in the case of Romania the second regime in the 3-regime model is characterized by 0.000 probabilities to stay within the same regime (see Appendix 6. 2, p.609). This is similar to the above mentioned case of Slovenia, although in this case the intercept and volatility coefficients (-6.8 %, 1.5 % and 6.09 % – regime coefficients, and 3.4; 0.46 and 1.8 per cent for the appropriate volatility coefficients) are all significant and all regimes are stable and continuous as the graph shows(see Appendix 6. 2, p.609). A similar situation with relatively lower probability to stay within one of the regimes as compared to the other countries' results, accompanied by significant coefficients, is observed in the cases of Armenia (0.57 and 0.27 probability of the first and second regime, see Appendix 6. 2, p.589); Macedonia (0.31 for the second regime, see Appendix 6. 2, p.605); and Lithuania (0.000 for the second regime, see Appendix 6. 2, p.585). Similar to the cases of Slovenia and Estonia, for these countries the 3-regime model is chosen as the preferred one, considering that the low persistence of one of the identified regimes is insufficient reason to favour the 2-regime model, though again with a mentioned caution.

- Conversely, the 2-regime model appears to capture the regime dynamics for the rest of the countries from the slow – J group: the Russian Federation, Belarus and Latvia, for which the AIC criterion favoured a 2-regime model.

Similarly, to the rapid-J group of countries, this group of countries is yet again characterised by the dominance of 3-regime model as appropriate to describe the GDP growth data series. This would suggest that the regime identification for this group as a whole fits the theoretical model expectations; however, further analysis should reveal whether there are significant differences among groups with respect to the peculiar characteristics of the identified regimes; i.e. whether, for example, the third regime in the rapid-J group differentiates from the third regime in the slow-J group, for example. We shall return to this remark in the following section.

3. *Incomplete –U group.* For the incomplete-U group the two-regime model is chosen for three countries: the Kyrgyz Republic, Serbia and Georgia based on the AIC. For the other three countries from this group such as: Ukraine, Moldova and Tajikistan three-regime model proved to fit the data series better, though again with some caution.

- Namely, in the cases of Ukraine and Tajikistan, although the AIC criterion favours the 3-regime model, two of the identified regimes are characterised by low probability to stay within the same regime, while this is also repeated in the case of Moldova, but only for one regime (see Appendix 6. 2, pages 625, 629 and 633). Similar to the above-mentioned cases, again the evidence is not strong enough to reject the 3-regime model and favour the two-regime one.
- For Georgia, Serbia and Kyrgyz Republic the two-regime model was favoured according to the AIC criterion (see Appendix 6. 2, p.643,647 and 639, though in the case of the Kyrgyz Republic the Portmanteu test for autoserial correlation revealed weaker rejection at only 10% level of significance for the two-regime model (see Appendix 6. 2, p.639).

In summary, half of the countries in this group fall into the two-regime model, which makes the highest fraction of countries of the whole group falling into two-regime model as compared to the other groups. Namely, in the rapid-J group only one country out of seven (and that only marginally) and in the slow-J group only three countries out of thirteen were represented better by the 2-regime model. In general, for the incomplete-U group having almost half of the two-regime model countries (three countries out of seven in total) is expected outcome if it is considered that these countries did not manage to close the U-curve of growth, consequently suggesting that they had passed fewer regimes or stages of transition as compared to the other countries. However, although this assumption might be appropriate for the incomplete-U 2-regime countries, is rather ambiguous when other groups' two-regime countries are observed. Namely, the group of two-regime countries is consisted of the Slovak Republic and Latvia together with Serbia, Georgia, the Kyrgyz Republic, Belarus and the Russian Federation, countries belonging to the various "success" groups with some being in the rapid-J or slow-J group and some in the incomplete – U group. Hence, the next step is to analyse the regimes separately by their within and in-between group characteristics and to determine what makes some countries outliers from their own group.

6.4.4 Individual results of the preferred model for each country

After comparison of the competing models and determining the preferred model for each country the preferred model's estimation results for a sample of 26 transition economies are presented in Table 6.4-2 below.

For each country, the chosen preferred model is shown, accompanied by:

- The estimated regime-specific intercepts of the series (Constant (x_j)) (section 1 in the table). Each coefficient indicates the country's mean growth rate for a specific regime.

- The regime standard deviation (Sigma (σ_i)) (section 2 in the table) is the next indicator that is used to measure GDP growth rate volatility within specific regimes for each country.
- The durations of each regime ($D(s_i)$) for each country, accompanied by the exact periods given in years in the brackets (section 3 in the table). These indicators also present valuable information on the duration of each of the regimes in concert with its volatility and mean GDP growth rate. In addition, it enables identification of the possible downturns in the countries in mid-transition, as well as fall due to the Global Financial Crisis after 2008. As will be shown later in Box 6.2, many countries experienced declines into the first regime in mid-transition due to various reasons, as well as after 2008 due to the Global Financial Crisis.
- In addition, finally, the persistence of each regime (section 4 in the table) which indicates the stability of each regime.
- In section 5 of the table, also the LR test is reported with modified critical values; accompanied by the diagnostic tests (section 6) and short description of the fall identified by the model due to the Global Financial Crisis given in section 7.

Each country in the table is grouped into one of the three groups of rapid – J, slow - J and incomplete-U countries as introduced in chapter 2. The results reported for each country in the columns in the table in full are reproduced in Appendix 6. 2 to this chapter. As mentioned above, in Appendix 6. 2 the results for the two- and three-regime models for each country are reported for comparison reasons; however, in the table only the preferred model results are summarized.

Table 6.4-2 A) Estimation results from Markov switching preferred model for the countries (Rapid – J group of countries)

Countries:	Albania	Slovak Rep	Slovenia	Estonia	Poland	Czech Rep.	Hungary
Regime specific intercepts:							
Constant(0)	-13.93(0.014)**	-5.34 (0.029)**	-5.23 (0.022)**	-8.23(0.014)**	0.560(0.747)	-1.59(0.401)	-3.42(0.103)
Constant(1)	5.37(0.000)*	5.43(0.000)*	3.18(0.000)*	4.69(0.027)**	4.47(0.000)*	2.51(0.000)*	0.98(0.000)*
Constant(2)	10.34(0.000)*		4.83(0.000)*	8.44(0.000)*	6.67(0.000)*	5.51(0.000)*	4.59(0.000)*
Regime standard deviations:							
Sigma (0)	9.22(0.024)**	4.86(0.006)*	3.92(0.017)**	6.66(0.004)*	3.61(0.007)*	4.34(0.003)*	4.68(0.004)*
Sigma(1)	1.55(0.001)*	2.55(0.000)*	0.35(0.008)*	3.81(0.008)*	0.67(0.007)*	0.79(0.037)**	0.25(0.014)**
Sigma(2)	1.95(0.006)*		0.93(0.001)*	1.21(0.002)*	0.37(0.012)**	1.14(0.076)***	0.67(0.001)*
Durations of regimes -length in number of years (in the brackets the period in which regime occurred or reoccurred) (with yellow mark is fall due to Global Financial Crisis):							
D(0)	3(1990-92); 1(97)	4(1990-93);2(2009-10)	2(1991-92);2(2009-10)	5(1990-1994);3(2008-10)	2(1991 – 92); 2(2001 – 02);1(2009 – 09)	3(1991 - 1993);2(1997 – 1998); 2(2008-09)	5(1990-94);1(2009)
D(1)	11 (2000-2010)	15(1994-2008)	1(1993),1(1996),1(1998),1(2001),1(03),1(2008)	5(1995 – 1999)	2(*93-94);3(98-00);3(03-05);1(*08),1(*10)	1(1994);5(1999-03);1(2010)	2(1995-96);3(2006-08);1(2010)
D(2)	4(1993-96);2(98-99)		2(1994-95),1(*97),2(*99 – 00),1(02),3(04 – 07)	8(2000 – 2007)	3(95-97);2(2006-07)	2(1995-96);4(2004-07)	9(1997 – 2005)
Persistence of the regimes:							
Regime 0	0.62	0.86187	0.83432	0.87	0.53	0.69	0.77
Regime 1	0.95	0.89094	0.00000	0.78	0.48	0.59	0.53
Regime 2	0.66		0.54091	0.83	0.57	0.64	0.86
LR statistics:							
	Chi ² (8) = 40.740 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (7) = 19.561 [0.0066]* approx. upperbound: [0.0041]*	Chi ² (7) = 38.135 [0.0000]* app. upperbound: [0.0000]*	Chi ² (7) = 28.257 [0.0002]* app.upperb: [0.0001]*	Chi ² (8) = 18.516 [0.0177]** app.upperb: [0.0173]**	LR-test Chi ² (7) = 15.301 [0.0323]** app.upperb: [0.0243]**	Chi ² (8) = 40.980 [0.0000]*approximate upperbound: [0.0000]*
Diagnostics tests:							

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Normality test:	Chi ² (2) = 0.64379 [0.7248]	Chi ² (2) = 1.5537 [0.4599]	Chi ² (2) = 3.7093 [0.1565]	Chi ² (2) = 0.41462 [0.8128]	Chi ² (2) = 1.4699 [0.4795]	Chi ² (2) = 5.4574 [0.0653]**	Chi ² (2) = 2.3635 [0.3067]
ARCH 1-1 test:	F(1,9) = 0.0052987 [0.9436]	F(1,13) = 0.011905 [0.9148]	F(1,9) = 0.11605 [0.7412]	F(1,10) = 0.32936 [0.5787]	F(1,8) = 0.0083343 [0.9295]	F(1,9) = 0.29395 [0.6009]	F(1,9) = 0.21696 [0.6524]
Portmanteau(4):	Chi ² (4) = 7.6918 [0.1035]	Chi ² (4) = 4.9719 [0.2902]	Chi ² (4) = 2.6372 [0.6203]	Chi ² (4) = 1.8833 [0.7572]	Chi ² (4) = 1.1610 [0.8845]	Chi ² (4) = 4.9780 [0.2896]	Chi ² (4) = 1.4385 [0.8375]
Fall due to Global Financial Crisis:							
	No regime change identified, moderate growth regime continued	Drop into first regime in 2009	Drop into first regime in 2009	Strong fall into first regime in 2008	Drop into second regime in 2008 and first regime in 2009	Drop into first regime in 2008	Drop into second regime in 2006 and fall in first regime in 2009

Notes: * - indicates significant at 1% level, ** - indicates significant at 5% level, and *** - indicates significant at 10% level of significance.

B) Estimation results from Markov Switching Model (Slow – J group of countries)

Countries:	Latvia	Lithuania	Armenia	Azerbaijan	Belarus	Kazakhstan	Russian Federation
Regime specific intercept							
Constant(0)	-7.99 (0.043)**	-11.02(0.005)*	-9.01(0.138)	-12.17(0.008)*	-8.06(0.001)*	-9.26(0.000)*	-5.57(0.005)*
Constant(1)	7.71 (0.000)*	2.76(0.000)*	6.38(0.000)*	9.26(0.000)*	7.15(0.000)*	1.28(0.112)	6.82 (0.000)*
Constant(2)		7.64(0.000)*	12.59(0.000)*	28.64(0.000)*		9.82(0.000)*	
Regime standard deviations							
Sigma (0)	10.45 (0.001)*	7.06(0.009)*	14.73(0.003)*	9.54(0.004)*	3.76 (0.015)**	2.49(0.010)**	5.09 (0.001)*
Sigma(1)	2.39 (0.000)*	0.77(0.030)**	0.68(0.008)*	2.03(0.001)*	3.36(0.000)*	1.73(0.015)**	1.64(0.001)*
Sigma(2)		1.38(0.001)*	1.65(0.004)*	4.17(0.033)**		1.61(0.002)*	
Durations of regimes -length in number of years (in the brackets the period in which regime occurred or reoccurred) (with yellow mark is fall due to Global Financial Crisis):							
D(0)	6(1990-95);3(2008-10)	4(1991-94);1(1999) 1(2009);	3(1991 –1993)1(1997) 1(1999),2(2009 – 2010)	7(1990 – 1996)	5(1991-95)	5(1991-95)	9(1990-98);2(2009-10)
D(1)	12(1996-2007)	1(1995)1(2000)1(2008) 1(2010);	3(1994 –96) 1(1998),2000)1(2008)	8(1997-04),3(08 -10)	14(1996-2010)	4(1996-99);2(2008-09)	10(1999-2008)
D(2)		3(1996 – 98)7(01 –07)	7(2001 – 2007)	3(2005 - 07)		8(2000-08);1(2010)	

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Persistence of the regimes							
Regime 0	0.92	0.59	0.58	0.94	0.91	0.92	0.91
Regime 1	0.88	0.00000	0.27	0.86	0.96	0.65	0.86
Regime 2		0.76	0.83	0.64		0.83	
LR statistics:							
	Chi ² (4) = 23.042 [0.0001]* approximate upperbound: [0.0002]*	Chi ² (8) = 33.889 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (8) = 35.134 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (8) = 38.989 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (4) = 22.063 [0.0002]* approximate upperbound: [0.0004]*	Chi ² (4) = 36.270 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (4) = 24.516 [0.0001]* approximate upperbound: [0.0001]*
Diagnostics tests:							
Normality test:	Chi ² (2) = 1.5278 [0.4659]	Chi ² (2) = 0.11708 [0.9431]	Chi ² (2) = 5.2717 [0.0717]	Chi ² (2) = 1.2195 [0.5435]	Chi ² (2) = 0.032119 [0.9841]	Chi ² (2) = 1.8085 [0.4049]	Chi ² (2) = 0.12507 [0.9394]
ARCH 1-1 test:	F(1,13) = 0.063122 [0.8056]	F(1,8) = 1.0022 [0.3461]	F(1,8) = 1.0767 [0.3298]	F(1,9) = 0.74617 [0.4101]	F(1,12) = 0.33123 [0.5756]	F(1,8) = 0.85465 [0.3823]	F(1,13) = 0.55871 [0.4681]
Portmanteau (4):	Chi ² (4) = 2.8149 [0.5893]	Chi ² (4) = 8.1185 [0.0873]	Chi ² (4) = 0.37104 [0.9848]	Chi ² (4) = 1.4859 [0.8291]	Chi ² (4) = 0.85961 [0.9303]	Chi ² (4) = 2.3702 [0.6680]	Chi ² (4) = 1.7863 [0.7750]
Fall due to Global Financial Crisis:							
	Drop into first regime in 2008	Fall in 2009	Fall in 2009	Fall into second regime in 2008	No fall identified	Drop into second regime	Drop in 2009
Slow – J group of countries (part II)							
Countries:	Bulgaria	Croatia	Macedonia	Romania	Turkmenistan	Uzbekistan	
Regime specific intercept							
Constant(0)	-3.61 (0.031)**	-5.37 (0.074)**	-3.99(0.002)*	-6.79(0.000)*	-7.72(0.001)*	-1.42(0.407)	
Constant(1)	4.55(0.000)*	4.51 (0.000)*	1.05(0.000)*	1.53(0.000)*	9.66(0.000)*	4.13(0.000)*	
Constant(2)	6.45 (0.000)*	6.27(0.000)*	4.23 (0.000)*	6.09(0.000)*	17.56(0.000)*	8.16(0.000)*	
Regime standard deviations							
Sigma (0)	4.49(0.001)*	7.51(0.002)*	2.64(0.004)*	3.47(0.003)*	4.972(0.002)*	4.677(0.002)*	
Sigma(1)	1.261(0.007)*	0.60(0.004)*	0.29(0.018)**	0.47(0.030)**	2.518(0.005)*	0.179(0.005)*	
Sigma (2)	0.171(0.011)**	0.38(0.019)**	0.84(0.002)*	1.79(0.000)*	1.584(0.013)**	0.838(0.003)*	
Durations of regimes -length in number of years (in the brackets the period in which regime occurred or reoccurred) (with yellow mark is fall due to Global Financial Crisis):							
D(0)	8(1990-97);2(2009-10)	3(1991-93)2(98-99),3(08-10)	5(1991-95); 1(2001);1(2009)	3(1990-92), 3(1997-99), 1(2009)	8(1990-97)	8(1990-97)	
D(1)	6(1998-03)	8(2000-2007)	2(96-97);1(2002);1(2010)	1(1993),1(2000),1(2010)	1(1998),6(2005-2010)	6(1998-2003)	
D(2)	5(2004-08)	4(1994-97)	3(1998-2000);6(2003-08)	3(1994-96),8(2001-2008)	6(1999-2004)	7(2004-2010)	
Persistence of the regimes							

Regime 0	0.93	0.77	0.64	0.638	0.938	0.94
Regime 1	0.80	0.84	0.31	0.00000	0.788	0.81
Regime 2	0.77	0.71	0.74	0.77938	0.805	0.935
LR statistics:						
	Chi ² (4) = 39.793 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (4) = 39.111 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (4) = 30.643 [0.0001]* approximate upperbound: [0.0000]*	Chi ² (6) = 29.502 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (8) = 38.304 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (7) = 51.920 [0.0000]* approximate upperbound: [0.0000]*
Diagnostics tests:						
Normality test:	Chi ² (2) = 0.57383 [0.7506]	Chi ² (2) = 1.9244 [0.3820]	Chi ² (2) = 0.62167 [0.7328]	Chi ² (2) = 0.70768 [0.7020]	Chi ² (2) = 0.0023080 [0.9988]	Chi ² (2) = 1.4700 [0.4795]
ARCH 1-1 test:	F(1,10) = 0.069302 [0.7977]	F(1,11) = 0.043779 [0.8395]	F(1,9) = 0.20791 [0.6592]	F(1,11) = 1.5959 [0.2326]	F(1,9) = 0.49619 [0.4990]	F(1,10) = 0.47748 [0.5053]
Portmanteau(4):	Chi ² (4) = 3.1590 [0.5316]	Chi ² (4) = 0.97084 [0.9142]	Chi ² (4) = 5.5497 [0.2354]	Chi ² (4) = 1.4407 [0.8371]	Chi ² (4) = 4.5754 [0.3337]	Chi ² (4) = 2.6405 [0.6197]
Fall due to the Global Financial Crisis:						
	Drop in first regime in 2009	Fall into first regime in 2008	Fall into second regime and then first regime 2009	Drop into first regime in 2009	No fall recorded	No fall recorded

Notes: * - indicates significant at 1% level, ** - indicates significant at 5% level, and *** - indicates significant at 10% level of significance.

C) Estimation results from Markov Switching Model (Incomplete – U group of countries)

Countries:	Ukraine	Tajikistan	Moldova	Kyrgyz Republic	Georgia	Serbia
Regime specific intercept						
Constant(0)	-9.26(0.001)*	-14.01(0.003)*	-25.21 (0.000)*	-12.52(0.000)*	-23.81(0.001)*	-15.16(0.030)**
Constant(1)	3.97(0.000)*	6.01(0.000)*	-1.15(0.361)	4.65(0.000)*	5.98 (0.000)*	4.87 (0.000)*
Constant(2)	9.13(0.000)*	10.11(0.000)*	7.17(0.000)*			
Regime standard deviations						

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Sigma (0)	6.44(0.001)*	9.09(0.004)*	6.82(0.053)**	5.37(0.010)*	12.43(0.008)*	10.66 (0.012)*
Sigma(1)	1.51(0.017)**	2.11(0.004)*	3.79(0.001)*	3.29(0.000)*	4.31(0.000)*	2.98(0.001)*
Sigma(2)	1.702(0.011)**	0.54(0.023)**	0.59(0.006)*			
Durations of regimes -length in number of years (in the brackets the period in which regime occurred or reoccurred) (with yellow mark is fall due to Global Financial Crisis):						
D(0)	10(1990-99);1(2009-09)	7(1990-96)	2(1991-92);1(1994)	5(1991-95)	5(1990-94)	4(1990-93);1(1999)
D(1)	1(2000),1(02),1(05),1(08),1(10)	4(1997-2000)5(2006-2010)	1(1990);1(1993);6(1995-2000);2(06-07);1(2009)	1(1990); 15(1996-2010)	16(1995-2010)	5(1994-98);11(2000-10)
D(2)	1(2001),2(03-04),2(06-07)	5(2001-2005)	5(2001-05);1(2008);1(2010)			
Persistence of the regimes						
Regime 0	0.866	0.93532	0.32	0.77	0.92	0.68
Regime 1	0.00000	0.82558	0.58	0.94	0.96	0.86
Regime 2	0.39536	0.76334	0.63			
LR statistics:						
	Chi ² (7) = 22.327 [0.0022]* approximate upperbound: [0.0012]*	Chi ² (8) = 46.467 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (4) = 33.735 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (4) = 21.571 [0.0002]* approximate upperbound: [0.0005]*	Chi ² (4) = 31.906 [0.0000]* approximate upperbound: [0.0000]*	Chi ² (4) = 24.324 [0.0001]* approximate upperbound: [0.0001]*
Diagnostics tests:						
Normality test:	Chi ² (2) = 0.14572 [0.9297] F(1,10) = 0.17075 [0.6882]	Chi ² (2) = 1.9458 [0.3780]	Chi ² (2) = 3.1001[0.2122] F(1,9) = 0.19925 [0.6659]	Chi ² (2) = 1.6157 [0.4458]	Chi ² (2) = 0.96275 [0.6179]	Chi ² (2) = 0.082084 [0.9598]
ARCH 1-1 test:	Chi ² (4) = 7.6706 [0.1044]	F(1,9) = 0.92083 [0.3623]	Chi ² (4) = 3.5233 [0.4743]	F(1,13) = 0.68587 [0.4225]	F(1,13) = 1.2614 [0.2817]	F(1,13) = 0.10446 [0.7517]
Portmanteau (4):		Chi ² (4) = 1.3152 [0.8588]		Chi ² (4) = 8.3262 [0.0803]**	Chi ² (4) = 3.4672 [0.4829]	Chi ² (4) = 4.7026 [0.3192]
Fall due to Global Financial Crisis:						
	Fall into first regime in 2009	No fall identified	Fall into second regime	No fall identified	No fall identified	No fall identified

Notes: * - indicates significant at 1% level, ** - indicates significant at 5% level, and *** - indicates significant at 10% level of significance.

Source: Author's own calculations. Data source: World Bank (2011). *World Development Indicators*. University of Manchester

After an examination of the Markov Switching models' results given in the tables above, the first step is to note that all transition countries are characterized by a large shift/or two such shifts in growth rates. These shifts are localized in episodes of discrete two/or three regimes in growth rates, characterised by coefficients, mostly estimated at the conventionally acceptable levels of statistical significance. However, the number, the length and characteristics of the regimes differ across different countries and across different country groups that, in turn, display heterogeneous growth stories more extensively described in the following section.

However, one final note that can be made at this instance considers the final section 7 of the table, which describes the fall in the countries recorded due to the Global Financial Crisis. Although the effects of the Global Financial Crisis are not part of this research, it can be noticed that most of transition countries experienced drops in economic activity significantly severe to return them into the first regime as a result of the impact of the Global Financial Crisis; the exceptions are Albania, Belarus, Tajikistan, the Kyrgyz Republic, Georgia and Serbia. Although the first three countries were characterised by a 3-regime model, in those cases the fall was not big enough to be identified as a switch into a different regime. This result is not surprising having in mind that these are among the least developed transition countries, to which the global effects come with delay. Conversely, the Crisis had the immediate effects in the rapid -J group of countries, causing the longest return into the first regime of almost two years on average, suggesting that the rapid-J countries are behaving more like other developed market economies.

6.5 Instability and volatility of growth –re-assessed by the use of univariate Markov Switching Model

6.5.1 General results

In order to be able to derive some summary conclusions, individual results for each country are summarized in Table 6.5-1 and then averages are calculated separately for each of the three groups of transition countries (rapid-J group, slow-J and incomplete-U group). As a reminder, the equation estimated was:

Equation 6.3-6 $\% \Delta GDP_t = \alpha_0(s_t) + u_t(s_t), u_t \sim N(0, \sigma_{s_t}^2)$

where the intercept term α_0 and the error term u_t depend on s_t . The intercept term α_0 is supposed to capture the mean GDP growth rate within a specific regime, while the switching variance in Equation 6.3-6 is supposed to capture the changing volatility in various regimes. Hence, the condensed results in the following table offer insights into the mean growth rates in each regime, i.e. before and after each switch, (given in columns 1, 3 and 5), their characteristic variances or volatility (given in columns 2, 4 and 6), the derived difference between the growth rates in the various subsequent regimes (columns 7 and 8) and the length of the various identified regimes (column 9,10 and 11). Following country results, the results at the end of the table are grouped in three sections:

- Section A comprising averaged results for the whole three groups as introduced in chapter 2 i.e. rapid-J group, slow-J and incomplete-U group.
- Section B comprising averaged results for the separate three groups but including only countries for which 3-regime model was preferred.
- Section C comprising averaged results for the separate three groups but including only countries for which 2-regime model was preferred.

Table 6.5-1 Statistics on instability and volatility of growth in various identified regimes /or stages of transition

		First regime (0)		Second regime (1)		Third regime (2)		The difference of growth between regime 1 and 2	The difference of growth between regime 2 and 3	The number of years spend in first regime*	The number of years spend in second regime	The number of years spend in third regime
		Growth (1)	Volatility (2)	Growth (3)	Volatility (4)	Growth (5)	Volatility (6)	(7)	(8)	(9)	(10)	(11)
	Statistical measure: Countries:	Mean GDPgrowth rate(0) (per cent)	Sigma (0) (per cent)	Mean GDPgrowth rate(1) (per cent)	Sigma (1) (per cent)	Mean GDPgrowth rate(2) (per cent)	Sigma (2) (per cent)	Mean GDP g.r (1)-Mean GDP g.r.(0) (per cent)	Mean GDP g.r (2)-Mean GDP g.r (1) (per cent)	D(0) (years)	D(1) (years)	D(2) (years)
Rapid-J group	Slovak Rep.	-5.34	4.86	5.43	2.55			10.77		6	15	
	Poland	0.56	3.61	4.47	0.67	6.67	0.37	3.91	2.2	5	10	5
	Czech Rep.	-1.59	4.34	2.51	0.79	5.51	1.14	4.1	3	7	7	6
	Hungary	-3.42	4.68	0.98	0.25	4.59	0.67	4.4	3.61	6	6	9
	Slovenia	-5.23	3.92	3.18	0.55	4.83	0.93	8.41	1.65	4	6	9
	Estonia	-8.23	6.66	4.69	3.81	8.44	1.21	12.92	3.75	8	5	8
	Albania	-13.28	9.22	10.34	1.95	5.37	1.55	23.62	-4.97	4	6	11
Slow-J group	Latvia	-7.99	10.45	7.71	2.39			15.7		9	12	
	Bulgaria	-3.61	4.49	4.55	1.26	6.45	0.17	8.16	1.9	10	6	5
	Croatia	-5.37	7.51	6.27	0.38	4.51	0.6	9.88	1.76	8	8	4
	Lithuania	-11.02	7.06	2.76	0.77	7.64	1.38	13.78	4.88	6	4	10

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	Armenia	-9.01	14.73	6.38	0.68	12.59	1.65	15.39	6.21	7	6	7
	Belarus	-8.04	3.79	7.15	3.36			15.19		5	14	
	Kazakhstan	-9.26	2.49	1.28	1.73	9.82	1.61	10.54	8.54	5	6	9
	Russ. Fed	-5.57	5.09	6.82	1.64			12.39		11	10	
	Macedonia	-3.99	2.64	1.05	0.29	4.23	0.84	5.04	3.18	7	4	9
	Romania	-6.79	3.47	1.53	0.47	6.09	1.79	8.32	4.56	7	3	11
	Turkmenistan	-7.72	4.97	9.66	2.51	17.56	1.58	17.38	7.9	8	7	6
	Uzbekistan	-1.42	4.67	4.13	0.18	8.16	0.83	5.55	4.03	8	6	7
	Azerbaijan	-12.17	9.54	9.26	2.03	28.64	4.17	21.43	19.38	7	11	3
Incomplete-U group	Ukraine	-9.26	6.44	3.97	1.51	9.13	1.7	13.23	5.16	11	5	5
	Tajikistan	-14.01	9.09	6.01	2.11	10.11	0.54	20.02	4.1	7	9	5
	Moldova	-25.21	6.82	-1.15	3.79	7.17	0.59	24.06	8.32	3	11	7
	Kyrgyz Republic	-12.52	5.37	4.65	3.29			17.17		5	16	
	Georgia	-23.81	12.43	5.98	4.31			29.79		5	16	
	Serbia	-15.16	10.66	4.87	2.98			20.03		5	16	
Complete groups averaged results												
A	Rapid-J group (average)	-5.2	5.3	4.5	1.5	5.9	1.0	9.7	1.5	5.7	7.0	8.0
	Slow-J group of countries (average)	-7.1	6.2	5.2	1.4	10.5	1.4	12.2	6.2	6	6.7	7.8
	Incomplete-U group (average)	-16.7	8.5	4.1	3.0	8.8	0.9	20.7	5.9	6.0	12.2	5.7
3-regime models averaged results for groups compared												
B	Rapid-J group (3 regime model) (all except Slovak Republic)	-5.2	5.4	4.4	1.3	5.9	1.0	9.6	1.5	5.7	6.7	8.0
	Slow-J group (3 regime model) (all except Latvia, Belarus, Russia)	-7.0	6.2	4.7	1.1	10.5	1.4	11.5	6.2	7.3	6.1	7.1

	Incomplete-U group(3 regime model) (Ukraine, Tajikistan, Moldova)	-16.2	7.5	2.9	2.5	8.8	0.9	19.1	5.9	7.0	8.3	5.7
	2 -regime models averaged results for groups compared											
C	Rapid-J group (2 regime model)	-5.3	4.9	5.4	2.6			10.8		6.0	15.0	
	Slow-J group (2 regime model)	-7.2	6.4	7.2	2.5			14.4		8.3	12.0	
	Incomplete-U group (2 regime model) (Kyrgyz Rep.,Serbia and Georgia)	-17.2	9.5	5.2	3.5			22.3		5.0	16.0	

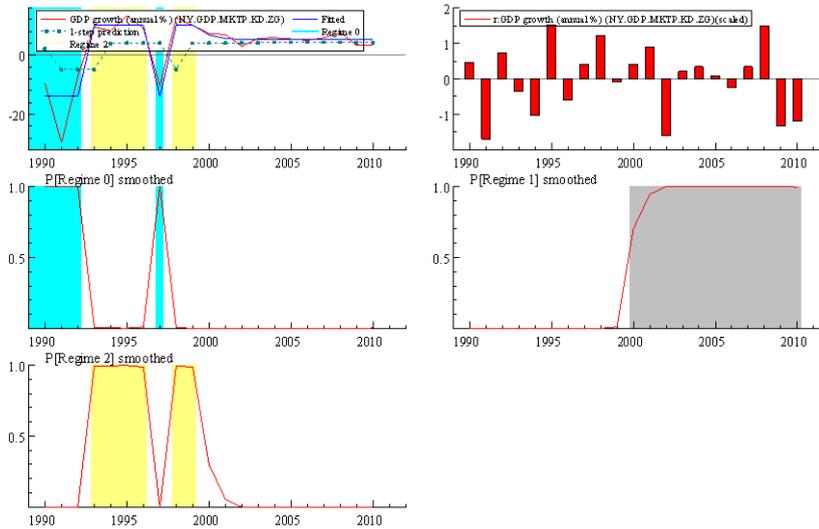
Note: * - Considering the fact that the regimes were not continuous, the indicator “the number of years spend within each regime” given in columns (9), (10) and (11), measures the entire time that each country has spent within one regime, including the reversal(s) into that regime.

Source: Author’s own calculations. Data source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

Before going into detailed observation, several general conclusions can be made:

- Firstly, the univariate MS analysis is consistent with the theoretical model insofar as it identifies statistically distinct growth regimes. As the table reveals, most transition countries experienced three regimes as was suggested by the model developed in chapter 4. The country data reveal important positive shifts or jumps in growth in all groups of countries, starting with negative mean growth rate in all groups in the first crash stage of transition, except for Poland (Column 1); and later turning into positive mean growth rates in the second recovery stage (column 3). This was followed in the three-regime countries by even higher positive mean growth rates in the third regime in most cases (column 5). Albania and Croatia are exception from this regularity, which is later discussed in more details. Volatility changes also met the expectations of the theoretical model with it being the highest in the first regime and lowest in the third regime in most countries except for Hungary, the Czech Republic, Slovenia, Lithuania, Macedonia, Romania, Uzbekistan and Azerbaijan. The summarized data across countries groups in section A of the table above confirm this depiction with the exception of the slow-J group that records similar volatility in the second and third regimes.
- Secondly, for two countries, Albania and Croatia, the second regime is characterized by the highest annual growth rate of 10.3 per cent and 6.27 per cent respectably, as compared to the third regime with mean annual growth rate of 5.4 per cent and 4.51 per cent, which would suggest that in these countries the recovery stage was the most pronounced, instead of the third regime as hypothesized by the theoretical model in chapter 4. For convenience reasons, here the graph for Albania from Appendix 6. 2, p. 569 is reproduced.

Figure 6.5-1 Regime identification for Albania (graph taken from original estimations from Appendix 6.2)



As can be noticed from the first graph, the drop which was prominent is recorded from 1990-92 characterised by mean annual growth rate of 13.9 per cent and volatility of 9.2 per cent (first blue marked area). After that follows the period from 1993 – 1996 of 4 years with high growth of 10.3 per cent (first yellow area). In 1997 the country fell back into the first regime due to pyramidal Ponzi schemes collapses that precipitated the civil unrest, and thereafter, immediately returned to high recovery in the third regime till 1999 (second blue marked area, followed by yellow marked area). Opposite to the other countries in this group, afterwards, relatively moderate growth followed of 5.4 per cent and volatility of 1.9 per cent lasting till the end of the research period (grey marked area), with no recorded fall due to the Global Financial Crisis.

Evidently, the various periodizations are an additional reason for cautious identification of these empirically identified regimes with the stages hypothesized by the theoretical model.

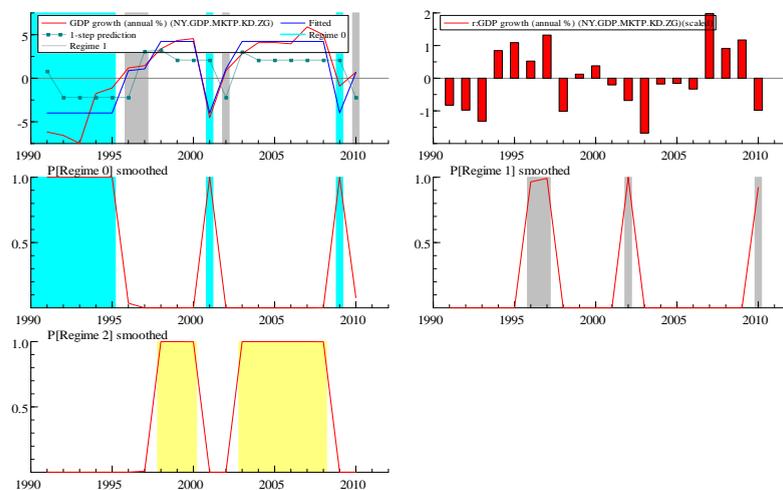
- Thirdly, as Table 6.4-2 reveals, some of the countries - Albania, Poland, Czech Republic, Lithuania, Croatia, Armenia, Macedonia and Romania - experienced

reversals of growth in mid-transition due to various reasons (Merlevede, 2003). Alongside underlying economic reasons, mostly shocks to the economy, such as: political changes, pyramidal Ponzi schemes collapses, civil wars or conflicts as explained in Box 5.1 in Appendix 5. 1 contributed to those reversals, usually meaning severe fall of growth into the first regime and afterwards similar pattern of recovery experienced like before. The reversals can be not only identified by the regime classification in results output, but even more visibly by the graphs given to the estimations. For convenience, in the following box Macedonia's case is explained (see Appendix 6. 2, p. 605).

Box 6.2 The case of repeating regimes (Macedonia 3-regime model)

The graph below shows the case of Macedonia, which has experienced three separate cycles of repeating regimes.

- As can be seen the first cycle starts with the start of transition with huge drop of -3.9 per cent annual growth rate and volatility of 2.6 per cent till 1995 (first blue in the marked area), followed by the second regime of moderate annual growth of 1.04 per cent and volatility of 0.3 per cent till 1997 (first grey area), and then a period of high growth marked in yellow (first yellow area) characterised by an annual growth rate of 4.2 per cent and volatility of 0.8 per cent lasting till 2001, i.e. until the internal ethnical conflict started.
- The country again falls into the first and then second regime for a year each time, to continue in relatively high growth regime after 2003 (second blue, grey and yellow areas).
- The depiction repeats once again with the drop in 2009 and moderate recovery in 2010 as a result of the impact of the Global Financial Crisis (last blue and grey areas). The persistence indicator, i.e. transition probability of the system to stay within the second regime is lowest (0.30), while it is much higher for the first and third regime - 0.64 and 0.73 - respectively. As mentioned, similar depiction with repeating regime (s) is repeated in some other countries.



- Fourthly, for two successful transition countries, Latvia and the Slovak Republic the two-regime model proved to fit the data better based on the AIC mostly. This was a rather unexpected result not in accordance with the expectations of the theoretical model and later success of these two countries..

- Finally, however, while informative about the dynamic of development under transition, univariate MS analysis reveals nothing about the causal mechanisms hypothesized in the interpretation of the model advanced in chapter 4.

Nevertheless, even with these remarks in mind, the univariate analysis of GDP growth rates only, giving rise to the summarized results in Table 6.5-1, reveals some initial insights into the differences between the various groups.

6.5.2 Groups results

6.5.2.1 Complete groups results (section A in Table 6.5-1)

When the averaged results for the complete three groups of transition countries are observed (see section A of the table above), several observations can be made:

- In the *first regime*, the incomplete - U group of countries suffered the most with respect to the fall of average annual growth rates to -16.7 per cent, as compared to the fall in the slow-J group to -7.1 per cent and the fall in the rapid- J group to only -5.2 per cent. Moreover, the volatility in the groups measured by the regime specific variance was diverse, with the incomplete-U group recording volatility of 8.56 per cent, the slow-J group volatility being in the middle with of 6.2 per cent, and the volatility of the rapid -J group being lowest - as expected - with volatility of 5.3 per cent. In terms of the length of various regimes, the first regime of sudden drop is shortest in the rapid-J group of countries – 5.7 years as compared to the slow-J group and the incomplete-U group where it lasts 7.5 and 6.0 years respectively, according to the estimation results.
- In the *second regime*, the situation changes, with the rapid – J groups of countries recording an average annual growth rate of 4.5 per cent as compared to the average mean growth rates in the slow-J and incomplete - U group of countries of 5.1 per cent and 4.1 per cent, respectively. This would suggest that in the second stage the

slow-J group recorded the strongest revival and the incomplete-U group the weakest recovery on average. Together with the change of the height of the growth rates, in the second stage the volatility also changes with the slow-J group recording the lowest volatility of 1.4 per cent as compared to the slightly higher volatility recorded in the rapid-J group of 1.5 per cent and the highest in the incomplete-U group of 3.0 per cent (see Table 6.5-1). Having in mind later success in the course of transition, it seems that higher volatility mixed with the lowest growth rates in the second stage of transition contributed to the later 'success' in the incomplete – U group. The second regime of recovery is shortest in the slow - J group of countries – 7.5 years on average as compared to the rapid-J group of 7.9 years and the incomplete-U group where it lasts 12.2 years. Interestingly, rapid-J group countries spent more time in the second regime as compared to the slow-J group of countries, while in the incomplete-U group it took almost double the time to pass through the second regime.

- The *third regime* into which most countries managed to enter is characterised by the highest average annual growth rates for all groups, though between-groups comparison reveals that it is lowest for the rapid-J group of 5.9 per cent, accompanied by volatility of around 1.0 per cent. On the other hand, the slow-J group recorded on average the highest annual growth rate of 10.7 per cent, accompanied by higher volatility of 1.4 per cent. Finally, the incomplete-U group is characterised by an annual average growth rate of 8.8 per cent and the lowest volatility of 0.9 per cent. However, the third regime lasts the longest in the rapid-J group with 8 years on average, followed by the slow-J group of 7.1 years on average and the incomplete-U group with only 5.7 years.
- The indicator given in columns 7 and 8 in Table 6.5-1 is the difference of the mean growth rates between regimes for various groups of countries. As can be seen, the difference is much higher for the jump from the first to the second regime (9.7 percentage points, 12.2 percentage points and 20.7 percentage points in the rapid-J, slow-J and incomplete-U countries, respectively) as compared with the differences of 1.5 percentage points, 6.2 percentage points and 5.9 percentage points for the jump from the second to third regime (for the J-group, slow-J group and incomplete-U

groups of countries, respectively). Additionally, while the first switch of regimes was the most pronounced in the incomplete-U group of countries, the second regime switch is highest for the slow-J group, though comparably to the first switch discrepancies it is much less prominent.

- Although indicative, the interpretation of the results should be treated with caution due to the fact that data series for some countries were shorter than others, starting in 1991 instead of 1990 and ending in 2009 instead in 2010. Additionally, in some countries, the first regime repeated itself in the mid transition due to wars, conflicts, and changes in economic policies as was shown in Box 6.2; or it repeated in late transition due to the Global Financial Crisis¹⁶⁹; hence, it does not reflect only the starting stage of transition. Finally, section A represents country group averages regardless of whether they experienced 2 or 3 regimes in the course of transition.

6.5.2.2 Between groups' comparison of the results (section B and section C from Table 6.5-1)

As can be seen from the table, the three-regime model results (section B) do not differ greatly from the complete groups' averages (section A). The average GDP growth rates for various regimes and appropriate averaged variances across groups show similar patterns and signs as compared to the appropriate groups in section A. The only more visible difference is in the sizes of the coefficients of the second regime in the slow-J and incomplete-U groups.

- Namely, extracting the two-regime countries from the incomplete-U group resulted in a smaller GDP constant and variance coefficient for the second regime (2.9 per cent as compared to 4.1 per cent), though still lowest in their-between groups comparison;

¹⁶⁹In a few countries, the Financial Crisis impact was not detected as a separate repeating regime; Belarus, Turkmenistan, Uzbekistan, Azerbaijan, Tajikistan, Kyrgyz and Georgia. However, having in mind the delayed impact of the crisis in lagging transition countries, accompanied by the fact that the data series for some countries end in 2009, this result is expected.

and accompanying lower volatility (2.5 per cent points as compared to 3.0 per cent points).

- For the slow-J group the difference is smaller, though again showing decrease in both indicators when two-regime countries are excluded (4.5 per cent average GDP mean growth rate and 1.1 per cent volatility as compared to 5.1 per cent average GDP mean growth rate and 1.4 per cent volatility for the second regime).
- For the rapid-J group these differences are much smaller when the Slovak Republic results, i.e. two-regime country's results are excluded from the group.

When the two- and three- regime models are compared among appropriate groups (sections B and C) some additional insights can be gained:

- Firstly, the two-regime average results show larger coefficients for the first two-regimes as compared to the coefficients of the first two regimes in the 3-regime model, which is especially emphasized for the second regime, especially in the volatility measure (see columns 3 and for 4, section C in comparison to column 3 and 4, section B). This would imply that 2-regime countries are characterised by greater volatility after entering into the second regime, which is a possible reason why the 3-regime exercise could not statistically identify the third regime in these countries.
- For the rapid-J group only one country recorded 2-regimes –the Slovak Republic. This country is the only exception with sizes and signs of the mean GDP coefficients comparable to 3-regime averages for the first and second regimes, although characterised by greater volatility (2.6 per cent as compared to the 3-regime group average of 1.3 per cent for the second regime).
- In the slow-J group, three countries created the two-regime fraction Latvia, Belarus and Russia. On average, these countries follow a similar trend to the 3-regime slow-J countries, with a difference in the second regime with mean GDP growth rate of 7.2 per cent and volatility of 2.5 per cent as compared to the 3-regime slow-J group average of 4.5 per cent and volatility of 1.1per cent.

- The incomplete-U group of two-regime countries consists of Georgia, Serbia and Kyrgyz Republic, and is characterised by higher coefficients in size, though similar in sign to the 3-regime group of incomplete-U countries. In this case, not only does the second regime differs, but also a similar difference is observable in the first regime with respect to the bigger size of the coefficients.

This estimation procedure reveals some of the features of each regime in each group. However, alongside with the group-specific differences in the identified regimes, the results indicated some country-specific variations from group norms.

Although informative about regimes, the above categorization based on the estimation results did not take into account the time periodization of the specific regimes, hence disclosing nothing about the regime changes in the country groups through time. In order to be able to get some intuition on that movement, the estimation results are related to their specific timing for each country group in the following section.

6.5.3 Stylized patterns of growth in the three groups of countries according to the model results

When the estimated results for each country are related to their specific timing in each of the regimes, a new improved stylized picture of the growth patterns in the three groups of countries emerges. Namely, in order to determine how regimes switch in each group through time, in the following interlocked figures in Figure 6.5-2 the average growth rates in each year for each of the three country groups are presented. Box 6.3 below explains the procedure of averaging the estimated results. In essence, each year's average growth rate is calculated by taking the growth rates by regime for all countries in each of the three groups (given by the intercept terms from Table 6.4-2) and then averaging for the total number of countries in the group.

Box 6.3 Averages of the estimation results

In order to explain the results better in the following table the estimated results on mean GDP growth rate for the seven rapid-J countries are presented for two comparable years – 1997 and 2001. The estimated data for the specific year and specific regime for each country were taken from Table 6.4-2 and a new table similar to one presented below was created. The small table below should help us only to explain the manner the graphs were produced.

For example in the year 1997, two countries - Albania and Czech Republic - were in the first regime, Estonia and Slovak Republic in the second regime, while Slovenia, Poland and Hungary were in their third regime. In 2001, the situation changes: Poland is in first regime, Estonia and Hungary in the third regime and the other four countries are in the second regime.

In order to calculate the average growth rate for the whole group for a specific year, but also taking into account the appropriate periodization of the regimes in each country, we construct the mean growth in each year from the model estimates (intercept terms) presented in Table 6.5-1.

$$\begin{aligned} \text{aver.GDP, rapid} - J_{1997} = & \\ & \left(\frac{\text{AlbaniaGDP}_{(1997)} + \text{Czech.RGDP}_{(1997)}}{7} \right) + \\ & \left(\frac{\text{EstoniaGDP}_{(1997)} + \text{Slov.R.}_{(1997)}}{7} \right) + \\ & \left(\frac{\text{SloveniaGDP}_{(1997)} + \text{PolandGDP}_{(1997)} + \text{Hung.GDP}_{(1997)}}{7} \right) \end{aligned}$$

		Albania	Slovenia	Estonia	Poland	Czech Rep.	Slovak Rep.	Hungary
Point A	1997	-13.9(1)*	4.83(3)	4.69(2)	6.67(3)	-1.6(1)	5.43(2)	4.59(3)
Point B	2001	5.4(2)	3.18(2)	8.44(3)	0.56(1)	2.51(2)	5.43(2)	4.59(3)

* - The number in the brackets marks the exact regime in which the country is.

Or, in numbers for the year 1997:

Point A:

$$\begin{aligned} \text{GDPg.r.aver}(1997) &= \left(\frac{-13.9 - 1.6}{7} \right) + \left(\frac{4.69 + 5.43}{7} \right) + \\ & \left(\frac{4.83 + 6.67 + 4.59}{7} \right) = -2.21 + 1.44 + 2.298 = 1.53 \end{aligned}$$

And for the year 2001:

Point B:

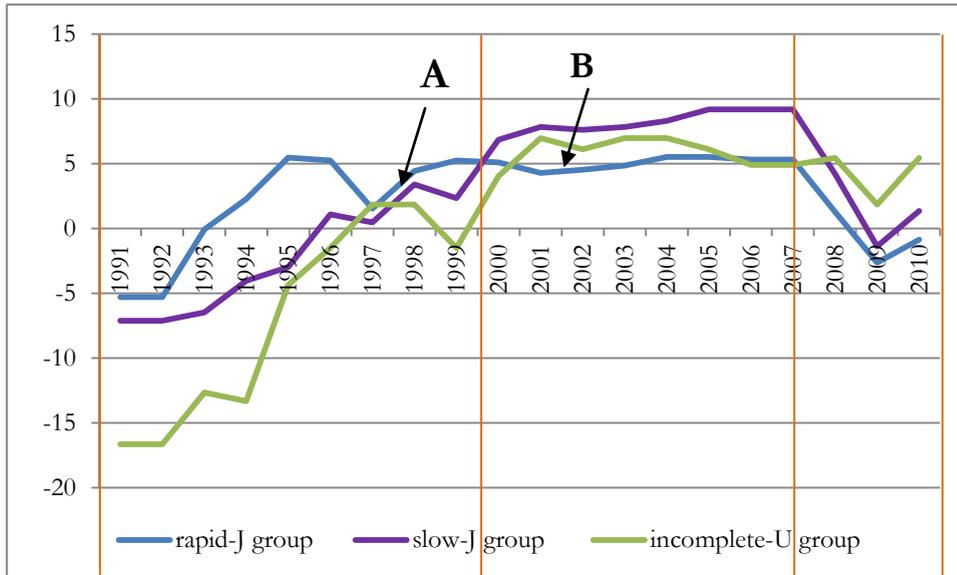
$$\begin{aligned} GDPg.r.aver(2001) &= \left(\frac{0.56}{7}\right) + \left(\frac{5.4 + 3.18 + 2.51 + 5.43}{7}\right) + \\ &\left(\frac{8.44 + 4.59}{7}\right) = 0.08 + 2.36 + 1.86 = 4.30 \end{aligned}$$

Similar estimation is performed for the other groups of countries for each year of transition. In addition, the procedure was repeated on the variance results in order to extract some information on change of volatility in the various groups of countries in the various regimes thorough the time of transition.

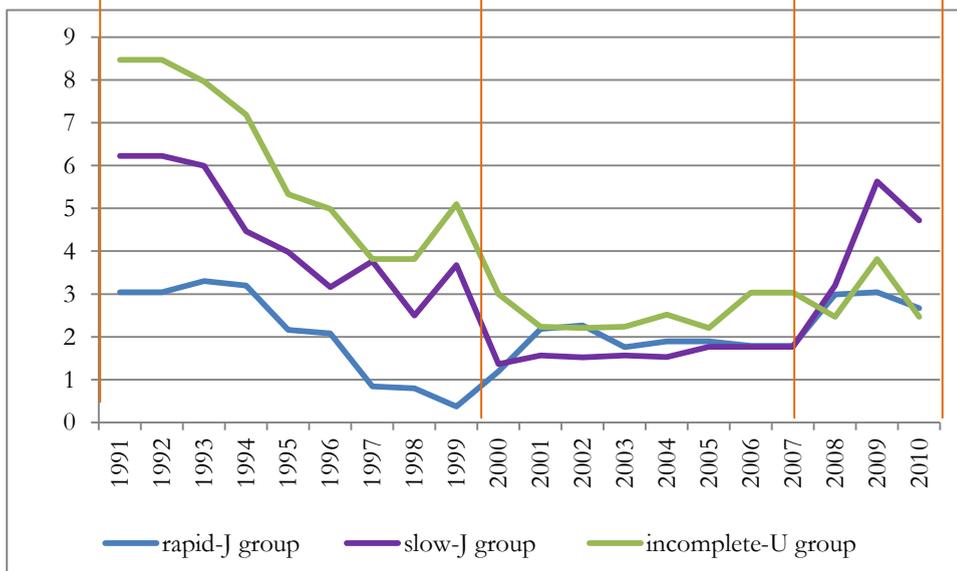
Based on the estimations similar to the ones presented in the box above Figure 6.5-2 is depicted. The top figure (A) shows the average annual GDP growth rate movements for the three country groups; while the second figure (B) presents the averaged volatility in each group. In both figures, the y-axis is measured in per cent, while the x-axis gives the period. The estimated data are taken from Table 6.4-2. For comparison, the figures are separated with vertical lines; showing the big changes that can be observed in 1999 and middle 2007. Points A and B match the calculation examples given in box 6.3.

**Figure 6.5-2 Stylized patterns of growth based on the estimation results
(In averages)**

A) Mean GDP growth rates



B) Volatility



Note: Points A and B match the calculation examples given in box 6.3.

In general, before observing separate regimes, the three groups' stylized patterns can be observed divided into 3 main periods: the first period from 1990 until 1999; the second from 2000 until middle 2007; and the last is after 2008, which captures the effects of the Global Financial Crisis.

- Until 1999, the rapid-J group is characterised by highest GDP average annual growth rate compared to other groups, except in 1997 when it falls close to the one recorded in the other groups. In the whole decade, the incomplete-U group is characterised by the lowest average GDP growth rate and, even more, by negative growth rate for most of the time. In addition, it took two and a half, five and a half and 6 years for the rapid-J, slow-J and incomplete-U group, respectively, to record zero growth rates and switch into positive growth rates, with the incomplete-U group falling again into the negative zone in 1999. It is interesting to note that the rapid-J group managed to reach its highest average growth rate as compared to later transition relatively early by 1995; on average this success was similar to the one recorded in late transition.
 - Appropriate volatility movements accompany these movements in GDP growth rates, with it being the highest in all groups at the beginning of transition, and afterwards falling gradually until 1997 when it records increases in the incomplete-U and slow-J groups. Although these years around 1997 were turbulent for the rapid-J group as well, the main impact of shocks in this group can be observed as a fall in mean annual GDP growth rates rather than in volatility, which seem to be falling until 1999. In summary, for the whole period volatility was significantly higher in the incomplete-U group, followed by the slow-J group and the lowest in the rapid-J group.
- After year 2000 the depiction changes. Namely, the rapid-J group maintains its positive growth rates, while the slow-J group catches up and surpasses it with even higher positive growth rates, notably the highest as compared to other groups. Even the incomplete-U group manages to surpass the rapid-J group growth rates in this period until 2004, suggesting some kind of 'catch up' story among the various groups of countries. Evidently, after 2004, the incomplete-U group fails to preserve the similar

pattern, losing impetus; and records slightly lower GDP growth rates accompanied by increased volatility; in contrast to the slow-J group and rapid-J groups.

- These movements are accompanied by changed depiction with respect to volatility. Namely, the highest volatility is still recorded in the incomplete-U group; however, the lowest is recorded in the slow-J group until 2005 when it slightly increases and it is almost equalized with the one characteristic for rapid-J group.
- Finally, because of the Global Financial Crisis all groups record a fall back into the first regime, except for the incomplete-U group that records a lesser fall, probably in the second regime; with rapid-J group recording the largest drop into negative zone.
 - Accordingly, the volatility increases in all groups, with the highest increase in the slow-J group, then the incomplete-U group and finally the rapid-J group. It is worth mentioning that the Global Financial Crisis effects-mix was different for the various groups:
 - For the rapid-J group characterised by positive but moderate growth rates and low volatility by the end of 2007, the Global Financial Crisis played its effect more through GDP growth rate fall rather than volatility change. This is similar to the situation in middle 1997 when volatility even kept decreasing in spite of the fall in GDP growth rate;
 - For the incomplete-U group that by 2007 recorded comparably similar to rapid-J group GDP growth rates, accompanied by the highest volatility, the Global Financial Crisis effects played themselves out more through the volatility change; and,
 - For the slow-J group characterised by the highest GDP growth rates, the Global Financial Crisis impact seems to be played out through both GDP fall and increased volatility.

In summary, the pattern observed here suggests that the 'less developed' incomplete-U group was less hit by the Global Financial Crisis, or maybe the effect comes with a delay, while the slow-J group of countries will suffer the most (European Bank for Reconstruction and Development, 2009).

The depiction is suggestive, however, in order to determine how the regimes changed through time in the separate country groups, in the following section the countries groups are separated and discussed in individual figures.

6.5.4 Regimes characteristics

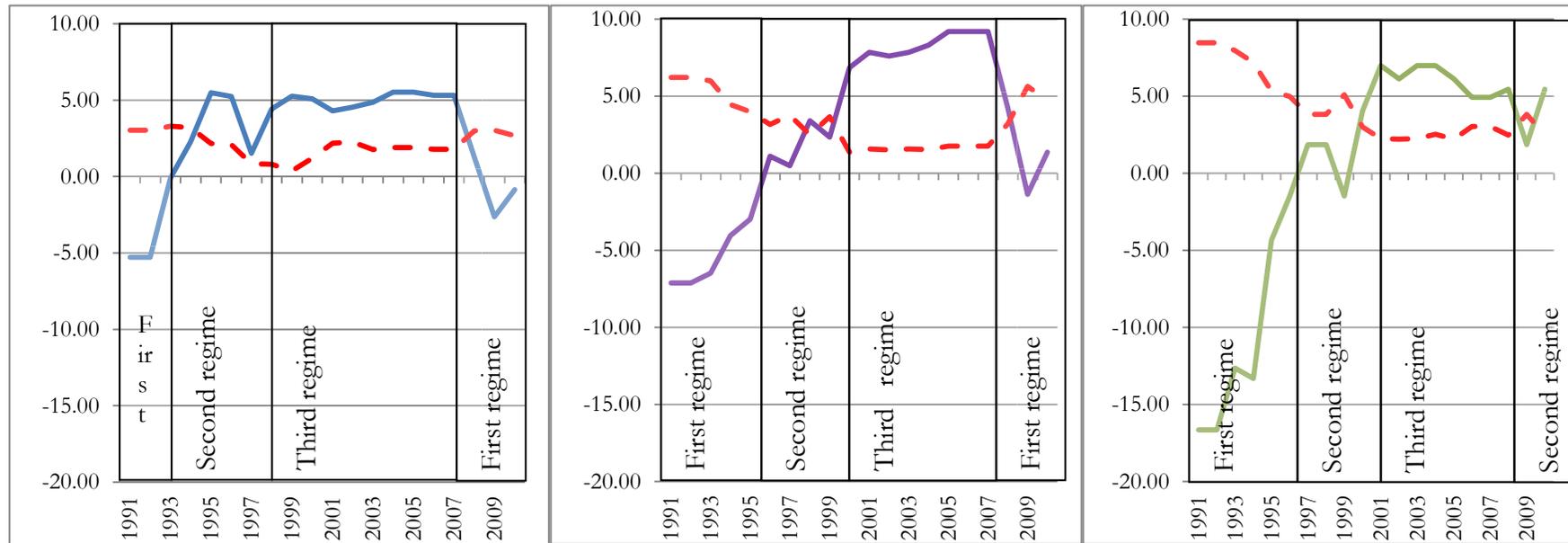
In the following figure, the stylized patterns are presented separately for the three groups of transition. Based on Figure 6.5-2, the y-axis represents the average of GDP growth rate in per cent (full line in the graphs) and averages of the volatility in the appropriate groups (fragmented line in red). The identified regimes in the figures are separated by full vertical lines and they are appropriately labeled.

Figure 6.5-3 Stylized patterns of separate regimes in the various groups (in averages for groups, in per cent)

a) Rapid-J group

b) Slow-J group

c) Incomplete-U group



Source: Author Own Calculations. Data source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

In general, several observations can be made:

- Opposite to expectations, the regime classification is the more distinct in the slow-J and incomplete-U group where the transition from one to another regime is very clear when the GDP growth rate line is observed. For the rapid-J group this distinction is more difficult due to the fact that the second and third regime do not differ significantly in their mean GDP growth rates, though differing in the volatility measure.
- Additionally, for all groups the switch into positive growth rates overlaps with a huge drop in volatility that falls even further as growth rates increase in the third regime.
- Finally, the rapid-J group and slow-J group experienced a fall back into the first regime because of the Global Financial Crisis, while the incomplete-U group recorded a fall into the second regime, which is in accordance with the assumption that in these countries the global effects come with a delay.

Now, if we go back to the various groups:

- The *rapid-J group*, after recording the first drop of 2 and a half years characterised by comparably the least GDP growth rates drop and comparably the least volatility is the fastest one switching into the second regime characterised with positive growth rates, comparably the highest GDP growth rates among the groups and decreasing and comparably the smallest volatility until middle of 1998. Afterwards, only after 7 and a half years of the start of transition, this group manages to enter the third regime characterised by its highest GDP growth rate and lowest volatility, though very modest if compared to the other groups. That fast recovery and switch into the third regime is not recorded in other groups of countries, and although interrupted with some events in 1997 and 1998, it remains even more stable after most of the rapid-J countries have joined European Union, i.e. after 2004. In addition, the change between the second and the third regime in the rapid-J group are between otherwise 'similar' regimes by their characteristics: i.e. close averaged mean GDP growth rate and close volatility.
- The *slow-J group* is good example of switching regimes during transition. Namely, after the first drop of 5 and a half years, follows a period of 4 and a half years of modest growth

and decreasing volatility, comparably higher than the one recorded in the incomplete-U group but lower than the rapid-J group; and, finally, almost 10 years after the start of transition, the highest and the lowest- volatility growth follows until 2007.

- Finally, the incomplete-U group records three regimes: the first one lasting for 6 years characterised by huge volatility and negative growth rates, the highest and the longest as compared to the other groups; the second regime that starts in the middle of 1999, though again characterised by comparably the lowest, even negative average GDP growth rates and the highest volatility; and the third one characterised by high growth rates and moderate volatility.

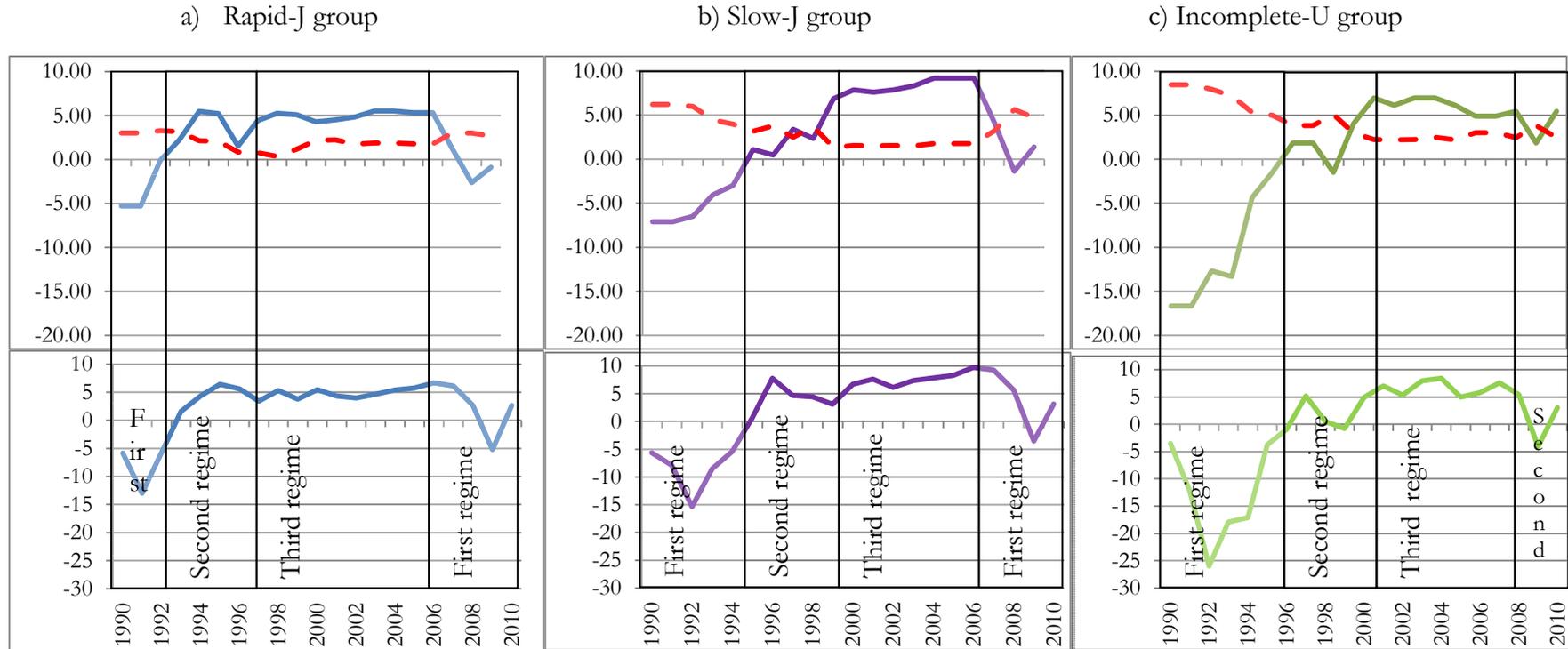
In general, the figures above reveal similar patterns in all transition groups. Alongside the differences, several similar features can be identified: namely, the first regime is characterised by the largest drop and highest volatility as compared to other regimes within each group; the second regime is a sort of stabilisation regime with increasing GDP growth rates and falling volatility; and the third regime is characterised by the highest GDP growth rates and the lowest volatility as compared to the previous regimes.

6.5.5 Comparing the results with the real data and with the theoretical model

Finally, as a concluding remark, it is interesting to compare the results and figures from the analysis and the regime identification procedure conducted in this chapter with the real results on average GDP growth rates given in Figure 2.5-2 in chapter 2. This comparison should give us some idea on the reliability of the model, that is, whether the model was able to replicate the GDP growth movements from reality, while, at the same time, identifying the regimes in the country groups. Nonetheless, it is not expected for the both figures to overlap completely, because the second figure is based purely on the estimation results and only models the reality based on the data.

In order to do so, in the following Figure 6.5-4 two sets of figures are interlocked and presented: Figure 6.5-2 from chapter 6 and Figure 2.5-2 from chapter 2 with y-axis presenting the GDP average growth rates for the three country groups: the estimated average GDP growth rates, accompanied by the dashed red line, showing volatility, both in the top panel; the actual average real GDP growth rates in the lower panel. The regimes are marked as estimated and established in Figure 6.5-2 and extended onto the lower panel, in order to see whether the regime identification can find some parallel in the actual real data on GDP growth rates.

Figure 6.5-4 Growth paths in the course of transition (Estimated growth rates, upper panel and Actual real GDP growth rates, lower panel, in per cent)



Source: Author Own Calculations. Data source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

In general, when the GDP growth rate lines are observed by eye, it looks like the model performed the best in the case of the rapid-J countries; however, even in the cases of slow-J and incomplete-U group the model gives relatively good representation of the real GDP growth rates movements, though with more emphasized switches. Several common features in this graph can be observed as a conclusion to this chapter.

- In all graphs, the end of the first regime of severe drop (in top panel) overlaps with the zero growth rates (in lower panel), that is the real beginning of the recovery of the real GDP growth rates accompanied by a huge drop in volatility. Only in rapid-J group, slight mismatch can be observed.
- The second regime is characterised by similar but decreasing volatility in all groups (in top panel), and one peculiar cycle of strong positive growth rates at the beginning of the regime that decrease slightly by the end of the regime (lower panel). This is an interesting feature of the second regime observed in all groups that can be related to the theoretical model developed in chapter 4, i.e. to the movement of the country along the second balanced growth paths $A_{c1} \frac{f(k)}{k}$ (see Figure 4.5-2), which was characterised by sudden positive growth rate that diminishes as the country moves along the growth path.
- Finally, the third regime is identifiable in all country groups, characterised by the lowest volatility and highest positive growth rates that overlap to a big extent with the real data presentation.

Based on the comparison, it can be concluded that the model represents the real GDP growth rates consistently; i.e. the hypothesized regimes are present in the data.

In addition, it seems that the findings do support our theoretical model developed in chapter 4, suggesting highest volatility and negative growth rates at the beginning of transition and positive growth rates and lower volatility as the country moves between

the various steady state balanced growth paths (see Figure 4.5-2 in chapter 4). This was confirmed by the empirical results.

In addition, the theoretical model predicted switches into higher regimes to be brought about by sudden positive increases in GDP growth rates(see Figure 4.5-2 in chapter 4). This was found in the empirical results where all the switches into another regime are easily visible. However, this is to some extent confirmed in the real GDP growth data also. Namely, the increases are easily identifiable at the beginning of each regime in the real data panel figures(in the lower panel in 1995 and 1998 in the rapid-J group graph; then, in 1996 and 2000 in the slow-J group graph; and, finally in 1997 and 2000 in the incomplete-U group graph).

Finally, in our theoretical model, the regime impetus was slightly lost, hence the growth rates were decreasing, as the country was moving along a certain balanced growth path due to the assumption of the diminishing returns to increased capital (see Figure 4.5-2, in chapter 4). This assumption was relaxed in the final stage of transition when the increased capital can employ the otherwise free labour force without encountering diminishing returns as suggested in section 4.5.3.1 in chapter 4. As mentioned above even this assumption can find some ground in the real data presentation especially for the second regime, when increase in GDP followed by decrease in GDP growth rates is observed.

6.6 Conclusion

In summary, the univariate analysis has enabled closer assessment of the peculiar characteristics of growth - instability and volatility - in the course of transition. Firstly, the individual analysis of each country; then, the analysis of the averaged results for the country groups; and, finally, the analysis of the averaged results that took into account

the appropriate periodization of each regime for every country. They all offer evidence in favour of the assumption of non-linear growth and the corresponding existence of various regimes or stages of transition as postulated by the theoretical model in chapter 4.

In addition, the regime description of the theoretical model with the expected high volatility and negative growth rates at the beginning and decreasing volatility and increasing growth rates in later stages of transition seems to fit the empirical results advanced in this chapter, though with group-specific variations.

Furthermore, the benefit of the empirical procedure is that the switches between regimes are easily visible and identifiable in most of the cases, for example in the slow-J group, which, in turn, again confirms the idea of switches of regimes among countries in contrast to the smooth linear growth process assumed in the growth studies.

Finally, the model is not far away from the actual real GDP growth data. It represents them relatively well, at the same time connecting our theoretical model with the empirical results from the real data sets.

However, the question arises as to whether this framework can be extended to investigate if the regimes identification persists when the main driving forces behind different transition stages or regimes are introduced? In order to do so, the next chapter extends the applied Markov Switching Model by introducing multivariate analysis. Namely, a novel approach to adapting the standard growth regression to the Markov Switching framework is employed in order to investigate whether instability and volatility of growth are still features of transition when the main growth determinants are introduced into the picture.

Chapter Seven

7 Instability and volatility of growth: Reassessed by the use of multivariate Markov switching model

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7.1 Introduction

In this chapter, the univariate analysis is extended to multivariate empirical analysis in order to create a framework that initially should be able to distinguish different regimes of transition, and then will be informative about the peculiar characteristics of each phase of transition, coherent with the model developed in chapters 4, 5 and 6.

In order to provide such an informative framework, a simple growth regression is used and placed into a Markov switching framework. The simplicity of the model employed in this chapter is due to two main limitations:

1. Firstly, we have available only a short span of data from 1992 to 2009, which is in conflict with highly data consuming techniques such as Markov Switching; and,
2. Secondly, as will be shown in this chapter, the limited span of data for the transition countries impedes attempts to calculate appropriately the two main growth determinants - i.e. stocks of both sorts of capital - physical and human and their growth rates- with the usually used techniques in growth studies. The problem of obsolescence and the unknown rate of depreciation of the physical capital in the course of transition has been already recognized as a major drawback in the growth empirical studies of transition as mentioned in chapter 3 (Akerlof et al., 1991, Ericson, 1996). Additionally, many authors have emphasized also the problem of calculation of the human capital in transition countries, which only adds to the difficulty of capital assessment (Ronnås, 1997, IMF *Country report*, 1998, Campos and Corriceli, 2002).

However, despite the weaknesses and limitations, given above, the modified MS growth regression exercise although very modest is still well worth the attempt for the case of transition economies, because it offers a novel insight into the different growth regimes in the course of transition. It should be noted though that this multivariate analysis has an aim to complement the findings from the univariate model and; hence, does not

pretend to explain comprehensively the growth determinants behind growth regimes in various transition countries groups. The reasons for that will be explained throughout the chapter.

This chapter is structured as follows. Section 7.2 gives the empirical findings in growth literature for the cases of developed, developing and transition countries, emphasizing the differences in the approaches appropriate for describing growth in various conditions. Next section 7.3 explains the subsequent steps in the model specification procedure, starting with the familiar growth regression postulation and then extending the framework in a Markov Switching VAR fashion. This section also discusses peculiarities, advantages and weaknesses of the applied technique in our research. Section 7.4 considers the data and model peculiarities in our modelling, followed by the results analysis discussed in section 7.5. This section compares the univariate results with the multivariate results derived in this chapter. Section 7.6 summarizes the results, while section 7.7 brings forward the conclusions.

7.2 Main empirical findings of in the literature

The main goal of this section is to provide a review of the papers that investigate empirically growth and its main determinants, concentrating on those papers that apply an approach useful for our analysis. A distinction is made between studies that investigate developed economies and those that concentrate on developing and transition economies. The reason for this is that they are different with respect to the modelling approach, yet share the same neoclassical origins in terms of selection of the variables. The former ones usually apply the modelling strategy based on the neoclassical linear framework and, although they are not in the spirit of our research, their review offers valuable insight and overview of the variables mostly used in growth studies and used in this chapter too. On the other side, the studies concerning developing countries are rather focused on finding new ways of empirically modelling growth in specific conditions. Although still the majority of the analyses are based on the linearity

assumption, in this review we shall treat only the ones that introduce non-linearity in the growth studies, assessing the ways they address the non-linearity observed in the data generating processes.

In general, growth theory does not offer a clear-cut path towards empirical investigation. Temple (1999) noticed that the empirical work on growth has often been controversial due to the widespread feeling that growth theory and econometrics are best kept apart. In fact, the lack of an apparent theoretical background has led empirical economists to follow theory loosely and simply "try" various variables as potentially important determinants of growth (Sala-i-Martin, 1997, Fischer and Gelb, 1991, Temple 1999). In consequence, the number of growth regression has grown far faster than the economies they analyse (Hendry and Krolzig, 2004). Many of these novel and informal models were initially described as mongrel or ad hoc regressions. Yet, they have gradually become the principal mode of analysing growth in general (Fischer, 1993).

7.2.1 Empirical analysis of growth in developed countries

The augmented-Solow model is the starting point in our review of the empirical findings on growth. Mankiw et al. (1992) examined whether the original Solow growth model can explain the international variations in the standard of living.¹⁷⁰ Using the model, the data on three samples of countries (98, 75 and 22 OECD countries and OLS techniques they found that the model correctly predicts the direction of the effects of the different

¹⁷⁰The first tested model regressed the real GDP per worker for each year on two main variables: n - average rate of growth of the working-age population between 15 and 64 years and s - the average share of real investment (including government investment) in real GDP. The data used in the study are from the Real National Accounts constructed by Robert Summers and Alan Heston from 1988.

factors, such as saving (s)¹⁷¹ and population growth (n), but it overstates their magnitudes.¹⁷² Because the estimates implied a high capital share, Mankiw et al. (1992) augmented the Solow model by including accumulation of *human capital* as an explanatory variable in their cross-country regressions. The improved model regresses $\ln(\text{GDP per worker})$ on $\ln(\text{capital per worker})$ and $\ln(\text{human capital per worker})$, while the estimate for capital per worker is the investment rate in physical capital over 1960-1985 and the estimate for human capital is the investment rate in human capital over 1960-85 measured as a percentage of secondary-school students in the working-age population.

Inclusion of human capital altered the empirical modelling, but also the theoretical modelling of economic growth. At the theoretical level, as we explained in chapter 4, the inclusion of human capital altered the notion of diminishing returns to reproducible capital, which became constant returns to broad capital (Lucas, 1988). However, Mankiw et al. (1992) preserved the notion of diminishing returns to all capital in their modelling, assuming that $\alpha + \beta < 1$. In this case, the economy will converge to its steady state as explained in Solow. We closely followed Mankiw et al. (1992) in developing the model in chapter 4, especially with respect of preserving the assumption of diminishing returns to capital. As mentioned, the expansion of the physical and human capital in the course of transition was mainly focused on low-skilled industries, which results in diminishing returns to the factors.

After imputing the human capital variable and regressing, Mankiw et al. (1992) found out that the human capital accumulation measure enters significantly in all three samples. In addition, their augmented model explains 80 per cent of the cross-country variation in income per capita from three variables: population growth; and investment rates in physical and human capital. The high R^2 is the basis of Mankiw's (1995) conclusion that: "Put simply, most international differences in living standards can be explained by differences in accumulation of both human and physical capital" (p. 295). The corollary

¹⁷¹ The saving variable actually is the fraction of income invested in physical capital, which indirectly in the equation measures the share of change of capital.

¹⁷² The value of α implied by the coefficients should equal capital's share in income, which according to Mankiw et al. (1992) is roughly 1/3. However, the estimates without human capital imply a much higher value (0.59) with a standard error of 0.02.

of their finding is that differences in technical efficiency, which on the other hand depend on resource endowments, climate, education, institutions and so on, and differ across countries, can have a relatively small role (less than 20 per cent) to play in explaining cross-country income variations.

Subsequently, Klenow and Rodriguez-Clare (1997) have drawn attention to the relatively exaggerated estimation of human capital in the Mankiw et al. model arguing that an important issue is how exactly human capital is measured in the models as sometimes human capital estimates can absorb part of the TFP specific for the countries.¹⁷³ They argue that the Mankiw et al. estimates of human capital effects do not capture only private gains but also the social gains of schooling that are always larger than the private benefit, consequently amplifying the role of human capital in the regressions. Correcting for this and using the same estimates for physical capital, they find that total factor productivity differences account for half or more of level differences in 1985 GDP per worker levels. In addition, when testing the growth rates (instead of levels) for the four Asian tigers (Hong Kong; Singapore; South Korea and Taiwan from the study of Young, 1995) they find that roughly 90% of country differences in Y/L growth are attributable to differences in A growth. Combining these growth results with their findings on levels, they call for returning productivity differences to the centre of theorizing about international differences in output per worker.

Although with various findings with respect to the size of the contribution of human capital to growth, growth empirics in general did emphasize the importance of the exact

¹⁷³Klenow and Rodriguez-Clare (1997) offer more exact measures of human capital for 98 countries, by updating Mankiw et al.'s data and adding data on primary and tertiary schooling in the model, as well as taking into account worker experience and the quality of education. Additionally, they offer extensive explanation and estimation of experience and quality of education for the countries in their analysis. Although interesting and maybe useful for our further research, we will not explain these methods in more depth because of the unavailability of data for our research required for these exercises. The main finding is not surprising; namely, that richer countries have older workforces and higher quality of education which, combined with the physical capital, results in higher growth rates.

measure of human capital that enters the growth regression. This seems especially important for the case of developed economies where human capital plays a significant role in growth through the engagement in research and development. However, in our context of transition, the role of the human capital solely or even more distinguished from TFP cannot be easily assessed because of the lack of data and also because of the close interrelation between the changes in the determinants of human capital development and the wider social and structural changes as argued in chapter 3, section 3.2.2.¹⁷⁴ Consequently, similarly to the distinction among private and social gains from human capital, we assume that the qualitative effects (gains or decreases) from human capital can not be easily differentiated from the quantitative effects of the employed labour.¹⁷⁵ However, in this research the differentiation between labour and human capital is not of huge importance, because we consider that the changes in human capital did not have big influence on the GDP regime switches, hence the labour force is simply proxied with the employment rate. All the effects from human capital remain to be captured by the intercept. We shall return to this assumption again later in the thesis.

In addition, many other studies on the East Asian episodes of growth illustrated the importance of neoclassical transition dynamics. Young (1995) provides a careful analysis of the historical patterns of output growth, factor accumulation and productivity growth

¹⁷⁴ The close interrelation of the changes makes it difficult to distinguish among the changes in various spheres of social life. Additionally it makes it even more difficult to differentiate causes from consequences. As mentioned in chapter 3, two main determinants of human capital such as education and experience also experienced huge changes and adjustments in the course of transition in order to offer skills and knowledge necessarily for the newly introduced market economy. However, as the course of changes was sudden, it cannot be easily distinguish from all the other changes in the society. Additionally, the effects of all the alterations, positive or negative cannot be disentangled too.

¹⁷⁵ Following the explanation in chapter 3, we assume that the qualitative changes of human capital will depend on the interplay between the wage changes and employment adjustments in the labour market. Namely, if the employment fall is slower than the output fall due to the very low wages (wage flooring), in the first stage of transition, it can be expected that the overall results on a social level would be rather negative, i.e. decreases, resulting in a falling labour productivity. On the other side, in later transition, if the employment growth is slower than the output increase, and the wages are pretty low due to the wage ceiling, then it can be expected that the gains in the society should be higher than the changes in the employment.

in the newly industrializing countries of East Asia: Hong Kong; Singapore; South Korea and Taiwan. He claims that the East Asian growth miracles, characterized by unprecedented growth in output and manufacturing sector exports, were fuelled more by growth in labour and capital than by rising total factor productivity as many authors had asserted before. More precisely, he argues that expanding investment rates (particularly investment in machinery) accompanied by rising labour force participation rates, intersectoral transfers of labour and improved levels of education are the main factors behind the growth miracle occurrences. In his paper, he offered detailed descriptive analysis of the data on two aggregate inputs, capital and labour¹⁷⁶ and estimated their share in various sectors in the economies. Once he accounted for the dramatic rise in factor inputs, he arrived at the estimated total factor productivity growth rates for his case countries that are closely approximated by historical performance of many of OECD and Latin American economies. Hence, he concluded that the “neoclassical theory with its highlight on factors changes and its well-articulated quantitative framework, can explain most of the difference between the performance of the newly industrialized countries and that of post-war economies” (Young, 1995, p. 675).

Bassanini and Scarpetta (2001) also have tested the augmented Solow model in the case of 21 OECD countries over a period 1971-1998. They started with a simple specification of the growth equation and then analysed extended models. Their initial specification is consistent with the neoclassical growth model including the convergence factor and the basic determinants such as accumulation of physical capital and population growth, similar to the one used in our model. The first extension involves human capital and further considers R&D, and a set of policy and institutional factors potentially affecting economic efficiency.¹⁷⁷ As the equation suggest, the most interesting novel aspect in this

¹⁷⁶ Young (1995) divided capital input in five categories: residential buildings, non-residential buildings, other durable structure, transport equipment and machinery; while labour is distinguished into seven categories on the basis on sex, age and education.

¹⁷⁷ Considering pooled cross-country time series (i denotes countries and t time) they have written the model in general form:

study is the differentiation between the long-run and the short-run dynamics in the model by including first differences of the steady-state determinants as short-run regressors in the estimated equations (Bassanini and Scarpetta, 2001). Under the assumption of long-run slope homogeneity¹⁷⁸, they use the pooled mean group estimator that allows intercepts, the convergence parameter (ϕ), short-run coefficients and error variances to differ freely across countries, but imposes homogeneity on long-run coefficients. The homogeneity of the long-run coefficients actually implies that the countries will approach the same steady state growth rate in the long run, which is due to similarity of the countries in terms of common technologies and intensive intra-trade and FDI and also due to the constancy of the coefficients across time.

Nonetheless, the introduction of the short-run dynamic and the allowance for it to differ across countries clearly implies that even in the case of developed and very similar countries the movement towards the steady state is not always smooth and linear; and neither is it equal for all the countries at a certain point of time.

7.2.2 Empirical studies of growth in developing countries and transition countries

$$\Delta \ln y_{i,t} = a_{0,i} - \phi_i \ln y_{i,t-1} + a_{1,i} \ln sk_{i,t} + a_{2,i} \ln h_{i,t} - a_{3,i} n_{i,t} + \sum_{l=4}^m a_{l,i} \ln V_{i,t}^l + a_{m+1,i} t + b_{1,i} \Delta \ln sk_{i,t} + b_{2,i} \Delta \ln h_{i,t} - b_{3,i} \Delta n_{i,t} + \sum_{l=4}^m b_{l,i} \Delta \ln V_{i,t}^l + \varepsilon_{i,t}$$

where y is GDP per capita, sk is the propensity to accumulate physical capital, h is human capital, n is population growth, the V^l is the vector of variables affecting economic efficiency, t is a time trend, the b - regressors capture short-term dynamics and ε is the usual error term.

¹⁷⁸ Although of secondary interest for this research, the Bassanini and Scarpetta (2001) results suggest various relationships among growth and the macroeconomic variables. Namely, they show that inflation is negatively associated with the accumulation of physical capital and through this channel affects growth. Moreover, high variability of inflation affects GDP per capita directly. In terms of government size, they found that overall government dimension might reach levels that hinder growth. On the other hand, government investments and consumption tend to have non-negative effects on output per capita, influencing growth by improving the framework conditions. With respect to R&D, their model does not reveal clear-cut results, although in general they found that business R&D could have high social returns. The empirical evidence also confirms the importance of financial markets for growth, both by encouraging investment and to channel resources.

Since growth processes in developing and transition countries may be very different to those countries near the technological frontiers, one should often be careful about extrapolating findings from the developing countries to the more developed and vice versa (Temple, 1999). As shown in the previous section, while explaining growth differences among developed countries most studies use balanced growth models, which means that several aggregate "great ratios" evolve smoothly over time, following the transitional path given in the neoclassical model. However, Pritchett (1997) notices that the history of many developing and transition countries has been marked by alternating booms and growth collapses that are rarely studied in the growth studies of transition. Instead, most empirical studies of transition still employ balanced growth models, following the example of growth studies of developed countries, generally disregarding the dramatic shifts of growth experienced by developing and transition countries, or alternatively only including them as a variables in the otherwise linear system (Jones and Olken, 2005). In many cases, although the output fluctuations can be easily perceived by looking at the time series behaviour of growth rates within countries, mainly in recent times, several influential authors as Pritchett (2000), Easterly et al. (1993, 2000) and Easterly (2009c) stressed the serious shortcoming of the standard empirical approach to growth. They claimed that a general framework is needed for thinking about macroeconomic discontinuities – one that encompasses differences among countries.

Jones and Olken (2005) explored a less common approach to growth that emphasizes actually the variation of the growth experience *within* countries. They examined more deeply the changes that occur when growth starts and stops in one country. Claiming that the transition between different growth regimes is highly important for better understanding of growth in all countries (except for richest ones), firstly, they identify structural breaks in the growth series for individual countries using the methodology of Bai and Perron (2003) and data from the Penn World Tables (Heston et al. 2012). Then,

they use the accounting exercise to analyse whether observable factors, such as the accumulation of physical capital, human capital¹⁷⁹, or changes in factor intensity, can account for significant parts of the structural change, or whether TFP, the unobserved residual, is left to explain the growth breaks. The analysis suggests that changes in the rate of factor accumulation explain relatively little of the growth reversals, especially for accelerations. Instead, the growth reversals are largely due to shifts in the growth rate of productivity. They find very similar results by using independent data on electricity consumption to infer total capital utilization rather than relying on investment data from the national accounts. The electricity data only confirms the previous findings, suggesting an efficiency story.

Jerzmanowski (2006) has built on Pritchett's observations on growth regimes and he characterized various growth regimes and the countries' transitions among them using a Markov-switching regression using cross-country data for 89 countries over a period of 1962-1994 on growth rates of output per worker from the Penn World Tables 6.1. He estimated four distinct regimes corresponding to four growth processes.

- A stable growth regime corresponds to the growth experience predominant among developed economies, with long-run average growth of about 2 per cent and low growth volatility.

¹⁷⁹The growth rate in the physical capital stock per-capita is defined as $g_k = \frac{I}{K} - \delta - n$

where I is gross investment, and n , the population growth rate and the depreciation rate, δ , is assumed to be 7%; while for measuring the human capital they start with taking the standard assumption of Mincerian returns to schooling which implies a 10% return in wages to an additional year of schooling, hence if s is years of schooling the growth rate of human capital can

be calculated as: $g_h = 0.1 \frac{ds}{dt}$.

- A stagnation regime is characterized by no growth on average and larger volatility of growth shocks. In this regime, periods of growth and decline occur but are not very persistent.
- He also identified a separate regime of one-time large shocks to growth, claiming that while these shocks tend on average to be negative reflecting economic crises, the dispersion is very large and positive shocks are possible. However, he found that these shocks have no persistence.
- Finally, he identifies a regime of fast, miracle-like growth with an average long-run growth of 6 per cent.

The specification he uses combines simple within-regime dynamics with transition probabilities, which depended on countries' quality of institutions. The quality of institutions is measured by the index of government anti-diversion policies¹⁸⁰ borrowed from Hall and Jones (1999). This index combines measures of rule of law, risk of expropriation, corruption, bureaucratic quality, and government repudiation of contracts. His results show that countries can switch among regimes of stable growth, "miracle" catch-up, stagnation and crisis with the transition probabilities determined by the quality of institutions. In his research, he offered the estimated transition probabilities to switch into certain regimes for four countries with various levels of quality of institutions, such as US, with the highest quality, Korea with high quality, Brazil intermediate quality and Nigeria with low quality of institutions. Better institutions appear to improve long-run growth by making episodes of fast growth more persistent. Low average growth rates in countries with weak institutions are a result of these countries spending more time in stagnation regimes rather than being incapable of fast growth at all. He argues that weak institutions do not rule out growth take-offs but limit their sustainability. Although focused on the institutions' role in growth, Jerzmanovski's approach was crucial for the empirical strategy in this thesis because it motivated the idea of growth regimes and

¹⁸⁰ In general, the anti-diversion policies in Hall and Jones' model (1999) are the policies that encourage productive activities such as the accumulation of skills or the development of new goods and production techniques in the society, and discourage predatory behavior such as rent-seeking, corruption, and theft.

switches, while at the same time suggesting the Markov Switching Modelling as an appropriate technique for identifying breaks in data series.

Young (1995, 2000) has emphasized another problem related to the growth analysis in the developing countries and that is the problem of misstating the data in the national statistics in the socialist country of China. He analysed the economic performance of the Republic of China using the statistics given by the national statistical office of China but making systematic adjustments using their own data. By simple descriptive but rather profound analysis on each data sets on labour market movements, he showed that the growth rates during the reform period in China 1978-98 are close to ones previously experienced by other rapidly growing economies. Namely, he claimed that the key force explaining the extraordinary improvements in per capita living standards in China is the labour deepening (the rise in participation rates, transfer of labour out of agriculture, and improvements in educational attainment) and *not* capital deepening. After taking into account these labour changes, he found that labour and total factor productivity growth in the non-agricultural economy are found to be 2.6 and 1.4 per cent per year, respectively; a respectable performance, but by no means extraordinary.

In the case of transition countries, growth empirics are even more ambiguous owing to the complexity of transition, the short span of data and the absence of coherent theory that explains and encompasses all processes during transition as explained in chapters 1 and 2. However, even in the limited cases that empirically analyse transition countries, the analysis is mainly based on the balanced linear growth model which, in turn, as mentioned before, disregards the huge changes experienced in the course of transition (De Melo et al, 1996 and 2001; Fidrmuc, 2003; Havrylyshyn and Rooden, 2000; Fischer and Sahay, 2000).

In general, alongside with the short length of data necessary for growth analysis, the main problem is that growth literature, which makes heavy use of balanced growth models, generally disregards the dramatic changes experienced by all transition

economies, whether these are described as structural changes, factors' reallocations, institutional changes and so on, as shown in chapter 4 and 5 (Kongsamut et al. 2001). In fact in empirical work, these changes are included as a separate variables in the growth regression models, but still within the linear framework, not allowing for their more substantial impact in the estimation procedure.

Completely different in approach as compared to our analysis, these studies will be observed in concert and only briefly in this subsection without going into details on measuring the various determinants.

In general, the main model, which is used in transition studies, has the following linear equation form:

Equation 7.2-1
$$y = \alpha + \beta Z + \chi X + u$$

where y is the GDP per capita growth rate, Z is a vector of core variables that usually appear in growth regressions such as initial level of GDP per capita, the investment rate, the secondary school enrolment rate and the rate of population growth, X is a vector of variables of interest and u is the error term. The choice of the included variables is based on past empirical studies and economic transition theory, while usually panel modelling is used in order to overcome the problem of lack of data and to obtain results, which will be relevant for the whole or separate groups of the transitional world (Hamma et al., 2012).

As mentioned, many researchers have performed empirical tests for various factors that may have caused the variation of growth across transitional world such as for example: De Melo et al. (1996 and 2001) Fidrmuc (2003), Havrylyshyn and Rooden, 2000, Fischer and Sahay (2000), Falcetti et al. (2002), Eschenbach and Hoekman (2006), Hamma et al., (2012) bringing forward several general conclusions:

- Firstly, most of the studies find the initial conditions measured by the initial GDP per capita for the starting year of transition to be statistically significant and important factor for later success especially at the beginning of transition (Fischer and Sahay, 2000, De Melo et al., 2001). However, studies also showed that the

importance of initial conditions decline over time as transition countries make progress with reforms.

- Secondly, the core variables that proved to be statistically significant in most of the studies are physical and human capital (Havrylyshyn et al., 1998).
 - Following the example of developed countries studies, in most of the transition studies change in physical capital is proxied by the ‘Investment annual growth rate’ or the ‘Share of Investment in GDP’ (Iradian, 2007, Dragutinović-Mitrović and Ivančev, 2010, Mervar, 2002). In the case of developed countries studies this approximation holds because the depreciation rate in the physical capital equation is considered as constant and proved constant in the studies. However, in the case of transition countries, as shown in chapter 3, section 3.2.1, the depreciation rate was changing drastically in the course of transition especially at the beginning, which in turn suggests that the simple investment rate could not proxy the movements of the physical capital. This conceptual flaw is usually repeated in transition studies.
 - In addition, human capital is mostly measured by the secondary school enrolment, which again does not represent human capital as an augmentation to labour as in developed countries growth analysis (Mervar, 2002, Arandarenko, 2007). This is because in the case of transition countries, the basis that is the labour quantity was the one that drastically changed rather than its augmentation or quality as discussed in chapter 2, 3 and 4.

Thirdly, the vector of variables of interest in the course of transition was heavily based on the transition literature, including variables such as: rate of inflation; fiscal balance relative to GDP; price and trade liberalisation indexes; privatisation indicators; and deeper institutional reforms, such as competition policy and financial sector development indexes. For example, studies suggested that lower inflation rates and smaller deficits are associated with higher growth and faster recovery (Fischer and Sahay, 2004). In addition, several papers concluded that liberalisation measures and small scale privatisation are supportive to growth (Havrylyshyn and Rooden, 2000; De Melo et al., 2001). Controlling for regressors commonly used in the growth literature, Eschenbach

and Hoekman (2006) find that measures of services policy reform are statistically significant explanatory variables for the post-1990 economic performance of a panel of 24 transition economies. Their findings suggest that services policies also should be considered more generally in empirical analyses of economic growth. One specific branch of transition literature studies the importance of the institutions and their building processes in explaining the variation in economic development and growth across transition economies (Beck and Laeven, 2006). Measuring institutions in various ways, all studies agree that quality institutions are important for growth. However, since we are limited to the usage of the core variables in our research programme, these variables and their treatment in empirical transition literature will not be further discussed.

In summary, while most of the growth models of developed countries describe the growth process as a smooth movement along the balanced growth path, this impression is quickly shattered once we move beyond these developed countries to the developing or transition countries (Kongsamut et al. 2001). The later accumulation of evidence about growth in transition countries led to more realistic specifications of growth models of transition as well. However, to make the best use of the existing empirical material, we believe that it is necessary to reshape and extend earlier models so as to make them more relevant to the processes of growth in transition countries.

7.2.3 Endogeneity in the regression analysis of growth

One important problem already recognized in the growth empirical literature is the potential endogeneity of the variables used in the growth regressions stemming from the interrelation of the determinants within the growth system (Pritchett, 2000).

Broadly, endogeneity is a situation when one or more independent variable(s) is correlated with the error term in the regression model, which gives rise to biased

regression coefficients¹⁸¹ (Wooldridge, 2002). In brief, there are several reasons for endogeneity, such as omitted variables, measurement problem and simultaneity, which may be particularly pronounced in dynamic systems.

- In the omitted variables case, there is a variable (or more than one variable) that needs to be included in the analysis based on the theoretical and empirical grounds and is correlated with the included variables, but still, it is not represented in the empirical model due to lack of data or insufficient knowledge.
- In the measurement error case, the estimation of the effect of certain explanatory variables on y is ambiguous if one or more variables are mismeasured.
- In the case of simultaneity, one or more of the explanatory variables and the dependent variable mutually determine one another (Wooldridge, 2000).

In the former two cases, the problems can be solved if better data are collected, while the latter case requires specific modelling approaches that will enable estimating unbiased regression coefficients (Wooldridge, 2002).

In our research, the small empirical model of growth is based on the basic growth equation deduced from the standard production function, comprising labour and physical capital variable and technical progress, captured by the intercept, which is considered as exogenous, as explained in the following section, 7.3.1. Namely, although many variables or determinants of growth, explaining the technical progress are known from the growth empirical literature, our model is limited to the two main determinants of growth as explained in section 7.3, considering that within the neoclassical model which is our basis, technical progress is assumed to be exogenous. Indeed, it is a relatively modest model that attempts to acquire information on the dynamics of growth switches rather than understanding of the myriad of potential growth determinants. Hence, we consider that the omitted variables issue is not a primary concern in our research. In addition, following the explanations in section 7.4, we regard the variables in

¹⁸¹ More on the explanation and sources of endogeneity see Wooldridge, 2002.

our model as appropriately measured or proxied, especially by making an attempt to take into consideration the huge obsolescence of the physical capital as explained in section 7.4.2.2.

However, the last important source of endogeneity relevant for the dynamic systems econometric modelling, and for this research, in particular, is simultaneity. Simultaneity arises when one or more of the explanatory variables and the dependent variable mutually determine one another (Wooldridge, 2000). In fact, simultaneity is the situation when the one-way causal relationship between the independent and dependent variable is accompanied by a backward causal relationship i.e. the dependent variable affects the independent variable, creating a two-way causal connection(s) among the dependent and independent variable(s) in the model. This situation is particularly relevant in the context of time series analysis of causal processes. Simultaneity occurs in dynamic models and systems where the variables, dependant and independent, are interconnected.

The possibility of mutual causation between determinants of growth and the growth of GDP has been already recognized in the growth literature (Mirestean and Tsangarides, 2009, Durlauf et al., 2008). Many authors have stressed that alongside the main relation – from the growth determinants - physical and human capital- to GDP growth, there is also a backward relation; that is:

- GDP growth is a determinant of the flow of investments and hence the physical capital flow (Jorgenson, 1963, Lucas and Prescott, 1971, Hall and Jorgenson, 1971, De Long and Summers, 1991); and,
- GDP growth is a determinant of employment and human capital development (Lucas, 1988, Barro and Lee, 2000).

Conventional economic thought has already established the relation between the growth of the economy and the *physical capital changes* in the concept of the accelerator effect. According to this conception, businesses will be encouraged to make new investments increasing the physical capital stock, determined by - among other factors - the expected profit rate; which in turn depends on the growth of the economy (Jorgenson, 1963).

Broadly, rising GDP (in an economic boom or prosperity) implies that businesses expect increasing sales, cash flow, more efficient use of the capacity and rising profits, which would encourage further investment in physical capital such as equipment and improved technology (Hall and Jorgenson, 1967). The opposite happens in the case of falling GDP when businesses are reluctant to invest as they expect falling sales and a worsened economic environment. As business confidence falls, the discouraged businesses may lead to negative growth of the economy through the further destimulation of consumer incomes and purchases resulting in negative multiplier effects (Lucas and Prescott, 1971). Although mainly related to business cycle movements and the business cycle concept, the feedback relationship between GDP growth and physical capital growth has general economic relevance, because it is part of the reasons behind deeper recessions and transition failure (Hall, 1993, Kornai, 1994). Namely, Hall (1993) found that the falling investment played a part in deepening recession. Explaining the vicious circle that developed in the course of the recession in United States in 1990-91, Hall (1993, p.5) concluded:

Firms cut all forms of investment; again as they would if there had been some permanent adverse shock. As usual in a recession, firms cut production by more than their sales fell, making up the difference from inventories.

In similar vein, Kornai (1994, p.54) found that the investment fall in the course of transition not only resulted from the fall in economic activity, but also contributed to the whole transitional recession, as "...the investment activity was completely paralyzed in certain periods of negative economic growth".

The economic literature also documents the two-way relationship between GDP growth and changes in the labour market (employment growth and human capital development). Namely, economic growth is not only determined by the labour and human capital among other factors, as discussed by the endogenous growth theories (Lucas, 1988, Barro and Lee, 2000); but also economic growth causes changes in the employment and human capital in an economy (Hull, 2009, Satchi and Temple, 2006). Although it is not

always clear how economic growth translates into labour market outcomes, in general, the literature suggests that positive economic growth exerts two main effects on labour markets: firstly, it stimulates job creation or employment increase (changes in the quantity of labour); and, moreover, it stimulates human capital development (changes in the quality of labour)¹⁸². The first effect is usually measured by the employment intensity of economic growth that is the growth in employment resulting from the growth in output (Hull, 2009). High employment intensity indicates that growth in output leads to considerable job creation, while low estimates of employment intensity suggest little correlation between economic growth and employment. The latter case is usually referred to as a “jobless recovery”, which can happen due to a variety of situations (Glosser and Golden, 2005). Namely, in some cases, economic growth favours increase in labour utilization rather than increase the number of jobs. This is especially emphasized in the eve of recessions, when companies are more reluctant to hire new workers until they are convinced about the sustainability of a new economic recovery (Glosser and Golden, 2005). Finally, another possibility is that companies employ new technologies and high-skilled labour resulting in increased productivity instead of mass job creation. In the latter case, the effects are related to improving the labour quality that is human capital development instead of increase in employment (Hull, 2009). In the opposite case of negative economic growth, the relation between the economic decline and labour market outcomes is again confirmed; with prompt or lagged conversion of economic downturn into increase in unemployment and negative impact on human development (Maddison, 1987). As mentioned in sections 3.2.2, 3.3.3 and 3.3.4, the negative economic growth in transition countries caused peculiar adjustments on the labour market, characterised by increase in unemployment, increase in the inactive labour force, informal employment and so on¹⁸³ (Nikoloski, 2009).

¹⁸² Indeed the impact and the effects of the interrelations depend on many factors studied in the literature, such as: the level of development of the country, the type of growth, the level of urbanization of the country, the labour market characteristics such as its sectorial structure, the share of informal sector, labour income and so on (Satchi and Temple, 2006).

¹⁸³ More extensive explanation on the labour market adjustments in the course of transition in Nikoloski (2009).

Although brief, the above discussions suggest that economic growth measured by the GDP growth affects the two main determinants of growth, thereby implying the problem of endogeneity in the empirical model. This is an important empirical problem that results in biased regression coefficients; hence, the results of the single equation regime switching regressions undertaken in the course of this research are not reported. Instead, in order to address the possible mutual determination of the dependent and independent variables, we apply the Markov Switching Vector Autoregressive (MSVAR) model in our modelling of GDP growth dynamics, which is explained in section 7.3.3. The MSVAR system addresses the problem of endogeneity as it allows modelling a system whereby each potentially endogenous variable is regressed on lags of all other potentially endogenous variables subject to the switch. In addition, this methodology has several other advantages: it not only allows for the inclusion of variables that are endogenous in a statistical sense, but it also encompasses the dynamic relationships among the variables and, also, the dynamic evolution of the growth process we are interested in. All of these - modelling the dynamics of growth as switching regimes and incorporating endogeneity - are issues of particular relevance to growth analyses that have been rarely considered jointly and, to our knowledge, have never been considered jointly in studies of growth in the course of transition. Hence, the following analysis attempts to fill this gap in the transition growth literature.

7.3 The multivariate model

7.3.1 Basic regression

The theoretical departures explained in chapter 4 and 5, accompanied by the problems of: lack of data, suspected nonlinear nature of the growth and the inability to conduct a growth accounting exercise for transition countries in the traditional fashion, urged the need for alternative ways to conduct regression analysis that would eventually yield

better and feasible empirical presentation of the big structural changes in the course of transition.

Hence, in this section, the regression approach analogous to “growth accounting” will be conducted in order to enable estimation of the contribution of the various factors to growth as identified by the Solow model, by relating growth in GDP to growth in fixed physical capital and to growth in employment. The estimable regression equation is as follows:

$$\text{Equation 7.3-1} \quad \left(\frac{\Delta Y}{Y}\right)_t = \alpha_0 + \beta_1 \left(\frac{\Delta K}{K}\right)_t + \beta_2 \left(\frac{\Delta L}{L}\right)_t + u_t, \quad u_t \sim N(0, \sigma^2)$$

Whereby $\frac{\Delta Y}{Y}$ is the GDP growth rate, $\frac{\Delta K}{K}$ is fixed physical capital growth rate, $\frac{\Delta L}{L}$ is the growth in employment, t – is time subscript, β_1 and β_2 are the coefficients on the variables, u_t is the error term which has a statistical role to capture the errors not captured by the variables in the model. The constant term α_0 will play the role of the technology term in the growth accounting framework - $\frac{\Delta A}{A}$, i.e. capturing all the systematic effects that are not included in the other two variables. In fact, the constant term will act as a “Solow residual”, capturing all the systematic changes not included in the model variables. This is a very important feature enabled by use of the Markov Switching framework into the growth regression, which will be further discussed in the chapter.

Conceptually, this is the regression version of the growth accounting formula Equation 4.2-1 given in chapter 4 and explained in Appendix. 4.2. This regression relates the economic growth over the twenty-year period of transition to the basic measures of physical and labour growth and to the unobserved technical change. As given in the Equation 7.3-1, our analysis includes two factors: labour (L) and physical capital (K). The measure of the human capital is not included simply because of the difficulties to estimate it in the transition context. However, we believe that the changes and possible

obsolescence of human capital will be captured in the intercept term in our model. The modest number of variables is due to the intention of the empirical exercise to put a focus on the shifts in growth rather than on the detailed determinants behind the shifts, consistent with the theoretical model given in chapter 4. Additionally, it should be emphasized that the informative purpose of this empirical model is limited by the lack of data for other possible variables and by the modelling procedure. Namely, as will be shown later, the modelling procedure becomes truly data consuming, especially when the switching regimes are introduced, which exponentially increases the number of the parameters to be estimated. In summary, the empirical investigation of growth and especially of growth switches is highly restricted when the range of potential factors and changes is large relative to the number of observations.

7.3.2 Markov Switching extension and the introduction of the concept of non-linearity into the growth regression

As mentioned, one silent feature of the growth exercises is the postulation of linearity implying only linear or trended movement in output growth and its relation with the explanatory variables discussed in chapter 5. This assumption is relevant when growth in developed countries is analysed, as it is usually described as variation around a single trend, which means that the variations are negligible and do not affect the linear trend in the data (Pritchett, 2000). However, in chapters 4, 5 and 6, we argued that growth in developing or transition countries can be better depicted by shifts in growth regimes due to its great instability over time. This idea was supported by the findings of many scholars who called for specification of a nonlinear data generating process (Durlauf et al., 2004, Pritchett, 2000, Easterly et al., 2000). Yet, there is no agreement among the growth researchers with respect to the empirical specification of growth nonlinearities, or with respect to the methods that should be used to distinguish growth modelling of developed and developing countries empirically.

Our approach is designed to fill this gap in the literature by introduction of a non-linear approach in the modified growth regression for transition countries. This group of countries represents a good candidate for non-linear modelling for several reasons:

- Firstly, the output growth actually recorded was not genuinely linear, which was also supported in our empirical analysis in chapters 5 and 6.
- Additionally, as shown in chapters 2 and 3, the collapses recorded in the course of transition had a peculiar nature and causation and in most cases lasted much longer than the collapses characteristic for the recession phase of the business cycle in developed countries, which was described in chapters 2 and 3 and further explained in chapters 4 and 5 (Aquiar and Gopinath, 2004, Pritchett, 2000).

Hence, the merger of Markov switching models with the empirical regression seems a reasonable next step in the model construction. As a result, the main formula to be estimated gets the following form:

Equation 7.3-2

$$\left(\frac{\Delta Y}{Y}\right)_t = \alpha_0(s_t) + \beta_1(s_t)\left(\frac{\Delta K}{K}\right)_t + \beta_2(s_t)\left(\frac{\Delta L}{L}\right)_t + u_t,$$

$$u_t \sim N(0, \sigma(s_t^2))$$

whereby, t – is the time subscript, $\frac{\Delta Y}{Y}$ is the GDP growth rate, $\frac{\Delta K}{K}$ is the fixed physical capital growth rate, $\frac{\Delta L}{L}$ is the growth in employment, β_1 and β_2 are the coefficients on the variables (dependant on s_t) and u_t is the error term dependant on s_t . The constant term α_0 captures technological progress which is a sufficiently broad concept to include the effects of shocks to human capital $\frac{\Delta A}{A}$ and is also dependant on the specific regime (s_t). The term (s_t) designates the specific regime in which the system exists. The equation relates the output growth in each regime with the growth rates of capital, labour and technical change specific for a certain regime.

This approach identifies the regime classification in the growth process in the course of transition for each country, not only based on the information on the output changes ΔY (*GDP*), as the in previous section of this chapter , but also on the information on the main determinants of output growth. This fusion should shed some new light on the contributions of various ingredients of growth in the different identified phases of transition or different regimes in the countries under analysis. As mentioned, one additional advantage of this framework is the fact that it enables the constant term of the “Solow residual”¹⁸⁴ to be interpreted differently in the crash, recovery and catching up stage of transition, depending on the conditions in the real economy.

7.3.3 Markov Switching Vector Autoregression Regression extension

As mentioned in section 7.2.3 there is some potential endogeneity of the variables used in Equation 7.3-2. The endogeneity stems from the interrelation of the determinants within the system and needs to be taken into account in the empirical modelling. In order to resolve endogeneity in the MS regression, Krolzig (1998) developed the MS methods in the context of vector auto-regressions (MS-VAR)(Krolzig, 1998; Krolzig and Toro, 2001). These are standard VAR models, whereby some or all of the

¹⁸⁴ The authors from the endogenous growth strand of the literature give additional theoretical content to the Solow residual, arguing that it reflects not just technology but resource endowments, climate, institutions, social capital, macroeconomic policy and so on and hence it may differ across countries (Mankiw et al. 1992, Barro, 1996a, Barro, 1996b). Due to all the different conditions, the various countries use their existing resources with diverse degree of efficiency. In addition, countries’ capacity for developing or adopting new technology differs greatly depending on the institutional arrangements and the organization of the society (Abramovitz and David, 1994). Empirically, the extended interpretation of the Solow residual offers the appealing possibility of negative changes in the Solow residual. Namely, even in the neoclassical context of freely available technology, the possible technological regress in one country instead of progress can be attributed not only to the developments in the technological sphere but also to the developments in the human and social capital, such as inadequate education and skills, undeveloped institutions, legal and regulatory barriers and macroeconomic instability as shown in chapter three (Parente and Prescott, 1994, Howitt and Mayer-Foulkes, 2002, Fischer, 1993).

interrelated parameters are allowed to switch when the regime changes. The most general form of the MS-VAR process is the following:

$$\text{Equation 7.3-3} \quad y_t = \alpha(s_t) + \sum_{i=1}^p \chi_i(s_t)y_{t-i} + u_t;$$

Where $y_t = (y_{1t}, \dots, y_{nt})$ is an n -dimensional transposed vector, α is the vector of intercepts, χ_1, \dots, χ_p are the matrices with the autoregressive parameters and u_t is the white noise vector process ($u_t | s_t \approx NID(0, \Sigma(s_t))$) and all can be dependent on the switching variable s_t . In general, MS-VARs appear in a variety of specifications depending on which variables are allowed to switch. By allowing the potential determinants of the switch to interact in a dynamic framework, the issue of endogeneity as explained in section 7.2.3 arising from the potential simultaneity of the relationship between GDP growth and the accumulation of both capital and labour is addressed.

In our research, the empirical model will be defined in a reduced form vector-autoregressive model:

$$\text{Equation 7.3-4} \quad y_t = \alpha(s_t) + \sum_{i=0}^p \beta_i(s_t)x_{t-i} + \sum_{i=1}^p \chi_i(s_t)y_{t-i} + u_t;$$

where y_t is our three-dimensional vector comprised of: GDP annual growth rate, $(\frac{\Delta Y}{Y})_t$; gross fixed capital annual growth rate proxied by the annual electricity consumption growth rate $\frac{\Delta K}{K}$; and employment growth rate $\frac{\Delta L}{L}$; x_t is a vector of exogenous variables which could enter contemporaneously or with a lag, but is not mandatory; α is the vector of intercepts, χ_1, \dots, χ_p and β_0, \dots, β_p are the matrices containing the autoregressive parameters and u_t is the white noise vector process ($u_t | s_t \approx NID(0, \Sigma(s_t))$).

7.4 Data and Model Considerations

Whichever techniques are applied, the weakness of the available data represents a major constraint on the potential of empirical growth research (Durlauf et al., 2004, p 3.)

7.4.1 The descriptive analysis

For the analysis, time-series data from 1990 to 2010 on the rate of economic growth (term $\frac{\Delta Y}{Y}$ in the Equation 7.3-4), on the rate of change in labour input (from 1992 -2009 in most cases) (term $\frac{\Delta L}{L}$ in the Equation 7.3-4), and, on the rate of change in the input of physical capital proxied by the growth rate of the electrical consumption from *World Development Indicators* and International Energy Agency¹⁸⁵ are collected (term $\frac{\Delta K}{K}$ in the Equation 7.3-4).

The rate of economic growth is the ***annual rate of real (constant price) gross GDP growth***. This variable is named GY growth (annual rate of change in per cent). Full definition is given in the footnote.¹⁸⁶

Consistent with the explanation in section 7.3, the introduced variables are also given in aggregate terms. Hence, the rate of ***change in labour inputs*** is the annual rate of

¹⁸⁵The data from *World Development Indicators* and IEA are accessible on the internet using www.esds.ec.uk.

¹⁸⁶Definition: Annual percentage growth rate of GDP at market prices based on constant local currency. Aggregates are based on constant 2000 U.S. dollars. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Source: World Bank data, and OECD National Accounts data files.

change in total employment.¹⁸⁷ In the appendices 7 DE marks this variable. As articulated in section 7.3, although in the growth regressions human capital is considered, the employment growth rate variable only will be used as a measure in quantitative terms, i.e. measuring labour quantity. The qualitative adjustment of the labour input is a difficult exercise for the case of transition countries for the reasons discussed in chapter 3 and section 7.3.2 of this chapter. Additionally, it is assumed that the movements in human capital growth cannot be as sharp as the changes in physical capital and employment; hence, it is expected that they will not have much explanatory power for the structural breaks in growth in the course of transition.¹⁸⁸ Nevertheless, the applied regime-switching model has the possibility to capture some of the impact of the human capital growth rate on GDP growth within the intercept term.

The greatest problem in growth exercises for the transition countries appears to be in calculating the *physical capital stock* and its growth in the economy (DC). The relevant literature provides several methods of estimating the stock of capital (e.g., King and Levine, 1993). The most used method as mentioned is based on a perpetual inventory approach. In this case the stock of capital is calculated depending on three factors: the investment variable; the depreciation rate (usually assumed to be 5 per cent or 10 per cent); and the initial capital-output ratio (3:1 or 5:1).¹⁸⁹ However, this is again a difficult exercise in the case of transition countries due to several reasons:

¹⁸⁷Time-series data for employment are calculated using the data on two indicators: the employment as a percentage of population and the data on population, which are available for the countries from the *World Development Indicators*. The employment as a percentage of population is multiplied by the population and divided by 100. The result is the absolute number of the employed persons, which is then logged, differenced and multiplied by 100 in order to get the rate of change of the employment.

¹⁸⁸In general, in the growth studies conducted for developed economies human capital growth rates movements are considered as a relatively smoothly adjusted variable without big sharp movements (Klenow and Rodriguez-Clare, , 1997). However, in the case of transition there was some movement in the human capital growth rate due to obsolescence as explained in chapter 3, section 3.2.2.1.

¹⁸⁹ Following the discussion in chapter three the most used equation for calculating the growth of physical capital is in the form: $\frac{K_{t+1} - K_t}{K_t} = \frac{I_t - \delta K_t}{K_t}$, where the growth rate of capital stock

- Transition countries have experienced huge depreciation and obsolescence in physical capital especially at the onset of transition.¹⁹⁰ As mentioned in chapter 3, section 3.2.1.2 at the beginning of transition, much of the physical capital in transition countries became useless for profitable production, due to changes in the structure of the economy on the demand and supply sides, liberalized trade flows, changes in international trade links, and changes in price levels (Ericson, 1996, Gylfason and Zoega, 2002). Thus, in the first years of transformation, the fall in effective capital stock was greater than that represented by a 5 per cent or 10 per cent depreciation rate (Burda and Hunt, 2001). As a result, in these years, the changes in capital stock may be radically underestimated if some conventional constant depreciation rate is assumed (Akerlof et al., 1991).
- Secondly, there is no data on the capital stock at the beginning of transition (K_0) that can be used as a baseline for calculation of the subsequent growth rate of capital stock. The data on Gross Investment¹⁹¹ are available, but in the absence of the initial capital stock and depreciation rate they cannot be used in order to calculate the physical capital growth rate nor they can be used to proxy the movements of physical capital as discussed before. Hence, the growth regression exercise has to be reconsidered without relying on imputations of physical capital stocks from aggregate investment data.

Consequently, in the absence of data on initial capital stock, in this analysis, the rate of *change in capital input* is proxied by the annual rate of change in the electricity

(left hand side) is calculated taking into account the Investment (I) minus depreciation rate (δ) on the past capital stock over the capital stock in previous period (see Appendices 4.1-4.3).

¹⁹⁰The usually applied depreciation rates within the studies such as constant depreciation rate (δ) of 7% (in Jones and Olken, 2005, Easterly et al., 2000) or 6% (in Hall and Jones, 1999) or 10% (in Aquiar and Gopinath, 2004) cannot be applied in this case.

¹⁹¹The Gross Investment indicator is actually denoted in the *World Development Indicators* as Gross capital formation (GFC).

consumption. The time-series data for the electrical consumption¹⁹² in kilowatts per hour (KW/hour) are available for all countries from the International Energy Agency.¹⁹³ The rate of change is calculated by taking logs and differencing.

7.4.2 The electricity consumption as a proxy variable

In general, the proxy variable should be correlated with the economic variable that it represents, i.e. it ought to be relevant.

7.4.2.1 The electricity consumption as a proxy variable in the literature

Using electricity consumption as a proxy for capital stock is not new. This strategy was first employed by Jorgenson and Griliches (1967) who discussed the errors in data compiling on growth of real product and growth of real factor input, which eventually results in serious biases in the growth accounts. One of the errors in explaining the productivity change, which is the focus in their study, is the measurement of capital stock in the economy that usually takes into account only the capital stock as accumulation of net flow investments but neglects its utilization. Stressing the importance of capital utilization for accurate estimations, Jorgenson and Griliches (1967) use the utilization of power source as a proxy for the capital assuming that “...*data on the relative utilization of electric motors provides an indicator of the relative utilization of capital in manufacturing, since electric motors are the predominant source of power there* (p.265, p.276-280).

¹⁹² Definition of the electrical consumption is given by the IEA and shows final consumption and trade in electricity (which is accounted at the same heat value as electricity in final consumption; i.e. 1 GWh = 0.000086 Mtoe).

¹⁹³ Usually, in market economies the electric power consumption is used as a proxy for the aggregate economic activity as they usually move in lockstep (with electricity-GDP elasticity close to one). However, in our case, for the reasons explained below, the growth rate of electricity consumption shall be used as a proxy for Physical capital growth rate.

Assuming that capital utilization is proportional to stock of capital¹⁹⁴, they apply this proxy in their growth accounting estimations and conclude that factor input explains 71.6 per cent of the rate of growth in total output, with the change of TFP explaining less than 30 per cent.¹⁹⁵ In similar vein, Costello (1993) also used the electrical consumption as a proxy for capital input in a growth accounting exercise focused on the Solow residual i.e. the nature of productivity growth.¹⁹⁶ Interested especially in the volatility of the capital stock, Costello (1993) suggests that capital utilization is a better measure for capital input in growth accounts, as it is more volatile than the capital stock over the cycle period. Similarly, Burnside et al. (1995) used industrial electrical consumption data in order to study the cyclical movements in capital utilization and services and their effects on labour productivity and the degree of returns to scale. They find that capital utilization rates are sharply procyclical, which was seriously understated when only capital stock without its utilization was taken into account in the studies. Hence, they conclude that in the models the movements in capital utilization rates should be considered as an important determinant when measuring labour productivity and when constructing growth accounts. Strauss-Kahn (2004) studied the impact of vertical specialization on the labour market using both capital stock and electricity consumption variable as proxies for capital. In their study, the regression analysis with both measures of capital at the two-digit industry level confirms that the choice of electricity consumption as a proxy for capital does not significantly affect the results.

¹⁹⁴In order to take into account the quantity of the capital stock, Jorgenson and Griliches (1967) multiply the relative utilization of capital by the stock of capital and use it in calculating the indexes of total input. Yet, the results they get are the same as before, when only the capital utilization indicator was used.

¹⁹⁵ In their study, Jorgenson and Griliches (1967) identify several other errors in calculating inputs, such as: errors in aggregation; errors in investment goods prices; errors in relative utilization; and errors in aggregation of capital services and labour services. Correcting for all the other types of miscalculations, they give the above conclusion that total input explains 71.6 per cent of the rate of growth in total output, with the rest explained by the change of TFP.

¹⁹⁶ This analysis is conducted for six countries, for five industries. The main finding is that productivity growth is more correlated across industries within one country than across countries within industry, which Costello (1993) attributes to nation-specific factors that are common across industries.

Building on previous work, recently, Jones and Olken (2005) used the electricity data in their growth accounting study claiming that the total amount of electricity consumption can capture the aggregate use of physical capital, incorporating both factor utilization and factor accumulation effects. In their study, capital stock at each point of time is decomposed in two main parts:

Equation 7.4-1
$$K_t = u_k \bar{K},$$

where K_t is the capital usage at some point of time, \bar{K} is the total aggregate physical capital in the economy, and u_k is the intensity with which this factor is employed. Focused on physical capital, they define a linear relationship between electricity use and physical capital use as:

Equation 7.4-2
$$E = Bu_k \bar{K}$$

where E is the electricity use and B is the slope parameter. The linear relationship finds support in their regression analysis in the wide selection of 125 countries, among which the developed but also developing countries that have experienced shocks in physical capital, whether in its accumulation or utilization.¹⁹⁷ Hence, they conclude that the electricity consumption growth rate (g_E) can be used as a proxy for capital growth (g_K) plus the growth in the intensity of capital use (g_{uk}); or, in equation form:

Equation 7.4-3
$$g_E = g_K + g_{uk}$$

¹⁹⁷ They confirmed their statement by running a linear regression in per capital terms in the following logform $e = \log B + \omega \log k + \varepsilon$ where the log of electricity is regressed on a constant and log of capital. In their study OLS confirms a linear relationship, estimating $\omega = 1.04$ with a standard error of 0.04 and a remarkably high R-squared of 0.9 in 1995 data. The study is performed for 125 countries for which data were available in the Penn World Tables.

Additionally, they relate the electrical consumption to utilization of human capital as well, stating that each machine is related to a person or labourer that controls its work. Hence, the electrical consumption data might reveal some aspects of the utilization of human capital also.

7.4.2.2 Electricity consumption data use as a proxy in transition countries

Alongside with its use in the literature, there are also several practical motives to use electricity consumption data as a substitute measure for the role of physical capital in this research.

- Firstly, in Central, Eastern and South Eastern Europe, industry and business consumes a large part of electric power, while the share used by households is fairly small and relatively constant (Dobozi and Pohl, 1996). As Dobozi and Pohl (1996) argue, two-thirds of electricity consumption is linked to power for driving machines, and for handling and processing materials; hence, every change in physical capital and its use will have an effect on electricity consumption. For example, at the onset of transition the huge drop in electricity consumption is mainly due to the drop in capacity utilization, the huge obsolescence effect accompanied by numerous closures of factories, decreasing investment and lack of funding for basic maintenance and repair (Dobozi and Pohl, 1996). On the other side, putting factories back to work again, which is usually accompanied by new investments and import of new equipment, by and large results in positive changes in electricity consumption.
- Secondly, electrical consumption will be able to capture the important aspect of the use of existing capital stock. The use of capital stock can be completely different from the quantity of available capital and usually is much more volatile than the capital stock itself (Costello, 1993). This is an important note relevant for capital movements in the course of transition, since there were huge discrepancies between the existing stock of capital and its usage in the different phases of transition. Namely, at the beginning of transition, although some capital stock was

there available for use, it was put out of use due to the huge obsolescence effect as shown in chapter 3, section 3.2.1.2 (Laski and Bhaduri, 1997). Conversely, in the later stages of transition, there were cases when machines and equipment were imported from abroad but could not be put in use due to the long starting business procedures (Kaufmann and Kaliberda, 1996). For this reason, the capital stock was not always overlapping with its utilization in the course of transition, which renders electricity consumption as a better proxy for the changes we want to capture in our model.

- Lastly, the electrical consumption data is a perfectly homogeneous input of invariant quality and, hence, presents no measurement problems related to the different value of various sorts of capital with respect of their age, level of obsolescence or industry (Costello, 1993).

Nevertheless, alongside the advantages, some criticisms may be levelled against this variable as a proxy for physical capital.

- Namely, the prices of electrical consumption were distorted by subsidy and so kept at a lower level than the market prices in some of the transition countries, since the electricity was the main energy source used by the households and business. Additionally, the subsidies were mainly directed towards the households' use of electricity consumption by differentiation of two tariffs, one subsidized for households and a market tariff for industry and business. Hence, the subsidizing effect can be isolated as it mainly had an impact on the household use of electricity, which on the other hand proved to be relatively constant in the course of transition. Even if it is assumed that the electricity subsidies were changed in later transition still only simple inspection of the energy consumption data suggests that: electricity consumption falls significantly at the beginning of transition, mostly due to the huge wave of factory closure, which could not have been saved even by relatively low energy prices; while, on the other hand, the electricity consumption even with subsidized prices could not have grown much in

later transition without the extension of limited capacities and costly new investments.

- In addition, in some studies, electricity consumption in transition studies was used in order to yield an estimate of the change in the size of the unofficial economy. Motivated by the work of Kaufmann and Kaliberda (1996), many studies used the difference between the growth rates of measured GDP and electricity consumption to estimate the size of the unofficial economy, which they define as “the unrecorded value added by any deliberate misreporting or evasion by a firm or individual (p. 83).”

Kaufmann and Kaliberda (1996) were the first to suggest that electric-power consumption can be regarded as a best physical indicator of economic activity due to its input dimension, that is, the idea that the electrical consumption feeds all the physical engines and machines used in production, or the so-called physical capital. Having this assumption in mind, we use electricity consumption as a proxy for the physical capital in the course of transition.

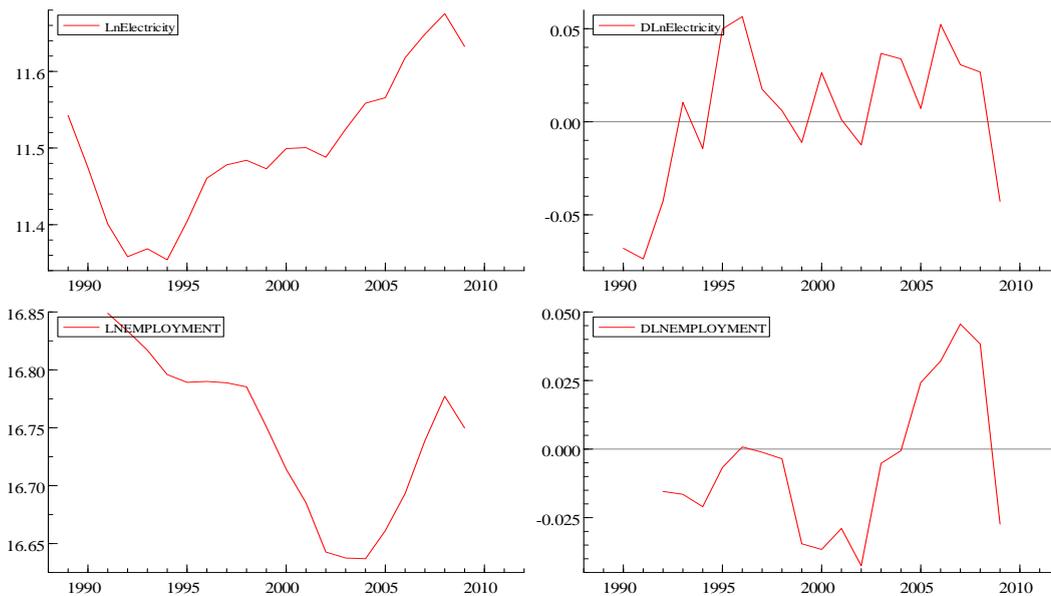
7.4.3 Testing for stationarity the control variables included in the multivariate model

As mentioned, the selection of control variables – employment growth rate and physical capital growth rate - is based on the theoretical model presented in chapter 4. In addition, in the previous section, we offered an extensive discussion on the use of the electricity consumption growth rate as a proxy for physical capital growth in our model. Nonetheless, the data we use in the following multivariate analysis remain limited by their availability for some countries.

Before proceeding with the multivariate analysis, we discuss and test the variables to be added to the model for stationarity. In order to illustrate the development of the variables above, we plot the data in levels and in first differences of the data series for

one country in Figure 7.4-1. Each panel of plots contain two series: the log-levels of each variable; and the first differences of the log-levels. The log-levels appear to show a trend rather than a constant mean, which indicates that the data are not stationary. In each case, the first differences of the log-levels apparently display a constant mean, indicating stationarity. Further, we test each variable for a unit root using EViews.

Figure 7.4-1 Data plots for log-levels (left-hand side) and first differences (right-hand side) for the variables for the Czech Republic (top panel – Electricity; lower panel – Employment)



Tests for stationarity rarely yield definitive results, even in the most favourable circumstances (Harris and Sollis, 2003). This applies particularly to the relatively short time spans and annual frequency of observations typical of time-series data from transition economies. In addition, the Perron-ADF test applied in Chapter 5 to test the unit root hypothesis for the GDP data series in the presence of structural breaks could

not be performed effectively on these two variables. This is because the employment and physical capital changes were less immediately and fully responsive to the big exogenous shocks, such as conflicts and wars (i.e. the break points required for the Perron-ADF test in Chapter 5). Visual inspection of the plots of the data suggested that employment and physical capital, both in levels and in growth rates, do not react to the “big” events, known from recent history, in any clear manner. If they do react then it is only with delay and with less pronounced changes. Conversely, as shown in Chapter 5, economic activity measured by GDP data in levels and growth rates typically shows a pronounced and rapid change when “major” events hit the economy. Accordingly, because the employment and physical capital variables do not so clearly develop through structural breaks in the manner of GDP and GDP growth, we do not attempt to apply the Perron-ADF procedure to these variables. Instead, to get an indication as to “whether the finite sample data used exhibit stationary or non-stationary attributes” (the “useful” purpose of unit root tests according to Harris and Sollis, 2003, p.77), we use the DF-GLS testing procedure to test each series for a unit root, hence for non-stationarity.

The DF-GLS test performs the modified Dickey–Fuller t -test that “optimises the power of the ADF unit root test by detrending” (Harris and Sollis, 2003, p.58). This test has “significantly greater power than the previous versions of the ADF test” (StataCorp, 2012, p.134). Essentially, the test is an augmented Dickey–Fuller test, except that the time series is transformed via a generalized least squares (GLS) regression before performing the test. The DF-GLS test, with and without a time trend, and with various lag orders, was initially implemented on the log-levels; and, after, DF-GLS with a constant was implemented on the first differences.

The full testing procedure and results for both variables for each of the 11 countries for which the multivariate analysis was conducted are reported in Appendix 7. 1 to this chapter. The results are summarized in the table below, where a cross indicates non-rejection of the unit root null and a tick rejection (and asterisks are used to indicate levels

of significance where results are not uniform at all conventional levels – these are fully explained in the Table key).

Table 7.4-1 Unit root test of the log-levels and growth rates of electricity consumption and employment

Country	Testing the log-levels of each variable				Testing the first differences of the log-levels	
	Constant and linear trend		Constant		Constant	
	Electricity y	Employment t	Electricity y	Employment t	Electricity	Employment t
Albania	x*	x*	x	x	√ all	√ all
Bulgaria	x	x	x**	x**	√**	√ all
Czech Rep.	√ all	x	x	x	√**	√ all
Hungary	x	x*	x*	√ all	√**	√ all
Latvia	x	x	x*	x	√*** (borderline)	√**
Estonia	x	x	x	x	√ all	x
Macedonia	x	√ all	x	√ all	√ all	√ all
Moldova	x	x	x**	x	√**	√ all
Poland	x	x**	x*	x*	√**	√ all
Turkmenistan	x	x	x*	x	√ all	√**
Ukraine	x	x	x	x	√***	√***

Note:

- √ all – unit root rejected at all conventional levels of significance
- √** - unit root rejected at 5% level
- √***- unit root rejected at 10% level
- x - unit root not rejected at all conventional levels
- x* – unit root not rejected at the 5% level
- x** - unit root not rejected at the 1% level

The lags are automatically selected according to the Schwarz information criterion.

These results confirm the judgement that the levels of the series are mostly non-stationary, but almost uniformly confirm that the first differences are stationary at standard levels of significance. Just for one country, Estonia, the unit root hypothesis could not be rejected for the first difference of the log level of employment (the t-statistics is -1.53 as compared to the critical value of -1.61 at the 10% level of significance). In addition, in the case of Latvia, for the first difference of the log level of electricity the unit root hypothesis rejection is on a borderline (namely, the t-statistic is -

1.59 as compared to the critical value of -1.61 at the 10% level of significance). This evidence suggests that it is reasonable to include the growth rates of these variables in our multivariate models on the assumption that they are stationary.

7.4.4 The choice of the model

Having in mind the estimation limitations due to data considerations, this section aims to conduct the multivariate analysis to answer the question as to whether multivariate analysis confirms or rejects the non-linearity of growth in the course of transition. However, this analysis is not able to identify the significance and the importance of the main growth determinants - i.e. growth in physical capital, labour and technical progress - in the various growth regimes in various countries' groups.¹⁹⁸ The admittedly restricted explanatory power of the analysis mainly is because the specified models could not converge and perform for all countries involved in the analysis; hence, only representative countries from each group could be included in the results.

In general, the analysis was conducted following the main guidelines of the modelling building procedure explained in section 7.3. Namely, a simple extension of the univariate model with the introduction of the two main variables - growth in physical capital and labour - was estimated as a MS-VAR in order to address possible endogeneity in the system following Equation 7.3-4. As discussed in section 7.2.3, the possible endogeneity is good reason not to report the multivariate single equation analysis.

¹⁹⁸ This might not be a severe limitation if the influence of capital and labour inputs comes through changes in their quantities rather than changes in their effects, which would have to be captured by regime-specific coefficients.

The data used are described in the previous section, while the estimations were performed using MS-VAR model in Ox Metrics, following the guidelines of Krolzig (1998). The choice of the preferred model with respect to the number of regimes was substantially guided by the information on the number of regimes obtained in chapter 6 (although the other alternatives were tested too), while the number of lags is one since we are dealing with annual data sets. No exogenous regressors were included in the basic specification.

The starting model was set as MSIH (s) –VAR (1), allowing the intercept and the variance to switch between three or two regimes. However, because of the large number of parameters, there were not enough degrees of freedom for estimation.

- Consequently, the coefficients of the lags of the growth of capital and labour are restricted to be the same in each regime.
- In addition, in most of the cases the model with switching intercept and switching variance parameters could not meet the convergence criteria, due to the huge number of parameters needed to be estimated from a limited amount of data. Hence, in those cases, it was decided for the variance not to be allowed to switch. The decision of losing information with respect to volatility was made on the account of the overriding priority of acquiring more information on the determinants.

The final model to be estimated in most cases was set as MSI (s) –VAR (1) allowing only for the intercept to switch between two or three regimes.

In the following Box 7.1, one country's modelling procedure example is presented.

Box 7.1 MS VAR estimation results for one country – Czech Republic

(Appendix 7.2, p.656 - 726)

In this box, one country estimation procedure is presented. It will be showed that the pursued procedure is similar to the one in univariate analysis; however, in this case the results are more suitable for visual inspection instead of numerical presentation specific for the univariate analysis results.

1. Firstly, in the case of the Czech Republic the MSIH (3)-VAR(1) model was tested in order to allow for switching intercepts and variance (see Appendix 7.1, First estimation, p. 722).
2. However, this model could not converge at all; hence, we proceeded with the MSI(3)-VAR(1) model, i.e. the same model as before though without switching variance (see Appendix 7.1, Second estimation). This model gave results that are further discussed.
 - Firstly, the linearity test was considered following the example of the univariate MS analysis and guidance from Box 6.1. This test is based on the likelihood-ratio statistic between the estimated model and the derived linear model and under the null hypothesis; the linear model is preferred (Doornik and Hendry, 2009). The first p-value is based on the conventional Chi-squared distribution, while the second is derived by Davies (1987). In all cases, the linearity test suggests that the model is significantly non-linear and that parameters switch between regimes (section 1, Appendix 7.1, p.723).
 - The remaining diagnostics is available only through visual checks which are given in Appendix 7.1, section 6, p.725. The same plots are given for each vector DY, DE and DC: the first left panel checks for serial correlation (indicated when bars exceed the band); the third panel checks for normality (the difference among the red and the blue curves); while the last panel provides evidence on the structural stability of the model (the 'distance' between the red and the blue line). The plots suggest that there are no problems with serial correlation, normality or stability of the model.
 - Section 2 of Appendix 7.1, p. 723 gives the regime probabilities and persistence indicators in the first part and regime properties in the second one given by the overall probability of each regime and its duration. As can be seen, the regimes are relatively persistent with 0.58, 0.79 and 0.75 probability that they will remain within the regime.
 - Section 4, p. 724 gives the contemporaneous correlation of the variables used, while section 7 gives the actual and fitted values, that is gives an idea whether the fitted model presents the actual values relevantly. As can be noticed, the GDP growth rate is positively correlated with gross fixed capital formation growth rate (0.63), while negatively but weakly correlated to the movements in the employment growth rate (-0.24).
 - Finally, section 3 and 5 (p. 723 and 724) describe the regimes more closely. Namely, section 3 gives the estimated coefficients, while section 6 gives the regime identification and also graphical presentation of it, with the first graph presenting the

variables' movements, the second presenting the first identified regime (area with the bars), the third graph –the second regime (area with the bars), and finally the fourth graph- the third identified regime (area with the bars). This graphical presentation is accompanied by the regime periodization given above the graphs.

3. In the cases where MSI (3)-VAR (1) model could not perform, we proceeded with the MSIH (2)-VAR (1) model with switching intercepts and switching variance between 2 regimes, and finally in the cases where that model could not perform it was finished by MSI (2)-VAR (1) model with switching intercepts only. The individual results for separate countries of each group are presented in Appendix 7.2, p. 727 - 748.

After performing the estimations, attention is focussed on two main aspects in explicating the results:

- Whether the results from multivariate analysis differed significantly from the univariate analysis; and,
- What general conclusions can be inferred from the multivariate analysis.

7.5 Univariate vs. multivariate results

7.5.1 Univariate vs. multivariate analysis – Czech Republic

Before going into the general analysis, at this instance a simple comparison between the Czech Republic univariate and multivariate results will be performed. The intention is to distinguish whether the extended multivariate model depicts a GDP broken growth picture similar to the univariate model or possibly it depicts a broken growth pattern characterised by more or less number of regimes as compared to the univariate model? In order to do so, the comparison will refer to results of the univariate model of the Czech Republic presented in Appendix 6.2, p. 554 and Appendix 7.1, p.723. For convenience, some of the results are reproduced in this section.

It was already established that both models meet the criteria of the linearity test and of the various diagnostic tests, hence, the focus here is on the regime classification and periodization, as well as on the estimated coefficients' similarities or differences.

Below, Table 7.5-1 shows the equations used in order to estimate the models. Evidently, the equations are different producing different sets of results. Hence, in the analysis, only an indirect comparison of the results can be performed; more reliable in the cases when the periodization of the regimes overlapped, and only indicative in the cases when regime periodizations did not overlap. We shall return to this remark later in the text.

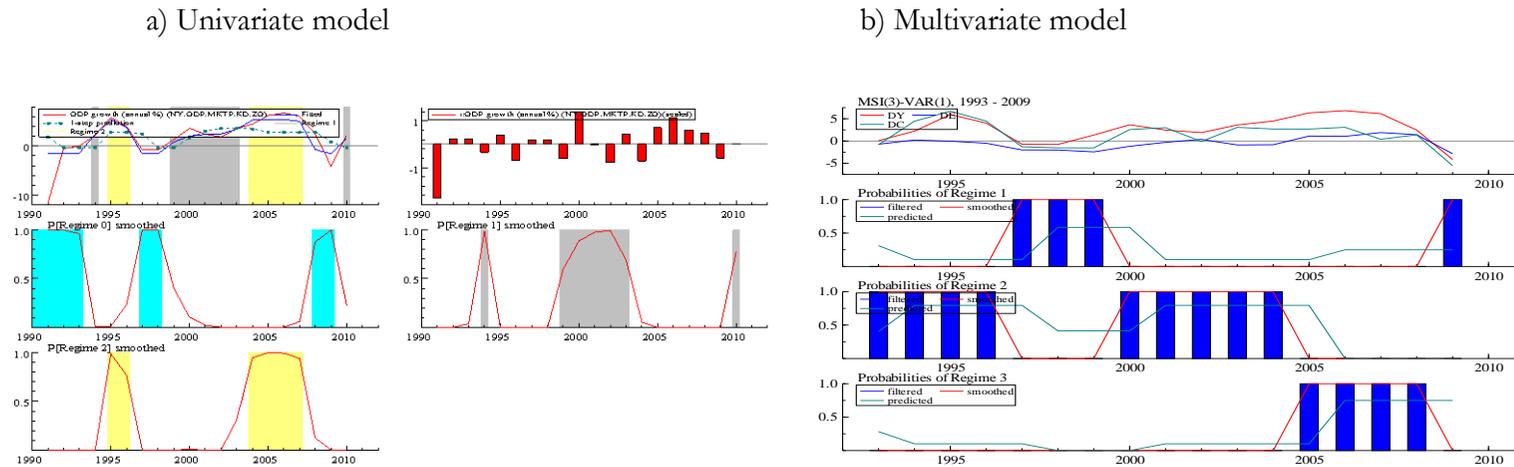
Table 7.5-1 The estimated equations in both models

Univariate model	Multivariate model
<p style="text-align: center;">Equation 6.3-6</p> $\% \Delta GDP_t = \alpha_0(s_t) + u_t(s_t),$ $u_t \sim N(0, \sigma_{s_t}^2)$	<p style="text-align: center;">Equation 7.5-1</p> $y_t = \alpha(s_t) + \sum_{i=0}^p \beta_i(s_t)x_{t-i} + \sum_{i=1}^p \chi_i(s_t)y_{t-i} + u_t;$

Note: Both equations preserve the appropriate notation as explained in their respective explanations on pages 265 and 348.

In Figure 7.5-1 below, the left-hand panel (A) presents the univariate results and the right-hand panel (B) the multivariate model results with respect to regime classification. In both panels, of interest are the last three graphs in each panel that show the first, second and third regimes separately. The y-axis in the first figure represents the growth rate and the x-axis is the time scale. The figure is accompanied by the appropriate Table 7.5-2 that shows the periodization of regimes for both models.

Figure 7.5-1 Comparison between univariate and multivariate regime classification



Note: The graphs are taken from the original output. However, of interest here is the comparison of the regimes:

- The first regime appears marked in light blue in graph 3 in the left-hand panel and in graph 2 in the right hand panel.
- The second regime appears marked in grey in graph 4 in the left-hand panel and in graph 3 in the right-hand panel.
- The third regime appears marked in yellow in graph 5 in the left-hand panel and in graph 4 in right-hand panel.

Table 7.5-2 Periodization of the regimes according to both models

Periodization of regimes (in years):	Univariate periodization	Multivariate periodization
First regime	1990-93; 1997-98 ; 2008-09	1997-1999, 2009 (1990-92–missing)
Second regime	1994, 1999-2003, 2010	1993-1996; 2000- 2004; (2010-missing)
Third regime	1995-96, 2004-2007	2005-2008

Visual inspection of the graphs and table above reveals an interesting depiction. First of all, both models, univariate and multivariate, have identified three regimes. In general, it can be noticed that the regime classification overlaps in large part in both panels; though taking into account that the period 1990-93 and the year 2010 are not presented on the right-hand panel due to lack of data. In addition, the dating of the regimes is slightly mismatched as explained below, with the second regime in the multivariate analysis absorbing a small portion of the third regime in mid-transition (1995-96) as captured by the univariate analysis. Namely, if we take into account that the period from 1990 -1993 and year 2010 (marked in the table above) is missing in the second panel, we observe the following.

- The first regime is overlapping in both panels with it starting from 1997 for 2 (or 3) years in first (or second) graph. It repeats again in late transition in both cases, starting in 2008 and lasting two years in univariate results and only in 2009 in the multivariate results (given in right-hand panel).
- The second regime depiction is interesting, because the end of the second regime overlaps in both panels i.e. the year 2003 (or 2004 in the left-hand panel). However, the second regime as depicted in the right-hand panel somehow looks like it absorbs the small high-growth period (the third regime in yellow) recorded between 1995-1996 in the left-hand panel. Hence, according to the multivariate analysis, in mid-transition no third regime was recorded in opposite to the univariate analysis in which it was occurring in both 1995-96 and again in 2004-2007.
- Finally, the third regime in both panels partly overlaps at the end of transition, starting 2004 or 2005 and lasting only for 3 years. However, as mentioned, in mid-transition the third regime (i.e.1995-96) is captured only in the univariate analysis.

These changes are due to the introduction of the additional variables in the model, which have affected the regime identification with their own dynamics.

Since the regime periodization is similar, the estimated coefficients can be observed in comparison in order to see what sort of changes dominated each regime. Though it should be kept in mind that the univariate and multivariate models are completely different models, not only by the introduction of the other variables in the model but also due to the fact that the variance could not be allowed to switch within the multivariate model. In addition, the estimation technique performed differently in both models. As a result, the constant coefficient conceptually differs in both models as Table 7.5-1 above shows. While in the first univariate model, it captures the mean GDP growth rate for each regime, in the second – multivariate model - it captures the so-called Solow residual as mentioned before as well as all other systematic changes that are not captured by other variables.¹⁹⁹ However, as the periodization overlap in both models some general indirect conclusions can be made.

The comparison of the estimated coefficients is given in Table 7.5-3 below. The coefficients in Table 7.5-3 for the MS VAR are from the first equation in the system, i.e. the one with DY on the left hand side.

¹⁹⁹In fact, according to the multivariate analysis the fitted growth rate in each year can be calculated as sum of the intercept or Solow residual, plus the growth rate of physical capital in the previous year multiplied by the estimated coefficient of DC_1, plus the growth rate of labour in the previous year multiplied by the estimated coefficient of DE_1, plus the growth rate of GDP in the previous year multiplied by the estimated coefficient of DY_1, plus the error term. These are the estimated or the fitted values from the model that is reported.

Table 7.5-3 Comparison of the estimation results - Czech Republic

		Univariate model (Appendix 6.2, p. 554)		Multivariate model (Appendix 7.1, p.656)	
		Constant coefficients (mean GDP growth rate, in per cent) (1)	Volatility (in per cent) (2)	Constant coefficients (Technical progress or Solow residual, in per cent)(3)	Volatility ²⁰⁰ (in per cent)(4)
First regime		-1.59	4.33*	-1.63***	1.29
Second regime		2.50*	0.78**	2.59*	1.29
Third regime		5.51*	1.14***	7.33*	1.29
Introduced variables:	DY_1			-0.44	
	DE_1			-0.81**	
	DC_1			0.63**	

Note: The estimated coefficients on DY_1, DE_1 and DC_1 given in column 3 present the estimated coefficients on the once lagged variables .

(*) – marks significance at 1% level of significance, (**) – marks significance at 5% level of significance, (***) – marks significance at 10% level of significance.

Because the comparison is made among different models, the conclusions are drawn only indirectly and should be considered with great caution.

1. However, the one general conclusion that can be made with great certainty is that the multivariate analysis does confirm the notion of non-linearity of GDP growth in the course of transition. In addition, it confirms the existence of three regimes, similar to the univariate model. The estimations suggest that regimes or stages of transition can be identified even when other variables are included in the analysis. We shall return to this remark later in the analysis.

²⁰⁰The preferred multivariate MS VAR model for Czech Republic was set as $MSI(x_t) - VAR(1)$ with switching intercept between 3 regimes; hence the variance is restricted to be the same for all three regimes.

2. Secondly, the technical progress changes (column 3) in sign and sizes are similar to the mean GDP growth rates as identified by the univariate model (column 1), suggesting negative changes and ‘technical regress’ in the first regime and positive changes or ‘technical progress’ in the next two regimes, with the third regime experiencing the highest positive changes, which was in accordance with the expectations of the theoretical model developed in chapter 4.
3. Thirdly, the size of the estimated constant coefficients in the multivariate analysis reveals a huge impact of the ‘technical progress’ or Solow residual (column 3) on GDP growth rates in the various regimes, with it being the most prominent and positive in the third regime. Again, this was implied by the theoretical model, claiming that the switch among regimes will come as a result of the moving of the country among various balanced growth patterns different by their specific level of technology (see Figure 4.5-2 in chapter 4).
4. Fourthly, the impact of other variables on the GDP growth rate can be inferred from the results.
 - Namely, the once-lagged GDP growth rate (DY_1) is statistically insignificant, which is an unexpected outcome as usually the GDP growth processes in developed countries are described as an autoregressive processes. However in the case of transition where big switches in GDP growth rates from one to another in successive year were experienced, this result is perhaps not surprising. As a matter of fact, this argument was advanced in section 6.3.3.1, chapter 6, where the non- introduction of lags in the univariate MS analysis was discussed.
 - The once-lagged Employment growth rate (DE_1) has a negative and statistically significant impact, according to the results. In addition, every increase by 1 percentage point in the previous year’s employment growth rate causes a 0.81 percentage points decrease in the contemporary GDP growth rate.²⁰¹ This is rather counterintuitive, since it implies that the

²⁰¹ For example, if the employment rate in 2000 was 2 per cent, its increase by one percentage point or by 50 per cent to 3 per cent should cause around a 40 per cent decrease ($50\% \times 0.81$) in

decrease in employment should lead to increase in GDP growth rates. However, there are two possible lines of argument peculiar to transition that may explain this atypical effect:

- Firstly, in the course of transition, the actual increase of economic activity was achieved parallel with the decreasing of the employed labour force as the actual data of many countries on GDP growth and employment growth shows. In fact, in early transition, as a result of the over employment specific for socialism, the reduced employment did not reduce the output, because reduced employment was part of a process of dramatic structural change, hence of reallocation of resources that – even at a constant technical level – enabled productivity growth sufficiently large to increase output as it was discussed in our theoretical model in chapter 4 (in the first crash stage of transition). In addition, the reduced employment reduced the wages' bills for the firms, releasing extra funds for raise in the production. Both lines of argumentation fit better the early rather than the later transition, which would suggest that in the estimated coefficient dominates the effect of the early transition. In fact, the estimated coefficient aggregates different effects as it was not allowed for it to switch across various regimes²⁰²; however in this case it is capturing mostly the effects of the early transition rather than the later. Namely, in this case, our employment growth variable may be acting as a proxy for productivity-enhancing structural change. Unfortunately, data limitations, and the corresponding limitations on the richness of our model, preclude further investigation of this possibility.
- The second explanation is empirical but is related to the one given above, i.e. to the economic explanation. Namely, the whole interpretation of the results needs to be observed in a system in which everything depends on everything, since everything is modelled in a small VAR system. Further investigation would lead to impulse response analysis that cannot currently be performed

the GDP growth rate for 2001. Namely, if the growth rate in 2001 is assumed to be 2 per cent, the GDP growth rate decreases to 1.2 per cent i.e. $(2-40\%*2)=1.2$.

²⁰² Switching lagged variables would burden additionally the otherwise overburdened models.

in the context of our MS-VAR model. In addition, the employment and GDP dynamics are not the focus of our research.

- Finally, the once-lagged Gross Fixed Capital growth rate (DC_1) impact on the current GDP growth rate is positive and statistically significant. Every increase in physical capital by 1 percentage points in the past year will result in increase in the contemporary GDP growth rate by 0.63 percentage points.²⁰³ This effect is in accordance with our model and the transition literature findings.

Finally, as mentioned above, the results of the multivariate analysis do not tell anything about the direct effect of contemporaneous variables such as employment and physical capital growth rates on GDP growth. However, some indirect conclusions on their impact on GDP growth can be made based on the estimated coefficients of the vectors on employment growth rate (DE) and physical capital growth rate (DC) given in Appendix 7.1., p.656 for the case of Czech Republic. These results are summarized in the following Table 7.5-4, where the three columns represent the estimated coefficients of the three vectors: annual GDP growth rate (DY) in column 1, employment growth rate (DE) in column 2 and physical capital growth rate (DC) in column 3.

Table 7.5-4 Estimated coefficients using MS VAR for the Czech Republic

	DY (in per cent) (1)	DE (in per cent) (2)	DC (in per cent) (3)
Constant (Reg.1)	-1.62***	-2.13*	-2.64**
Constant (Reg.2)	2.59*	-0.17	2.77**
Constant (Reg.3)	7.32*	2.21*	4.01***
DY_1	-0.44	-0.21***	-0.54
DE_1	-0.81**	0.07	-0.44
DC_1	0.63**	0.16**	0.64**
SE(in per cent)	1.29	0.38	1.61

²⁰³ For example, if the GFC growth rate in 2000 was 5 per cent, its increase by one percentage point or by 20 per cent, to 6 per cent should cause around a 12 per cent increase in the GDP growth rate ($20\% \times 0.63$) for 2001. Namely, if the growth rate in 2001 is assumed to be 1 per cent, the GDP growth rate rises to 1.12 per cent.

(*) – indicates significance at 1% level of significance, (**) – indicates significance at 5% level of significance and (***) – indicates significance at 10% level of significance.

Several conclusions can be drawn from the estimated results:

1. The employment growth rate (DE) also experienced switches with it recording a negative intercept in the first and the second regime (though insignificant in the second) and positive intercept only in the third regime. In the terms of our theoretical model, this finding would suggest that within the first stage of transition, employment recorded systematic negative changes which turn into positive change in the later transition. Interestingly, the negative relation among Employment and GDP growth rates is confirmed in reverse order. Namely, the past GDP growth rate exerts negative and significant impact on the contemporary employment growth rates. Every increase in past GDP growth rate by one percentage point causes decrease in the employment growth rate by 0.21 percentage points. Conversely, the previous growth rate of the physical capital stock has a statistically significant and positive effect on the employment growth rate. Namely, every one percentage point increase in the past DC growth rate causes an increase in the Employment growth rate by 0.16 percentage points. The past employment growth rate does not exert any impact on the contemporary employment growth rate according to the results. In general, this variable experiences the least volatility measured by the standard error of 0.38 per cent.
2. The physical capital growth rate (DC) experienced similar switches as the GDP growth rate with respect to the sign and size of the changes: negative intercept term in the first regime and positive intercept term in the second and even higher positive intercept in the third regime, all statistically significant. Again, this movement confirms the idea that also the physical capital experienced switches similar to the GDP growth rates, which is in accordance with our theoretical model developed in chapter 4, where at the beginning some technical regress or mass obsolescence was recorded followed by adoption of free technology and import of technology later on. The lagged variables on the GDP growth rate and the employment growth rate are

not significant, while there is some positive influence of the previous year's physical capital growth rate on the contemporary physical capital growth rate. Namely, every increase in physical capital growth rate by one percentage point in the previous year causes an increase in the contemporary physical capital growth rate by 0.64 percentage points²⁰⁴. As can be noticed, this is the most volatile vector, with volatility of 1.61 per cent.

In general, the results for the Czech Republic are in line with the theoretical model developed in chapter 4. They do confirm the idea that not only did GDP growth rates experience switches of regime, but also that the physical capital and employment growth rates experienced such switches, contributing to the overall non-linear pattern of GDP growth. In addition, the impact of the past physical capital growth rate is always positive and significant, not only on GDP growth rates, but also on the other two vectors in the analysis. That is past increase in physical capital stimulates increases in contemporary investments and employment. Conversely, past employment growth rates seem to have no impact on contemporary employment or physical capital growth rates, which would suggest that the labour market situation was not of primary importance for the contemporary investments. Finally, the negative relationship between the GDP growth rate and Employment growth rates empirically confirms the specific conditions as explained above, prevalent for the course of transition.

This comparison of the univariate and multivariate results for one country is suggestive, as it confirms our concept of non-linear growth regimes in the course of transition. Remarkably, the number of the regimes identified by the both models is same and their periodization is similar to some extent. In addition, the comparison confirms some of

²⁰⁴ For example, if the GFC growth rate in 2000 was 5 per cent, its increase by one percentage point or by 20 per cent to 6 per cent should cause around a 13 per cent increase in the GDP growth rate ($20\% \cdot 0.64$) for 2001. Namely, if the growth rate of GFC in 2001 is assumed to be 6 per cent, the GDP growth rate rises to 6.78 per cent.

the peculiarities of transition, especially related to labour market adjustments. Although for more general conclusions, the exercise needs to be repeated for the rest of the countries in order to be able to lead to relevant conclusions for separate groups of transition countries.

7.5.2 Univariate vs. multivariate analysis – Latvia

In addition to the Czech Republic, a comparison between Latvia's univariate and multivariate results will be performed. In this case, as it will be shown later, the multivariate model depicts a completely different GDP broken growth picture from the one given by the univariate model in the sense that it identifies different number of regimes. Namely, the multivariate analysis identifies only two regimes, as compared to the univariate analysis that have identified three regimes. Similarly as above, the comparison will refer to the results of the univariate model for Latvia presented in Appendix 6.2, p. 575 and Appendix 7.1, p.727. For convenience, some of the results are reproduced in this section.

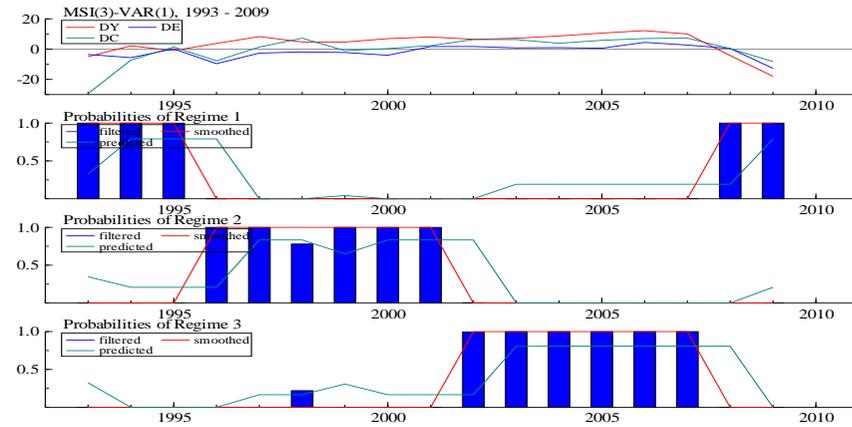
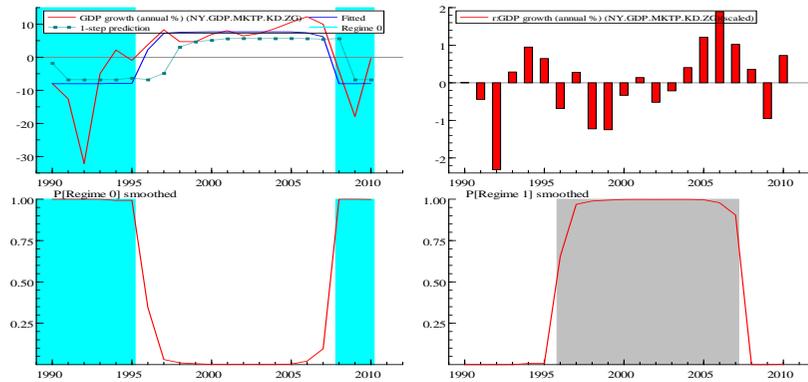
Firstly, the regime classification and periodization is observed, as well as the estimated coefficients. In Figure 7.5-2 below, the left-hand panel (A) is presenting the univariate results and the right-hand panel (B) is presenting the multivariate model results with respect to regime classification. The y-axis in the first figure represents the growth rate and the x-axis is the time scale.

The figure is accompanied by the appropriate Table 7.5-5 that shows the periodization of regimes for both models.

Figure 7.5-2 Comparison between univariate and multivariate regime classification

A) Univariate model

B) Multivariate model



Note: The graphs are taken from the original output. However, here of interest is the comparison of the regimes:

- The first regime appears marked in light blue in graph 3 in the left-hand panel and graph 2 in the right hand panel.
- The second regime appears marked in grey in graph 4 in the left-hand panel and graph 3 in the right-hand panel.
- The third regime is not identified in the left-hand panel but it is identified in graph 4 in the right-hand panel.

Table 7.5-5 Periodization of the regimes according to both models

Periodization of regimes (in years):	Univariate periodization	Multivariate periodization
First regime	1990-95; 2008-10	1993-1995; 2008-10
Second regime	1996-2007	1996-2001
Third regime		2002-2007

Visual inspection of the graphs reveals a different story in both graphs. Namely, as mentioned, the multivariate analysis allowed for one additional regime in this country case, which is due to the introduction of the additional variables in the model. If we take into account that the period from 1990 -1993 and the year 2010 is missing in the second panel, it becomes obvious that:

- The first regime is overlapping in both panels with it ending in 1995, and again reappearing in 2008 and lasting for 2 years in both panels.
- The second regime depiction is interesting because in this case opposite to the previous case of Czech Republic, the multivariate model splits the second regime as depicted in the univariate analysis into two separate regimes. Namely, the second regime in the multivariate analysis starts in 1996 and lasts until 2001 and it is relatively short lived as compared to the univariate analysis where the second regime lasts until 2007.
- Finally, the third regime is identified only in the multivariate analysis, lasting from 2002 until 2008.
- In general, it is difficult to draw conclusion about the extend of overlap among these two models because the later model identifies three regimes as oppose to the two regimes identified in the univariate model. However, the first regime is the most coinciding one in this case.

In addition, the estimated coefficients can be observed in comparison in order to see what sort of changes dominated each regime. Again, a note of caution is preserved as the models are different not only in the estimated coefficients, unrestricted or restricted variances but also in their periodization; hence again the results can be discussed only with caution.

The comparison of the estimated coefficients is given in Table 7.5-6 below. The coefficients for the MS VAR are from the first equation in the system, i.e. the one with DY on the left hand side.

Table 7.5-6 Comparison of the estimation results - Latvia

	Univariate model (Appendix 6.2, p. 575)		Multivariate model (Appendix 7.1, p. 727)	
	Constant coefficients (mean GDP growth rate, in per cent) (1)	Volatility (in per cent) (2)	Constant coefficients (Technical progress or Solow residual, in per cent)(3)	Volatility ²⁰⁵ (in per cent)(4)
First regime	-7.99**	10.44*	-7.91*	2.84
Second regime	7.71*	2.38*	4.25**	2.84
Third regime			8.88*	2.84
Introduced variables:	DY_1		0.306**	
	DE_1		-0.159	
	DC_1		-0.404**	

Note: The estimated coefficients of DY_1, DE_1 and DC_1 given in column 3 present the lagged variables accompanied by their estimated coefficients. (*) – marks significance at 1% level of significance, (**) – marks significance at 5% level of significance, (***) – marks significance at 10% level of significance.

Several conclusions can emerge from this comparison:

- Again, the multivariate analysis confirmed the idea of different regimes in GDP growth in the course of transition. However, in this case, we have the peculiarity that the number of the identified regimes changed with the introduction of the other variables in the model. Namely, while the univariate analysis identified three regimes, the multivariate analysis identified only two regimes.
- Secondly, the technical progress changes (column 3) in sign and sizes are similar to the ones identified in the case of Czech Republic, suggesting negative intercept term and ‘technical regress’ in the first regime and positive intercept term or ‘technical progress’ in the next two regimes, with the third regime experiencing the highest positive intercept term. If compared to the univariate analysis, the multivariate analysis in the case of Latvia identifies one additional regime, splitting the second

²⁰⁵The preferred multivariate MS VAR model for Latvia was set as $MSI(s_t) - VAR(1)$, similarly to the Czech Republic’s model, with switching intercept between 3 regimes; hence the variance is restricted to be the same for all three regimes.

regime from the univariate analysis into two distinct regimes, while the first regime seems to overlap in the respective periodization. This result places Latvia among the small number of countries that managed to record three regimes according to the multivariate analysis.

- Thirdly, the impact of other variables on the GDP growth rate can be inferred from the results.
 1. Namely, the once-lagged GDP growth rate (DY_1) is statistically significant and positive. Namely, in the case of Latvia every increase of the past GDP growth rate by 1 percentage point causes increase in the contemporary GDP growth rate by 0.31 percentage points.
 2. The once-lagged Employment growth rate (DE_1) has a negative but statistically insignificant impact, while
 3. The impact of once-lagged Gross Fixed Capital growth rates (DC_1) on current GDP growth rates is negative and statistically significant, which again is a counter-intuitive result. Namely, every increase in physical capital for 1 percentage point in the past year will result in decrease in GDP growth rate by 0.40 percentage points. This is a rather unexpected effect that is not in accordance with our model and the transition literature findings. This inconsistent effect is only found in one more country, Bulgaria, and it is probably due to the small sample size and small empirical system in which the interpretation needs to be observed in a context where everything depends on everything else. In addition, as mentioned, the once-lagged variable on Gross Physical capital has not been allowed to switch between regimes due to the limitations of the modelling procedure. As a result this might have led to the confusion of the dynamics of the variable, by smoothing the long-run variation in GFC growth rates, leaving higher frequency variation (such as within one specific regime) to determine the estimate for the whole period for which the magnitude and possibly the signs might be different from the long-run ones (Kennedy, 2005). Durlauf and Quah (1999) made a similar point in the context of estimating the determinants of economic growth. Namely, they argued that the short-run variations (such as business cycles) can overpower the long-run

variations in growth rates depending on the estimation method. For example, they suggested that the cross-country panel method removes the individual effects removing also the long-run variation (i.e. across countries) in growth rates, which might result in higher frequency data of the business cycle to dominate the estimates which also eventually can result in wrong sizes and signs

Finally, as mentioned above, the results of the multivariate analysis lack information on the direct effect of contemporaneous variables such as employment and physical capital growth rates on GDP growth. Again, some indirect conclusions on their impact on GDP growth can be made based on the estimated coefficients of the vectors on employment growth rate (DE) and physical capital growth rate (DC) given in Appendix 7.3, p. 727 for the case of Latvia. These results are summarized in the following Table 7.5-4, where the three columns represent the estimated coefficients of the three vectors: annual GDP growth rate (DY) in column 1, employment growth rate (DE) in column 2 and physical capital growth rate (DC) in column 3.

Table 7.5-7 Estimated coefficients using MS VAR for Latvia

	DY (in per cent) (1)	DE (in per cent) (2)	DC (in per cent) (3)
Constant (Reg.1)	-7.91*	-3.99**	-4.89*
Constant (Reg.2)	4.25**	-5.46*	-5.12*
Constant (Reg.3)	8.88*	1.36	-0.26
DY_1	0.31**	0.14	0.83*
DE_1	-0.16	-0.51	-0.53**
DC_1	-0.40**	0.03	-0.02
SE(in per cent)	2.84	3.02	1.5

(*) – indicates significance at 1% level of significance, (**) – indicates significance at 5% level of significance and (***) – indicates significance at 10% level of significance.

Several conclusions can be drawn for the additional two vectors:

1. The employment growth rate (DE, column 2) also experienced switches with it recording negative and statistically significant intercept terms in the first and the second regime (similarly to the Czech Republic) and positive intercept only in the

third regime though insignificant. The previous growth rates on the lagged variables have no influence at all, which again suggest that the labour markets evidenced peculiar adjustments in the course of transition as explained in our theoretical chapter 4. In general, this is the variable that experience the highest volatility measured by the standard error of 3.02 per cent.

2. The physical capital growth rate (DC, column 3) experienced switches, characterised by a negative intercept term, which are statistically significant in the first and the second regimes, while the third regime intercept is not significant. This could suggest that the obsolescence effects in this case was prolonged lasting in the course of the first two regimes. In this case the lagged variable on GDP growth rate has a positive significant impact, suggesting that every increase in the past GDP growth rate by one percentage point will result in increase in the contemporary physical capital growth rate for 0.83 percentage points. In contrast, the past employment growth rate has a statistically significant and negative impact on the physical capital growth rate. Namely, every decrease in the past employment growth rate by one percentage point causes an increase in the contemporary physical capital growth rate by 0.53 percentage points. In economic terms, this relation seems contra intuitive, but as already mentioned, the transition countries labour market adjustments are peculiar, mainly due to the over employment inherited from the previous system. Hence, as it was argued the increase of GDP and Physical capital growth rates can be accompanied by the decrease in Employment growth rate. As can be noticed, this is the least volatile vector, with standard deviation of 1.5 per cent.

The results for Latvia show that the regime switches identification can change drastically once the two additional variables are included in the analysis. This change is not so drastic in terms of the sizes of the estimated coefficients, but rather in the different number of the identified regimes. As mentioned the three regimes as identified by the univariate analysis, are downsized to two regimes in the multivariate analysis in this country case. Although depicting different picture again these results confirm that transition can be observed as separate switches between various regimes.

7.6 The condensed results

This section will condense the results of the multivariate analysis into one global depiction, in order to extract additional information, different from but complementary to the results of the univariate analysis, and to draw some general conclusions. However, it should be noted that the model converged only in the case of 11 countries from the full sample and, therefore, results are reported for these countries only in Appendix 7.2. The limited number of countries limits the scope of this analysis too, as the conclusions are being made only on the significant coefficients estimated for the included countries. Nevertheless, this analysis brought forward some additional evidence, though the inferences should be treated cautiously.

In order to summarize, the results from Appendix 7.2 of the multivariate analysis performed on each country are given in Table 7.6-1 below. In the table, individual country results are presented in a separate row, while the averages are calculated for:

- the ‘newly’ identified groups: namely, the new 2-regime and new 3-regime groups; together with their subgroups: the new 2-regime group minus Hungary, and the new 3-regime group plus Hungary²⁰⁶; and,
- the ‘old’ groups - the rapid-J 3-regime group, the rapid-J 2-regime group, the slow-J 2-regime group and the incomplete-U 2-regime group.

The table reports the estimated coefficients, that is the results for the DY vector, i.e. annual GDP growth rate, where

²⁰⁶ The reasoning for creating the two subgroups are discussed further in the following text.

- the constant term captures the so-called Solow residual or change in the GDP growth rate due to systematic changes not captured in the model variables (column 1, 2 and 3 for all three regimes);
- DY_1 captures the impact of the past GDP growth rate on the contemporary GDP growth rate (column 4);
- DE_1 captures the impact of the past employment growth rate on the contemporary GDP growth rate (column 6);
- DC_1 captures the impact of the past physical growth rate on the contemporary GDP growth rate; and (column 5); and
- SE measures the standard error, which in this case is the indicator for measuring the volatility of the GDP growth rate variable (column 7).

In addition, column 8 gives the latest data on real GDP per capita (constant US \$) for 2011 (World Bank, 2012). The idea is to determine which countries - 'successful' or 'lagging' - actually fitted the newly established categorisation groups.

In this research we are primarily interested in the regime switches and changes that happened in the GDP growth rates, hence the focus will be on these results. The results on DE and DC show the dynamics and regime switches for the Employment and Physical capital growth rates, but these are not our primary interest.

Table 7.6-1 The condensed results from the multivariate analysis DY (GDP annual growth, in per cent)

Country	Constant 1 (1)	Constant 2 (2)	Constant 3 (3)	DY_1 (4)	DC_1 (5)	DE_1 (6)	SE (7)	Real GDP per capita(current US \$ for 2011) (8)
Czech Rep.	-1.62***	2.59*	7.32*	-0.44	0.63**	-0.81**	1.29	20 407
Latvia	-7.91*	4.25**	8.88	-0.31**	-0.40**	-0.16	2.84	12 726
Poland	0.95	3.52**	3.32**	0.42***	-0.05	-0.01	1.10	13 463
Estonia	-7.79*	-0.20	3.98**	0.64*	0.01	-0.93***	2.95	16 556
3-reg. rapid-J group (unweighted average)	-5.77	3.45	4.87	0.25	0.12	-0.87	2.05	15 788
Hungary (a specific case)	-1.42	2.19**		0.505***	0.00	0.01	1.86	14 044
Albania	3.19	5.85*		0.27	-0.09	-1.35***	4.14	4 030
2-reg. rapid-J group (unweighted average)	†	4.02		0.51	†	-1.35	3.00	9 037
Bulgaria	-1.16	6.39*		0.22	-0.36**	-0.53**	2.20	7 158
Macedonia	0.19	3.73**		0.36**	-0.16	-0.17	2.41	4 925
Turkmenistan	-12.68*	9.34*		0.08	-0.03	1.73**	3.26	4 722
2-reg. slow-J group (unweighted average)	-12.68	6.49		0.36	-0.36	0.60	2.62	5 602
Ukraine	-13.04*	6.05**		-0.14	0.40	-2.58**	4.21	3 615
Moldova	-6.03***	9.07**		-0.36**	0.28***	0.56	5.75	1 967
2-reg. incomplete-U group (unweighted average)	-9.54	7.56		-0.36	0.28	-2.58	4.98	2 791
New 2-regime group (unweighted average)	-10.58	6.09		0.17	-0.04	-0.68	3.40	5 780
New 3-regime group (unweighted average)	-5.77	3.45	4.87	0.25	0.12	-0.87	2.05	15 788
New 2-regime group minus Hungary (unweighted average)	-10.58	6.74		0.00	-0.04	-0.68	3.66	4 403
New 3-regime group plus Hungary (unweighted average)	-5.77	3.45	4.34‡	0.31	0.12	-0.87	2.01	15 439

Note: *-marks 1% level of significance, **-marks 5% level of significance and ***-marks 10% level of significance. † - The averages are being estimated based only on the significant coefficients estimated for the included countries, hence in the two marked cases where the estimated coefficients were insignificant the average values are missing. ‡ - The coefficient of the constant 2 for Hungary is included in the calculation of the average constant for the third regime, i.e. average constant 3, in accordance with the explanations given further in the text. Real GDP per capita in column 8 is in current US \$ for 2011.

As the table shows, the multivariate analysis confirms the idea of the non-linear growth hypothesis and reveals that all 11 countries for which the model could be estimated have experienced various regime switches in the course of transition. For the rest of the countries the tested models could not converge at all, probably because of overburdening of the available data.

The results can be observed according to the ‘old’ country groups established in chapter 2 in parallel to the ‘newly established groups’ according to the multivariate analysis, regarding the two main groups of countries and their subgroups.

- The *new 3 – regime group*, which is substantially changed and consists of 4 countries: Poland; the Czech Republic; Estonia; and Latvia (a previously slow-J country).
- The *new 2 – regime group*, which consists of:
 1. The 2-regime *incomplete –U group* countries, the Ukraine and Moldova;
 2. The 2-regime *slow-J group* consisting of Macedonia, Bulgaria and Turkmenistan; and,
 3. The 2-regime *rapid-J group* consisting of Hungary and Albania.

One country – Hungary - appears to be a specific case as it will be discussed later; hence in the further analysis it will be considered within two additional subgroups – the 2-regime group minus Hungary and the 3-regime group plus Hungary, in order to see whether the results change drastically or not.

7.6.1 The 'new 3-regime group'

As can be noticed from the group's average results, the 'new three-regime group' of countries fits the theoretical model predictions the best. The empirical model for this group identifies three various regimes for the GDP growth rates (results reported for DY) in which:

1. The constant terms or so called Solow residual records negative change for the first regime, or technology regress, and increase in the second regime followed by a larger increase in the third regime. This is very much in line with the theoretical model assumptions that predicted negative changes in technology in the first regime and positive and increasing changes afterwards in mid and later transition.
2. On average for this group, the past GDP growth rates exert positive and statistically significant impact. Namely, every one percentage point increase in the past GDP growth rate contributes to increase in the contemporary GDP growth rate by 0.25 percentage points.
3. The past physical capital growth rate also has a positive statistically significant effect in accordance with the expectations. Namely, every one percentage point increase in the past physical growth rate causes increase in the contemporary GDP growth rates by 0.12 percentage points.
4. On average, the past employment rate has a negative and statistically significant effect on the contemporary GDP growth rates. Namely, every decrease in the employment by one percentage point actually leads to a 0.87 percentage points increase in the GDP growth rates which, as explained above for the case of the Czech Republic, is not such a surprising result if the peculiar conditions of transition are taken into account. Namely, as mentioned, as a result of the inherited overemployment characteristic of socialism, the decrease of employment in the course of transition meant not only increasing productivity but also increasing production for a good part of the transition period for most of the countries. Hence,

although at odds with the conventional understanding, this negative sign is not so surprising.

5. According to the results, the volatility of the GDP growth rates is the lowest for the ‘new 3-regime group’ at 2.05 per cent (column 7 in the Table), which again is in the accordance with the transition literature that claims that less volatility was more conducive to growth (Hnatkovska and Loayza, 2003).
6. Country results in this group are relatively uniform in that they depict a similar story in terms of signs, statistical significance and size of the coefficients. Only in one case, Latvia, are the results for the separate coefficients rather unusual in sign. Namely, the past GDP growth rate and the past physical capital growth rate seem to be exerting a negative impact on the contemporary GDP growth rates, which is unexpected and not in accordance with the assumptions of our theoretical model as explained above. This unexpected sign also repeats in two more cases: the past GDP growth rate for the case of Moldova, and for the past physical capital growth rate for the case of Bulgaria. Nonetheless, again it should be mentioned that the results can be interpreted only within the system, where everything depends on everything else (Kennedy, 2005). And, as mentioned previously, the changes in various variables in the course of transition were really drastic, changing from positive to negative within various but not always overlapping timings, which in the case of relatively short span of data, makes it more difficult for the model to extract conclusive information. In addition, as we argued before, the estimation method does not allow for switching of all once-lagged variables, which in turn might confuse the dynamics of the variables and their relations, allowing for data of shorter frequency rather than the long-run frequency data i.e. of one regime to dominate the estimates (Kennedy, 2005).
7. Finally, one country – Hungary – that by the real GDP per capita indicator for 2011 (column 8 in the table) should belong to the elite of the most developed transition countries, is listed among the 2-regime countries, according to the multivariate model results. It however can be considered as a special case due to several reasons.
 - Namely, with respect to the constant terms, Hungary records a negative but statistically insignificant constant term for the first regime of -1.42 per cent which is relatively shallow initial decline in the ‘Solow residual’ probably due to this

country history of market-inspired reforms under the old regime (as pointed out in chapter 3).

- This relatively small initial drop in the Solow residual gave way to a prolonged period of continuous growth or technology progress of 2.19 per cent in the second regime in Hungary. Compared to the rest of the most developed transition countries, the second regime in the case of Hungary is undifferentiated into different regimes and it is characterised by comparably lower estimated constant than in the other 3-regime countries (2.19 per cent for Hungary's second regime vs. 3.45 per cent on average for the second regime for the 3-regime group on average).
- In addition, Hungary records a specific 'low volatility' of 1.86 per cent, which is more comparable and even lower than the new 3-regime group of countries volatility of 2.05 per cent rather than the 2-regime one where volatility is above 3.53 per cent on average.

Arguably, Hungary's history of reform enabled it to move from the initial decline in the first regime directly into a long period of stable growth that had more in common with the third regime of the more developed transition countries than with the second regime of the less developed transition countries. In fact, Hungary moved through a period of crash adjustment directly into the third regime identified in the model and has got to the same point as other four countries of the elite 3-regime rapid-J group. The low volatility of Hungarian growth in its second regime of 1.86 per cent— indeed, below the mean volatility of the three-regime countries of 2.05 per cent - is consistent with this interpretation.

Consequently, Hungary is included in the 3-regime group and excluded from the 2-regime group, creating the 2 additional separate subgroups – 'the 3-regime group plus Hungary' and 'the 2-regime group minus Hungary', that might enable conducting sensitivity test on the categorisation (last two rows in Table 7.6-1).

8. *The 'new 3-regime group plus Hungary'*. When Hungary is included in the analysis, the estimated average coefficients do not change in sign as compared to the original 'new 3-regime group'. In fact, only three coefficients change slightly in size, though preserving the same sign:
- a. The coefficient of the third regime constant term (column 3) decreases from 4.87 per cent to 4.34 per cent, suggesting less positive technical progress in the group on average in the third regime when Hungary is included in the group.
 - b. The coefficient on past GDP growth rate increases from 0.25 to 0.31 per cent suggesting that every one percentage point increase in the past GDP growth rate contributes to increase in the contemporary GDP growth rate by 0.31 percentage points on average for the 3-regime group when Hungary is included.
 - c. Finally, the inclusion of Hungary decreased the average group volatility from 2.05 per cent to 2.01 per cent.

In summary, the inclusion of Hungary in the new 3-regime group did not change the estimated results remarkably.

7.6.2 The 'new 2-regime group'

The newly formed group of two-regime countries is quite heterogeneous taking into account that it encompasses countries such as Albania and Hungary that were listed in the rapid-J group in chapter 2, alongside with all the rest tested incomplete-U and slow-J countries. However, as mentioned above, the most unexpected example is possibly Hungary, which might be a special case and so misplaced in this category as explained above. In contrast, Albania and the other countries in the 2-regime group seem to find their place more easily among the transition countries characterised by two distinct regimes of transition and by much smaller real GDP per capita in 2011 as compared to the 3-regime group (see column 8). In fact, observed by the real GDP per capita in 2011,

the new 2-regime group is rather homogeneous, encompassing relatively similar countries distinct from the elite 3-regime group, all except Hungary.

In general, according to the results, this group of countries managed to record only 2 regimes, with specific characteristics:

1. Firstly the constant terms, that capture all the systematic non-modelled elements show a more drastic drop in the first regime as compared to the 3-regime group (-10.6 per cent as compared to -5.7 per cent) and positive increase in the second regime, though in this case with a less exaggerated difference to the 3-regime group (6.1 per cent for the 2-regime group as compared to 3.45 per cent for the 3-regime group). This sort of movement in constant terms is observed in all the 'old' subgroups in the 2-regime group.
2. On average, for the 2-regime group, the past GDP growth rates exert a positive and statistically significant impact. Namely, on average for the group, every one percentage point increase in the past GDP growth rate contributes to the increase in the contemporary GDP growth rate by 0.17 percentage points, which is smaller than the impact of 0.25 percentage points for the same coefficient for the 3-regime group. However, when the subgroups are observed, the incomplete-U group seems to be not fitting this pattern, rather displaying a negative statistically significant impact of past GDP growth rates on contemporary GDP growth, which is atypical though when observed in a small system not so unusual as discussed above.
3. The past physical capital growth rate has a negative statistically significant effect on GDP growth rates on average for the group. Namely, every one percentage point increase in the past physical growth rate causes decrease in the contemporary GDP growth rates by 0.04 percentage points, which is estimated with an unexpected sign. This negative sign on average for the group comes mostly from the slow-J group where all the coefficients on the lagged physical capital growth rate for all the tested countries are negative. Once again, this is not in accordance with the expectations of our theoretical model, nor with the findings of the transition literature; however it might be due to the confusion of dynamics of the variables and their relations in the estimation technique as mentioned above (Kennedy, 2005).

4. On average for the group, the past employment rate has a negative and statistically significant effect on the contemporary GDP growth rates, similarly to the 3-regime group. Namely, every increase in the employment rate for one percentage point actually leads to a 0.68 percentage points decrease in the GDP growth rates²⁰⁷, which again confirms the detrimental effect that the increased labour growth in the wrong circumstances could have on the GDP growth rate. In most of the countries in this group, the coefficient on employment is negative or it is insignificant in all cases when it is positive.
5. According to the results the volatility of the GDP growth rates is comparably higher for the 2- regime group at 3.53 per cent as compared to the 3-regime group of only 2.05 per cent. In the 'old' subgroups, it is highest for the incomplete-U group at 4.98 per cent, lower for the rapid-J 2-regime subgroup at 3 per cent, and lowest for the slow-J group at 2.62 per cent. This ordering of the country group volatility is in accordance with the expectations of our theoretical model.
6. As can be noticed, the results for this group are less uniform, with separate coefficients showing various signs and sizes for various countries. The conclusions for the group were made based on the averages of the significant coefficients, while emphasizing the exceptions. Having this in mind, the depiction for this group explanation is less uniform and less reliable.
7. In addition, as we considered Hungary as a special case that possibly belong better to the 3-regime group, here the new 2-regime group is reduced creating the subgroup – the new 2-regime group minus Hungary. The '*new 2-regime group minus Hungary*'. When Hungary is excluded from the 2-regime group, the estimated average coefficients do not change in sign as compared to the original 'new 2-regime group'. In fact, only three coefficients change slightly in size, though preserving the same sign:
 - a. The coefficient of the second regime constant term (column 3) increases from 6.09 per cent to 6.74 per cent, suggesting higher technical progress in the group on average when Hungary is excluded from the group. Although slightly contra

²⁰⁷ All things being equal, for 3-regime group every increase in the past employment rate by one per cent would result in a decrease of 0.87% in GDP growth rates.

intuitive, this result confirms the general finding from the multivariate analysis that the less developed transition countries recorded higher positive ‘Solow residuals terms’ in their second regimes (column 2 in the table) needed to make it up for deeper declines in the first regime (column 1). These results are also in line with the similar finding in the univariate analysis, where the estimated mean GDP growth rates for the second and third regimes for the less developed groups were mostly higher than the ones in the rapid-J group.

- b. The coefficient on past GDP growth rate lost its impact on the contemporary GDP growth rate falling from 0.17 to 0 with the exclusion of Hungary. This is also an interesting finding, suggesting that for more developed transition countries data generating process of GDP at some point in the course of transition took the feature of autoregressive process specific for the developed countries with the contemporary GDP growth rate being dependant on its past values. According to the results, for the less developed transition countries this is not the case suggesting that the GDP data generating process is still characterised by large negative or large positive changes which confirms the arguments advanced in chapter 6, section 6.3.3.1.
- c. Finally, the exclusion of Hungary increased the average volatility from 3.40 per cent points to 3.66 per cent for this subgroup, which again indirectly confirms the findings on volatility from the multivariate univariate analysis suggesting that the less developed transition groups record higher volatility.

This estimation procedure reveals some of the features of each regime in each group enriched by the additional information on the added variables – physical capital and labour. However, alongside the group-specific differences in the identified regimes, the results indicated some country-specific variations from the group norms.

Although informative about regimes, the above categorization based on the estimation results did not take into account the periodization of the specific regimes, hence disclosing nothing about the regime changes in the country groups through time. In

order to be able to get some intuition on that movement, the estimation results i.e. the fitted values of GDP growth rates are related to their specific timing for each country group in the following section.

7.6.3 Stylized patterns of growth in the new groups of countries according to the multivariate MS VAR model results

When the fitted values of the GDP growth rates for each country are related to their specific timing in each of the regimes, a new improved stylized picture of the growth patterns in the two new groups of countries and their subgroups emerges. Namely, in order to determine how regimes switch in each group through time, in the following Figure 7.6-1 the average fitted GDP growth rates in each year for each of the new country groups are presented, similar to the procedure followed in chapter 6, section 6.5.3. In essence, the procedure of averaging the estimated fitted values is similar to the one explained in Box 6.3 in chapter 6, except in this case the average growth rates for each group are calculated from the fitted GDP growth rates results given by the multivariate analysis. In addition, the respective groups are much smaller with:

- The new 3-regime group consisting of 4 countries as explained above, and
- The new 2-regime group consisting of 7 countries. For comparison, two additional graphs are added for the created subgroups:
 - the new 3-regime group plus Hungary, and
 - the new 2-regime group minus Hungary.

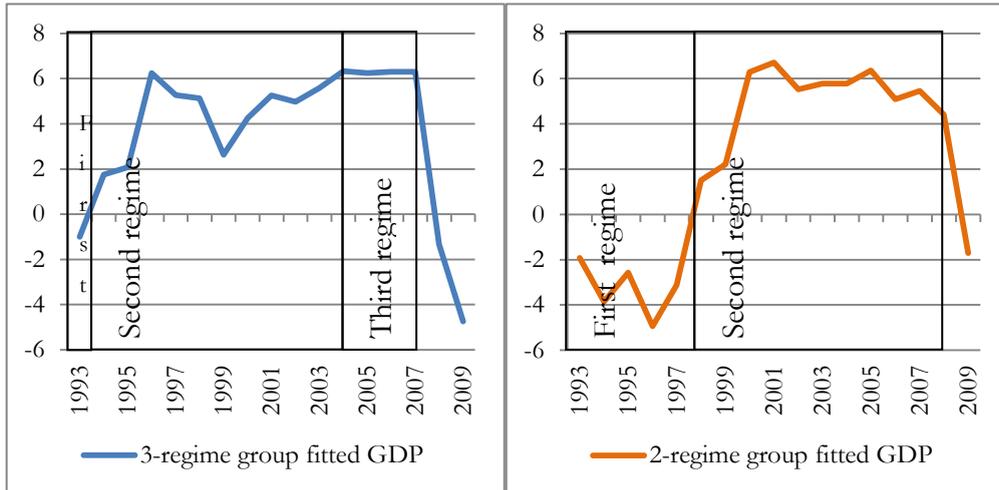
Basically, each years' growth rate is calculated by taking the fitted GDP growth rates by regime for all countries in the respective group (fitted values are given by the estimation results for each country) then averaging by the number of the countries within the group. The procedure could not be repeated on the variance results since the variance in our multivariate models could not be allowed to switch between regimes due to the problem of overburdening the data and the other problems as explained above.

Based on the estimations, Figure 7.6-1 is depicted. The left top figure (A) shows the average annual fitted GDP growth rate movement for the three-regime country group (full blue line); while the second top figure (B) presents the average annual fitted GDP growth rate movement for the two-regime country group (full brown line). Bottom figures C and D reproduce the original respective 3- and 2-regime groups' average annual fitted GDP growth rate movements as in A and B (in full lines), though adding the average annual fitted GDP growth rate movements for the 3-regime group plus Hungary and for the 2-regime group minus Hungary (in broken lines). The purpose of graphs C and D is to see whether the movement of Hungary from one to another group changes the original groups' GDP growth rate movements remarkably. In all figures, the y-axis is measured in per cent, while the x-axis gives the period. The identified regimes in the figures are divided with vertical lines and labelled appropriately.

Figure 7.6-1 Stylized patterns of the separate regimes based on the fitted GDP growth rates in the New groups (in averages for groups, in per cent)

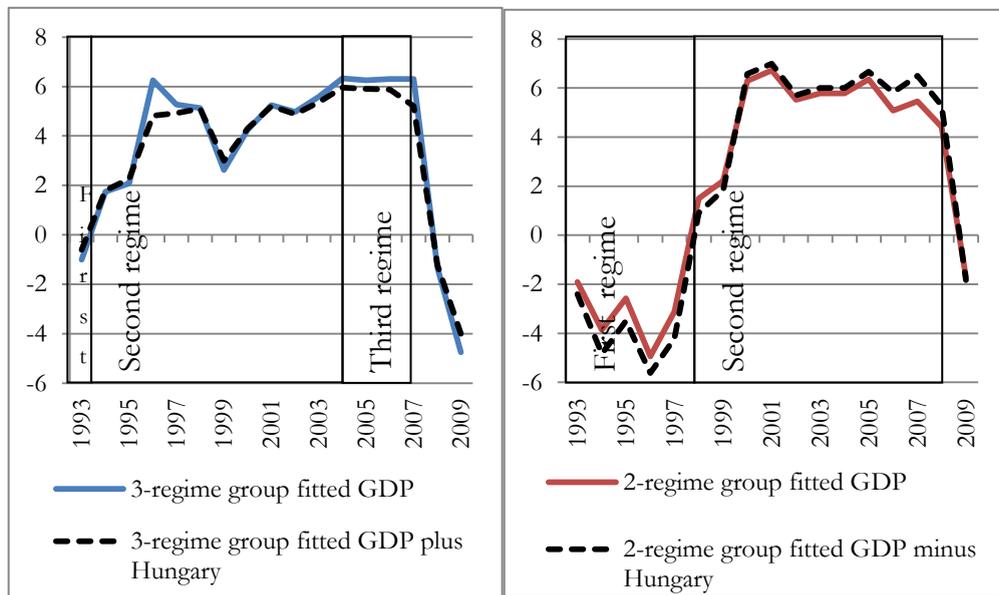
a) New 3-regime group

b) New 2-regime group



c) New 3-reg.group plus Hungary

d) New 2-reg.group minus Hungary



Source: Author Own Calculations. Data source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

The regime classification is once again confirmed by the multivariate results and visible in our Figures produced above. It is distinct in both groups and both subgroups, with it being especially pronounced for the switches from the first to the second regime. The switch between the second and third regime in the new 3-regime group is less pronounced, though still distinctive in the sense that it reveals a more stable and steadily increasing growth rate for the third regime in contrast to the second relatively volatile and instable regime (see Figure A above). This is also the case when Hungary is included in this group (see Figure C). In all groups, the drop back into the first regime at the end of the research period as a result of the Global Financial Crisis is also identifiable. In addition, the sensitivity tests involving shift of Hungary from the 2- to 3-regime group, results only in slight changes from the original graphs. We shall return to this point again later.

Now, if we return to the various groups:

- The *3-regime group*, after recording the first drop of one year²⁰⁸ (4 years if we take into account the period before 1993), is characterised by comparably the lowest GDP growth rates drop (Figure A). After the first regime, this group switches into the second regime relatively rapidly. The second regime is characterised with positive growth rates until 2003, comparably similar in sign, size and volatility to the ones recorded in the 2-regime group. Afterwards, after more than 13 years from the start of transition, this group manages to enter the third regime characterised by its highest and steady GDP growth rate according to the multivariate analysis. That fast recovery and switch into the second regime is not recorded in other countries, and although interrupted in 1998, which also appears in the univariate analysis, becomes even more stable after 2003. This also confirms the univariate analysis findings.
- The *2-regime group* also provides an example of switching regimes during transition, although not in three distinct regimes (Figure B). Namely, after the first drop of five

²⁰⁸ The estimation period starts with year 1993 in this case due to conversion of the data in growth rates as opposite to the univariate analysis, where it was starting with 1991.

years (eight if we take into account the period before 1993), follows a decade of relatively high, but volatile growth on average for the group. For this group, multivariate analysis could not identify any additional regimes, but only a drop back into the first regime as a result of the Global Financial Crisis.

When the special case of Hungary is taken into account by including Hungary into the new 3-regime group and excluding it from the 2-regime group, the previous graphs do not change remarkably.

- Namely, the inclusion of Hungary in the 3-regime group slightly lowered the fitted average real GDP growth rate for the second and third regime, also reducing the volatility slightly in these regimes as compared to the original group average fitted real GDP growth rate movements (Figure C).
- In contrast, the exclusion of Hungary from the 2-regime group lowered the fitted average real GDP growth rate for the first regime as compared to the original group average fitted real GDP growth rate movements. This was expected because of the dominance of the more severe drops specific for the less developed transition countries. In addition Hungary's exclusion increased the fitted average real GDP growth rate for the final years of transition as compared to the original group average fitted real GDP growth rate movements. This is also not surprising, having in mind that Hungary as a more developed country was more affected by the Global Financial Crisis, whilst the less 2-regime countries were later affected recording delayed fall.

In general, the figures above reveal different growth patterns in the both major transition groups, while at the same time revealing only subtle differences among the main group and their appropriate subgroup. The differences in the various movements of the fitted averaged GDP growth rates among both main groups are conditional upon the impact that physical capital growth and labour growth had on growth rates, as explained above.

7.6.4 Comparing the results with the observed data, the univariate stylized patterns and with the theoretical model

Finally, following the example of chapter 6, we shall compare the stylized patterns and figures from the multivariate analysis and the regime identification procedure conducted in this chapter with the stylized patterns and figures from the univariate analysis as well as with the observed data on average GDP growth rates given in Figure 2.5-2 in chapter 2. This triple-comparison should give us some additional information in several respects:

- Firstly, it should closer consider the reliability of the model; that is, whether the model was able to replicate the GDP growth movements from reality, while, at the same time, identifying the regimes in the new country groups.
- Secondly, it should shed some light on the differences of the results among the univariate and multivariate models.
- Finally, it should enable drawing some conclusions on the fit with our theoretical model and on its empirical support in the MS-VAR results.

Nonetheless, it is worth mentioning that the figures cannot be compared directly, because they encompass different sets of countries. This is especially the case for the groups in the final country grouping where the groups were created based on the MS VAR results for only 11 countries, as compared to the univariate MS model results for 26 countries. In addition, the comparison of the figures is difficult because the various figures present different stylized patterns created by the use of different data: observed, or actual mean real data; estimated (i.e. fitted) mean real GDP growth rates from the univariate model; and estimated (i.e. fitted) mean values of the real GDP growth rates from the multivariate model, though taking into consideration the special case of

Hungary.²⁰⁹ Nevertheless, we will make an effort in order to see whether we can extract some additional information from this comparison: in the figures, the ‘new 3-regime plus Hungary’ will be compared with the rapid-J group as the closest one in terms of the country sets; while the ‘new 2-regime minus Hungary’ group will be compared to both the ‘old’ slow-J and incomplete-U groups. With all notes of restraint mentioned above, the comparison should be taken with caution.

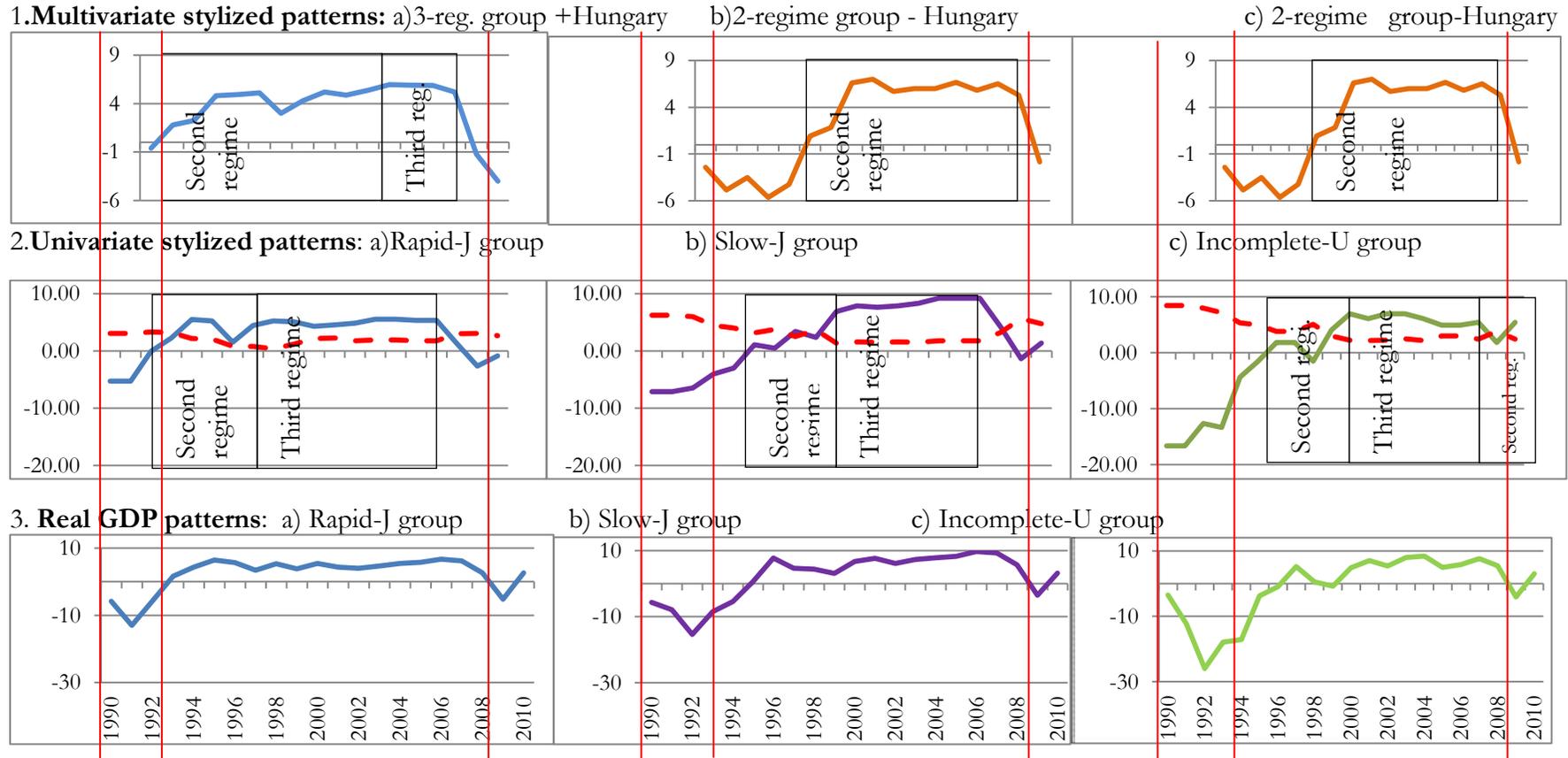
In order to do so, in the following Figure 7.6-2 three sets of figures are interlocked and presented: Figure 7.6-1 (figures C and D) from this section (top panel under section 1); Figure 6.5-2 from chapter 6 (middle panel under section 2); and Figure 2.5-2 from chapter 2 (bottom panel under section 3). In each case, the y-axis presents the GDP average growth rates for the country groups:

- the multivariate estimated real GDP averages in the top panel;
- the univariate estimated real GDP average GDP in the middle panel;
- the observed or actual average real GDP growth rates in the lower panel.

The regimes are highlighted as estimated and established in the respective stylized patterns based on the univariate or multivariate analysis, with the first regime left unmarked. For ease of interpretation, the red vertical lines mark the years 1990, 1993 and 2008 in all panels.

²⁰⁹ As mentioned, the estimated results as well as the produced figures for the subgroups do not differ remarkably from the original 2- and 3-regime groups. Nonetheless, in the following discussion the subgroups are taken into account, considering them as more reliable for the reasons explained in the previous section.

Figure 7.6-2 Growth paths in the course of transition (Multivariate fitted real GDP growth rates, top panel; Univariate fitted real GDP growth rates, middle panel; and observed actual real GDP growth rates, lower panel. All in per cent p.a.)



Source: Author Own Calculations. Data source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

7.6.4.1 Multivariate vs. real data stylized patterns

In general, when the GDP growth rate lines are observed by eye, it looks like both models give relatively good representations of the observed GDP growth rates movements. It appears that the stylized patterns created by the univariate analysis (section 2 in Figures, referred to as ‘univariate stylized patterns’) are closer to the observed data movements (section 3 in the Figures), capturing the reversals and smaller breaks present in the observed data, while the stylized patterns created by the multivariate analysis (section 1, referred to as ‘multivariate stylized patterns’) present a rather more smooth representation of the average growth rates for the different groups. Nevertheless, in summary, all models capture faithfully the trend of the real movements, moving from negative to positive growth rates as transition progresses.

- By eye inspection is not precise and cannot reveal whether the univariate or multivariate stylised patterns present the observed GDP growth rates movements better. However, when the sizes and the timing of the stylized patterns are observed across various country groups, it seems that the univariate and multivariate stylized patterns represent the rapid-J group real GDP growth rate movements the best. This is due to several reasons: this group is probably the most homogeneous group in terms of the changes in the variables; hence the models probably fit this group the best; and furthermore, the comparison sets of countries are the most overlapping in the case of the rapid-J and 3- regime groups of countries.
- In turn, the new 2-regime group seems to represent the slow-J group of countries real GDP movements better rather than the incomplete-U group, since the new 2-regime stylized patterns are not presenting well the size of the drop recorded in the real GDP growth rates in the incomplete-U group. Namely, if the first regime in the

‘new 2-regime group’ stylized pattern is compared by the same time movements in the real GDP growth rates for the slow-J group and incomplete-U group, it is obvious that in terms of the size of the drop, the multivariate stylized pattern is closer to the slow-J group rather than to incomplete-U group in which the fall was on average for the same period to around -15 per cent. In turn, if the second regime in the ‘new 2-regime group’ stylized pattern is compared to the same time movements in the observed GDP growth rates for the slow-J group and the incomplete-U group, it can be said that it fits better the incomplete-U group real GDP growth rates movements, recording on average lower GDP growth rates than the slow-J group.

Having in mind that the country groups are not fully represented in the new country categorisation, this discrepancy in the stylized patterns is not surprising. In addition, the multivariate stylized pattern is created based on multivariate analysis; hence, it is possible that the recorded drops and the recorded recoveries as well as the regime switches will change due to the inclusion of the additional variables. In our case, when additional variables are added in the MS- VAR model, the estimated drops in the first regime for all country groups are smaller than the actual real GDP growth rates movements for the respective country groups. This is also the case for the univariate estimates. In addition, the recovery or positive growth rates in later regimes for all country groups estimated by both the univariate and multivariate approaches are smaller than the actual real GDP growth rates movements for the respective country groups. This would imply that the size of the structural changes as described by the observed real GDP growth rate movements decreases once the additional variables are taken into account. It appears that the fall in economic activity was not as large as presented in the real GDP growth rate data, but also that the recovery was not as spectacular as the one presented in the observed real GDP growth rate data. In other words, estimation has a “smoothing effect” on the pattern of GDP growth. This is because estimation, especially in the MS-VAR approach, involves loss of the observations for the early transitional years. This tends to lower estimates of the initial very sharp fall in growth rates and, correspondingly, gives rise to less “spectacular” estimates of the subsequent recovery of growth rates.

7.6.4.2 Multivariate vs. univariate stylized patterns

Although the multivariate and the univariate stylized patterns for various country groups are very much alike when the estimated or fitted GDP growth patterns are observed (section 1 and section 2 in Figure 7.6-2), there is one huge difference among them related to the number of the regimes identified in the various country groups. Namely, as mentioned, the multivariate analysis captured three regimes in the cases of four countries, while for all the rest of the tested countries it identified only two distinct regimes. The reasons for this are several and interrelated. Namely, the univariate and the multivariate models are different in their nature and their explanatory power in the sense that the former ones are the most restricted models that make fewer demands on the data as compared to the multivariate models which are less restricted but impose more demands on the data. Consequently, the univariate models are less informative as compared to the multivariate modes.

In the context of our research, this means that our univariate analysis created stylized growth patterns for all the 26 countries of interest, identifying the regime switches only by the use of one variable – GDP growth rates, and thereby resulting in an general depiction for the switches of growth in the course of transition. In turn, the multivariate analysis and its consequent stylized patterns could not capture all the countries due to the greater demands on limited data, though in the cases where the model managed to converge, the models identified regime switches based on three variables or vectors instead of one, eventually resulting in an incomplete, but in parts more detailed, depiction of the growth in the course of transition.

When the univariate and multivariate stylized patterns are observed in more detailed comparison, several conclusions can be made:

- In the case of the new 3-regime group and the rapid-J group, the regime identification overlaps in large parts. Namely, the first regime ends in both two figures in 1993, which in turn overlaps with the zero growth rate (or point 2) in the observed GDP growth rate pattern. In addition, due to the impact of the Global

Financial Crisis, these groups turn back into the first regime in all figures at a similar point in time. The second regime is of much shorter duration in the univariate analysis, lasting until 1998, while according to the multivariate analysis it lasts until 2002. Compared to the observed GDP growth rates, the third regime starts in 2002, which follows the point 4 as identified in chapter 2, section 2.5.3. Namely, that is the point of the lowest positive growth rate in late transition, after which the growth rates in the rapid-J group recorded steady increase and lower volatility. In addition, according to the multivariate analysis, the third regime starts in 2002 lasting until 2007, after which these groups fall back into the first regime. These observations imply that the new 3-regime group probably fits not only the stylized real GDP growth rates the best, but also our theoretical model assumptions. We shall return to this remark in the next section.

- For the new 2-regime group, the comparison with the both – slow-J and incomplete-U group leads to similar conclusions. Namely, the multivariate analysis captured only two regimes for both groups as compared to the univariate analysis. In addition, the length of the first regime is longer in the multivariate analysis for both groups as compared to the univariate stylized patterns, which would imply that these countries remained longer in the first regime than the actual real data on GDP growth rates suggested. As a result of the impact of the global Financial Crisis, this group also falls back into the first regime, which overlaps with the falls identified for the groups by the univariate analysis.

7.6.4.3 Multivariate stylized pattern vs. the theoretical model

In general, although different to the univariate analysis, the multivariate analysis seems to fit the theoretical model even better; suggesting that only a few of the ‘most successful transition’ countries managed to pass through all three regimes or stages of transition, while the rest have still to develop beyond the second regime. For some of the other most successful countries such as, for example Slovenia and the Slovak Republic, the model could not converge at all. As mentioned, Hungary can be considered as a category of its own,

although recording only 2 distinct regimes: the first and the third regime, this country managed to reach the point of the most developed transition countries as mentioned above.

Nevertheless, the model applies most fully to the most developed transition countries and that feature is well replicated in the empirical results. As column (8) from Table 7.6-1 shows, the real GDP per capita for 2011 in the ‘new rapid-J group’ countries, Hungary included is significantly higher than for the others countries, which would suggest that only the elite group of countries managed to pass through all the stages of transition as described by the theoretical model, while the others have yet to develop beyond the second regime.

Comparison of the multivariate stylized pattern for the 3 –regime group with the theoretical model predictions reveals several similarities.

- The first stage of ‘crash adjustment’ characterised by negative growth rates in our theoretical model is well replicated in the multivariate stylized pattern of the 3 – regime group: it is relatively short; of only above 3 years duration on average; and characterised by negative GDP growth rates.
- Afterwards the countries move into the second regime of ‘recovery’, characterised by positive but unstable GDP growth rates, a development which also fits out theoretical model predictions. According to the multivariate results, this regime is long, almost a decade, and it is longer than the duration suggested by the univariate analysis. Although our theoretical model does not make time-length predictions, in reality the longer length of the second regime is also feasible, since it took time for most of the countries to truly reconsolidate their economy, institutional settings, social capital and so on, in many cases by the guidance of the European Union, which was accompanied by positive but volatile growth rates.
- Finally, according to the theoretical model, transition countries move on to the final balanced growth line in the third regime. According to the theoretical model, the switch onto the higher, third regime should have been brought about by sudden positive increases in GDP growth rates (see Figure 4.5-2 in chapter 4). However, while this was rather obvious for the switch between the first and second regime, it is less visible in the switch onto the third regime. In this case, it seems that the switch is

achieved rather by a move into a different growth regime characterised by steady positive GDP growth rates.

- Finally, the multivariate stylized pattern also replicates the fall recorded due to the impact of the Global Financial Crisis in 2008.

7.7 Conclusion

The multivariate analysis performed in this chapter adds to the evidence in favour of non-linear growth and the corresponding existence of various regimes or stages of transition as postulated by the theoretical model in chapter 4. Augmented by the introduction of the additional variables, the multivariate analysis identifies switches taking into account not only GDP growth rates but also the employment and physical capital growth rates. Evidently, when these variables are added into the estimation equation, the number of switches and regimes diminishes for most transition countries. In other words, although it seemed that some of the transition countries are more advanced in their progress towards a developed market economy, according to the univariate analysis, they seem to be not so advanced when the growth rates in physical capital and employment are taken into account.

As a consequence, the multivariate analysis has changed the number of identified regimes and their periodization to various extents in various countries. Namely, according to the multivariate analysis only four countries (or five when Hungary is included) recorded three regimes in the course of transition, three (four) of which belonging to the initially identified rapid-J 3- regime group according to univariate analysis – the Czech Republic, Poland, Estonia (and Hungary) - and one slow-J 2-regime country, according to univariate analysis, that is Latvia. It seems that these four (five with Hungary included) most advanced transition countries correspond quite well to the theoretical model. As mentioned Hungary is two-regime country recording two distinct regimes: the regime one or fast crash adjustment stage and the regime three, that is the take off (or catching up) stage; whilst the other 2-regime countries record the two subsequent regimes: the regime one or crash adjustment stage and

the regime two or recovery stage. In other words, all other tested countries recorded only two regimes according to the multivariate analysis, i.e. only one switch in the course of transition. Compared to the univariate analysis, these results are considerably different in the sense that they are more detailed in parts, but also less generalized, as the multivariate MS VAR model could not converge for all the transition countries.

Nonetheless, our multivariate analysis, interpreted in the light of our theoretical model, suggest that only a few transition countries can be regarded as having completed their journey by becoming developed market economies. The others continue to be properly regarded as transition countries; moreover, in the aftermath of the Global Financial Crisis, are likely to remain so for some time to come.

Chapter Eight

8 Conclusions

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8.1 Introduction

For more than two decades, transition countries have been undergoing reforms and changes intended to develop themselves into technologically advanced modern market economies. Some transition countries, generally more successful than the others, have completed accession to the European Union, i.e. to move one-step further towards their difficult wished – for goal. However, even these are still not quite there. A brief comparison of GDP per capita for 2011 show that for example Slovenia and the Czech Republic, the two most successful of our rapid-J countries recorded 17400 and 14700 GDP per capita (in Euro); results comparable to Portugal and Greece, though below the average EU-27 GDP per capita of 25100 (Euro) and substantially lagging the western and northern EU members all recording above 30000 (Euro) GDP per capita (Eurostat, 2012). The GDP growth pattern and its determinants has been an important tool to observe that process, though in most transition studies they were analysed without sufficiently taking into account the peculiarities of the transition process itself.

Therefore, the main goal of this thesis was to reassess growth patterns in transition countries by adapting mainstream exogenous growth theory to the peculiarities of the transition process itself. One of the main research questions was to assess how growth theory can be modified in order to allow for the huge systemic shocks that happened in the course of transition – such as sudden and huge obsolescence of physical capital, huge unemployment and vast changes in systems' features and in the nature of technical progress; changes that have not been commonly observed in mature developed economies and, hence, not typically incorporated into growth theory. Following that inspiration, this thesis developed a novel perception of growth in the course of transition, which can be described as a *stages switching process* instead of the smooth linear process known in the conventional growth literature.

In addition, modification of the theory required an appropriate adjustment of the empirical approach, which was further developed by modelling growth through the application of non-

linear models; in particular of Markov switching univariate and multivariate Models. The empirical univariate Markov Switching analysis has enabled closer assessment of the peculiar characteristics of growth - instability and volatility - in the course of transition. Based on the individual analysis of each country, it offered closer description on each regime, giving information, such as: the mean GDP growth rate within certain regime, the specific regime volatility, the approximate timing of the switches between regimes, the specific persistence of each regime, the probability of the system to switch into another regime and the periodization of each regime for every country. All this information, available for most of the transition countries, offered evidence in favour of the assumption of non-linear growth and the corresponding existence of various regimes or stages of transition as postulated by the theoretical model in chapter 4. In addition, the multivariate Markov Switching Model was further developed in order to investigate if the regimes identification persists when the main growth driving forces, such as labour, physical capital and technical progress are introduced. Once more, the multivariate analysis confirmed the instability and volatility of growth as important features of transition, suggesting that the main determinant governing the switches is the “Solow residual” or the “black box” indicator, which could not be detangled due to data and modelling limitations. Both theoretical and empirical approaches yield new insights into the growth processes in the course of transition.

This chapter summarizes the main findings of the thesis and considers their policy implications. To this end, this chapter is organized as follows. Section 8.2 reviews the main issues and main findings addressed in previous chapters and discuss the main policy implications. Section 8.3 identifies the main contributions to knowledge of this research project, pointing out the limitations of the research and concluding with possible areas for further research.

8.2 Main findings and policy recommendations

8.2.1 Main findings

Transition is usually described as a distinctive but temporary process of transformation from socialism to capitalism characterized by huge structural changes and unpredictable growth patterns. Uncertain and irregular, this process in terms of the observed growth patterns differs greatly from the smooth growth path of mature industrial economies, as this thesis argues at the very beginning. In addition, it was shown that the changes in the course of transition had a different nature from the changes occurring in developed countries' business cycles in terms of their deepness, severity, causes and consequences. Hence, transition developed as a "sui generis" process, rather than according to any well-known growth or, indeed, business cycle theory or any newly born coherent theory of transition. Nevertheless, as demonstrated in this research, in transition studies, growth was mainly treated in the framework of neoclassical or endogenous theories, which leave out aspects of transition that are surely important. Modelling under assumptions that do not accommodate reality can be problematic and yield unreliable conclusions. Hence, the main research goal in this thesis was to create a tighter connection between the stylized facts of transition, growth theory and empirics.

Chapter 2 was conceived as a general overview of growth patterns in transition countries starting with the familiar regional categorization given in transition literature (CEECs, SEECs, BCs and CISs). However, as this chapter shows, this categorization was altered once the real GDP movements were taken into account. Namely, the analysis of real GDP showed that two main groups can be identified, i.e. successful countries that managed to recover their starting GDP positions, though with differing recovery speeds, and lagging countries that did not managed to achieve that goal by the end of 2010. According to this, when combined with several other characteristics proved relevant in the transition literature - such as years of downturn and year in which the regaining of the starting position was achieved -the movement of the real GDP in the course of transition suggested a new

categorization of transition countries into three groups: a rapid J-group; a slow J-group; and an incomplete U-group of countries. The first two are subgroups of the “successful” group, though differing by the speed of recovery.

Each of the new groups is characterized by a specific growth pattern.

- The *rapid J-group* consisting of transitional countries that succeeded in achieving sustainable growth after a relatively short period: Albania, Czech Republic, Estonia, Hungary, Poland, Slovak Republic and Slovenia, i.e. mainly CEECs.
- The *slow J-group* comprises the countries that experienced delayed recovery: Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, Kazakhstan, Latvia, Lithuania, Russia, Romania, Macedonia, Uzbekistan and Turkmenistan, Romania, Macedonia, and Bulgaria.
- The *incomplete U-group* of countries, characterized by the absence of a second development stage of sustainable recovery. This group comprises Georgia, Tajikistan, Ukraine, Serbia, Moldova and the Kyrgyz Republic.

Stylized growth patterns for each group have suggested one novel angle of observed transition. Namely, the transition growth pattern can be scrutinized through different stages that are separated by several important points: bottoming of the real GDP; regaining of the starting real GDP position, accompanied by positive growth rates; mid-transition fall of growth rates; and late-transition stable growth rates leading to fast increase in real GDP. Although not all countries passed all these identified points on their path to capitalism, the idea of switching points led the research towards exploring the transition as a non-linear process characterised by switching points and stages.

As demonstrated in chapter 3, transition represented a process characterized by great variations in key variables, such as: gross capital formation; changes in employment of the labour; wages; and structural changes with respect to the share of industry, services and agriculture shares in GDP value added; as well as big changes in the economic policies. Chapter 3 offers a mainly descriptive overview of these growth variables specific for transition countries, with the intention to compare them between country groups, but also to offer perspective of their changes over time. In general, the main findings in this chapter are

organized to follow the GDP growth pattern story through various stages and important points as identified in the previous chapter. Briefly, here the main findings with respect to the adjustments of physical capital and labour markets are summarized.

- As the evidence showed, the bottoming of real GDP is characterized by not only a fall in investment - i.e. drop of GFC formation - but mainly by huge and sudden obsolescence of the physical and human capital stock. Further analysis demonstrated a striking contrast: this point marks full downward adjustment of the physical capital stock in the course of transition; yet, in terms of labour market adjustments, this stage is characterized by a much lower propensity of adjustment in terms of falling wages relative to the huge obsolescence of the human capital – the skills and knowledge - inherited from the previous system.
- In the next stage, the adjustment of the labour market takes place by mass shedding of labour into unemployment, inactivity or immigration for most of the countries. This enabled restoring of labour productivity, which in turn promoted increase in investments. The joint result from the increased labour productivity and increasing investment, accompanied by structural reforms, led towards the point of regaining the initial GDP positions in transition countries.
- After the recovery to initial per capita GDP, there is a period of revitalization characterized by a steady rate of growth in GFC formation. Additionally, unemployment decreases very slowly in this period. Evidently, this is the period in which a more favourable economic environment is created, yet not in all countries and with different speeds in the successful ones.
- In the last stage, i.e. until the Great Financial Crisis, productivity shows an even more spiky increase, which can be especially related to the spectacular increase in GFC formation, i.e. rise in investments, which probably is also related to acquiring better technology in the successful countries. Increase in wages and a further drop in unemployment rates accompany this.

Better description of each stage of transition and its determinants introduced the notion of modelling transition through different stages and switching points. In addition, the analysis pinpointed several particular features of transition:

- the appearance of shocks, such as the sudden obsolescence of physical capital and the appearance of unemployment as an adjustment on the labour market;
- the existence of rigidities on factors markets, which slowed down the market functioning ;
- the sudden opening of the transition economies; and,
- huge structural changes and reforms that changed drastically the economic setting in which firms operate.

These features by definition are precluded by the assumptions of the neoclassical growth model, which makes its use in its original form questionable for the case(s) of transition countries.

Hence, the next step in the fourth chapter was to adapt mainstream growth theory to take into account the stylized facts of transition and then use it to consider transition theoretically. Alongside an overview of the neoclassical theoretical model, critical assessment is undertaken from the perspective of modifying and applying mainstream theory to the analysis of transition. First, we examined the assumptions of the Solow model to assess which hold for the case of transition countries, and can be adopted, and which need to be modified. The analysis suggested that some model assumptions need to be modified in order to allow for an open market economy; existence of non-perfect markets for some periods of transition; and occurrence of shocks. Based on the modified assumptions, transition was modelled as a series of switches between different balanced growth steady state patterns. This model demonstrated the interrelations among the main growth variables in the course of transition, and shed some new light on the importance of the switches associated with the structural changes that take place in transition. In addition, this analysis brought forward the need for

some formal concepts to better describe the notion of switching between growth stages or regimes.

The formal concepts to better accommodate the switching notion in the course of transition are developed in chapter 5 through distinguishing between the instability and volatility of growth. The critical assessment of the literature which discussed these concepts, mostly in the case of developing countries, suggested some common features with the growth processes in the course of transition; namely: huge drops, switches to high or medium growth rates, followed by further drops ... and so on. Hence, these concepts are applied in our analysis of transition, because they are complementary to the theoretical model developed in the previous chapter. Furthermore, in beginning our empirical investigation into the evidence of switches, this chapter applies a standard univariate structural break test to the data series for transition countries in order to confirm or reject the initial idea. The model applied, although not “the most” appropriate, revealed evidence in favour of switching regimes. The main finding from this chapter suggested that transition countries have experienced both instability and volatility of growth, as defined in the literature, and that this is to some extent confirmed by initial empirical investigation. Finally, this chapter concluded that better empirical ways to capture instability and volatility are needed, pointing towards the introduction of non-linear modelling.

Paradoxically, the appropriate modelling strategy to capture switches between stages or regimes of growth was borrowed from business cycle theories. Although business cycle theory is not an appropriate framework for analysing growth in transition, the review of business cycle analyses indicated that possible empirical solutions for capturing both the instability - hence, breaks – *between* growth regimes and, at the same time, the volatility of growth *within* growth regimes can be found in nonlinear econometric models, Markov Switching Models in particular. After assessing the applicability of non-linear models in the case of transition countries, in chapter 6, univariate Markov Switching Models were used to

analyse transition. The main findings of this chapter suggested that most of the countries experienced three regimes in the course of transition, with seven countries, half of which belong to the incomplete-U group, experiencing two regimes. Additionally, this analysis showed that volatility of growth was also an important feature of transition that possibly determined the further success of transition, with it being the highest in the first regime and comparably lower in the next two regimes. To our knowledge, this analysis is the first to provide measures of instability and volatility of growth at the same time for transition countries' GDP growth movements. Additionally, it is a first analysis to apply a theoretically informed Markov Switching Model to investigate growth in transition countries.

Chapter 7 provided a synthesis of the previous chapters and introduced an extended multivariate empirical model of the instability of growth under transition, which allows for the growth of physical capital and labour as endogenous variables. The analysis from the previous chapters established that measurement of the physical capital in the course of transition is mission impossible. Hence, in this chapter, we measure physical capital through the proxy of electricity consumption. Most machines and engines are powered by electricity; hence, the electricity consumption growth rate was used to proxy the physical capital stock and its utilisation growth rate, while the proxy for the human capital growth rate was the employment growth rate, considering that human capital changes in quality will not have major impact on regime switches. After specifying the main variables and estimating the model, several findings emerged.

- Firstly, the multivariate analysis once again confirmed the idea of instability of growth in the course of transition. Although the volatility effects could not be captured always within this analysis, yet the main finding is that countries in the course of transition indeed passed through various regimes or stages of transition.
- Secondly, according to this analysis which could be performed for 11 out of 26 transition countries, most of the countries recorded only two regimes, with five countries recording three regimes. However, these five countries belong to the most developed of the transition economies and all are members of EU. In contrast, the rest of the countries recorded only two regimes, suggesting that they are still to develop right

policies to finish transition, which in turn remains uncertain in the aftermath of the Global Financial Crisis

- This result is consistent with our theoretical model in identifying three main stages or growth regimes to the transition process. Finally, most of the growth in the course of transition in all stages and regimes can be attributed to the influence of the “technical changes” factor, which is a factor that can encompass institutional setting policy variables, obsolescence of physical and human capital and so on. This captures the “black box” of transition.

In summary, there are some differences in the results of econometric modelling as we progressed from the standard univariate structural break test to the univariate Markov Switching Model and multivariate Markov Switching VAR Model.

The *univariate analyses* conducted in chapter 5 and 6 bring forward relatively consistent results. Namely, the testing for structural breaks in presence of unit root yielded results which suggested big breaks in the data generating processes for most of the countries. Further on, the results from the univariate MS analysis suggested that most transition countries have undergone three different regimes and the rest of the countries, seven in total, only two regimes. The advantage of this type of modelling – univariate modelling - is that although these models are most restricted they make fewer demands of the data. Conversely, by definition, this modelling approach is less informative than less-restricted multivariate models.

On the other hand, the *multivariate model* applied in this research, MS VAR model in particular, is less restricted in that it estimates regime change and regime characteristics conditional on the two main determinants of growth identified in mainstream growth theory and discussed in our model in chapter 4; namely, physical and human capital. Because this model is less restricted and hence, make greater demands on data, it could be estimated for only 11 from 26 transition countries. However, the results from MS VAR model by and large fit with in the theoretical model developed in chapter 4, in particular four of the most developed transition countries, those for which transition can be regarded as more or less

complete. The remainder for which transition is not complete display two distinct growth regimes.

8.2.2 Policy recommendations

This thesis investigated growth patterns in the course of transition in ways that have not previously been undertaken and has thereby generated new knowledge on this topic. The thesis showed that growth in the course of transition could be viewed from a different perspective – as a non-linear switching process characterized by “tectonic” structural changes and reforms, instead of a smooth linear process as described by conventional growth theory. As shown, successful transition requires big regime shifts that will move the country on to higher growth steady state patterns characterized by higher levels of technology.

While this “new perspective on growth” does not point directly to particular policies, it does have profound implications for analysis and, hence, indirect implications for policy. Namely, the peculiar breaks of growth in the course of transition should be considered both - theoretically and empirically - at the early stages of future research and corresponding policy formulation, as they might drastically change the approach and, hence, the results and conclusions.

For example, in empirical analyses of developed market economies, the Hodrick-Prescott (HP) filter is often used to identify trend output growth and so clearly distinguish potential output from the cyclical component of growth (Hodrick and Prescott, 1997). This filter decomposes the time series into two components: the trend component and the cyclical component. Depending on the research goals, the findings from the filtering are then used to conduct additional analyses in various spheres: fiscal policy; monetary policy; and business cycle analysis. Finally, the outcomes inform the appropriate policies, such as fiscal policy and monetary policy.

Yet the findings of this thesis imply that the use of the Hodrick-Prescott (HP) filter to identify trend

output growth in the transition context might be misleading. The main reason for this is that the HP filter neglects structural breaks and shifts, assuming output to be “varying smoothly over time” (Hodrick and Prescott, 1997). For example, if one-time permanent shocks occur, the filter will generate shifts in the trend that do not actually exist and will distort the estimates of the underlying trends, both before and after the shock (Duy, 2012). Use of the HP filter in the transition context characterised by various shocks is likely to give misleading estimates of trend growth and, hence, of the cyclical component. In turn, if such estimates are used to inform, for example, active fiscal policy, then the actual effects of such policy are likely to be very different from the anticipated effects. Hence, caution is recommended regarding HP estimations, especially in the region of large shocks (Duy, 2012).

Conversely, in this context, our results lend support to using the Kalman filter for such estimates. The Kalman filter is an algorithm which uses a series of measurements observed over time, containing Unobserved Components (UC) - namely, trend, cycle and noise (random variations) - to produce estimates of these unknown variables. The Kalman filter works in a two-step process: in the prediction step, the Kalman filter produces estimates of the current state variables, along with their UCs (Harvey, 1990). Once the outcome of the next measurement (necessarily corrupted by some amount of error, including random noise) is observed, the estimates are updated using a weighted average, with more weight being given to estimates with higher certainty. Due to its recursive nature, the algorithm runs in real time using only the present input measurements and the previously calculated state without requiring additional past information. An important advantage of the unobserved components (UC) approach implemented by the Kalman filter is that it does not require identifying the break points prior to estimation, since it identifies them through the recursive process, that is “... the UC approach lets the data decide the relative importance of the shocks to potential output and the corresponding output gap (Gerlach and Smets, 1997, 4).” In this case, *the Kalman filter approach is in better accord with our findings as it takes into consideration possible breaks in growth in the course of transition and so should better inform appropriate policy.*

This short example shows that although our findings do not relate directly to particular policies, they do inform analysis and, hence, may indirectly inform policy.

In addition, the core idea conveyed by this research is that drastic changes require radical policy orientation, instead of the incremental approach that is more appropriate for guiding economic growth in mature developed economies. Radical policy orientation should encompass measures that will best enable the shift of the country onto a higher transitional growth pattern, i.e. in terms of the model switching from a negative to a positive “black box” indicator. How can this switch be described? It is not clear, since the black box is not disentangled within this research. However, this research shows how this switch can be initiated. It can be initiated only if the probabilities to switch into the next regime are increased, and they can be only increased by creating the specific environment for the desired regime.

The main proposed track is to look for possible solutions within the supply-side theories, which are designed to improve the supply-potential of the economy, by creating more favourable conditions for markets and firms’ operations and therefore contributing to increasing the rate of economic growth. In general, all policies that have an effect to increase competition and efficiency within the economy belong in these supply-side policies. Typical policy recommendations of supply side economist are lower marginal tax rates and less regulation for mature developed economies. However, in the case of transition countries this combination can be enriched by policies that will enable adoption of free technology as well as imitation and import of technology. In general, all those supply-side policies are mainly long-term; they give results only in the long run, which is probably their main flaw, which makes them non-interesting as a tools for short-run results oriented politicians in transition countries, in lagging ones especially.

In sum, this thesis develops and applies long-period growth analysis, and, correspondingly, focuses attention on long-run supply-side policies. No long-run analysis can offer solutions that will work in the short run.

8.3 Contribution to knowledge

Complementing the main findings identified in the previous sections, this research has contributed to knowledge in several areas.

Firstly, the conventional theoretical growth model usually used to analyse growth in the course of transition was broadened to account for the huge structural changes that happened in the course of transition. The critical assessment of the previous transition and growth literature indicated lack of appropriate theoretical background for analysing growth in the course of transition, completely ignoring the peculiarities of transition itself. Hence, the idea was firstly to modify theory to better accommodate transition reality.

Secondly, growth under transition was analysed through the concepts of instability and volatility using conventional structural break tests. This approach confirmed that there is some evidence of switches in the course of transition, which, in turn, suggests that studies based on the linear approach might offer unreliable or misleading results and conclusions. As a possible solution, Markov Switching Models were used to account for both instability and volatility in the course of transition, which has not to the best of our knowledge been done before. We demonstrated how these models work and how their results can be interpreted.

Thirdly, the growth pattern in the course of transition was further analysed by Markov Switching VAR Modelling. The issues of the determinants of growth have been hugely

investigated in transition studies, yet these are mostly based on the neoclassical linear approach in the modelling. However, this study demonstrated that the adopted non-linear approach is both supported by the data and hugely affects the results and conclusions, as it allows for observing transition in different stages.

Fourthly, many transition studies analyse transition countries as one homogeneous group, merging the data usually into a panel. This study undertakes a different approach. Namely, although starting with the familiar regional groups of countries (CEEC, SEEC, BC and CIS), the thesis promotes the individual *within country* analysis of growth process and its determinants in each transition country, thereby allowing for the uniqueness of the transition process in each country. However, the individual results of our analysis permit to inform new country groupings that are at once theoretically grounded and empirically supported. These are:

- The *3-regime group* comprising Poland, the Czech Republic, Latvia and Estonia; and,
- The *2-regime group* comprising Albania, Hungary, Macedonia, Bulgaria, Turkmenistan, Ukraine and Moldova.

This new categorisation of countries based on the multivariate MS VAR analysis differs from the categorisation established based on the results of the univariate analyses, in the sense that it allows only for few, notably most developed countries to belong to the elite three regime group. Estimating the regimes switches conditional on GDP growth rates and also on the two main growth determinants – physical and human capital, the MS VAR analysis brought forward the depiction that is very much in line with the theoretical model.

In general, we believe that the main contribution of this research lies in the innovative approach to analysing transition from a perspective different from the conventional one. In this thesis, the conventional neoclassical approach was combined with recent breakthroughs on the instability and volatility of growth in order to be able to theoretically and empirically investigate transition as a non-linear process. These two approaches have not been combined

before, although once combined they offer stronger possibilities for analysing non-linearities in growth under transition.

8.4 Limitations of the research

The first and probably the most obvious limitation of every investigation of growth conducted for transition countries is the limited and short span of data available for analysis. This research also suffered from this problem. Namely, growth theory and also growth empirics are typically developed observing long-run data over 40 years or even longer horizons. That enables observation of the long-run relationships among the variables in the analysis; hence, bringing more reliable conclusions. However, in the case of transition countries the data span available typically starts only in 1990 or 1991 (for some even later), which hinders the analysis and places a question mark over the results.

An additional problem related to data availability is the lack of data on physical capital at the beginning of the period of analysis. Even in the cases when some data are available for the pre-transition period, they cannot be used as starting values for the transition period, because the data collection and aggregation differed greatly in the socialist and transition periods. Furthermore, for the course of transition there are data on investment. However, there are no data available on the depreciation rate of physical capital in the course of transition, which is an additional obstacle to calculating physical capital growth rates through time. Hence, in this study physical capital and its utilisation had to be proxied by electrical consumption, which should capture part of the obsolescence and depreciation, while the rest of the depreciation and obsolescence were addressed only indirectly by capturing them in the intercept term. Still in the sphere of data problems, one additional limitation imposed by the data deficiency was the absence of data for some newly proclaimed countries, which had to be left out of the analysis.

From the empirical point of view, one important limitation of this thesis is the inability to perform panel analysis for certain groups of countries. This analysis would have served as a robustness check for the results and groups conclusions. However, Markov Switching VAR Modelling is a relatively new method in the empirical literature and has yet to be developed for panel analysis.

8.5 Small sample size bias – problems, limitations and assessment of the results

Inference in econometric models is typically likelihood based and relies on the asymptotic properties of the estimators. Indeed, there is only one estimator that has known small sample characteristics and that is Ordinary Least Squares. Maximum Likelihood and General Methods of Moments approaches require large samples as the basis for inference.

In reality though, often the samples available for analysis are small, thereby imposing the question as to what happens to the point estimates and statistical inference in this case. Is the sample size bias so great as to invalidate the results of estimation? This question is of particular concern in our research. Namely, the sample size for each country is small, while our MS Models are estimated by maximum likelihood approaches. For example, the degrees of freedom in our multivariate MS-VAR models are 21 for the three-regime multivariate models and 29 for the two-regime multivariate models, showing that the number of independent pieces of information that go into the estimate of parameters is very limited.

In estimation, the MS VAR model converges through an iterative process, and proceeds by estimating each of the equations in the VAR system separately by GLS regression. Hence, it uses the available observations repeatedly for each equation, which in our case means that the MS-VAR is estimated using 51 observations; that is 17 observations in each equation multiplied by 3 (the number of equations in the VAR). The degrees of freedom are calculated as the difference between the number of the observations available for each country and the

number of the parameters estimated, which was 30 for the three-regime model and 22 for the two-regime model²¹⁰. In fact, it can be said that the VAR structure of the model makes good use of the available data, which permits only 17 usable observations for each country²¹¹. However, this point still does not diminish the fact that the degrees of freedom are indeed small.

In the rest of this section we explain: (1) why panel estimation was not an option for our investigation, which in turn conditioned our decision to use the MS VAR approach; and (2) the consequent limitations of our research arising from this choice.

One way to increase the degrees of freedom, hence to increase confidence in our estimates, would be to estimate a Markov Switching VAR *panel* model that is not only using panel data for each of the groups identified in the univariate analysis but also taking into account the endogeneity of the variables of interest (labour and physical capital). However, panel Markov switching models of any type are not common in the economics literature. A particularly relevant example for our work is Jerzmanovski (2006) who uses annual data on 89 countries for the period from 1962 – 94 to estimate a panel MS model for 89 countries for the period 1962-94. However, in our view, what Jerzmanovski actually estimates is obscure. Additional reasons not to build on this approach are as follows.

1. Less subjective is the observation that full details are not provided as to how the estimator is derived and implemented. Although a footnote promises “details on the

²¹⁰ For example, the parameters estimated in the three-regime model are: coefficients on the constant term for the three regimes (3); coefficients on the three lagged variables (3); and the Standard error (1). These coefficients are calculated for each of the equations in the MS VAR system, which means that the number of the parameters for each equation is multiplied by 3, that is $3 \times 7 = 21$. In addition, 9 transition probabilities are calculated. The total number of the parameters in the three-regime model is $21+9=30$. The degrees of freedom are calculated as the difference between the number of available observations and the number of parameters to be estimated (i.e. $51-30=21$). In the two-regime model the number of parameters is counted and the degrees of freedom calculated in the same manner.

²¹¹ Due to the limited data on employment, the data sets are for the period of 1993-2009.

estimation procedure”, the URL does not lead to a functioning web site (<http://people.clemson.edu/mjrzma/research.html>).

2. No software or code is provided to enable the application to be replicated.
3. There is no assessment of the performance of the estimator as either “T” or “N” increase. This is particularly problematic from the perspective of assessing the extent to which increasing observations in the cross-section dimension (N) can compensate for limited observations in the time-series dimension (T).
4. Jerzmanovski assumes that the transition probabilities in each country in his sample are potentially endogenous, depending on institutional quality. However, Jerzmanovski does not take account of the widely recognised endogeneity of institutional quality itself. Yet Kim (2004) suggest that endogenous regressors in a Markov switching model generally render the estimates inconsistent if the endogeneity is not accounted for. This suggests that what is needed is not simply an approach to estimating a panel MS model but *a panel MS-VAR model*.
5. Moreover, growth panel regressions implicitly assume a homogeneous effect of growth regressors across countries, which is quite unlikely given the markedly different country environments in the course of transition. In our case, even if panel estimation were to be feasible, multiple panels would need to be estimated, one for each of the three groups of countries, to take account of possibly fundamental sources of heterogeneity in patterns of growth.

In general, time series modelling with panel data continues to entail severe difficulties especially when the endogeneity issue is placed into the picture. In other areas of time-series modelling with panel data progress has been made but is far from complete; for example: the estimation of wide “N” and short “T” panels by difference and system GMM; and estimators for single equation error correction/cointegration modelling, which are now widely used by applied economists (Blackburne and Frank, 2007), although we still await the development of a panel counterpart to the Vector Error Correction approach, which has long been routine in time series analysis. However, at the time of considering our empirical strategy in this thesis and, to our knowledge, subsequently, no widely accepted non-linear MS VAR panel estimator with regime switching that could account for endogeneity as well as for the

dynamics of switching has been developed and made available to the community of applied economists.²¹²

Of course, all of this is background to our decision to explore regime changes using an established – and well-documented - MS-VAR approach to investigating regime changes in spite of very limited degrees of freedom. We now assess the consequent limitations of our research arising from this choice.

Estimation and inference in Markov Switching models is typically likelihood based, and relies on the first-order asymptotic properties of the maximum likelihood estimator (MLE) and of related statistics (Psaradakis and Sola, 1998). However, although there is a huge empirical literature concerning various applications of MS Models, mainly in financial and business cycle analyses, there is very little interest and information concerning the quality of the asymptotic approximations as the basis for inference.

Psaradakis and Sola's (1998) study on the finite sample properties of ML estimator in autoregressive models with Markov Switching is one of the rare studies that assess the quality of approximate inferential procedures for MS models, various sample sizes and parameter values that are common in empirical applications. Indeed, this is the only study of MS models with constant transition probabilities, which is a characteristic of the models estimated in this thesis. They use Monte Carlo experimentation with 1000 replications in order to examine the finite-sample properties of the maximum likelihood estimator in autoregressive models subject to Markov mean and variance shifts with constant transition probabilities, which are characteristics of the models used in our empirical investigation. The data-generating process (DGP) used in their experiments is defined by the nonlinear autoregressive mechanism, where the error follows $N(0,1)$ and (s_t) is a two-state, homogeneous, irreducible and aperiodic Markov chain. The experiments are conducted for

²¹² Another paper estimating a “panel model with regime switching”, Chen (2007), is likewise less than fully coherent. In particular, while the author sets out a panel model, the estimator is applied to a single time series. This paper seems to have made little impact on subsequent publications.

various combinations of the parameter values of the model under investigation. The sample sizes tested are 100, 200, 400 and 800 observations, the last two of which are not uncommon in studies using weekly or daily data in financial data analyses. The outcome of their experiments is generally “discouraging” for all simulations on all variations of the parameter values, with the quality of asymptotic approximations being mostly poor for all sample sizes of less than 400.

The evidence of the problem exposed in this paper is important, suggesting that the use of asymptotic inference procedures can be doubtful even in what are normally thought of as relatively large samples. In the specific context of this thesis, the Psaradakis and Sola (1998) study suggests practical implications for the assessment of both the point estimates and the associated hypothesis tests.

- Psaradakis and Sola (1998, p.383) find that, in general, “the MLE is not significantly biased”. For example, for a model with an autoregressive parameter of 0.6 estimated on the smallest sample tested ($T=100$) the bias on the intercept in regime 1 is 0.000 and in regime 2 -0.008 on a parameter value of 5. The indication is that small sample bias is not an issue of practical importance. However, it should be noted that the sample tested in their analysis had 100 observations, and also that the estimated bias on the intercept term is probably not linear at smaller sample sizes; hence we cannot make a certain judgement as to how large sample size bias might be in our case.

- Matters are even more serious with respect to the finite sample implications for hypothesis testing. Psaradakis and Sola (1998) demonstrate that in small samples hypothesis tests suffer from size distortions. The size of the test gives the probability of Type I error deemed to be acceptable by the researcher. Size distortion in a MS model estimated on a finite sample means that actual probability values (p-values) can be much larger than their reported or nominal values. For example, in a sample of 100 observations, in a model with an autoregressive parameter of 0.6, a nominal p-value of 0.05 on the Regime 2 intercept corresponds to an actual p-value of 0.098. In round terms, this degree of size distortion corresponds to the loss of “one star” (i.e.

results reported as significant at the 5% level can be regarded as significant at the 10% level. However, again having in mind that their smallest sample size is 100 observations, and observing that increases in size distortion are non-linear in reductions of sample size, we conclude that size distortions in the results reported for our models – in particular, for the MS VAR models – are likely to be much larger. An additional finding by Psaradakis and Sola (1998) may somewhat attenuate this conclusion, *while not challenging it in principle*. The size distortion effect of finite samples diminishes significantly with lower levels of persistence as measured by the autoregressive parameter. Size distortions typified by the above example arise from simulations with an autoregressive parameter of 0.6. The typical autoregressive parameter reported in our results is 0.4 or lower. Hence, although we estimate with fewer observations than the lower level considered by Psaradakis and Sola (1998) our estimated models display much lower levels of autoregression. While the former tends to increase size distortion the latter tends to reduce it.

- Finally, Psaradakis and Sola (1998) do not cover the multivariate case, where usually the concerns about the sample size are greater. Nevertheless, Psaradakis and Sola (1998, p384) conclude that although their findings are specific to the particular first-order model, they anticipate that likelihood-based inference will encounter similar difficulties in more general dynamic systems, suggesting that “the problems are more likely to become severe as the dimension of such systems increases”.

Although the span of our annual data series favours the identification of structural breaks (in the context of transition, 20 years is a long period) (see Campbell and Perron, 1991, on the importance of span), *our estimates nonetheless lack the degrees of freedom necessary for unbiased estimation and, even more so, for confident inference*. In conclusion, we acknowledge the limits of ML estimation with small samples. Given this, our results should be treated with caution. However, this problem is common in empirical analyses of transition countries, for which data limitations are well documented and recognized in the literature (Havrylyshyn, 2001).

8.6 Avenues for further research

This research paves the way for some different thinking on growth in the course of transition. It established some main ideas and findings, at the same time opening up new ideas and challenges for further investigations.

Focused on growth patterns in the course of transition, this research revealed little in terms of the technical changes variable, which is still something of a “black box” in our analysis. Our research revealed its importance in the various stages of transition, yet leaving enormous un-researched space in terms of what is inside that box in the various regimes. Endogenous theories of growth offer possible answers in the form of 145 or so determinants of growth that can be further explored. It would be interesting to see whether any of these variables can be placed in the specific contexts of regime switches in the course of transition. For example, it would be interesting to investigate whether the same regime-switching notion can be observed in the institutional development, in the forms of exports, in the forms of production or adoption of new technology, in social capital developments and so on. Each of these variables has its specific contribution to growth, which potentially can be investigated for non-linear effects. However, this could not be fully done in this thesis due to the need to explore each variable individually and to lack of data. Maybe case studies analyses can shed some new light in this area.

In addition, in this thesis growth processes in the course of transition were observed as patterns towards some equilibrium (i.e. each successive stage of the growth process is characterised by its own steady state and by corresponding adjustment paths). However, this research was not based on the catch up concept and methodology, although splitting transition into several stages with the third growth stage of transition in the model being a final stage of catch up towards a technologically developed market economy (approximating, the level of development of the western and northern European members of the EU) is suggestive of a catch up process. In turn, this consistency however, might offer the basis for

analysing growth from a different angle, within the catch up story and convergence clubs perspective.

From the policy point of view, it should be admitted that this research was rather focused on altering the main concepts of transition, which in turn cannot result in straightforward, specific policy recommendations. In summary, it resulted in the finding that changing the concept of understanding transition might be potentially very important as to how transition can be observed and analysed in the future. As such, although our analysis and findings do not support specific policy prescriptions, they do provide a particular perspective for policy making; namely, one oriented to long-run supply-side reform.

Finally, one rather personal research question that was conceived in the course of conducting this research was the question of relating growth and social capital changes in the course of transition. Some relevant investigation has been conducted as part of institutional growth studies for transition countries. However, there remains huge potential for research on social capital change and economic development in the course of transition.

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APPENDICES

APPENDICES Chapter 2

Appendices

Appendix 2. 1 GDP per capita growth rate (%annual)

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Country/Group																						
Albania	7.8	10.5	-	-6.5	11.0	9.8	14.7	10.1	-9.6	13.2	10.3	7.3	6.8	2.5	5.1	5.3	4.9	4.5	5.5	7.3	2.9	3.1
Armenia	..	..	10.9	40.8	-6.6	8.0	9.1	7.6	4.6	8.2	3.9	6.4	9.9	13.4	14.1	10.4	13.7	13.1	13.6	6.7	14.3	1.9
Azerbaijan	..	..	-2.2	23.8	24.3	20.8	12.8	0.3	4.8	9.0	6.5	10.2	9.1	9.8	10.4	9.2	25.1	33.0	23.6	8.5	7.1	3.8
Belarus	..	..	-1.2	-9.8	-7.8	11.6	10.1	3.1	11.9	8.9	3.8	6.1	5.1	5.5	7.6	12.0	10.0	10.5	9.0	11.4	1.2	7.8
Bosnia and Herzegovina	..	..	..	..	..	..	25.5	90.5	32.0	11.8	5.9	2.9	2.9	4.5	3.8	6.1	5.0	6.2	6.9	5.6	-2.7	1.0
Bulgaria	-2.2	-7.5	-7.5	-6.3	-0.7	2.2	3.3	-8.6	-1.0	5.6	2.5	6.2	6.1	6.7	6.1	7.3	6.9	7.1	6.9	6.7	-5.0	0.9
Croatia	..	..	16.4	10.9	11.4	5.6	6.3	10.0	4.7	3.6	-2.2	6.8	3.3	4.9	5.4	4.2	4.2	5.0	5.2	2.2	-5.9	-0.9
Czech Republic	..	..	11.4	-0.6	0.0	2.2	6.0	4.1	-0.6	-0.7	1.4	3.8	2.8	2.2	3.6	4.4	6.1	6.5	5.5	1.6	-4.7	2.0
Estonia	2.7	-7.1	-7.5	19.7	-3.3	0.5	6.9	6.5	12.1	6.4	0.6	10.0	8.9	8.4	8.0	7.6	9.7	10.8	7.1	-5.0	13.9	3.1
Georgia	-7.4	14.8	21.7	45.3	29.8	-9.5	5.4	14.0	12.6	4.1	3.7	2.6	5.6	6.2	11.8	6.1	8.5	8.5	12.6	2.4	-4.4	5.4
Hungary	1.8	-2.5	11.9	-3.0	-0.5	3.1	1.6	0.3	3.3	4.3	3.5	4.5	4.0	4.8	4.1	5.0	4.2	4.1	0.3	1.1	-6.7	1.5
Kazakhstan	..	..	11.6	-5.2	-8.6	11.3	-6.6	2.0	3.3	-0.2	3.7	10.1	13.7	9.8	8.9	8.8	8.7	9.5	7.7	2.0	-1.4	5.8
Kosovo	..	..	..	..	..	..	..	..	..	..	..	..	25.4	-1.6	4.8	2.1	3.3	5.4	5.8	6.3	2.3	3.4
Kyrgyz Republic	0.8	4.5	-9.3	14.9	15.5	20.1	-6.4	5.5	8.3	0.6	2.1	4.2	4.3	-0.9	5.9	5.7	-1.3	2.0	7.5	7.4	1.7	-2.5
Latvia	5.1	-7.8	12.2	31.2	-3.1	3.9	0.5	5.0	9.4	5.7	5.6	7.7	8.9	7.2	7.8	9.3	11.2	12.8	10.6	-3.8	17.5	0.4
Lithuania	..	..	-5.8	21.2	15.8	-9.1	4.1	6.0	8.3	8.4	-0.4	4.0	7.3	7.2	10.7	7.9	8.5	8.5	10.4	3.5	14.3	2.9

Appendices

Macedonia, FYR	..	..	-6.8	-7.1	-7.9	-2.2	-1.6	0.7	0.9	2.9	3.9	4.1	-4.9	0.5	2.5	4.4	4.1	4.8	5.9	4.7	-1.1	1.6
Moldova	4.4	-2.8	16.2	29.2	-1.1	30.7	-0.9	-5.0	1.8	-6.3	-3.2	2.3	6.3	8.0	6.9	7.7	7.8	5.1	3.3	8.0	-5.9	7.1
Montenegro	..	..	..	..	..	..	..	..	..	5.4	-8.9	3.6	1.5	2.2	2.7	4.5	4.2	8.5	10.5	6.7	-5.9	2.2
Poland	..	..	-7.3	2.2	3.5	5.1	6.8	6.2	7.0	4.9	4.5	4.8	1.7	1.5	3.9	5.4	3.7	6.3	6.8	5.1	1.5	3.9
Romania	-6.2	-5.8	12.1	-8.0	1.6	4.1	7.4	4.3	-5.8	-4.6	-1.0	2.2	7.2	6.7	5.5	8.7	4.4	8.1	6.2	9.6	-8.4	1.1
Russian Federation	..	-3.4	-5.3	14.6	-8.6	12.5	-4.0	-3.3	1.7	-5.0	6.8	10.0	5.3	5.2	7.8	7.7	6.9	8.6	8.8	5.4	-7.7	4.1
Serbia	..	-8.1	-9.9	27.6	31.0	2.0	6.0	8.2	11.0	1.8	10.9	5.7	5.5	4.2	2.9	9.6	5.7	4.0	5.8	4.2	-3.1	1.4
Slovak Republic	0.7	-3.1	14.6	-6.8	-4.1	5.8	5.5	6.7	4.2	4.2	-0.1	1.5	3.7	4.6	4.8	5.0	6.6	8.3	10.4	5.7	-5.1	4.0
Slovenia	..	..	-9.0	-5.3	3.1	5.4	3.6	3.7	5.1	3.7	5.3	4.0	2.8	3.7	2.9	4.3	3.8	5.5	6.3	3.4	-8.8	0.9
Tajikistan	-9.2	-3.1	-9.1	30.3	17.7	22.5	13.7	17.9	0.2	3.9	2.4	7.1	9.1	8.2	9.3	9.7	9.4	5.5	5.7	6.4	6.4	2.4
Turkmenistan	-6.7	-1.9	-7.3	-8.0	12.5	19.4	-9.2	-8.4	12.7	5.3	15.0	17.2	19.1	14.6	15.9	16.0	11.8	10.1	10.5	13.3	4.8	7.9
Ukraine	3.4	-6.6	-8.6	10.0	14.3	22.6	11.5	-9.2	-2.1	-1.0	0.7	7.0	10.3	6.3	10.3	13.0	3.5	8.0	8.5	2.9	14.4	4.6
Uzbekistan	0.7	-0.8	-2.6	13.3	-4.5	-7.0	-2.7	-0.2	3.2	2.6	2.8	2.7	2.9	2.7	3.0	6.5	5.8	6.0	8.0	7.3	6.3	6.7

Note: The indicator used is GDP per capita growth (annual %) for which the long definition is given by World Bank. Namely, annual percentage growth rate of GDP per capita based on constant local currency. GDP per capita is gross domestic product divided by mid-year population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Aggregation method: Weighted average.

Source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester World Bank national accounts data, and OECD National Accounts data files.

Appendix 2. 2 A) GDP per capita transformed into indexes (with the starting value of 100 in 1990)

Country/Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Albania	100	70.4	65.9	73.2	80.4	92.2	101.5	91.7	103.8	114.5	122.9	131.4	134.9	142.2	150.0	157.6	164.9	174.2	186.6	190.6	195.9
Armenia	100	89.1	52.8	49.3	53.2	58.1	62.5	65.3	70.7	73.4	78.1	85.9	97.4	111.1	122.7	139.6	157.8	179.2	191.1	163.3	166.8
Azerbaijan	100	97.8	74.5	56.5	44.7	39.0	39.1	41.0	44.6	47.5	52.4	57.1	62.7	69.2	75.6	94.6	125.8	155.6	170.4	184.1	167.3
Belarus	100	98.8	89.1	82.1	72.6	65.3	67.3	75.3	82.0	85.1	90.3	94.9	100.1	107.7	120.7	130.8	145.1	159.9	178.4	181.3	194.2
Bulgaria	100	92.5	86.7	86.1	88.0	90.9	83.1	82.2	86.8	89.0	95.8	101.7	107.0	113.5	121.9	130.3	139.5	149.3	159.3	152.2	152.6
Croatia	100	83.6	74.5	66.0	69.7	74.1	81.6	85.4	88.5	86.6	92.4	95.5	100.1	105.5	109.9	114.5	120.2	126.4	129.5	122.1	120.5
Czech Rep.	100	88.9	88.3	88.3	90.2	95.6	99.6	99.0	98.3	99.7	103.5	106.5	108.7	112.6	117.6	124.8	132.8	140.1	142.3	135.4	138.3
Estonia	100	92.5	74.2	71.8	72.1	77.1	82.1	92.0	97.9	98.5	108.4	117.2	127.1	136.8	148.6	164.1	182.8	196.0	186.1	159.9	163.2
Georgia	100	79.5	44.4	31.9	29.2	30.4	34.4	38.5	40.2	41.9	43.2	45.8	48.9	55.2	58.5	63.5	68.9	77.6	79.5	76.3	80.1
Hungary	100	88.1	85.4	85.1	87.7	89.1	90.2	94.3	99.3	103.8	110.6	115.4	120.8	126.4	132.6	138.1	143.8	145.5	146.6	137.6	182.3
Kazakhstan	100	88.4	83.8	76.6	67.9	63.5	64.8	66.9	66.8	69.2	76.3	86.7	95.2	103.7	112.9	122.7	134.4	144.7	147.7	147.4	154.0
Kyrgyz Rep.	100	90.7	77.2	65.3	52.2	48.9	51.6	55.9	56.2	57.4	59.9	62.6	62.1	65.9	69.8	69.0	70.4	75.8	81.5	82.8	80.2
Latvia	100	87.7	60.2	58.2	60.4	60.6	63.5	69.9	74.4	78.6	84.6	92.0	98.8	106.5	116.3	129.4	146.0	161.4	154.7	127.5	128.5
Lithuania	100	94.2	74.2	62.5	56.8	59.0	62.6	67.7	73.4	73.1	76.2	81.7	87.6	97.0	104.7	113.6	123.2	136.1	140.6	120.1	124.3
Macedonia	100	93.2	86.6	79.7	77.9	76.6	77.1	77.8	80.1	83.1	86.6	82.4	82.9	85.0	88.3	91.8	95.3	100.8	105.6	104.8	107.9
Moldova	100	84.1	59.7	59.1	40.9	40.4	38.3	39.0	36.5	35.3	36.1	38.4	41.5	44.4	47.8	51.5	54.1	55.9	60.3	56.5	60.8

(Table continues on the next page)

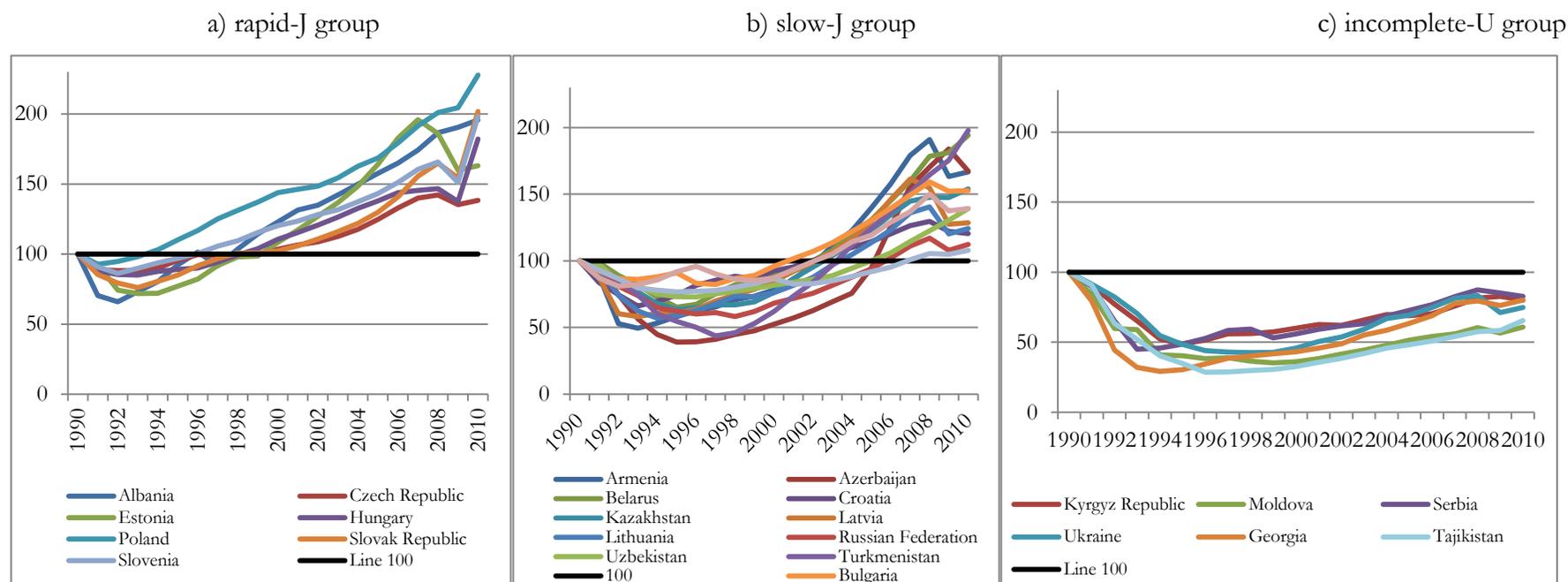
Appendix 2.2B) GDP per capita transformed into indexes (with the starting value of 100 in 1990)

Country /Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Poland	100	92.7	94.8	98.2	103.0	110.1	116.9	125.1	131.3	137.2	143.8	146.4	148.5	154.4	162.7	168.7	179.3	191.6	201.1	204.4	227.8
Romania	100	87.2	80.9	82.2	85.6	91.9	95.9	90.2	86.1	85.2	87.1	93.4	99.6	105.1	114.2	119.2	128.9	136.9	150.1	137.5	139.1
Russian Fed.	100	94.7	80.9	74.0	64.8	62.2	60.1	61.1	58.0	62.0	68.2	71.9	75.6	81.5	87.8	93.9	102.0	111.0	117.0	107.8	112.3
Serbia	100	90.1	65.2	45.0	45.9	48.7	52.7	58.5	59.5	53.0	56.0	59.3	61.6	63.2	68.6	72.7	76.8	82.4	87.4	85.1	82.7
Slovak Rep.	100	85.4	79.3	76.1	80.5	85.0	91.6	96.7	100.8	100.7	102.2	106.0	110.8	116.1	121.9	129.9	140.8	155.6	164.9	154.3	201.8
Slovenia	100	90.9	86.2	90.0	93.7	97.1	100.5	105.7	109.7	115.4	120.2	123.5	128.2	131.8	137.3	143.2	151.1	160.4	165.8	151.2	198.2
Tajikistan	100	90.9	63.4	52.1	40.4	34.9	28.7	28.7	29.9	30.6	32.7	35.7	38.5	41.9	45.9	48.3	51.0	54.1	57.5	58.5	65.5
Turkmenistan	100	92.7	85.3	74.6	60.2	54.6	50.0	43.7	46.0	52.9	61.9	73.5	83.9	96.8	111.8	124.5	136.8	150.9	164.6	175.4	198.0
Ukraine	100	91.4	82.3	70.5	54.6	48.4	43.9	43.0	42.5	42.9	45.8	50.6	53.7	59.3	66.9	69.3	74.8	81.2	83.4	71.2	74.8
Uzbekistan	100	97.4	84.5	80.7	75.0	73.0	72.8	75.2	77.2	79.3	81.5	83.9	86.2	88.8	94.5	99.9	105.9	114.4	122.6	130.4	139.2

Notes: The values coloured in yellow mark the years in which countries managed to return to the starting value of 100. In green are marked the countries that have not managed to return to the value of 100 until 2010.

Source: Author's own calculation based on data from World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester

Appendix 2.3 Divergent growth paths in the various groups of transition countries



Source: Author's own calculations based on Appendix 2.2.A) and B). Data source: World Bank data, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

APPENDICES Chapter 3

Appendices

Appendix 3. 1 Gross capital formation (current US\$) (formerly gross domestic fixed investment) in indexes (1990=100)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Albania	100	13.6	6.0	26.3	57.7	82.7	100.3	60.0	72.2	106.3	148.1	183.0	176.9	215.1	288.9	320.9	371.4	517.6	676.6	566.6	496.2
Armenia	100	58.8	21.7	15.0	26.6	23.7	28.5	26.5	30.7	30.3	35.2	37.4	50.1	64.5	85.3	145.9	226.7	339.8	475.8	268.3	309.6
Azerbaijan	100	56.1	60.7	46.4	48.5	26.6	51.5	81.7	88.0	72.8	68.0	72.7	118.4	214.3	279.1	304.8	347.2	394.0	517.6	525.9	491.1
Belarus	100	103.6	112.8	144.8	130.3	90.6	81.6	93.5	103.6	83.9	84.2	73.5	84.2	111.1	153.7	210.2	287.7	372.8	531.0	475.1	555.8
Bulgaria	100	45.1	38.2	31.8	30.3	45.4	30.4	25.9	38.7	45.1	46.2	57.5	66.2	89.1	116.8	168.8	208.0	274.1	395.1	269.7	254.2
Croatia	100	61.9	44.7	54.8	66.2	97.1	134.1	160.4	166.3	153.0	132.5	146.2	184.8	278.2	330.4	360.5	422.4	506.4	621.6	506.6	428.3
Czech Rep.	100	69.8	94.3	109.2	133.8	197.2	225.6	193.8	197.5	184.3	179.9	196.5	234.6	276.2	320.7	351.0	399.4	497.2	586.3	488.8	464.6
Estonia	100	84.2	70.4	77.3	88.2	98.3	104.9	119.4	143.0	118.0	122.8	138.7	182.8	261.3	312.2	375.0	487.6	620.4	579.5	350.1	301.0
Georgia	100	67.7	33.4	4.6	3.7	6.0	31.8	35.8	51.0	40.6	43.0	48.5	46.0	58.8	77.8	99.5	109.4	144.6	152.0	85.7	111.4
Hungary	100	109.9	116.3	114.5	131.3	147.9	154.9	158.0	170.9	177.7	172.7	191.4	240.3	291.5	360.2	396.6	383.0	458.4	489.0	411.0	363.0
Kyrgyz Rep.	100	72.6	54.6	43.7	33.7	55.5	66.8	36.0	35.0	32.3	40.4	41.9	42.8	42.9	52.7	57.3	105.5	151.3	185.7	156.6	209.8
Latvia	100	24.3	31.7	35.9	44.0	42.1	54.4	61.7	97.0	97.8	110.9	120.7	129.5	159.4	220.7	286.8	379.7	565.4	596.4	326.0	251.7
Lithuania	100	79.5	67.9	59.1	55.4	55.3	59.5	78.0	92.4	82.8	73.8	84.3	98.9	135.2	173.2	203.7	261.1	381.4	408.9	217.3	201.0
Macedonia	100	113.4	55.8	52.9	64.5	91.4	95.5	80.4	77.3	75.8	72.3	63.4	78.1	96.3	118.9	123.2	143.9	198.8	283.3	238.6	223.4
Moldova	100	78.4	56.0	54.9	49.0	41.7	49.9	57.3	55.8	32.2	29.6	29.8	40.4	54.8	82.1	109.5	144.1	223.9	306.9	207.9	196.6
Poland	100	120.4	114.3	110.2	143.5	199.0	250.7	284.4	336.2	330.8	328.5	318.2	299.9	319.3	369.1	447.3	542.3	740.8	941.9	730.5	753.4
Romania	100	54.7	63.5	62.2	80.5	100.1	107.0	98.5	101.0	83.1	92.4	109.5	128.8	168.1	215.4	300.4	380.8	642.9	821.3	644.8	664.1
Russ. Fed.	100	79.9	74.3	59.8	58.1	56.2	52.8	49.9	29.5	19.0	29.5	39.0	41.7	53.4	73.3	91.4	123.5	184.0	249.1	178.1	218.5
Slovak Rep.	100	101.3	128.2	131.0	141.7	170.9	236.5	250.1	285.7	241.2	202.3	236.0	258.8	309.7	368.1	444.8	479.7	599.8	662.2	494.1	528.6
Slovenia	100	80.1	70.7	73.2	87.1	139.3	144.7	148.2	165.2	180.7	159.1	154.6	163.1	213.4	257.9	279.2	317.0	401.7	482.5	356.5	310.7
Tajikistan	100	72.3	37.5	32.4	56.1	46.0	24.3	28.6	31.1	31.7	11.2	17.0	13.5	21.9	37.8	55.7	62.9	143.1	184.4	149.9	185.7
Ukraine	100	82.7	106.9	85.0	65.9	59.8	49.2	53.0	43.7	32.4	32.7	39.9	43.3	55.0	78.0	100.8	141.3	206.0	246.2	108.8	139.9
Uzbekistan	100	84.4	83.7	80.2	82.4	107.4	125.1	121.5	108.7	113.2	80.5	77.6	52.3	53.2	69.1	76.7	74.7	113.7	172.3	204.3	251.5

Source: Author's Calculations based on source: World Bank, *World Development Indicators* (Edition April 2012), ESDS International, University of Manchester.

Appendix 3.2 Unemployment (as a percentage of labour force)

year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	9.5	8.3	24.4	18.6	16.0	10.2	12.4	14.9	17.8	18.4	16.8	16.4	15.8	15.0	14.4	14.1	13.8	13.2	12.7	13.7
Armenia			3.5	6.3	6.6	6.7	9.3	10.8	9.4	11.2	11.7	10.4	10.8	10.1	9.6	8.2	7.5	7.0	6.3	6.8
Azerbaijan			15.4	0.5	0.6	0.7	0.8	1.0	1.1	1.1	1.1	1.3	1.4	1.4	1.4	1.4	6.8	6.5	4.3	
Belarus	0.0	0.1	0.5	1.4	2.1	2.7	3.9	2.8	2.3	2.1	2.1	2.3	2.9	3.0	1.9	1.5	1.2	1.0	0.8	0.9
B&H									38.4	37.9	39.0	40.2	41.0	42.1	42.9	42.0	44.8	28.9	23.4	24.1
Bulgaria	1.6	10.5	15.0	16.3	18.6	13.7	13.0	14.5	16.0	17.0	16.4	19.5	16.8	12.5	11.5	10.0	9.8	6.3	3.6	6.8
Croatia	9.3	13.2	13.2	14.8	14.5	14.5	10.0	9.9	11.4	13.5	15.7	16.4	14.5	14.4	13.8	12.3	10.5	9.7	8.7	9.2
Czech	0.7	4.1	2.6	4.3	4.3	4.0	3.9	4.8	6.5	8.7	8.8	8.1	7.3	7.8	8.3	8.0	7.1	5.3	na	
Estonia	0.6	1.5	3.7	6.6	7.6	9.7	10.0	9.6	9.8	12.2	13.6	12.6	10.3	10.0	9.6	7.9	5.9	4.7	5.5	13.8
Macedonia	18.5	19.2	27.8	27.7	30.0	35.6	31.9	36.0	34.5	32.4	32.2	30.9	31.9	36.7	37.2	37.3	36.0	34.9	33.8	32.2
Georgia	0.0	0.1	5.4	9.1	3.6	3.1	2.8	7.5	12.4	12.6	10.3	11.1	12.6	11.5	12.6	13.8	13.6	13.3	16.5	
Hungary	1.4	8.2	9.3	11.9	10.7	10.2	9.9	8.7	7.8	7.0	6.4	5.7	5.8	5.9	6.1	7.2	7.5	7.7	8.0	10.5
Kazakhstan	na	0.1	0.4	0.5	8.0	10.1	7.6	6.5	13.1	13.5	12.8	10.4	9.3	8.8	8.4	8.1	7.8	7.6	6.6	6.6
Kosovo	na		na	na	na	na	na	na	na	na		na	57.1	55.0	49.7	39.7	41.4	44.9	43.6	47.5
Kyrgyz Rep.	na		na	na	na	5.7	na	na	5.9	7.4	7.5	7.8	13.4	10.3	8.7	8.2	8.3	8.2	8.3	8.5
Latvia	0.5	0.6	3.9	8.7	16.7	18.1	20.5	15.4	14.3	14.5	14.6	13.3	12.1	10.7	10.6	8.8	7.0	6.2	7.8	17.3
Lithuania	na	0.3	1.3	4.4	3.8	17.5	16.4	14.1	13.2	14.6	16.4	17.4	13.8	12.4	11.4	8.3	5.6	4.3	5.8	13.7
Moldova	na		na	na	na	na	na	na	10.1	11.1	8.5	7.3	6.8	7.9	8.1	7.3	7.4	5.1	4.0	6.4
Montenegro	na	28.7	32.5	32.6	31.3	32.1	32.7	30.2	31.6	33.9	37.3	41.6	40.2	38.5	29.3	25.2	20.6	16.8	14.4	15.1
Poland	6.5	12.2	14.3	16.4	16.0	14.9	13.2	10.9	10.2	13.4	16.1	18.3	20.0	19.7	19.0	17.8	13.9	9.6	7.1	8.5
Romania										7.1	7.3	6.8	8.6	7.0	8.1	5.9	5.2	4.1	4.4	7.8
Russian Fed.			5.3	6.0	7.7	9.2	9.3	10.8	11.9	12.9	10.7	8.8	8.5	7.8	7.9	7.1	6.7	5.7	7.8	8.2
Serbia	19.7	22.2	23.8	23.1	22.7	24.2	25.4	24.1	24.6	25.5	25.6	26.8	29.0	31.7	31.6	32.4	33.2	29.8	28.4	27.9
S&M	19.7	22.2	23.8	23.1	22.7	24.2	25.4	24.1	24.6	24.3	24.4	25.5	27.6	30.3	31.7					

Appendices

Slovak Rep.	1.2	9.5	10.4	14.4	13.6	13.1	11.3	11.8	12.5	16.2	18.6	19.2	18.5	17.4	18.1	16.2	13.3	11.0	9.6	12.1
Slovenia		7.3	8.3	9.1	9.1	7.2	6.9	7.1	7.4	7.4	6.4	6.8	6.3	6.8	6.4	7.2	5.5	4.7	4.3	6.0
Tajikistan	0.0	0.0	0.4	1.2	1.7	2.0	2.6	2.8	3.2	3.0	2.7	2.3	2.5	2.4	2.0	1.9	2.2	2.3	2.2	2.1
Turkmenistan	17.1	18.3	21.0	20.0	20.9	23.9	22.5	21.0	24.2	27.9	27.9	28.8	29.3	29.8	30.2					
Ukraine	0.0	0.0	0.2	0.3	0.3	0.3	1.3	2.3	3.7	4.3	11.6	10.9	9.6	9.1	8.6	7.2	6.8	6.4	6.4	8.1
Uzbekistan				0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.3	0.3	0.3	0.2	0.4

Source: (European Bank for Restructuring and Development, 2012). Data accessible on internet:
<http://www.EBRD.com/pages/research/economics/data/macro.shtml>

Appendix 3.3 Emigration rate²¹³ in selected transition countries in 2000

(Ordered by the altitude of the rate)

Country	emigration rate	country	emigration rate
BIH	31.6	Bulgaria	8.9
Kazakhstan	20.9	Lithuania	8.8
Albania	20	Estonia	8.6
Croatia	18.9	Latvia	8.4
Armenia	17.2	Slovak Rep.	7.8
Georgia	17	Poland	6.8
Azerbaijan	14.5	Romania	6
Macedonia	14.2	Uzbekistan	5.8
Belarus	13.2	Slovenia	5.7
Kyrgyz Rep.	12.2	Turkmenistan	5.6
Serbia&Montenegro	11.9	Hungary	4.3
Moldova	10.7	Czech Rep.	3.1
Ukraine	10.5	Russian Fed.	2.5
Tajikistan	9.4		

Source: Dumont, Jean-Christophe, Spielvogel, Gilles, and Sarah Widmaier (2010). *International Migrants in Developed, Emerging and Developing Countries: An Extended Profile*. OECD *Social, Employment and Migration Working Papers No. 113*.

²¹³The emigration rate of a given origin country *i* in a given year is defined as the share of the native population of country *i* residing abroad at this time.

APPENDICES Chapter 4

Appendix 4. 1 Solow growth model in formulas

The Solow model starts with a Cobb-Douglas production function:

$$Y = A \cdot F(K, L) \quad 4-1$$

where Y is output, A is level of technology, K refers to physical capital, L refers to labour. For a given technology level A , the function $F(K, L)$ determines how additional units of labour or capital affect output level.

Thus, the production function is a relation between the levels of Y and the levels of A , K and L .

Every increase in one factor while other factors being constant, raises output by its marginal product, since factors are productive at their margin. (For example, an increase in Y as a result of increase of K is the marginal product of capital.²¹⁴) This marginal product is always positive, but it is diminishing over time. *Diminishing returns to factors is one of the crucial model assumptions.* (This would mean that every additional increase in one unit of K would result in a lower marginal product, i.e. diminishing increase in Y , and lower return to capital, i.e. profit.) In addition to that, the model assumes that *factors returns are equal to their marginal product*, which is enabled by perfect markets.

Another assumption is that the production function exhibits *constant returns to scale* in the two factors (K, L), i.e. every increase in both factors results in a proportional increase in Y . If K and L are multiplied by $1/L$, thus Y will also multiply by the same number, i.e.,

$$Y = A \cdot F(K, L); \quad \div \frac{1}{L} \text{ i.e.} \quad 4-2$$

²¹⁴ The marginal product of capital is the actual increase in Y if K increases by one unit.

$$\frac{Y}{L} = A \cdot F\left(\frac{K}{L}, \frac{L}{L}\right)^{215} \quad 4-3$$

In this case, the production function expresses labour productivity $y = \frac{Y}{L}$, which demonstrates that output per worker depends on capital per worker $k = \frac{K}{L}$.

This new function relates y and k and can be written:

$$y = Af(k) \quad 4-4$$

For a given technology level, **labour productivity, i.e. output per worker** depends on a function of capital per worker, which is characterised by diminishing marginal product.

²¹⁵ $\frac{L}{L}$ is one, constant

Appendix 4. 2 Solow Model in Growth rates

Starting with these basic relations, the Solow model seeks to explain the growth rates of Y ²¹⁶ and the growth rates of K and L , as well as their contribution to the growth rate of output.

Firstly, the assumption of constant returns to scale assumes that the share of capital and labour in total income equals 1, i.e.

$$\alpha + \beta = 1, \text{ or } \beta = 1 - \alpha \quad 4-5$$

where α is the share of capital and β is the share of labour in total income. (For example, the contribution of capital growth rate to output growth rate will depend also on the share of capital in the income.)

The growth accounting formula establishes the relation between the growth rate of Y and the growth rates of A , K , L .

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha \frac{\Delta K}{K} + \beta \frac{\Delta L}{L}, \text{ or} \quad 4-6$$

$$\frac{\Delta Y}{Y} = \frac{\Delta A}{A} + \alpha \frac{\Delta K}{K} + (1 - \alpha) \frac{\Delta L}{L} \quad 4-7$$

If we want to focus on per worker output, or labour productivity, then the growth rate of output per worker will depend on the growth rate of output and the growth rate of labour.²¹⁷

²¹⁶ The changes in Y , K and L are represented by ΔY , ΔK and ΔL and the growth rates are $\frac{\Delta Y}{Y}$, $\frac{\Delta K}{K}$, $\frac{\Delta L}{L}$ respectively.

²¹⁷ Increase in labour growth rate while output growth rate remains the same means less output per worker.

Thus in per capita terms, output per worker growth rate is presented as a difference between the growth rates of output and labour.

$$\frac{\Delta y}{y} = \frac{\Delta Y}{Y} - \frac{\Delta L}{L} \quad 4-8$$

Correspondingly, the capital per worker growth rate is presented as:

$$\frac{\Delta k}{k} = \frac{\Delta K}{K} - \frac{\Delta L}{L} \quad 4-9$$

Assuming no technical progress, i.e. $\frac{\Delta A}{A} = 0$, and substituting for $\beta = 1 - \alpha$ in equation 4-7, we will get

$$\frac{\Delta Y}{Y} = \alpha \frac{\Delta K}{K} + \frac{\Delta L}{L} - \alpha \frac{\Delta L}{L} \quad 4-10$$

Rearranging terms that contains α on left we will get

$$\frac{\Delta Y}{Y} - \frac{\Delta L}{L} = \alpha \frac{\Delta K}{K} - \alpha \frac{\Delta L}{L} \text{ or } \frac{\Delta Y}{Y} - \frac{\Delta L}{L} = \alpha \left(\frac{\Delta K}{K} - \frac{\Delta L}{L} \right) \quad 4-11$$

Or finally the growth rate of output per worker depends on the growth rate of capital per worker, assuming that the shares of factors are constant over time, i.e. α is constant.

$$\frac{\Delta y}{y} = \alpha \frac{\Delta k}{k} \quad 4-12$$

Appendix 4. 3 The explanation of the capital per worker growth rate

The question here is how the capital per worker growth rate can be explained.

The change in capital stock depends on real savings.²¹⁸ On the other hand, savings in Solow model are a constant rate of national income, which present the difference of output (Y) minus depreciation (δ) of existing capital (K), or:

$$\Delta K = s(Y - \delta K) \tag{4-13}$$

And, both sides divided by K:

$$\frac{\Delta K}{K} = s \frac{Y}{K} - s\delta \tag{4-14}$$

In per worker terms, if we substitute for $\frac{\Delta K}{K}$ from (4-14) in (4-9)

$$\frac{\Delta K}{K} = s \frac{Y}{K} - s\delta \text{ on the left side } \frac{\Delta k}{k} = \frac{\Delta K}{K} - \frac{\Delta L}{L}, \tag{4-15}$$

we approach the main Solow equation, which is Equation 4.2-3 in Chapter 4:

$$\frac{\Delta k}{k} = s \frac{Y}{K} - s\delta - n, \tag{4-16}$$

where $\frac{\Delta L}{L} = n$ - growth rate of population. If $\frac{Y}{K} = \frac{\frac{Y}{L}}{\frac{K}{L}} = \frac{y}{k}$ then the average product of

capital $\frac{Y}{K}$ can be expressed as the ratio of the output per worker and the capital per worker.

Hence, 4-16 can be rewritten as:

²¹⁸ In fact, real savings are equal to net investment in the Solow model.

$$\frac{\Delta k}{k} = s \cdot \frac{y}{k} - s\delta - n \quad 4-17$$

Finally, substituting for y from 4-4:

$$\frac{\Delta k}{k} = s \left(\frac{Af(k)}{k} \right) - (s\delta + n) \quad 4-18$$

which is the key equation of Solow growth theory (Equation 4.2-3 in Chapter 4).

APPENDICES Chapter 5

Appendix 5. 1 Relevant historical events that
affected the economic growth in transition countries

Box 5. 1 Relevant historical facts

- Albania disintegrated into chaos and armed revolt soon after pyramid investment schemes failed in January 1997. By 1997, after uncontained rioting on the streets, the country descended into anarchy in which some 2 000 people were killed.
- In 1991, the Soviet Union broke apart and Armenia established its independence. However, in 1994 Azerbaijan and Armenia had finally agreed to a ceasefire.
- By the end of hostilities with Armenia, Azerbaijan had experienced internal political turmoil marked by attempts at military coups. Finally, in 1995, the last coup attempt was averted and a relatively stable government was elected.
- In 1994, Alexander Lukashenko was elected for president in Belarus. However, only after 1996 did GDP started to grow as the Union of Russia and Belarus, a supranational confederation, was established in a 1996–99 series of treaties that called for monetary union, equal rights, single citizenship, and a common foreign and defence policy.
- Bosnia and Herzegovina is one of the former Yugoslav Republics that probably suffered the worst war in the course of transition ending with the Dayton accords signed in 1995. With this agreement, the country was divided on several levels, yet into two main entities: Republika Srpska and the Federation of Bosnia and Herzegovina. Due to the war conditions, huge institutional complexity and ethnic tensions, data sets for B&H are not complete or reliable, especially for the first year of transition.
- Since 1989, Bulgaria has held multi-party elections and privatized its economy, but economic difficulties and a tide of corruption lead to high unemployment, unstable (and often high) inflation rates and discontent of the market system. The reform package introduced in 1997 restored positive economic growth, but led to rising social inequality. Bulgaria entered EU in 2007.
- The Czech Republic was formed in 1993 when Czechoslovakia peacefully split into Czech Republic and Slovakia. Although one of the most stable and prosperous of post-Communist states, in 1997 it experienced political and financial crisis due to the delays in enterprise restructuring and failure to develop a well-functioning capital market, which resulted in a currency crisis in 1997 and huge current account deficit, which reached nearly 8% of GDP. In response to the crisis, two austerity packages were introduced, which cut government spending by 2.5% of GDP, but also affected growth, which dropped to 0.3% in 1997, -2.3% in 1998, and -0.5% in 1999. This country acceded to EU membership in 2004.
- Croatia gained its independence after the end of the Croatian War of Independence in 1995. From 1989 to 1993, its GDP fell by 40.5%. With the end of the war, Croatia's economy recovered but only moderately due to the corruption and a general lack of transparency that hindered foreign investment and tourism. Croatia's economy turned the corner in early 2000, stimulated by a credit boom led by newly privatized and foreign-

capitalized banks, some capital investment and, most importantly, road construction, further growth in tourism, and gains by small and medium-sized private enterprises.

- In 1999, Estonia experienced its worst year economically in the course of transition, largely because of the impact of the 1998 Russian financial crisis. Estonia joined the WTO in November 1999. With assistance from the international community, Estonia completed most of its preparations for European Union membership by the end of 2002, and joined it in 2004.

- Hungary in 1994 initiated the whole reform process, after the severe recession that started in 1991 and was exacerbated by the fiscal austerity necessary to reduce inflation and stimulate investment. The year 1994 was also the year of new elections when the Hungarian Socialist Party led by former Communists won an absolute majority in parliament. Ten years later Hungary also joined the EU.

- After independence from the Soviet Union, Georgia became involved in a bitter war that lasted almost until 1995. In 1995, Shevardnadze was officially elected as president of Georgia. At the same time, simmering disputes within two regions of Georgia, Abkhazia and South Ossetia, between local separatists and the majority Georgian populations, erupted into widespread inter-ethnic violence and wars. Supported by Russia, Abkhazia and South Ossetia, with the exception of some "pockets" of territory, achieved de facto independence from Georgia, which led to a major crisis later in 2004.

- The year 2000 is the turning point when Kazakhstan started to record really high growth rates, mainly due to high world crude oil prices. Additionally, Kazakhstan is one of the leading exporters of uranium. In 2000, Kazakhstan became the first former Soviet republic to repay all of its debt to the International Monetary Fund (IMF), 7 years ahead of schedule.

- The Kyrgyz Republic was the second poorest country in the former Soviet Union and is, today, the second poorest country in Central Asia. After the independence, the Kyrgyz Republic has had economic difficulties mainly as a result of the breakup of the Soviet trading bloc and resulting loss of markets, which impeded the republic's transition to a free market economy. While economic performance has improved considerably in the last few years, and particularly since 1995-96, difficulties remain in securing adequate fiscal revenues and providing an adequate social safety net. Remittances of around 800,000 Kyrgyz migrants working in Russia represent 40% of Kyrgyzstan's GDP.

- Kosovo is the latest newly born state of Former Yugoslavia that proclaimed its independence at the beginning of 2008. Due to the war conditions in this country in early transition, data sets are incomplete and start in late transition.

- Latvia's parliament was elected in 1993 and Russia completed its military withdrawal in early 1994. After this Latvia introduced reforms which resulted in joining EU in 2004.

- The last Soviet troops left Lithuania by the end of 1993. The beginning of 1994 is marked also with the establishing of the new administrative division in Lithuania and application for NATO membership. EU membership was realized in 2004.

- GDP growth in Poland had been strong and steady from 1993 to 2000 with only a short slowdown from 2001 to 2002 mainly due to systematic problems. In 2004, Poland joined the EU. Additionally, Poland is the only member of the European Union to have avoided a decline in GDP during the late 2000s recession.

- Romania entered transition as a relatively poor country, largely a result of the failed economic policies of Nicolae Ceaușescu in the pre-transition period. The reforms in the 2000s, and generous financial and technical assistance, facilitated Romania's reintegration

into the world economy, especially after 1999, when the European Union invited Romania to formally begin accession negotiations at the Helsinki Summit, ended in 2007 when Romania joined the EU. All these resulted in an improved economic outlook.

- By the end of 1997, the Russian Federation had achieved some progress in the course of transition by stabilizing inflation and the value of the ruble, conducting ambitious privatization and adopting important market-oriented laws. However, in 1998 difficulties in implementing fiscal reforms aimed at raising government revenues and a dependence on short-term borrowing to finance budget deficits led to a serious financial crisis in 1998, contributing to a sharp decline in Russia's earnings from oil exports and resulting in an exodus of foreign investors. The government allowed the ruble to fall precipitously and stopped payment on \$40 billion in ruble bonds.

- After the dissolution of Yugoslavia, Serbia continued to be politically involved in the region, in the wars in B&H and Croatia. Because of that, during the 1990s sanctions were imposed by the UN, which led to political isolation, hyperinflation and economic decline. By the end of the nineties, the Kosovo war started.

- Since the establishment of the Slovak Republic in 1993, Slovakia has undergone a transition, which was slowed down significantly until 1998 due to corruption and government policy failures. While economic growth and other fundamentals improved steadily until 1995, public and private debt and trade deficits also rose, and privatization was uneven. Real annual GDP growth peaked in 1995 but declined to 1.3% in 1999. All this called for more dedicated policies of macroeconomic stabilization and market-oriented structural reforms, which were pursued after 1998. In 2004, Slovak Republic joined the EU.

- Slovenia was the most productive Yugoslavian Republic, accounting for one-fifth of Yugoslavian GDP and one-third of its exports in the 1980s. After independence in 1991 and an initial output drop, Slovenia's relatively prosperous economy extended the market ties to the West starting from early transition in 1993. Since that time, it has pursued vigorously diversification of its trade with the West and integration into Western and transatlantic institutions. Slovenia was the first ex- Yugoslavian country to join the EU (in 2004).

- After independence in 1991, Macedonia, which was the poorest Yugoslav republic, suffered huge decline in economic activity due to the loss of the Yugoslavian market and a Greek economic embargo. In mid-transition in 1999, neighbouring Kosovo's war started and a huge number of refugees found escape in Macedonia. In 2000 and 2001, Macedonia also suffered a civil war, which ended with NATO intervention and the Ohrid Agreement.

- In 1992, Moldova introduced a market economy, liberalizing prices, which resulted in huge inflation. From 1992 to 2001, Moldova suffered its worst economic crisis, leaving most of the population below the poverty line. Even after that period, Moldova's progress has been negligible due to the sporadic and ineffective enforcement of the law, economic and political uncertainty, and government harassment and interference in the economy.

- Montenegro declared independence from Yugoslavia in 2006. Most of the transition reforms in Montenegro had been undertaken within Yugoslavia, starting in the nineties. However, data sets are incomplete for the starting years of transition for Montenegro alone.

- In the post-Soviet era, Turkmenistan experienced a slow and complicated transition, characterized by huge inflation, measured in hundreds and thousands per cent; by unpaid gas barter deals with other CIS countries; by a huge agriculture sector; and by

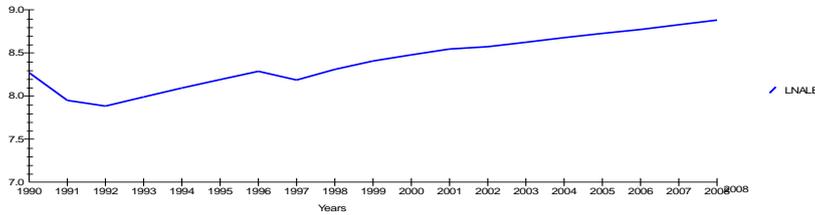
gas and oil resources. It should be noted that, as in the Soviet era, central planning and state control pervade the system, and the government (in power 1991–2006) consistently rejected proper introduction of market reform programs.

- After the gained independence, Tajikistan promptly fell into a civil war from 1992–1997, which ended with a fragile negotiated peace implemented in 2000. Tajikistan's economy grew substantially after the war. However, over of 50% of Tajikistani citizens have lived below the poverty line during transition.
- Ukraine's economy experienced a deep recession during the 1990s, including hyperinflation and a drastic fall in economic output. In 1995, Ukraine's per capita GDP was about half of the per capita GDP it achieved before independence. Ukraine recorded positive growth rates only after 2000.
- Uzbekistan's GDP declined during the first years of transition and then started to recover after 1995, as the cumulative effect of policy reforms began to be felt. Although the progress with the reforms has been cautious, official unemployment in this country was relatively low, especially in mid-transition. Agriculture and manufacturing industries contribute equally to the economy, each accounting for about one-quarter of GDP.

Note: The source for this Box historical data is the CIA (2012). *World Fact Book*. Information accessible on internet: www.cia.gov/library/publications/the-world-factbook/

Appendix 5. 2 Testing for structural breaks in lnGDP

Albania



Ordinary Least Squares Estimation

Dependent variable is **DLNALB**

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	5.0340	.34524	14.5811[.000]
TREND	.076209	.0035954	21.1965[.000]
DTB	-.14099	.018258	-7.7219[.000]
DU	.25806	.030089	8.5766[.000]
DT	-.042316	.0045352	-9.3305[.000]
LNALB(-1)	-.66657	.042855	-15.5541[.000]

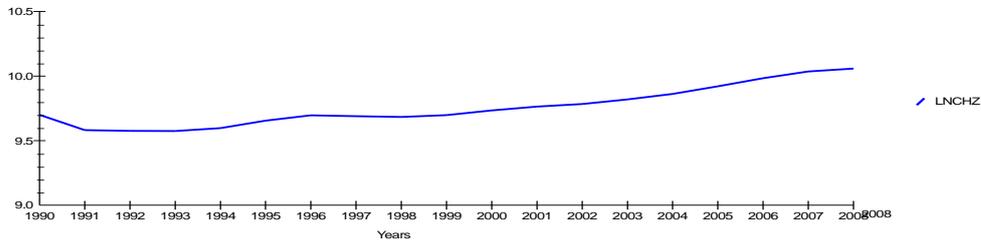
R-Squared .98570 R-Bar-Squared .97974
 S.E. of Regression .015026 F-stat. F(5, 12) 165.3817[.000]
 Mean of Dependent Variable .033878 S.D. of Dependent Variable .10555
 Residual Sum of Squares .0027092 Equation Log-likelihood 53.6724
 Akaike Info. Criterion 47.6724 Schwarz Bayesian Criterion 45.0013
 DW-statistic 2.3802

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.84922[.357]*	F(1, 11)= .54467[.476]*
* B:Functional Form *CHSQ(1)=	.65469[.418]*	F(1, 11)= .41519[.533]*
* C:Normality *CHSQ(2)=	.70396[.703]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.28459[.594]*	F(1, 16)= .25703[.619]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Czech Republic



Ordinary Least Squares Estimation

Dependent variable is DLNCHZ

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	4.6515	.86014	5.4079[.000]
TREND	.026307	.0031460	8.3620[.000]
DTB	.031572	.017615	1.7923[.098]
DU	-.052522	.036844	-1.4255[.179]
DT	-.0045126	.0049473	-.91213[.380]
LNCHZ(-1)	-.49621	.089236	-5.5607[.000]

R-Squared .92992 R-Bar-Squared .90072
 S.E. of Regression .013016 F-stat. F(5, 12) 31.8477[.000]
 Mean of Dependent Variable .019880 S.D. of Dependent Variable .041311
 Residual Sum of Squares .0020331 Equation Log-likelihood 56.2560
 Akaike Info. Criterion 50.2560 Schwarz Bayesian Criterion 47.5849
 DW-statistic 1.7290

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= .18224[.669]*F(1, 11)= .11251[.744]*

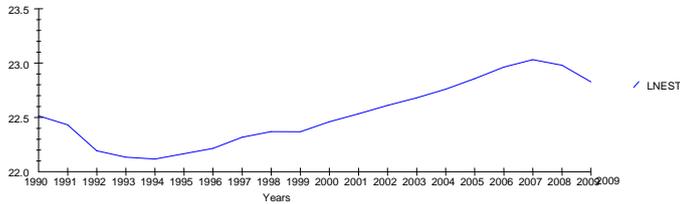
* B:Functional Form *CHSQ(1)= 2.1194[.145]*F(1, 11)= 1.4681[.251]*

* C:Normality *CHSQ(2)= 1.1697[.557]* Not applicable *

* D:Heteroscedasticity*CHSQ(1)= .0038890[.950]*F(1, 16)= .0034576[.954]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Estonia



Ordinary Least Squares Estimation

Dependent variable is DLNEST

19 observations used for estimation from 1991 to 2009

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	1.3900	4.3982	.31604[.757]
TREND	.033999	.012140	2.8005[.015]
DU	.48110	.21800	2.2069[.046]
DT	-.046707	.024501	-1.9064[.079]
DTB	-.14250	.083787	-1.7007[.113]
LNEST(-1)	-.071656	.19608	-.36545[.721]

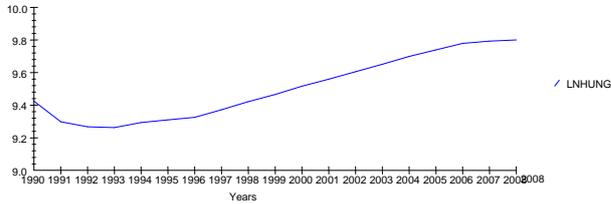
R-Squared .62409 R-Bar-Squared .47951
 S.E. of Regression .068481 F-stat. F(5, 13) 4.3166[.016]
 Mean of Dependent Variable .016425 S.D. of Dependent Variable .094922
 Residual Sum of Squares .060966 Equation Log-likelihood 27.5881
 Akaike Info. Criterion 21.5881 Schwarz Bayesian Criterion 18.7548
 DW-statistic 1.4508

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.52511[.469]*	F(1, 12)= .34108[.570]*
* B:Functional Form *CHSQ(1)=	3.3097[.069]*	F(1, 12)= 2.5313[.138]*
* C:Normality *CHSQ(2)=	1.1976[.549]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.28482[.594]*	F(1, 17)= .25872[.618]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Hungary



Ordinary Least Squares Estimation

Dependent variable is DLNHUN

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	6.2552	1.7955	3.4839[.005]
TREND	-.056052	.028264	-1.9832[.073]
DTB	.043087	.019877	2.1676[.053]
DU	-.38514	.16219	-2.3747[.037]
DT	.082643	.034816	2.3737[.037]
LNHUN(-2)	-.64911	.18303	-3.5464[.005]

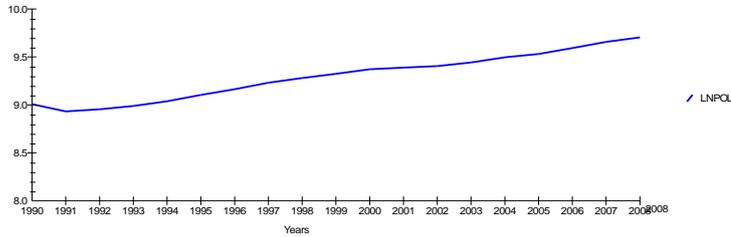
R-Squared	.83184	R-Bar-Squared	.75541
S.E. of Regression	.011453	F-stat. F(5, 11)	10.8830[.001]
Mean of Dependent Variable	.029529	S.D. of Dependent Variable	.023158
Residual Sum of Squares	.0014429	Equation Log-likelihood	55.5596
Akaike Info. Criterion	49.5596	Schwarz Bayesian Criterion	47.0600
DW-statistic	1.5198		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	1.7314[.188]*	F(1, 10)= 1.1340[.312]*
* B:Functional Form *CHSQ(1)=	4.4561[.035]*	F(1, 10)= 3.5524[.089]*
* C:Normality *CHSQ(2)=	.67889[.712]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.47361[.491]*	F(1, 15)= .42987[.522]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Poland



Ordinary Least Squares Estimation

Dependent variable is DLNPOL

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	6.2288	.53235	11.7006[.000]
TREND	.039523	.0028172	14.0291[.000]
DT	-.0017681	.0018610	-.95003[.361]
DU	-.055501	.026853	-2.0668[.061]
DTB	.031634	.011543	2.7406[.018]
LNPNOL(-1)	-.70855	.060379	-11.7351[.000]

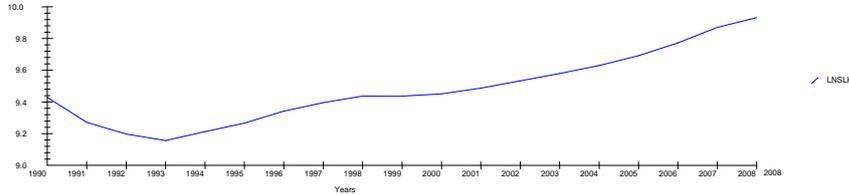
R-Squared .95235 R-Bar-Squared .93250
 S.E. of Regression .0085012 F-stat. F(5, 12) 47.9678[.000]
 Mean of Dependent Variable .038709 S.D. of Dependent Variable .032720
 Residual Sum of Squares .8672E-3 Equation Log-likelihood 63.9242
 Akaike Info. Criterion 57.9242 Schwarz Bayesian Criterion 55.2531
 DW-statistic 1.6813

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= .59701[.440]*	*F(1, 11)= .37736[.552]*
* B:Functional Form	*CHSQ(1)= .24503[.621]*	*F(1, 11)= .15181[.704]*
* C:Normality	*CHSQ(2)= .0088532[.996]*	Not applicable *
* D:Heteroscedasticity*	*CHSQ(1)= .29177[.589]*	*F(1, 16)= .26363[.615]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Slovak Republik



Ordinary Least Squares Estimation

Dependent variable is DLNSLK

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	3.6757	.58561	6.2767[.000]
TREND	.030198	.0026424	11.4281[.000]
DU	-.092291	.046794	-1.9723[.072]
DTB	.023402	.021948	1.0662[.307]
DT	-.5085E-3	.0046144	-.11020[.914]
LNSLK(-1)	-.41372	.063225	-6.5435[.000]

R-Squared .94750 R-Bar-Squared .92563
 S.E. of Regression .017026 F-stat. F(5, 12) 43.3150[.000]
 Mean of Dependent Variable .027861 S.D. of Dependent Variable .062433
 Residual Sum of Squares .0034788 Equation Log-likelihood 51.4220
 Akaike Info. Criterion 45.4220 Schwarz Bayesian Criterion 42.7509
 DW-statistic 1.8689

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= .083251[.773]*F(1, 11)= .051112[.825]*
 * * * * *

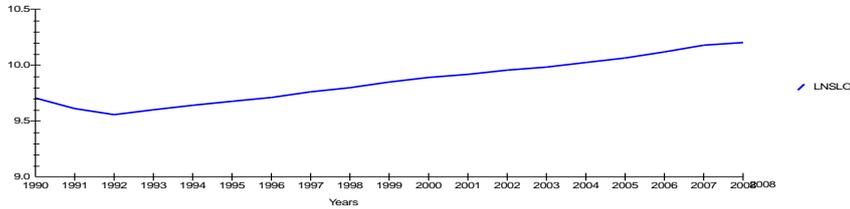
* B:Functional Form *CHSQ(1)= 1.1716[.279]*F(1, 11)= .76584[.400]*
 * * * * *

* C:Normality *CHSQ(2)= .43761[.803]* Not applicable *
 * * * * *

* D:Heteroscedasticity*CHSQ(1)= .48747[.485]*F(1, 16)= .44536[.514]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Slovenia



Ordinary Least Squares Estimation

Dependent variable is DLNSLO

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	4.8493	2.5206	1.9238[.078]
TREND	-.0068915	.027751	-.24833[.808]
DTB	.0034316	.010943	.31357[.759]
DU	-.036235	.13109	-.27641[.787]
DT	.027289	.036922	.73911[.474]
LNSLO(-1)	-.50803	.25471	-1.9946[.069]

R-Squared	.95695	R-Bar-Squared	.93902
S.E. of Regression	.0096035	F-stat. F(5, 12)	53.3546[.000]
Mean of Dependent Variable	.027572	S.D. of Dependent Variable	.038889
Residual Sum of Squares	.0011067	Equation Log-likelihood	61.7297
Akaike Info. Criterion	55.7297	Schwarz Bayesian Criterion	53.0585
DW-statistic	1.6969		

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= 2.6856[.101]*F(1, 11)= 1.9290[.192]*

* * * *

* B:Functional Form *CHSQ(1)= 2.6355[.104]*F(1, 11)= 1.8869[.197]*

* * * *

* C:Normality *CHSQ(2)= 1.1533[.562]* Not applicable *

* * * *

* D:Heteroscedasticity*CHSQ(1)= .53436[.465]*F(1, 16)= .48952[.494]*

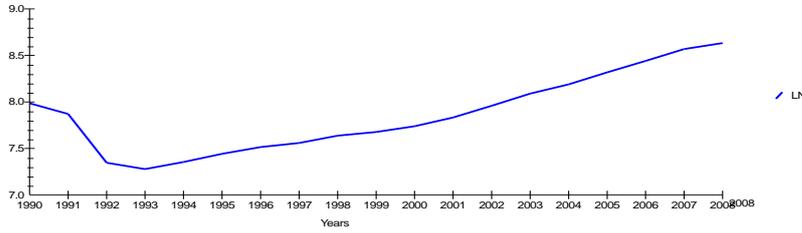
A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

ARMENIA



Ordinary Least Squares Estimation

Dependent variable is DLNARM

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	1.5798	.97340	1.6230[.131]
TREND	-.42058	.041541	-10.1244[.000]
DTB	-.10540	.040999	-2.5707[.025]
DU	-.81090	.19901	-4.0748[.002]
DT	.43389	.046104	9.4112[.000]
LNARM(-1)	-.10693	.11786	-.90728[.382]

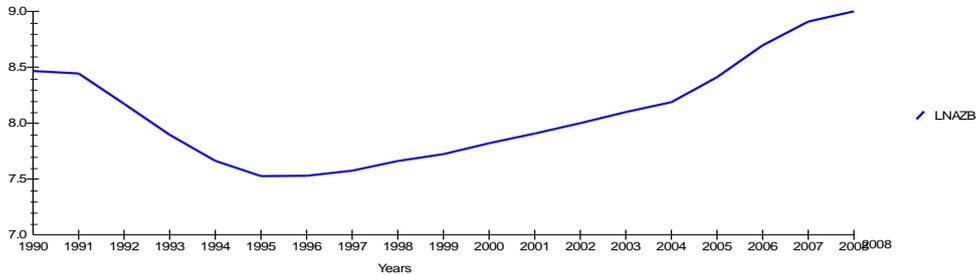
R-Squared .97716 R-Bar-Squared .96764
 S.E. of Regression .027762 F-stat. F(5, 12) 102.6771[.000]
 Mean of Dependent Variable .035978 S.D. of Dependent Variable .15433
 Residual Sum of Squares .0092485 Equation Log-likelihood 42.6221
 Akaike Info. Criterion 36.6221 Schwarz Bayesian Criterion 33.9510
 DW-statistic 1.5922

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= 2.6850[.101]*	*F(1, 11)= 1.9285[.192]*
* B:Functional Form	*CHSQ(1)= 9.3870[.002]*	*F(1, 11)= 11.9886[.005]*
* C:Normality	*CHSQ(2)= 1.8355[.399]*	Not applicable *
* D:Heteroscedasticity	*CHSQ(1)= .76270[.382]*	*F(1, 16)= .70795[.413]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Azerbaijan



Ordinary Least Squares Estimation

Dependent variable is **DLNAZB**

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	2.1224	1.2453	1.7043[.114]
TREND	-.11044	.039520	-2.7945[.016]
DTB	-.048537	.094496	-.51364[.617]
DU	-.65258	.35026	-1.8631[.087]
DT	.15073	.051555	2.9238[.013]
LNAZB(-1)	-.23495	.13881	-1.6925[.116]

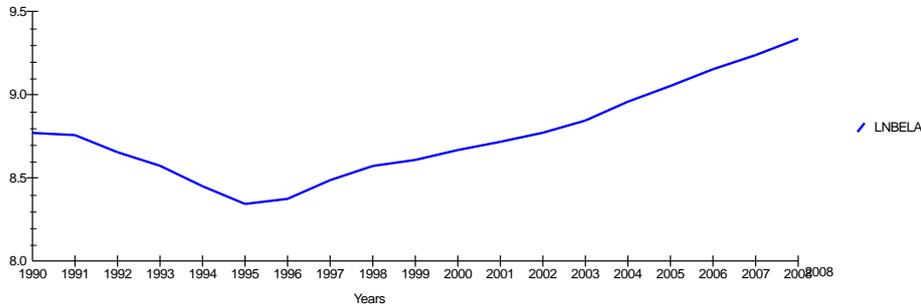
R-Squared	.89321	R-Bar-Squared	.84871
S.E. of Regression	.063300	F-stat. F(5, 12)	20.0730[.000]
Mean of Dependent Variable	.029617	S.D. of Dependent Variable	.16274
Residual Sum of Squares	.048083	Equation Log-likelihood	27.7859
Akaike Info. Criterion	21.7859	Schwarz Bayesian Criterion	19.1148
DW-statistic	1.6731		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	1.7695[.183]*	F(1, 11)= 1.1993[.297]*
* B:Functional Form *CHSQ(1)=	.24253[.622]*	F(1, 11)= .15024[.706]*
* C:Normality *CHSQ(2)=	.59211[.744]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	1.6104[.204]*	F(1, 16)= 1.5722[.228]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Belarus



Ordinary Least Squares Estimation

Dependent variable is DLNBELA

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	2.4314	1.8398	1.3216[.211]
TREND	-.049698	.018427	-2.6970[.019]
DTB	-.10298	.052256	-1.9707[.072]
DU	-.30024	.23730	-1.2652[.230]
DT	.072776	.031588	2.3039[.040]
LN BELA(-1)	-.26905	.20594	-1.3064[.216]

R-Squared	.92703	R-Bar-Squared	.89662
S.E. of Regression	.026015	F-stat. F(5, 12)	30.4896[.000]
Mean of Dependent Variable	.031450	S.D. of Dependent Variable	.080911
Residual Sum of Squares	.0081211	Equation Log-likelihood	43.7921
Akaike Info. Criterion	37.7921	Schwarz Bayesian Criterion	35.1209
DW-statistic	1.7032		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= .48179[.488]*	*F(1, 11)= .30253[.593]*
* B:Functional Form	*CHSQ(1)= 2.7571[.097]*	*F(1, 11)= 1.9897[.186]*
* C:Normality	*CHSQ(2)= .47116[.790]*	Not applicable *
* D:Heteroscedasticity*	*CHSQ(1)= 2.2805[.131]*	*F(1, 16)= 2.3212[.147]*

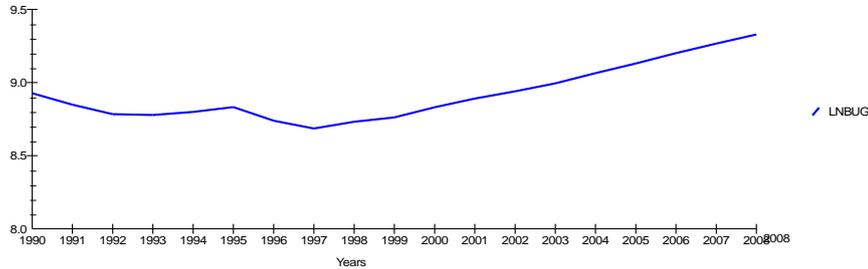
A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

Bulgaria



Ordinary Least Squares Estimation

Dependent variable is DLNBUG

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	4.7336	.85401	5.5428[.000]
TREND	.013057	.0052963	2.4653[.030]
DTB	.029270	.028079	1.0424[.318]
DU	-.29517	.074768	-3.9478[.002]
DT	.022113	.0093235	2.3718[.035]
LNBUG(-1)	-.54430	.095309	-5.7109[.000]

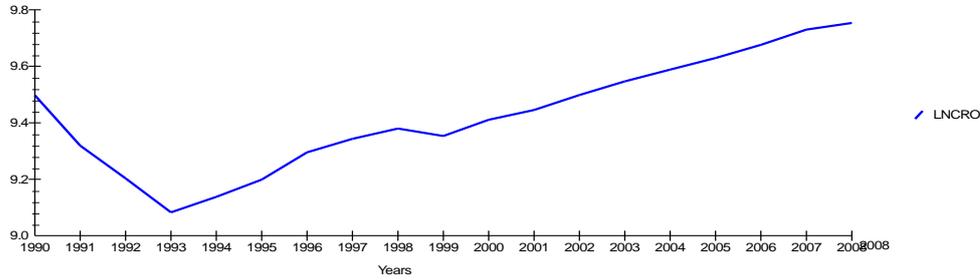
R-Squared .95900 R-Bar-Squared .94191
 S.E. of Regression .013542 F-stat. F(5, 12) 56.1328[.000]
 Mean of Dependent Variable .022301 S.D. of Dependent Variable .056188
 Residual Sum of Squares .0022007 Equation Log-likelihood 55.5434
 Akaike Info. Criterion 49.5434 Schwarz Bayesian Criterion 46.8723
 DW-statistic 2.4004

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	1.8868[.170]*	F(1, 11)= 1.2880[.281]*
* B:Functional Form *CHSQ(1)=	6.7599[.009]*	F(1, 11)= 6.6155[.026]*
* C:Normality *CHSQ(2)=	.26835[.874]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.8961E-3[.976]*	F(1, 16)= .7966E-3[.978]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Croatia



Ordinary Least Squares Estimation

Dependent variable is DLNCRO

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	3.1267	.84417	3.7038[.003]
TREND	.030558	.0048673	6.2783[.000]
DTB	-.054578	.038172	-1.4298[.178]
DU	.10574	.079274	1.3339[.207]
DT	-.015725	.0081761	-1.9233[.078]
LNCRO(-1)	-.35741	.090373	-3.9549[.002]

R-Squared	.88309	R-Bar-Squared	.83438
S.E. of Regression	.030485	F-stat. F(5, 12)	18.1289[.000]
Mean of Dependent Variable	.014217	S.D. of Dependent Variable	.074909
Residual Sum of Squares	.011152	Equation Log-likelihood	40.9374
Akaike Info. Criterion	34.9374	Schwarz Bayesian Criterion	32.2663
DW-statistic	2.0351		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= .095977[.757]*	*F(1, 11)= .058967[.813]*
* B:Functional Form	*CHSQ(1)= 10.2423[.001]*	*F(1, 11)= 14.5231[.003]*
* C:Normality	*CHSQ(2)= 17.6384[.000]*	Not applicable *
* D:Heteroscedasticity*	*CHSQ(1)= .1029E-4[.997]*	*F(1, 16)= .9146E-5[.998]*

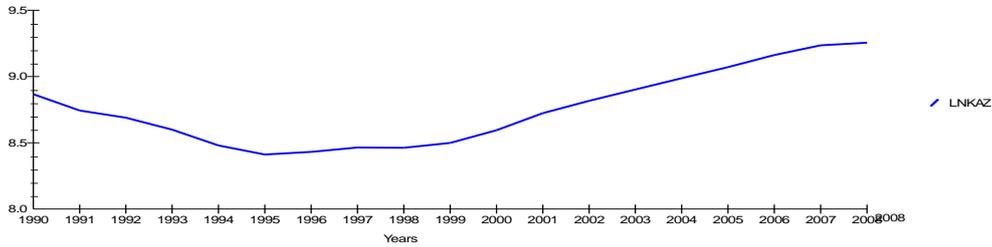
A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

Kazakhstan



Ordinary Least Squares Estimation

Dependent variable is DLNKAZ

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio [Prob]
C	5.7900	2.5411	2.2786[.044]
TREND	-.035630	.026223	-1.3587[.201]
DTB	-.013877	.052943	-.26211[.798]
DU	-.73827	.44751	-1.6497[.127]
DT	.087860	.049417	1.7779[.103]
LNKAZ(-2)	-.65346	.27836	-2.3476[.039]

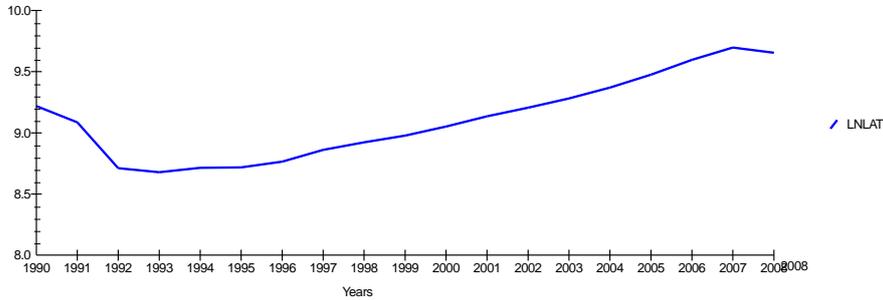
R-Squared .87188 R-Bar-Squared .81364
 S.E. of Regression .031934 F-stat. F(5, 11) 14.9711[.000]
 Mean of Dependent Variable .030094 S.D. of Dependent Variable .073975
 Residual Sum of Squares .011218 Equation Log-likelihood 38.1275
 Akaike Info. Criterion 32.1275 Schwarz Bayesian Criterion 29.6278
 DW-statistic 1.3179

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.42930[.512]*	F(1, 10)= .25907[.622]*
* B:Functional Form *CHSQ(1)=	1.8303[.176]*	F(1, 10)= 1.2065[.298]*
* C:Normality *CHSQ(2)=	.014156[.993]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.36493[.546]*	F(1, 15)= .32906[.575]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Latvia



Ordinary Least Squares Estimation

Dependent variable is DLNLAT

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	5.0513	1.8173	2.7796[.017]
TREND	-.30974	.056192	-5.5122[.000]
DTB	.018215	.056196	.32414[.751]
DU	-.94485	.27572	-3.4268[.005]
DT	.34820	.063784	5.4591[.000]
LNLAT(-1)	-.49502	.19120	-2.5890[.024]

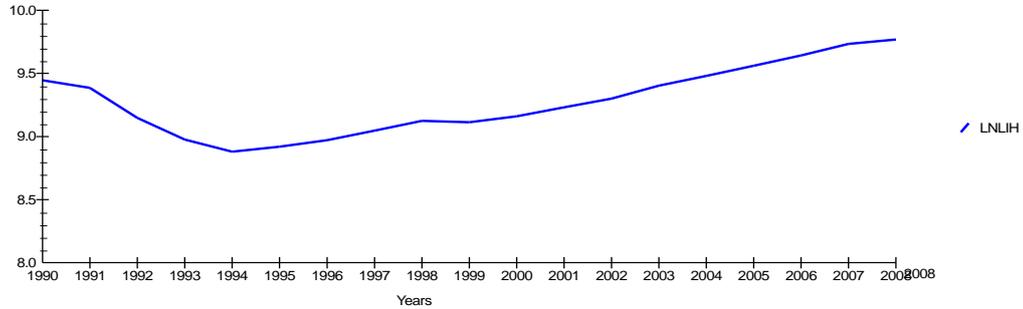
R-Squared	.93620	R-Bar-Squared	.90961
S.E. of Regression	.035544	F-stat. F(5, 12)	35.2154[.000]
Mean of Dependent Variable	.024234	S.D. of Dependent Variable	.11823
Residual Sum of Squares	.015161	Equation Log-likelihood	38.1738
Akaike Info. Criterion	32.1738	Schwarz Bayesian Criterion	29.5027
DW-statistic	1.6494		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= .12985[.719]*	*F(1, 11)= .079928[.783]*
* B:Functional Form	*CHSQ(1)= .27324[.601]*	*F(1, 11)= .16956[.688]*
* C:Normality	*CHSQ(2)= 2.0822[.353]*	Not applicable *
* D:Heteroscedasticity	*CHSQ(1)= .56645[.452]*	*F(1, 16)= .51987[.481]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Lithuania



Ordinary Least Squares Estimation

Dependent variable is DLNLIH

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	5.1108	1.9857	2.5738[.024]
TREND	-.13393	.037877	-3.5360[.004]
DTB	-.035130	.055761	-.63001[.540]
DU	-.66908	.27996	-2.3899[.034]
DT	.16995	.049050	3.4649[.005]
LNLIH(-1)	-.52173	.20305	-2.5695[.025]

R-Squared	.92230	R-Bar-Squared	.88993
S.E. of Regression	.032233	F-stat. F(5, 12)	28.4885[.000]
Mean of Dependent Variable	.017911	S.D. of Dependent Variable	.097153
Residual Sum of Squares	.012467	Equation Log-likelihood	39.9343
Akaike Info. Criterion	33.9343	Schwarz Bayesian Criterion	31.2631
DW-statistic	1.8614		

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= .14252[.706]*F(1, 11)= .087788[.773]*

* B:Functional Form *CHSQ(1)= 7.1567[.007]*F(1, 11)= 7.2601[.021]*

* C:Normality *CHSQ(2)= 1.8107[.404]* Not applicable *

* D:Heteroscedasticity*CHSQ(1)= 1.7316[.188]*F(1, 16)= 1.7031[.210]*

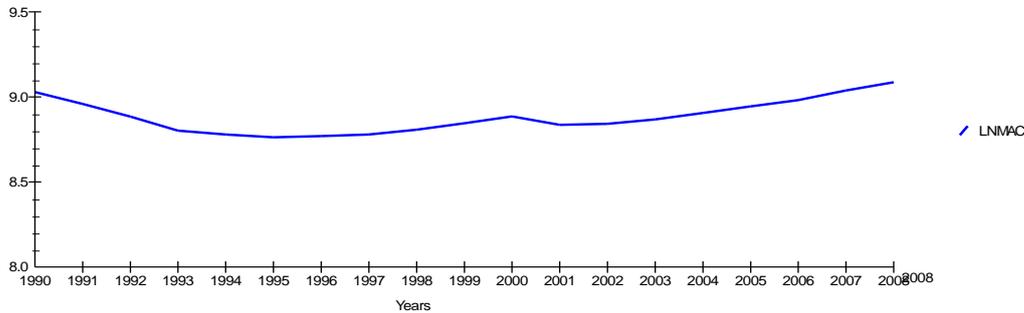
A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

Macedonia



Ordinary Least Squares Estimation

Dependent variable is DLNMAC

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	.60809	.55254	1.1005[.293]
TREND	.013285	.0018424	7.2108[.000]
DT	-.0037557	.0043062	-.87217[.400]
DU	-.010081	.053760	-.18753[.854]
DTB	-.049679	.017394	-2.8560[.014]
LNMAC(-1)	-.080158	.061564	-1.3020[.217]

R-Squared .94808 R-Bar-Squared .92645
 S.E. of Regression .012299 F-stat. F(5, 12) 43.8248[.000]
 Mean of Dependent Variable .0032031 S.D. of Dependent Variable .045350
 Residual Sum of Squares .0018153 Equation Log-likelihood 57.2761
 Akaike Info. Criterion 51.2761 Schwarz Bayesian Criterion 48.6050
 DW-statistic 2.1517

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= .68977[.406]*F(1, 11)= .43832[.522]*

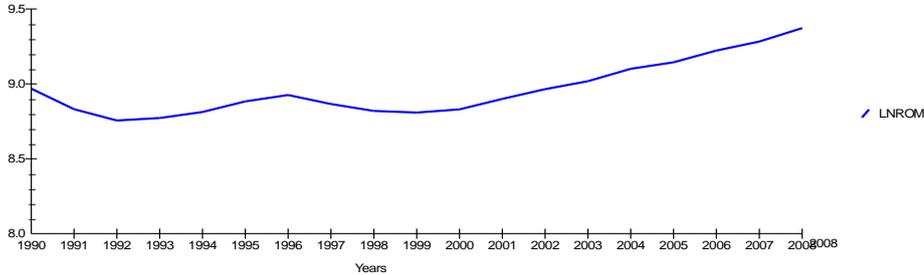
* B:Functional Form *CHSQ(1)= 13.0337[.000]*F(1, 11)= 28.8686[.000]*

* C:Normality *CHSQ(2)= 14.3469[.001]* Not applicable *

* D:Heteroscedasticity*CHSQ(1)= 1.7647[.184]*F(1, 16)= 1.7391[.206]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Romania



Ordinary Least Squares Estimation

Dependent variable is DLNROM

16 observations used for estimation from 1993 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	2.4997	.67037	3.7288[.004]
TREND	-.0072091	.0093604	-.77017[.459]
DT	.024285	.010592	2.2928[.045]
DU	-.24763	.068551	-3.6124[.005]
DTB	-.037166	.021507	-1.7281[.115]
LNROM(-3)	-.27371	.072727	-3.7636[.004]

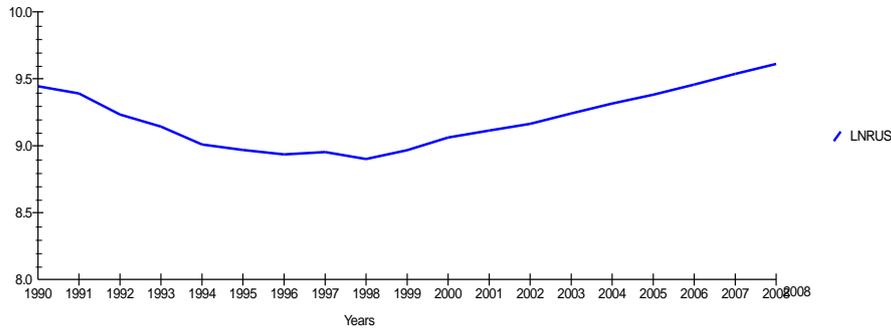
R-Squared .89242 R-Bar-Squared .83863
 S.E. of Regression .017936 F-stat. F(5, 10) 16.5909[.000]
 Mean of Dependent Variable .038543 S.D. of Dependent Variable .044651
 Residual Sum of Squares .0032172 Equation Log-likelihood 45.3917
 Akaike Info. Criterion 39.3917 Schwarz Bayesian Criterion 37.0740
 DW-statistic 2.4605

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	1.5265[.217]	*F(1, 9)= .94925[.355]*
* B:Functional Form *CHSQ(1)=	3.3156[.069]	*F(1, 9)= 2.3525[.159]*
* C:Normality *CHSQ(2)=	.43508[.804]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.31770[.573]*	*F(1, 14)= .28362[.603]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Russia



Ordinary Least Squares Estimation

Dependent variable is DLNRUS

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	2.8640	.98267	2.9145[.013]
TREND	-.049580	.023721	-2.0902[.059]
DT	.072529	.026262	2.7617[.017]
DU	-.35631	.13295	-2.6800[.020]
DTB	-.0038796	.049275	-.078732[.939]
LNRUS(-1)	-.30096	.10137	-2.9691[.012]

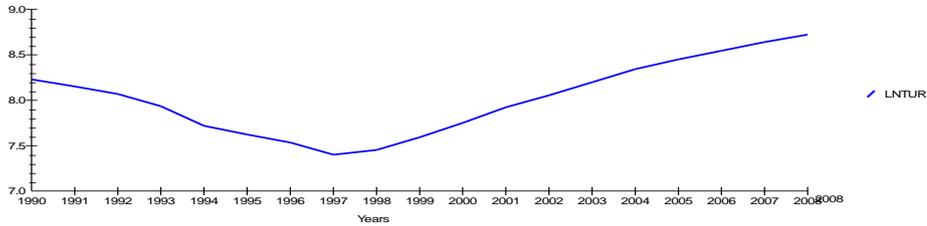
R-Squared	.90204	R-Bar-Squared	.86122
S.E. of Regression	.029926	F-stat. F(5, 12)	22.1000[.000]
Mean of Dependent Variable	.0092475	S.D. of Dependent Variable	.080332
Residual Sum of Squares	.010747	Equation Log-likelihood	41.2708
Akaike Info. Criterion	35.2708	Schwarz Bayesian Criterion	32.5997
DW-statistic	2.6529		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	3.1619[.075]*	F(1, 11)= 2.3440[.154]*
* B:Functional Form *CHSQ(1)=	.55631[.456]*	F(1, 11)= .35081[.566]*
* C:Normality *CHSQ(2)=	10.4878[.005]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.29854[.585]*	F(1, 16)= .26984[.611]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Turkmenistan



Ordinary Least Squares Estimation

Dependent variable is DLNTURK

16 observations used for estimation from 1993 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	1.6633	.58851	2.8263[.018]
TREND	.0040512	.015011	.26988[.793]
DT	.015957	.019301	.82677[.428]
DU	-.060190	.17310	-.34771[.735]
DTB	-.16365	.048858	-3.3495[.007]
LNTURK(-3)	-.22466	.067645	-3.3212[.008]

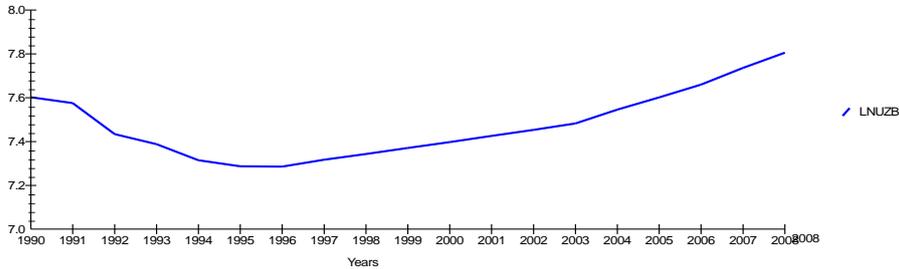
R-Squared .96274 R-Bar-Squared .94410
 S.E. of Regression .030227 F-stat. F(5, 10) 51.6708[.000]
 Mean of Dependent Variable .040815 S.D. of Dependent Variable .12785
 Residual Sum of Squares .0091368 Equation Log-likelihood 37.0413
 Akaike Info. Criterion 31.0413 Schwarz Bayesian Criterion 28.7235
 DW-statistic 2.9811

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= 5.1437[.023]*	*F(1, 9)= 4.2642[.069]*
* B:Functional Form	*CHSQ(1)= 1.1240[.289]*	*F(1, 9)= .68005[.431]*
* C:Normality	*CHSQ(2)= 4.9047[.086]*	Not applicable *
* D:Heteroscedasticity*	*CHSQ(1)= 1.1638[.281]*	*F(1, 14)= 1.0983[.312]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Uzbekistan



Ordinary Least Squares Estimation

Dependent variable is DLNUZB

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-3.2468	1.1828	-2.7449[.019]
TREND	.062158	.013456	4.6194[.001]
DTB	-.053920	.022586	-2.3873[.036]
DU	.53217	.13560	3.9246[.002]
DT	-.070334	.018059	-3.8947[.002]
LNUZB(-2)	.38601	.15057	2.5637[.026]

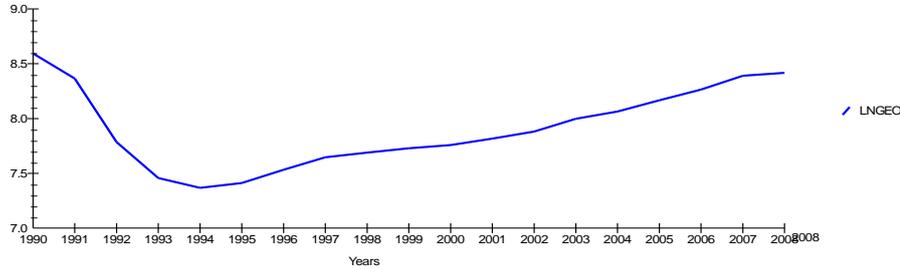
R-Squared .95656 R-Bar-Squared .93682
 S.E. of Regression .014340 F-stat. F(5, 11) 48.4464[.000]
 Mean of Dependent Variable .013537 S.D. of Dependent Variable .057049
 Residual Sum of Squares .0022620 Equation Log-likelihood 51.7383
 Akaike Info. Criterion 45.7383 Schwarz Bayesian Criterion 43.2386
 DW-statistic 2.1648

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	1.0511[.305]*	F(1, 10)= .65904[.436]*
* B:Functional Form *CHSQ(1)=	11.1314[.001]*	F(1, 10)= 18.9677[.001]*
* C:Normality *CHSQ(2)=	2.7920[.248]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	2.4803[.115]*	F(1, 15)= 2.5624[.130]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Georgia



Ordinary Least Squares Estimation

Dependent variable is DLNGEO

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	2.1238	1.6796	1.2645[.232]
TREND	.16824	.062397	2.6962[.021]
DTB	.033495	.099242	.33750[.742]
DU	.53166	.45265	1.1745[.265]
DT	-.14251	.070825	-2.0121[.069]
LNGEO(-2)	-.37347	.18013	-2.0733[.062]

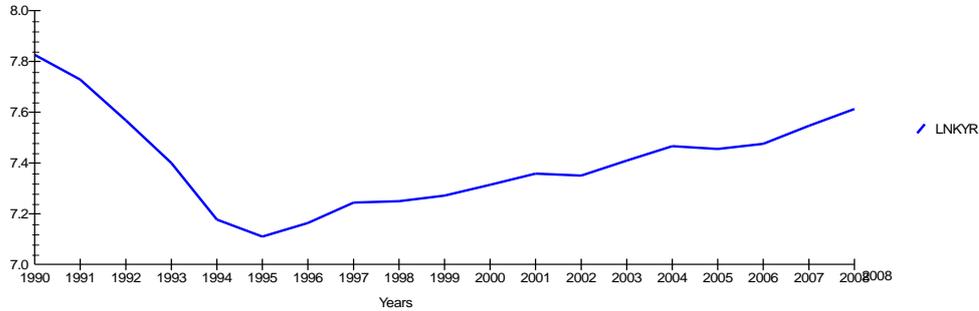
R-Squared .97792 R-Bar-Squared .96788
 S.E. of Regression .033188 F-stat. F(5, 11) 97.4175[.000]
 Mean of Dependent Variable .0030548 S.D. of Dependent Variable .18517
 Residual Sum of Squares .012116 Equation Log-likelihood 37.4728
 Akaike Info. Criterion 31.4728 Schwarz Bayesian Criterion 28.9732
 DW-statistic 1.7297

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.18193[.670]*	F(1, 10)= .10818[.749]*
* B:Functional Form *CHSQ(1)=	.41953[.517]*	F(1, 10)= .25302[.626]*
* C:Normality *CHSQ(2)=	.86033[.650]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	1.6062[.205]*	F(1, 15)= 1.5651[.230]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Kyrgistan



Ordinary Least Squares Estimation

Dependent variable is DLNKYR

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	6.8070	2.3301	2.9213[.013]
TREND	-.15925	.042537	-3.7437[.003]
DTB	-.047780	.033426	-1.4294[.178]
DU	-.96205	.35294	-2.7258[.018]
DT	.18704	.051745	3.6146[.004]
LNKYR(-1)	-.84034	.28643	-2.9338[.013]

R-Squared .95427 R-Bar-Squared .93522
 S.E. of Regression .023554 F-stat. F(5, 12) 50.0850[.000]
 Mean of Dependent Variable -.011881 S.D. of Dependent Variable .092541
 Residual Sum of Squares .0066572 Equation Log-likelihood 45.5809
 Akaike Info. Criterion 39.5809 Schwarz Bayesian Criterion 36.9098
 DW-statistic 2.0414

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= .67079[.413]*F(1, 11)= .42579[.527]*
 * * * * *

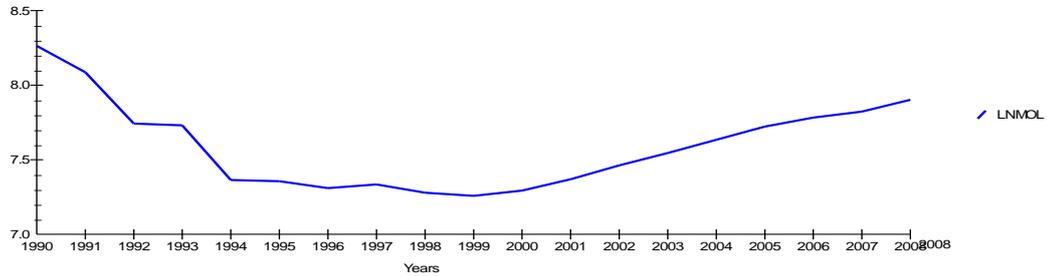
* B:Functional Form *CHSQ(1)= .91252[.339]*F(1, 11)= .58743[.460]*
 * * * * *

* C:Normality *CHSQ(2)= .42921[.807]* Not applicable *
 * * * * *

* D:Heteroscedasticity*CHSQ(1)= .43320[.510]*F(1, 16)= .39456[.539]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Moldova



Ordinary Least Squares Estimation

Dependent variable is DLNMOL

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	3.9686	.70677	5.6151[.000]
TREND	-.24606	.070596	-3.4854[.005]
DT	.27523	.071103	3.8708[.002]
DU	-.99836	.21394	-4.6666[.001]
DTB	.32479	.066985	4.8487[.000]
LNLMOL(-1)	-.44209	.079416	-5.5668[.000]

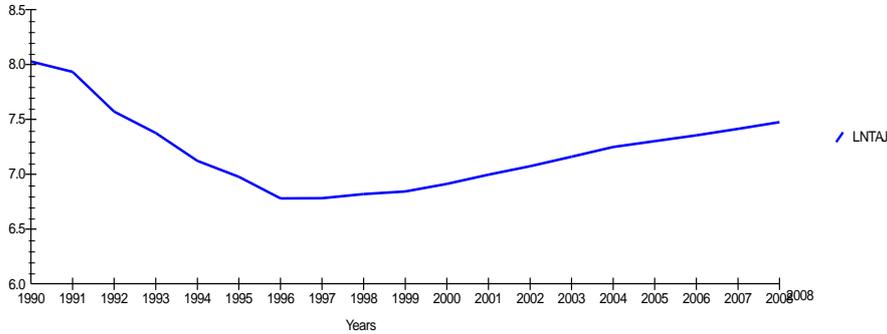
R-Squared .91391 R-Bar-Squared .87804
 S.E. of Regression .048919 F-stat. F(5, 12) 25.4770[.000]
 Mean of Dependent Variable -.020090 S.D. of Dependent Variable .14008
 Residual Sum of Squares .028717 Equation Log-likelihood 32.4247
 Akaike Info. Criterion 26.4247 Schwarz Bayesian Criterion 23.7536
 DW-statistic 1.7711

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.24038[.624]*	F(1, 11)= .14889[.707]*
* B:Functional Form *CHSQ(1)=	6.6940[.010]*	F(1, 11)= 6.5129[.027]*
* C:Normality *CHSQ(2)=	.79439[.672]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.021993[.882]*	F(1, 16)= .019573[.890]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

TAJIKISTAN



Ordinary Least Squares Estimation

Dependent variable is DLNTAJ

18 observations used for estimation from 1991 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	9.3892	2.3947	3.9208[.002]
TREND	-.25218	.064119	-3.9331[.002]
DT	.33071	.083249	3.9726[.002]
DU	-2.4360	.67594	-3.6038[.004]
DTB	.068718	.056863	1.2085[.250]
LNTAJ(-1)	-1.1283	.28119	-4.0125[.002]

R-Squared	.94070	R-Bar-Squared	.91598
S.E. of Regression	.040596	F-stat. F(5, 12)	38.0689[.000]
Mean of Dependent Variable	-.030750	S.D. of Dependent Variable	.14006
Residual Sum of Squares	.019777	Equation Log-likelihood	35.7818
Akaike Info. Criterion	29.7818	Schwarz Bayesian Criterion	27.1107
DW-statistic	1.5057		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= 1.2331[.267]*	*F(1, 11)= .80897[.388]*
* B:Functional Form	*CHSQ(1)= 3.0532[.081]*	*F(1, 11)= 2.2470[.162]*
* C:Normality	*CHSQ(2)= .47600[.788]*	Not applicable *
* D:Heteroscedasticity*	*CHSQ(1)= 4.3588[.037]*	*F(1, 16)= 5.1125[.038]*

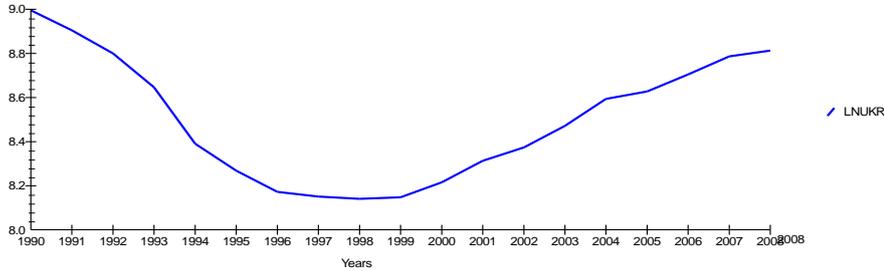
A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

Ukraine



Ordinary Least Squares Estimation

Dependent variable is DLNUKR

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	6.0663	3.0838	1.9671[.075]
TREND	-.073610	.048924	-1.5046[.161]
DTB	.0041091	.070538	.058253[.955]
DU	-1.0988	.73553	-1.4940[.163]
DT	.12082	.073890	1.6352[.130]
LNUKR(-2)	-.66698	.32503	-2.0521[.065]

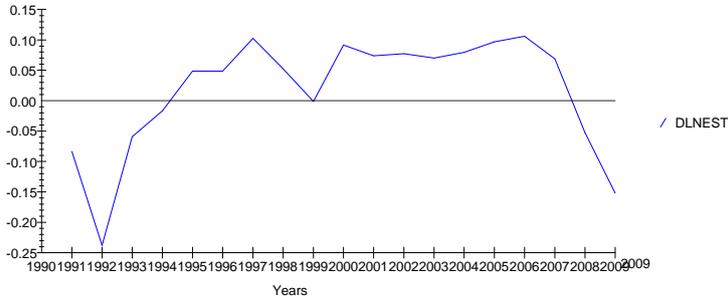
R-Squared	.88027	R-Bar-Squared	.82585
S.E. of Regression	.044408	F-stat. F(5, 11)	16.1745[.000]
Mean of Dependent Variable	-.0054163	S.D. of Dependent Variable	.10641
Residual Sum of Squares	.021693	Equation Log-likelihood	32.5218
Akaike Info. Criterion	26.5218	Schwarz Bayesian Criterion	24.0221
DW-statistic	2.4013		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	1.7117[.191]*	F(1, 10)= 1.1196[.315]*
* B:Functional Form *CHSQ(1)=	1.9401[.164]*	F(1, 10)= 1.2883[.283]*
* C:Normality *CHSQ(2)=	1.8202[.402]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	3.7733[.052]*	F(1, 15)= 4.2792[.056]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Appendix 5. 3 Testing for structural breaks in the first differences of lnGDP Estonia



Ordinary Least Squares Estimation

Dependent variable is DDLNEST

18 observations used for estimation from 1992 to 2009

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	4.6256	1.8561	2.4921[.025]
DU	.058830	.051136	1.1505[.268]
LNEST(-1)	-.20726	.083507	-3.4519[.005]

R-Squared	.53250	R-Bar-Squared	.44350
S.E. of Regression	.068456	F-stat. F(2, 15)	3.7359[.048]
Mean of Dependent Variable	-.0038014	S.D. of Dependent Variable	.078706
Residual Sum of Squares	.070293	Equation Log-likelihood	24.3682
Akaike Info. Criterion	21.3682	Schwarz Bayesian Criterion	20.0327
DW-statistic	2.2466		

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= 1.2575[.262]*F(1, 14)= 1.0515[.323]*

* B:Functional Form *CHSQ(1)= .020472[.886]*F(1, 14)= .015941[.901]*

* C:Normality *CHSQ(2)= .31902[.853]* Not applicable *

* D:Heteroscedasticity*CHSQ(1)= .63100[.427]*F(1, 16)= .58126[.457]*

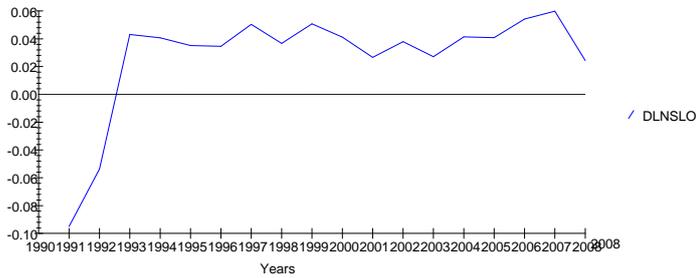
A:Lagrange multiplier test of residual serial correlation

B:Ramsey's RESET test using the square of the fitted values

C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

Slovenia



Ordinary Least Squares Estimation

Dependent variable is DDLNSLO

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.060479	.030910	-1.9566[.072]
DU	.10358	.043078	2.4045[.032]
DLNSLO(-1)	-1.0720	.30535	-3.5108[.004]

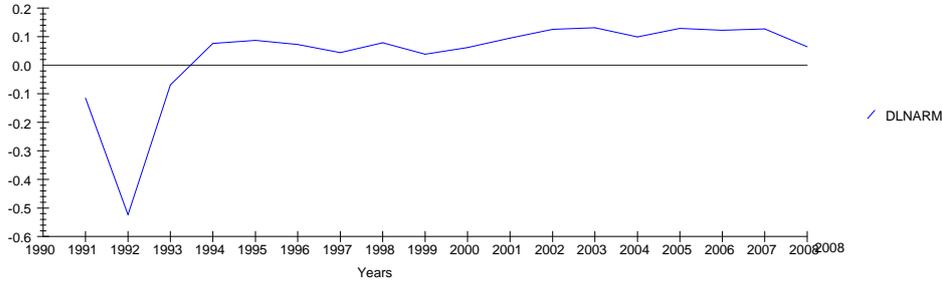
R-Squared	.88742	R-Bar-Squared	.86144
S.E. of Regression	.010663	F-stat. F(3, 13)	34.1592[.000]
Mean of Dependent Variable	.0070188	S.D. of Dependent Variable	.028648
Residual Sum of Squares	.0014782	Equation Log-likelihood	55.3541
Akaike Info. Criterion	51.3541	Schwarz Bayesian Criterion	49.6877
DW-statistic	1.8707		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= .084205[.772]*	*F(1, 12)= .059734[.811]*
* B:Functional Form	*CHSQ(1)= .32251[.570]*	*F(1, 12)= .23206[.639]*
* C:Normality	*CHSQ(2)= .47936[.787]*	Not applicable *
* D:Heteroscedasticity*	*CHSQ(1)= .73161[.392]*	*F(1, 15)= .67457[.424]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Armenia



Ordinary Least Squares Estimation

Dependent variable is DDLNARM

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.49328	.029133	-16.9323[.000]
DU	.56224	.030426	18.4787[.000]
DLNARM(-1)	-.73815	.046436	-15.8959[.000]

R-Squared	.97166	R-Bar-Squared	.96761
S.E. of Regression	.028638	F-stat. F(2, 14)	239.9671[.000]
Mean of Dependent Variable	.010556	S.D. of Dependent Variable	.15911
Residual Sum of Squares	.011482	Equation Log-likelihood	37.9300
Akaike Info. Criterion	34.9300	Schwarz Bayesian Criterion	33.6802
DW-statistic	1.3736		

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= 1.2813[.258]*F(1, 13)= 1.0597[.322]*

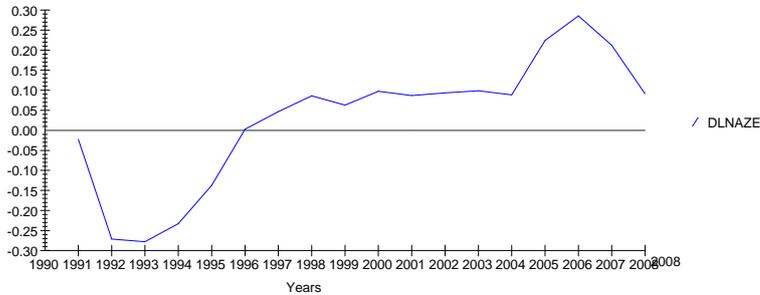
* B:Functional Form *CHSQ(1)= .022044[.882]*F(1, 13)= .016879[.899]*

* C:Normality *CHSQ(2)= 1.1224[.571]* Not applicable *

* D:Heteroscedasticity*CHSQ(1)= 1.9505[.163]*F(1, 15)= 1.9441[.184]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

AZERBEIJAN



Ordinary Least Squares Estimation

Dependent variable is DDLNAZE

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.15998	.043474	-3.6799[.002]
DU	.21727	.051620	4.2090[.001]
DLNAZE(-1)	-.47148	.12146	-3.8817[.002]

R-Squared .59253 R-Bar-Squared .53433
 S.E. of Regression .063737 F-stat. F(2, 14) 10.1794[.002]
 Mean of Dependent Variable .0066940 S.D. of Dependent Variable .093401
 Residual Sum of Squares .056873 Equation Log-likelihood 24.3292
 Akaike Info. Criterion 21.3292 Schwarz Bayesian Criterion 20.0794
 DW-statistic 1.6059

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= .073577[.786]*F(1, 13)= .056509[.816]*

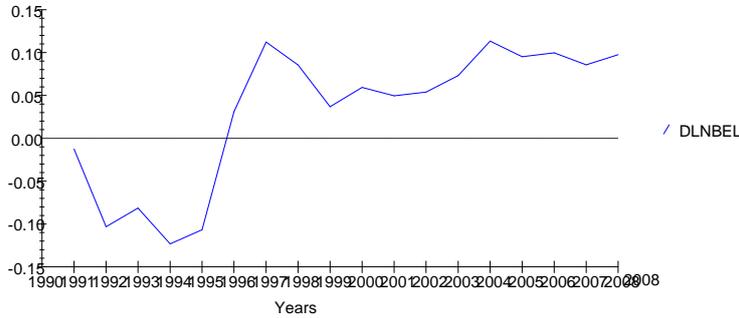
* B:Functional Form *CHSQ(1)= 4.3328[.037]*F(1, 13)= 4.4466[.055]*

* C:Normality *CHSQ(2)= .65367[.721]* Not applicable *

* D:Heteroscedasticity*CHSQ(1)= .78285[.376]*F(1, 15)= .72410[.408]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

BELARUS



Ordinary Least Squares Estimation

Dependent variable is DDLNBEL

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.066991	.023198	-2.8879[.012]
DU	.10455	.028152	3.7138[.002]
DLNBEL(-1)	-.45842	.13548	-3.4836[.004]

R-Squared .53986 R-Bar-Squared .47412
 S.E. of Regression .037109 F-stat. F(2, 14) 8.2126[.004]
 Mean of Dependent Variable .0064739 S.D. of Dependent Variable .051172
 Residual Sum of Squares .019279 Equation Log-likelihood 33.5246
 Akaike Info. Criterion 30.5246 Schwarz Bayesian Criterion 29.2748
 DW-statistic 2.1514

Diagnostic Tests

* Test Statistics * LM Version * F Version *

* A:Serial Correlation*CHSQ(1)= .25285[.615]*F(1, 13)= .19627[.665]*

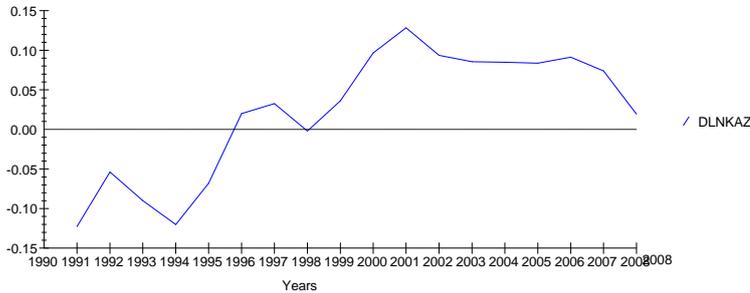
* B:Functional Form *CHSQ(1)= 3.5583[.059]*F(1, 13)= 3.4413[.086]*

* C:Normality *CHSQ(2)= .16433[.921]* Not applicable *

* D:Heteroscedasticity*CHSQ(1)= 9.1760[.002]*F(1, 15)= 17.5920[.001]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Kazakhstan



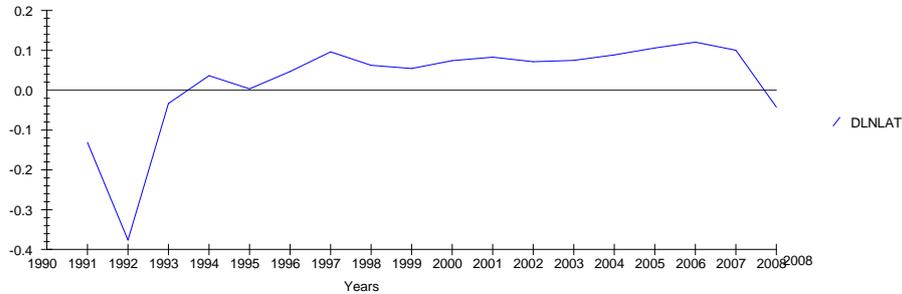
Ordinary Least Squares Estimation

```

*****
Dependent variable is DDLNKAZ
16 observations used for estimation from 1993 to 2008
*****
Regressor      Coefficient    Standard Error    T-Ratio[Prob]
C              -.035231      .019788           -1.7804[.098]
DU             .081589      .033700           2.4210[.031]
DLNKAZ(-2)    -.60583      .19975            -3.0330[.010]
*****
R-Squared      .41821    R-Bar-Squared    .32870
S.E. of Regression .033076  F-stat.  F( 2, 13)  4.6724[.030]
Mean of Dependent Variable .0045641  S.D. of Dependent Variable .040370
Residual Sum of Squares .014223  Equation Log-likelihood  33.5011
Akaike Info. Criterion  30.5011  Schwarz Bayesian Criterion  29.3422
DW-statistic   .93621
*****
Diagnostic Tests
*****
* Test Statistics *    LM Version    *    F Version    *
*****
* A:Serial Correlation*CHSQ( 1)= 1.3697[.242]*F( 1, 12)= 1.1234[.310]*
*          *          *          *
* B:Functional Form *CHSQ( 1)= .41797[.518]*F( 1, 12)= .32189[.581]*
*          *          *          *
* C:Normality *CHSQ( 2)= 2.2672[.322]* Not applicable *
*          *          *          *
* D:Heteroscedasticity*CHSQ( 1)= 1.2711[.260]*F( 1, 14)= 1.2081[.290]*
*****
A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

```

Latvia



Ordinary Least Squares Estimation

```

*****
Dependent variable is DDLNLAT
17 observations used for estimation from 1992 to 2008
*****
Regressor      Coefficient    Standard Error    T-Ratio[Prob]
C              -.34554        .041945           -8.2380[.000]
DU             .39566        .044174           8.9569[.000]
DLNLAT(-1)    -.76759       .088799          -8.6441[.000]
*****
R-Squared      .89198    R-Bar-Squared    .87655
S.E. of Regression .040291  F-stat.  F( 2, 14)  57.8045[.000]
Mean of Dependent Variable .0052291  S.D. of Dependent Variable .11467
Residual Sum of Squares .022727  Equation Log-likelihood  32.1261
Akaike Info. Criterion  29.1261  Schwarz Bayesian Criterion  27.8763
DW-statistic   1.2982
*****

```

Diagnostic Tests

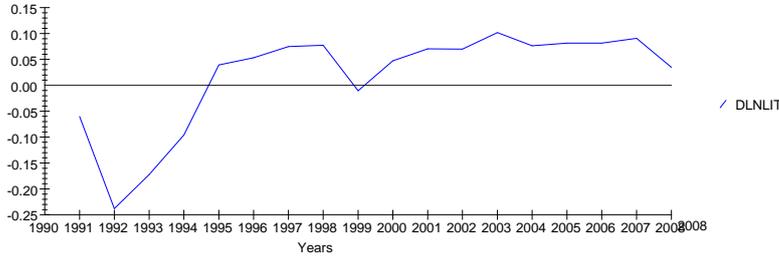
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*****
* Test Statistics *   LM Version   *   F Version   *
*****
* A:Serial Correlation*CHSQ( 1)= .15640[.692]*F( 1, 13)= .12071[.734]*
*                   *                   *                   *
* B:Functional Form *CHSQ( 1)= .097517[.755]*F( 1, 13)= .075002[.788]*
*                   *                   *                   *
* C:Normality      *CHSQ( 2)= 18.1142[.000]*   Not applicable   *
*                   *                   *                   *
* D:Heteroscedasticity*CHSQ( 1)= .38020[.537]*F( 1, 15)= .34315[.567]*
*****

```

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Lithuania



Ordinary Least Squares Estimation

Dependent variable is DDLNLIT
17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.20702	.030488	-6.7902[.000]
DU	.27117	.037092	7.3107[.000]
DLNLIT(-1)	-1.0123	.14045	-7.2074[.000]

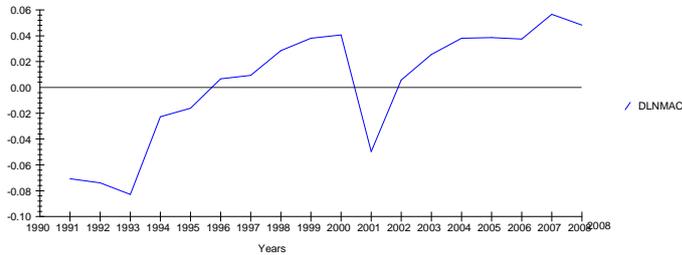
R-Squared	.83339	R-Bar-Squared	.79494
S.E. of Regression	.031357	F-stat. F(3, 13)	21.6754[.000]
Mean of Dependent Variable	.0055820	S.D. of Dependent Variable	.069246
Residual Sum of Squares	.012783	Equation Log-likelihood	37.0176
Akaike Info. Criterion	33.0176	Schwarz Bayesian Criterion	31.3512
DW-statistic	1.7776		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)= .051680[.820]*F(1, 12)= .036591[.851]*		
* B:Functional Form *CHSQ(1)= 3.6720[.055]*F(1, 12)= 3.3062[.094]*		
* C:Normality *CHSQ(2)= 3.0885[.213]* Not applicable *		
* D:Heteroscedasticity*CHSQ(1)= .013286[.908]*F(1, 15)= .011732[.915]*		

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Macedonia



Ordinary Least Squares Estimation

Dependent variable is DDLNMAC

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	.0041838	.012290	.34043[.739]
DU	.0056747	.018658	.30415[.765]
DLNMAC(-1)	-.33979	.21200	-1.6028[.131]

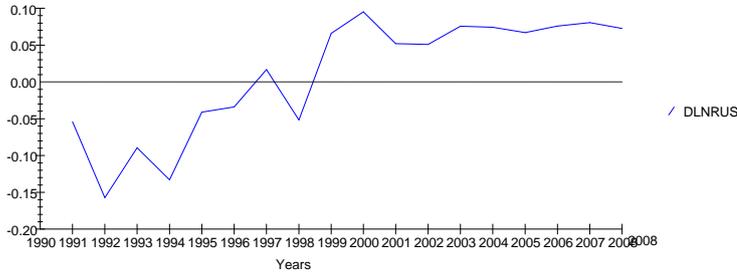
R-Squared	.18953	R-Bar-Squared	.073744
S.E. of Regression	.030534	F-stat. F(2, 14)	1.6369[.230]
Mean of Dependent Variable	.0070020	S.D. of Dependent Variable	.031727
Residual Sum of Squares	.013053	Equation Log-likelihood	36.8397
Akaike Info. Criterion	33.8397	Schwarz Bayesian Criterion	32.5899
DW-statistic	2.2414		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= .95999[.327]*	*F(1, 13)= .77804[.394]*
* B:Functional Form	*CHSQ(1)= .27029[.603]*	*F(1, 13)= .21003[.654]*
* C:Normality	*CHSQ(2)= 15.8404[.000]*	Not applicable *
* D:Heteroscedasticity*	*CHSQ(1)= .058074[.810]*	*F(1, 15)= .051417[.824]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Russia



Ordinary Least Squares Estimation

Dependent variable is DDLNRUS

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.058888	.021152	-2.7841[.015]
DU	.12068	.033463	3.6062[.003]
DLNRUS(-1)	-.84220	.20910	-4.0278[.001]

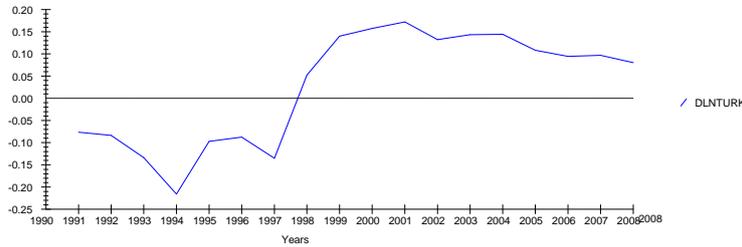
R-Squared	.54241	R-Bar-Squared	.47704
S.E. of Regression	.040232	F-stat. F(2, 14)	8.2976[.004]
Mean of Dependent Variable	.0074468	S.D. of Dependent Variable	.055633
Residual Sum of Squares	.022660	Equation Log-likelihood	32.1510
Akaike Info. Criterion	29.1510	Schwarz Bayesian Criterion	27.9012
DW-statistic	1.3957		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	CHSQ(1)= .61831[.432]*	F(1, 13)= .49067[.496]*
* B:Functional Form	*CHSQ(1)= .68482[.408]*	*F(1, 13)= .54567[.473]*
* C:Normality	*CHSQ(2)= 1.4320[.489]*	Not applicable *
* D:Heteroscedasticity*	CHSQ(1)= .55608[.456]*	F(1, 15)= .50725[.487]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

TURKMENSTAN



Ordinary Least Squares Estimation

Dependent variable is DDLNTURK

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.095564	.021361	-4.4738[.001]
DU	.18979	.033661	5.6383[.000]
DLNTURK(-1)	-.74215	.12808	-5.7946[.000]

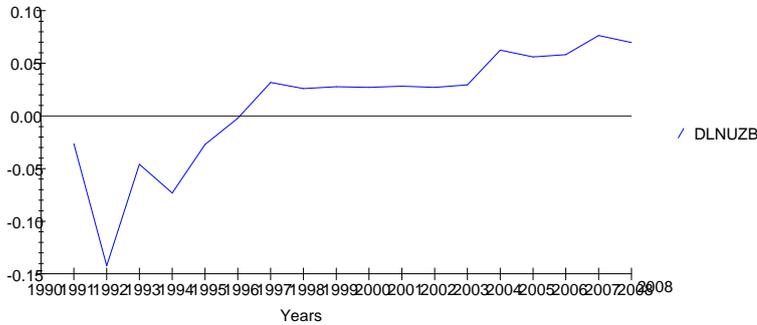
R-Squared	.71957	R-Bar-Squared	.67951
S.E. of Regression	.037697	F-stat.	F(2, 14) 17.9620[.000]
Mean of Dependent Variable	.0092370	S.D. of Dependent Variable	.066590
Residual Sum of Squares	.019895	Equation Log-likelihood	33.2572
Akaike Info. Criterion	30.2572	Schwarz Bayesian Criterion	29.0074
DW-statistic	1.7810		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*	*CHSQ(1)= .059548[.807]*	*F(1, 13)= .045697[.834]*
* B:Functional Form	*CHSQ(1)= .0080755[.928]*	*F(1, 13)= .0061783[.939]*
* C:Normality	*CHSQ(2)= .99372[.608]*	Not applicable
* D:Heteroscedasticity*	*CHSQ(1)= .40695[.524]*	*F(1, 15)= .36788[.553]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

UZBEKISTAN



Ordinary Least Squares Estimation

Dependent variable is DDLNUZB

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.067307	.023360	-2.8813[.012]
DU	.10503	.030899	3.3992[.004]
DLNUZB(-1)	-.93345	.24178	-3.8608[.002]

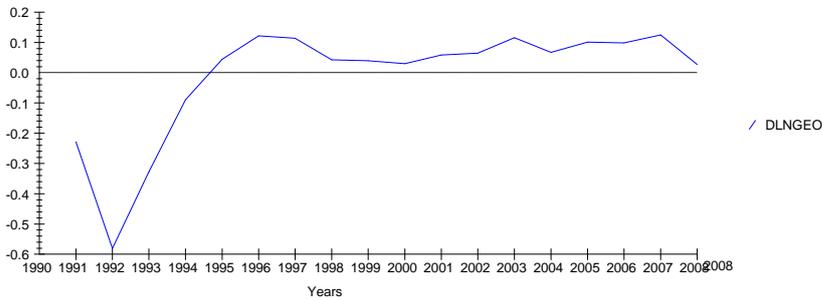
R-Squared	.51873	R-Bar-Squared	.44998
S.E. of Regression	.031221	F-stat. F(2, 14)	7.5449[.006]
Mean of Dependent Variable	.0056454	S.D. of Dependent Variable	.042098
Residual Sum of Squares	.013647	Equation Log-likelihood	36.4616
Akaike Info. Criterion	33.4616	Schwarz Bayesian Criterion	32.2118
DW-statistic	1.7457		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.24622[.620]*	F(1, 13)= .19105[.669]*
* B:Functional Form *CHSQ(1)=	1.2810[.258]*	F(1, 13)= 1.0594[.322]*
* C:Normality *CHSQ(2)=	1.4210[.491]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	1.7510[.186]*	F(1, 15)= 1.7224[.209]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

GEORGIA



Ordinary Least Squares Estimation

Dependent variable is DDLNGEO

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.40200	.12666	-3.1738[.007]
DU	.48919	.14712	3.3251[.005]
DLNGEO(-1)	-1.1828	.29911	-3.9543[.001]

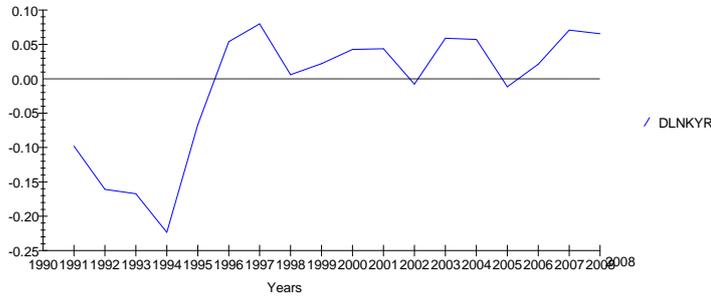
R-Squared	.53340	R-Bar-Squared	.46675
S.E. of Regression	.097934	F-stat. F(2, 14)	8.0022[.005]
Mean of Dependent Variable	.015050	S.D. of Dependent Variable	.13411
Residual Sum of Squares	.13428	Equation Log-likelihood	17.0272
Akaike Info. Criterion	14.0272	Schwarz Bayesian Criterion	12.7774
DW-statistic	1.8239		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.21709[.641]*F(1, 13)=	.16815[.688]*
* B:Functional Form *CHSQ(1)=	6.6695[.010]*F(1, 13)=	8.3929[.012]*
* C:Normality *CHSQ(2)=	7.4188[.024]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.0086541[.926]*F(1, 15)=	.0076398[.932]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Kirgiz Rep.



Ordinary Least Squares Estimation

Dependent variable is DDLNKYR

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.14227	.026161	-5.4382[.000]
DU	.17032	.028516	5.9729[.000]
DLNKYR(-1)	-.70697	.12013	-5.8852[.000]

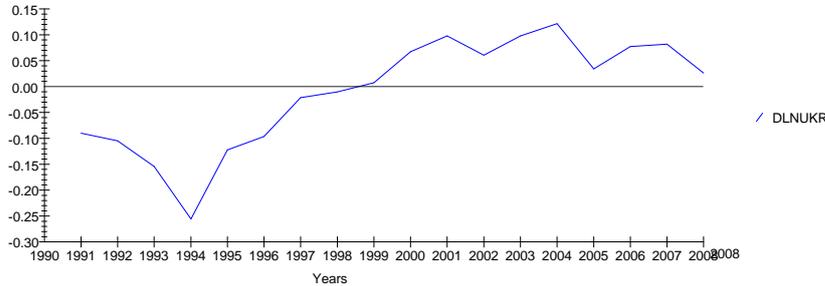
R-Squared	.75362	R-Bar-Squared	.71842
S.E. of Regression	.034355	F-stat. F(2, 14)	21.4112[.000]
Mean of Dependent Variable	.0096220	S.D. of Dependent Variable	.064742
Residual Sum of Squares	.016524	Equation Log-likelihood	34.8356
Akaike Info. Criterion	31.8356	Schwarz Bayesian Criterion	30.5858
DW-statistic	2.2105		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.36358[.547]*	F(1, 13)= .28411[.603]*
* B:Functional Form *CHSQ(1)=	1.8926[.169]*	F(1, 13)= 1.6286[.224]*
* C:Normality *CHSQ(2)=	1.2328[.540]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.014426[.904]*	F(1, 15)= .012740[.912]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Ukraine



Ordinary Least Squares Estimation

Dependent variable is DDLNUKR

17 observations used for estimation from 1992 to 2008

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
C	-.054307	.037434	-1.4507[.169]
DU	.092598	.054683	1.6934[.113]
DLNUKR(-1)	-.54456	.25692	-2.1196[.052]

R-Squared	.24620	R-Bar-Squared	.13851
S.E. of Regression	.055544	F-stat. F(2, 14)	2.2863[.138]
Mean of Dependent Variable	.0068318	S.D. of Dependent Variable	.059843
Residual Sum of Squares	.043192	Equation Log-likelihood	26.6682
Akaike Info. Criterion	23.6682	Schwarz Bayesian Criterion	22.4184
DW-statistic	1.8777		

Diagnostic Tests

* Test Statistics *	LM Version	* F Version *
* A:Serial Correlation*CHSQ(1)=	.040948[.840]	*F(1, 13)= .031389[.862]*
* B:Functional Form *CHSQ(1)=	1.2408[.265]	*F(1, 13)= 1.0235[.330]*
* C:Normality *CHSQ(2)=	2.2500[.325]*	Not applicable *
* D:Heteroscedasticity*CHSQ(1)=	.034563[.853]	*F(1, 15)= .030559[.864]*

- A:Lagrange multiplier test of residual serial correlation
- B:Ramsey's RESET test using the square of the fitted values
- C:Based on a test of skewness and kurtosis of residuals
- D:Based on the regression of squared residuals on squared fitted values

Appendix 5. 4 Fitting a single trend in GDP growth rates in the various transition countries

Rapid J- curve countries

1. Albania

Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\J-folder\Albania.xls

The estimation sample is: 10 - 30

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-8.67253	7.067	-1.23	0.2347	0.0735
Trend	0.585139	0.3382	1.73	0.0998	0.1361

sigma	9.38378	RSS	1673.05139
R ²	0.136129	F(1,19) =	2.994 [0.100]
Adj.R ²	0.0906617	log-likelihood	-75.7655
no. of observations	21	no. of parameters	2
mean(Y)	3.03026	se(Y)	9.84045

AR 1-2 test: F(2,17) = 1.5243 [0.2461]

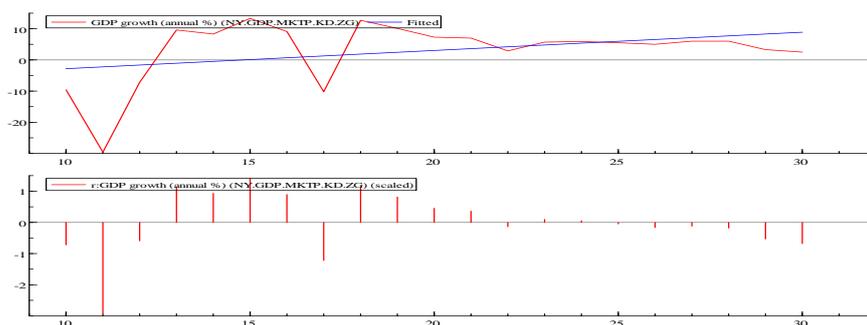
ARCH 1-1 test: F(1,19) = 0.00089700 [0.9764]

Normality test: Chi²(2) = 6.3442 [0.0419]*

Hetero test: F(2,18) = 3.9950 [0.0367]*

Hetero-X test: F(2,18) = 3.9950 [0.0367]*

RESET23 test: F(2,17) = 5.3375 [0.0159]*



2. Czech Republic

EQ(27) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\J-folder\Czech Republic.xls

The estimation sample is: 1991 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-4.70293	3.511	-1.34	0.1980	0.0955
Trend	0.323789	0.1693	1.91	0.0728	0.1771

sigma	4.04212	RSS	277.758607
R ²	0.177053	F(1,17) =	3.657 [0.073]
Adj.R ²	0.128644	log-likelihood	-52.4418
no. of observations	19	no. of parameters	2
mean(Y)	1.77284	se(Y)	4.33024

AR 1-2 test: F(2,15) = 0.87735 [0.4362]

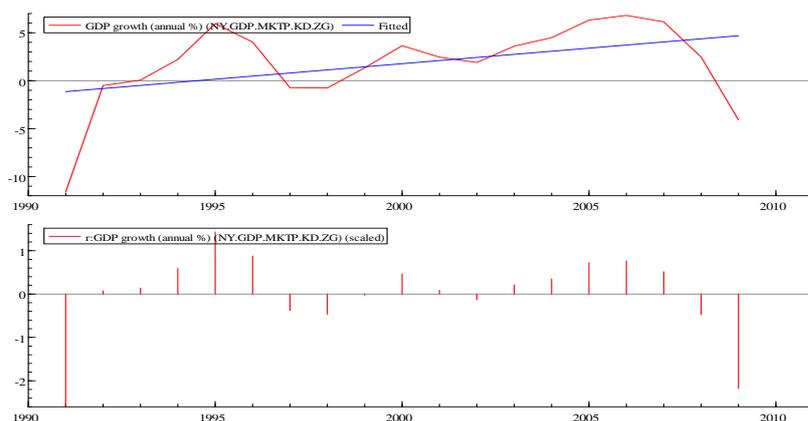
ARCH 1-1 test: F(1,17) = 0.15190 [0.7016]

Normality test: Chi²(2) = 8.0822 [0.0176]*

Hetero test: F(2,16) = 5.6985 [0.0135]*

Hetero-X test: F(2,16) = 5.6985 [0.0135]*

RESET23 test: F(2,15) = 3.1508 [0.0720]



3. Estonia

EQ(21) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: D:\empirics_chapter6_growth accounting_TOTAL\J-curve\Estonia.xls

The estimation sample is: 10 - 30

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-4.70482	7.161	-0.657	0.5190	0.0222
Trend	0.278778	0.3427	0.814	0.4260	0.0337

sigma	9.50875	RSS	1717.91155
R ²	0.0336617	F(1,19) =	0.6619 [0.426]
Adj.R ²	-0.0171982	log-likelihood	-76.0433
no. of observations	21	no. of parameters	2
mean(Y)	0.870738	se(Y)	9.42803

AR 1-2 test: F(2,17) = 9.0444 [0.0021]**

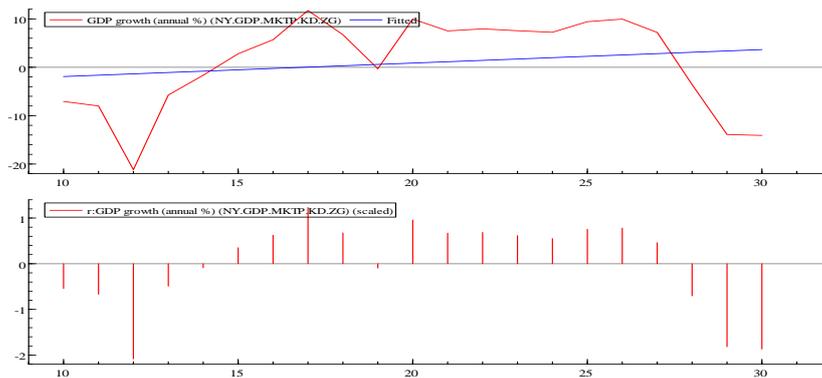
ARCH 1-1 test: F(1,19) = 0.63714 [0.4346]

Normality test: Chi²(2) = 8.1102 [0.0173]*

Hetero test: F(2,18) = 3.1420 [0.0675]

Hetero-X test: F(2,18) = 3.1420 [0.0675]

RESET3 test: F(2,17) = 22.292 [0.0000]**



4. Hungary

Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: D:\empirics_chapter6_growth accounting_TOTAL\J-curve\Hungary.xls

The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-2.84471	3.167	-0.898	0.3803	0.0407
Trend	0.200734	0.1516	1.32	0.2011	0.0845

sigma	4.20563	RSS	336.058386
R ²	0.0845211	F(1,19) =	1.754 [0.201]
Adj.R ²	0.0363381	log-likelihood	-58.9117
no. of observations	21	no. of parameters	2
mean(Y)	1.16997	se(Y)	4.28418

AR 1-2 test: $F(2,17) = 3.7651 [0.0443]^*$

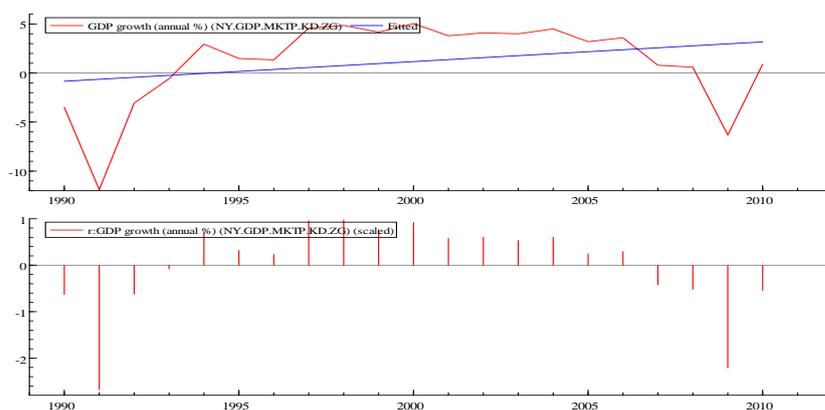
ARCH 1-1 test: $F(1,19) = 0.20013 [0.6597]$

Normality test: $\chi^2(2) = 11.452 [0.0033]**$

Hetero test: $F(2,18) = 1.6995 [0.2108]$

Hetero-X test: $F(2,18) = 1.6995 [0.2108]$

RESET23 test: $F(2,17) = 16.313 [0.0001]**$



5. Poland

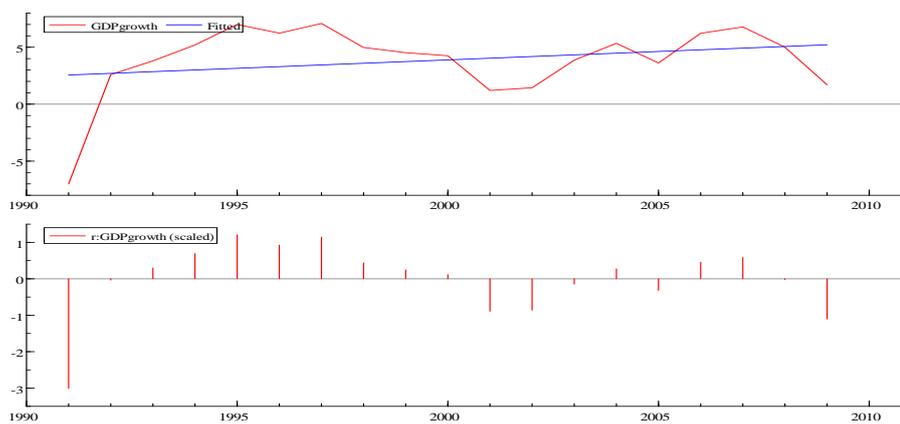
Modelling GDPgrowth by OLS

The dataset is: D:\empirics_chapter6_growth accounting_TOTAL\J-curve\Poland.xls

The estimation sample is: 1991 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	0.790883	2.891	0.274	0.7877	0.0044
Trend	0.147507	0.1332	1.11	0.2836	0.0673
sigma	3.1805	RSS	171.964363		
R ²	0.0672698	F(1,17) =	1.226	[0.284]	
Adj.R ²	0.0124033	log-likelihood	-47.8869		
no. of observations	19	no. of parameters	2		
mean(GDPgrowth)	3.88854	se(GDPgrowth)	3.20041		

AR 1-2 test: F(2,15) = 0.70230 [0.5110]
 ARCH 1-1 test: F(1,17) = 0.46692 [0.5036]
 Normality test: Chi²(2) = 8.5258 [0.0141]*
 Hetero test: F(2,16) = 4.3022 [0.0320]*
 Hetero-X test: F(2,16) = 4.3022 [0.0320]*
 RESET23 test: F(2,15) = 5.8747 [0.0131]*



6. Slovak Republik

EQ(17) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: D:\empirics_chapter6_growth accounting_TOTAL\J-curve\Slovak republic.xls

The estimation sample is: 10 - 30

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-4.90206	4.541	-1.08	0.2938	0.0578
Trend	0.348210	0.2173	1.60	0.1255	0.1191

sigma	6.02961	RSS	690.768738
R ²	0.119065	F(1,19) =	2.568 [0.126]
Adj.R ²	0.0727	log-likelihood	-66.4772
no. of observations	21	no. of parameters	2
mean(Y)	2.06214	se(Y)	6.26151

AR 1-2 test: $F(2,17) = 6.7294 [0.0070]**$

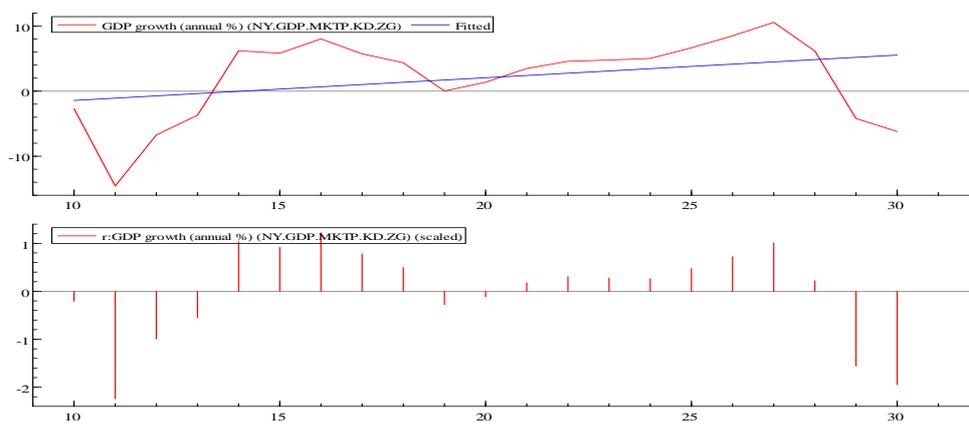
ARCH 1-1 test: $F(1,19) = 0.46760 [0.5023]$

Normality test: $\chi^2(2) = 6.4833 [0.0391]*$

Hetero test: $F(2,18) = 5.1944 [0.0166]*$

Hetero-X test: $F(2,18) = 5.1944 [0.0166]*$

RESET23 test: $F(2,17) = 5.9816 [0.0108]*$



7. Slovenia

EQ(11) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: D:\empirics_chapter6_growth accounting_TOTAL\J-curve\Slovenia.xls

The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-0.348974	2.473	-0.141	0.8893	0.0010
Trend	0.156625	0.1970	0.795	0.4364	0.0322

sigma	5.4662	RSS	567.707489
R ²	0.0322014	F(1,19) =	0.6322 [0.436]
Adj.R ²	-0.0187354	log-likelihood	-64.4171
no. of observations	21	no. of parameters	2
mean(Y)	1.3739	se(Y)	5.4157

AR 1-2 test: F(2,17) = 11.972 [0.0006]**

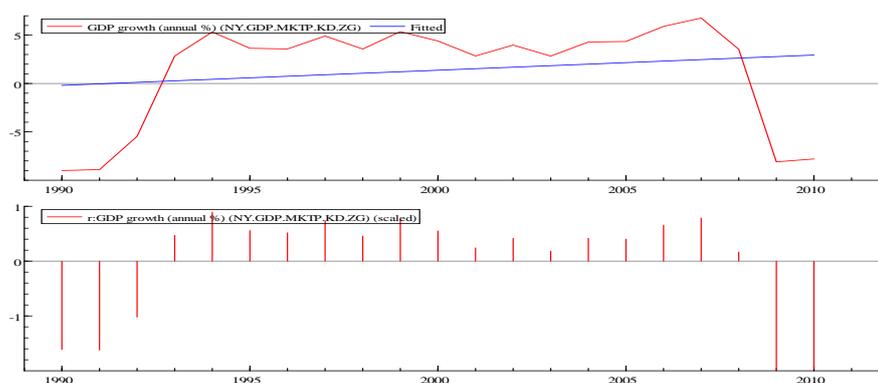
ARCH 1-1 test: F(1,19) = 10.202 [0.0048]**

Normality test: Chi²(2) = 27.378 [0.0000]**

Hetero test: F(2,18) = 16.887 [0.0001]**

Hetero-X test: F(2,18) = 16.887 [0.0001]**

RESET23 test: F(2,17) = 17.558 [0.0001]**



Slow J-curve countries

8. Armenia

EQ(29) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\U-countries\Armenia.xls

The estimation sample is: 1991 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-9.20747	6.855	-1.34	0.1969	0.0959
Trend	1.07379	0.5579	1.92	0.0712	0.1789

sigma	13.3189	RSS	3015.66267
R ²	0.178939	F(1,17) =	3.705 [0.071]
Adj.R ²	0.130642	log-likelihood	-75.0976
no. of observations	19	no. of parameters	2
mean(Y)	2.60421	se(Y)	14.2846

AR 1-2 test: $F(2,15) = 1.5811 [0.2382]$

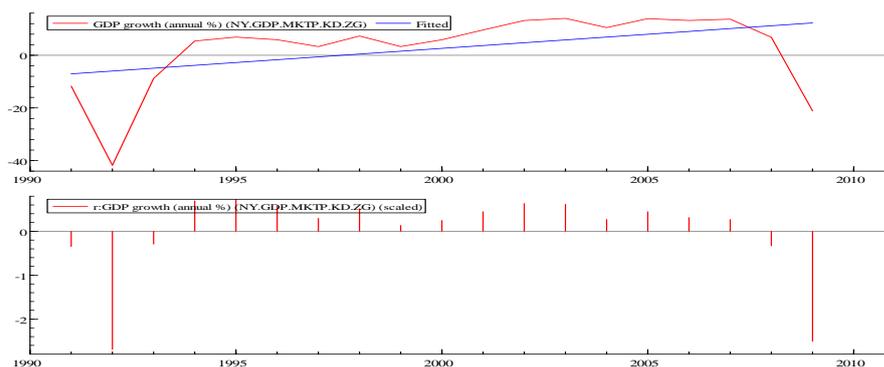
ARCH 1-1 test: $F(1,17) = 0.23590 [0.6334]$

Normality test: $\chi^2(2) = 35.793 [0.0000]**$

Hetero test: $F(2,16) = 3.0439 [0.0758]$

Hetero-X test: $F(2,16) = 3.0439 [0.0758]$

RESET23 test: $F(2,15) = 7.4614 [0.0056]**$



9. Azerbaijan

EQ(31) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\U-countries\Azerbaijan_1.xls

The estimation sample is: 9 - 28

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-35.0822	7.225	-4.86	0.0001	0.5671
Trend	2.15025	0.3728	5.77	0.0000	0.6488

sigma	9.61486	RSS	1664.01888
R ²	0.648845	F(1,18) =	33.26 [0.000]**
Adj.R ²	0.629336	log-likelihood	-72.5914
no. of observations	20	no. of parameters	2
mean(Y)	4.69745	se(Y)	15.7926

AR 1-2 test: F(2,16) = 6.4717 [0.0087]**

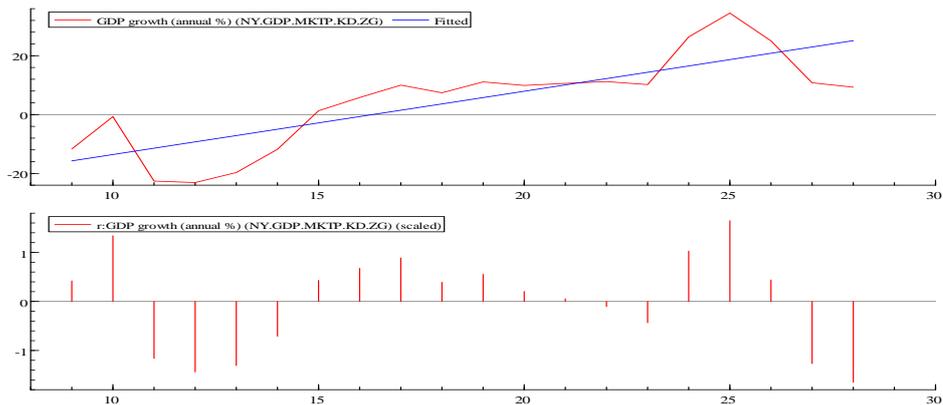
ARCH 1-1 test: F(1,18) = 2.2196 [0.1536]

Normality test: Chi²(2) = 1.2696 [0.5301]

Hetero test: F(2,17) = 4.3271 [0.0303]*

Hetero-X test: F(2,17) = 4.3271 [0.0303]*

RESET23 test: F(2,16) = 4.3204 [0.0316]*



10. Belarus

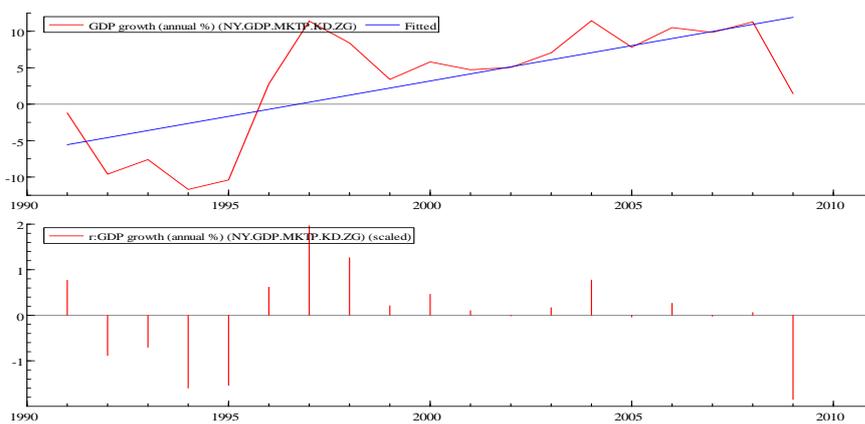
EQ(33) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\U-countries\Belarus.xls

The estimation sample is: 1991 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-7.49934	2.918	-2.57	0.0199	0.2798
Trend	0.971073	0.2375	4.09	0.0008	0.4958

sigma 5.67009 RSS 546.549318
 R² 0.495826 F(1,17) = 16.72 [0.001]**
 Adj.R² 0.466169 log-likelihood -58.8721
 no. of observations 19 no. of parameters 2
 mean(Y) 3.18246 se(Y) 7.76047
 AR 1-2 test: F(2,15) = 2.6098 [0.1065]
 ARCH 1-1 test: F(1,17) = 0.58538 [0.4547]
 Normality test: Chi²(2) = 0.91791 [0.6319]
 Hetero test: F(2,16) = 0.55935 [0.5824]
 Hetero-X test: F(2,16) = 0.55935 [0.5824]
 RESET23 test: F(2,15) = 2.9787 [0.0814]



11. Bulgaria

EQ(39) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\w-countries\Bulgaria.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-11.9750	3.648	-3.28	0.0041	0.3744
Trend	0.653727	0.1794	3.64	0.0019	0.4245

sigma	4.62685	RSS	385.339729
R ²	0.424465	F(1,18) =	13.28 [0.002]**
Adj.R ²	0.392491	log-likelihood	-57.9627
no. of observations	20	no. of parameters	2
mean(Y)	0.772642	se(Y)	5.93621

AR 1-2 test: F(2,16) = 1.5281 [0.2470]

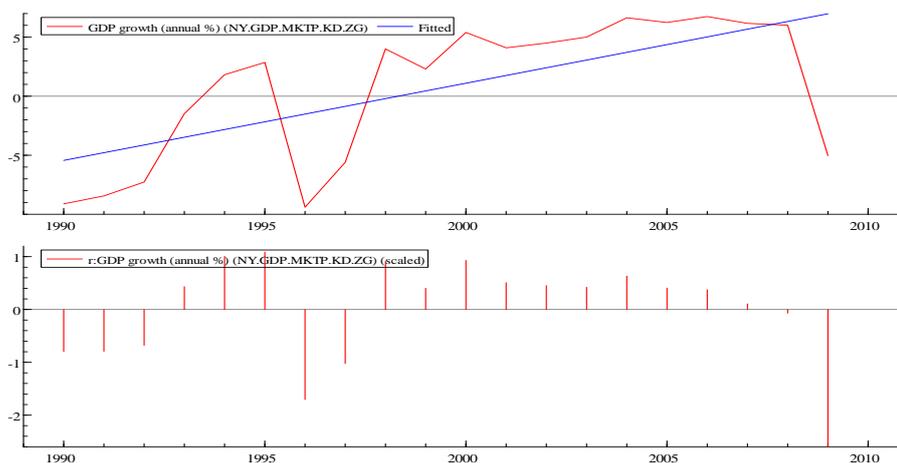
ARCH 1-1 test: F(1,18) = 2.7518e-005 [0.9959]

Normality test: Chi²(2) = 7.2557 [0.0266]*

Hetero test: F(2,17) = 1.1777 [0.3319]

Hetero-X test: F(2,17) = 1.1777 [0.3319]

RESET23 test: F(2,16) = 4.8466 [0.0226]*



12. Croatia

EQ(41) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasja Trajkova\Desktop\growth accounting_28_03_2011\w-countries\Croatia.xls

The estimation sample is: 1991 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-5.34339	3.571	-1.50	0.1529	0.1164
Trend	0.569922	0.2906	1.96	0.0665	0.1845

sigma	6.9382	RSS	818.356946
R ²	0.184497	F(1,17) =	3.846 [0.066]
Adj.R ²	0.136526	log-likelihood	-62.707
no. of observations	19	no. of parameters	2
mean(Y)	0.925758	se(Y)	7.46659

AR 1-2 test: F(2,15) = 3.3854 [0.0612]

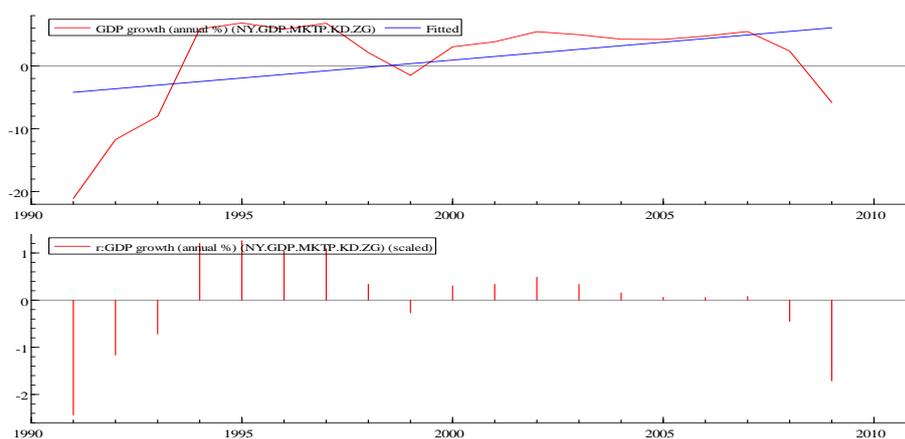
ARCH 1-1 test: F(1,17) = 2.4781 [0.1339]

Normality test: Chi²(2) = 3.7177 [0.1559]

Hetero test: F(2,16) = 11.492 [0.0008]**

Hetero-X test: F(2,16) = 11.492 [0.0008]**

RESET23 test: F(2,15) = 13.497 [0.0004]**



13. Kazakhstan

EQ(35) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\U-countries\kazakhstan_1.xls

The estimation sample is: 13 - 31

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-22.0018	5.352	-4.11	0.0007	0.4986
Trend	1.10175	0.2360	4.67	0.0002	0.5617

sigma	5.63551	RSS	539.902456
R ²	0.561698	F(1,17) =	21.79 [0.000]**
Adj.R ²	0.535915	log-likelihood	-58.7559
no. of observations	19	no. of parameters	2
mean(Y)	2.23684	se(Y)	8.27246

AR 1-2 test: F(2,15) = 8.7787 [0.0030]**

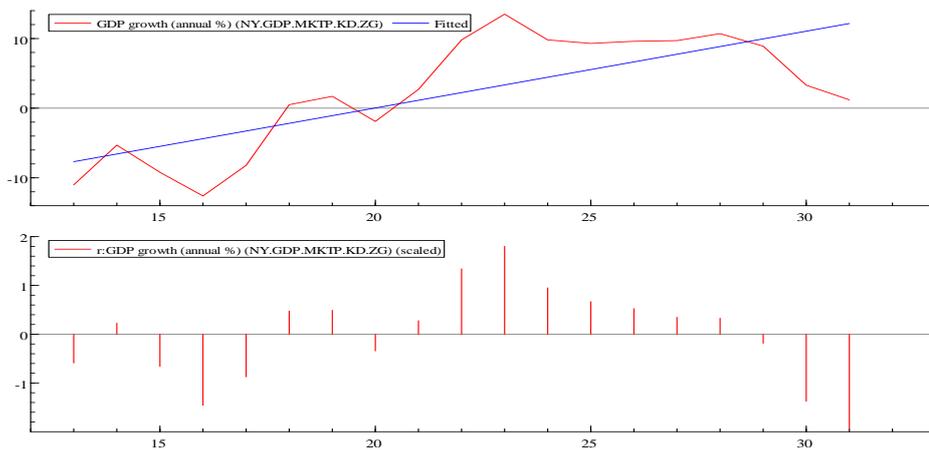
ARCH 1-1 test: F(1,17) = 3.3554 [0.0846]

Normality test: Chi²(2) = 0.40278 [0.8176]

Hetero test: F(2,16) = 1.0064 [0.3875]

Hetero-X test: F(2,16) = 1.0064 [0.3875]

RESET23 test: F(2,15) = 20.971 [0.0000]**



14. Lithuania

EQ(13) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: D:\empirics_chapter6_growth accounting_TOTAL\J-curve\Lithuania.xls

The estimation sample is: 11 - 30

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-8.33420	8.496	-0.981	0.3396	0.0507
Trend	0.399739	0.3990	1.00	0.3296	0.0528

sigma	10.2882	RSS	1905.23719
R ²	0.0528269	F(1,18) =	1.004 [0.330]
Adj.R ²	0.000206188	log-likelihood	-73.9451
no. of observations	20	no. of parameters	2
mean(Y)	-0.139549	se(Y)	10.2892

AR 1-2 test: F(2,16) = 8.7420 [0.0027]**

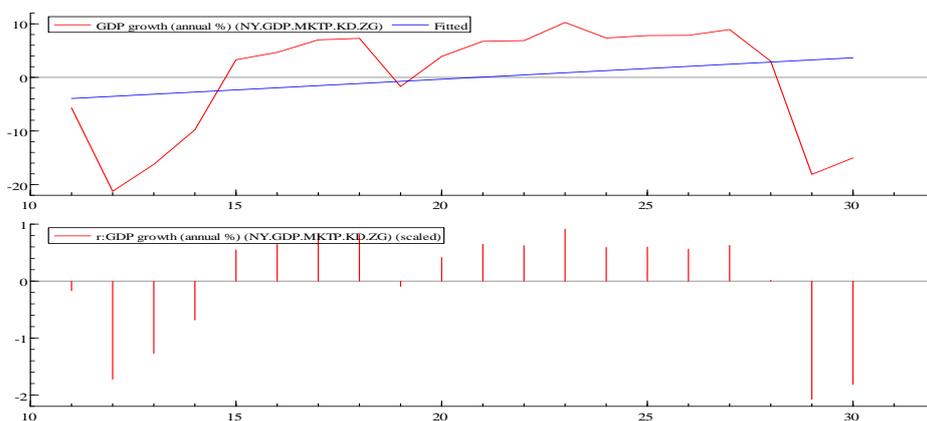
ARCH 1-1 test: F(1,18) = 2.3535 [0.1424]

Normality test: Chi²(2) = 16.386 [0.0003]**

Hetero test: F(2,17) = 5.6243 [0.0133]*

Hetero-X test: F(2,17) = 5.6243 [0.0133]*

RESET23 test: F(2,16) = 16.652 [0.0001]**



15. Latvia

EQ(15) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: D:\empirics_chapter6_growth accounting_TOTAL\J-curve\Latvia.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-14.1218	8.335	-1.69	0.1075	0.1375
Trend	0.756549	0.4099	1.85	0.0815	0.1591

sigma	10.5705	RSS	2011.22449
R ²	0.159134	F(1,18) =	3.406 [0.081]
Adj.R ²	0.112419	log-likelihood	-74.4864
no. of observations	20	no. of parameters	2
mean(Y)	0.630953	se(Y)	11.2199

AR 1-2 test: F(2,16) = 3.4842 [0.0555]

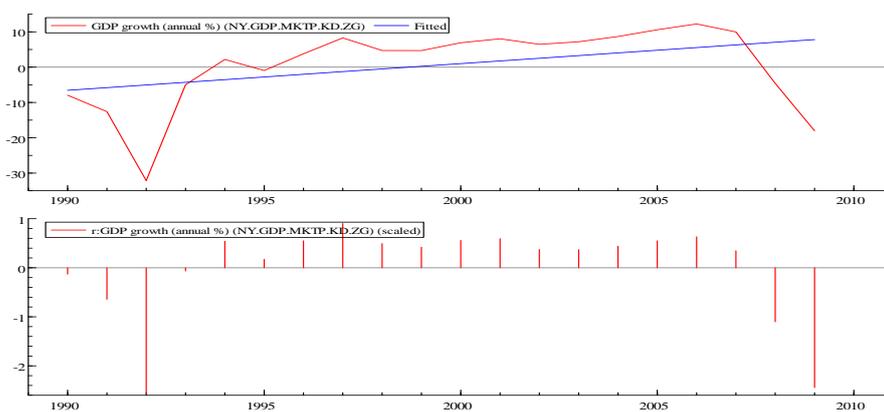
ARCH 1-1 test: F(1,18) = 0.00044246 [0.9834]

Normality test: Chi²(2) = 27.144 [0.0000]**

Hetero test: F(2,17) = 2.2954 [0.1311]

Hetero-X test: F(2,17) = 2.2954 [0.1311]

RESET23 test: F(2,16) = 10.754 [0.0011]**



16. Macedonia

EQ(43) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

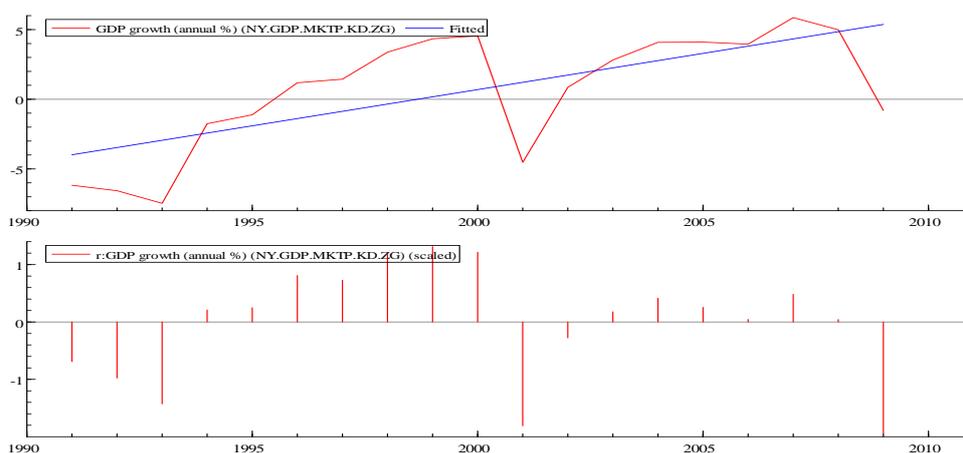
The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\w-countries\Macedonia.xls

The estimation sample is: 1991 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-9.70235	2.753	-3.52	0.0026	0.4221
Trend	0.519719	0.1328	3.91	0.0011	0.4741

sigma	3.16985	RSS	170.814889
R ²	0.474054	F(1,17) =	15.32 [0.001]**
Adj.R ²	0.443116	log-likelihood	-47.8232
no. of observations	19	no. of parameters	2
mean(Y)	0.692032	se(Y)	4.24772

AR 1-2 test: F(2,15) = 1.1391 [0.3463]
 ARCH 1-1 test: F(1,17) = 0.12846 [0.7244]
 Normality test: Chi²(2) = 2.7338 [0.2549]
 Hetero test: F(2,16) = 0.059482 [0.9425]
 Hetero-X test: F(2,16) = 0.059482 [0.9425]
 RESET23 test: F(2,15) = 3.4382 [0.0590]



17. Romania

EQ(45) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\w-countries\Romania.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-9.65033	4.468	-2.16	0.0445	0.2058
Trend	0.551313	0.2197	2.51	0.0219	0.2591

sigma	5.66592	RSS	577.847009
R ²	0.259143	F(1,18) =	6.296 [0.022]*
Adj.R ²	0.217984	log-likelihood	-62.0145
no. of observations	20	no. of parameters	2
mean(Y)	1.10027	se(Y)	6.40711

AR 1-2 test: F(2,16) = 2.7490 [0.0941]

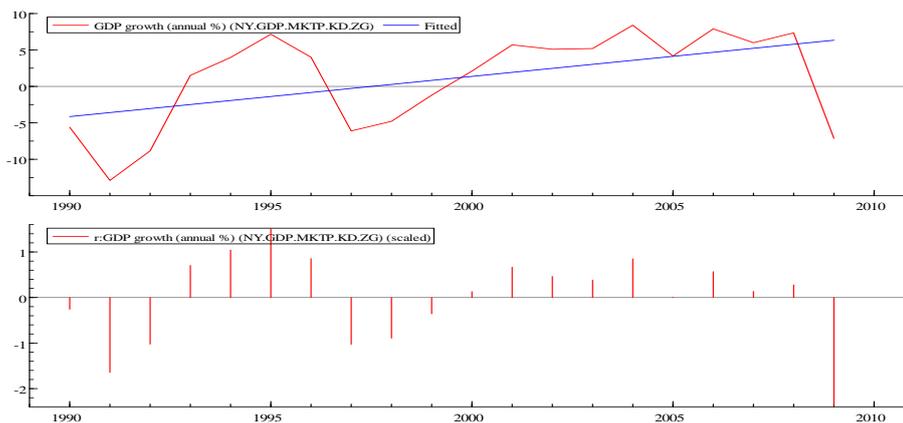
ARCH 1-1 test: F(1,18) = 0.059509 [0.8100]

Normality test: Chi²(2) = 3.2067 [0.2012]

Hetero test: F(2,17) = 1.8845 [0.1823]

Hetero-X test: F(2,17) = 1.8845 [0.1823]

RESET23 test: F(2,16) = 2.0918 [0.1559]



18. Russian Federation

EQ(37) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

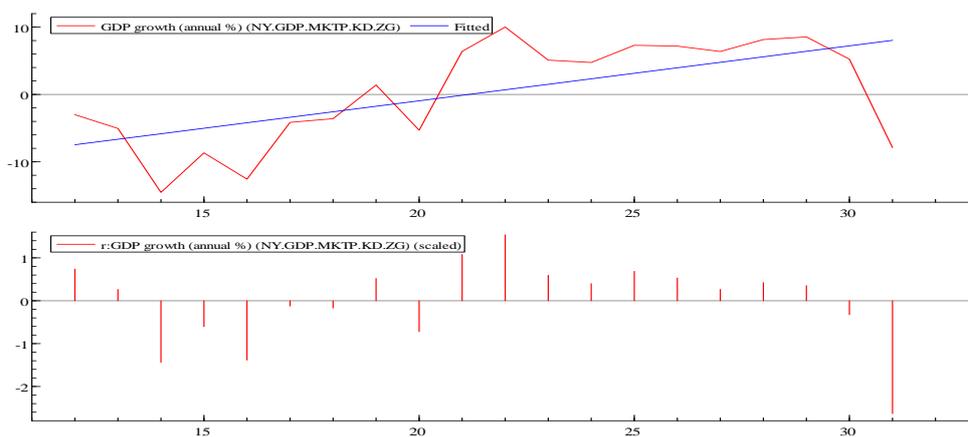
The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\U-countries\Rusian federation_1.xls

The estimation sample is: 12 - 31

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-17.2525	5.222	-3.30	0.0039	0.3775
Trend	0.815622	0.2346	3.48	0.0027	0.4018

sigma	6.04951	RSS	658.738229
R ²	0.401757	F(1,18) =	12.09 [0.003]**
Adj.R ²	0.368522	log-likelihood	-63.3247
no. of observations	20	no. of parameters	2
mean(Y)	0.28335	se(Y)	7.61274

AR 1-2 test: F(2,16) = 1.4279 [0.2688]
 ARCH 1-1 test: F(1,18) = 0.37995 [0.5453]
 Normality test: Chi²(2) = 4.7361 [0.0937]
 Hetero test: F(2,17) = 1.6298 [0.2251]
 Hetero-X test: F(2,17) = 1.6298 [0.2251]
 RESET23 test: F(2,16) = 13.952 [0.0003]**



19. Turkmenistan

EQ(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\nee data\Turkmenistan.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-9.18137	4.085	-2.25	0.0374	0.2192
Trend	1.37545	0.3410	4.03	0.0008	0.4748

sigma	8.79332	RSS	1391.80368
R ²	0.474768	F(1,18) =	16.27 [0.001]**
Adj.R ²	0.445589	log-likelihood	-70.805
no. of observations	20	no. of parameters	2
mean(Y)	5.26081	se(Y)	11.8096

AR 1-2 test: F(2,16) = 8.6525 [0.0028]**

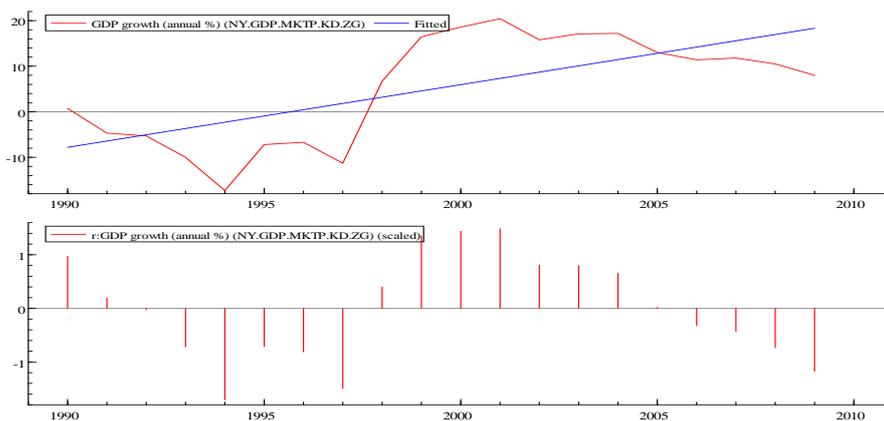
ARCH 1-1 test: F(1,18) = 0.30748 [0.5861]

Normality test: Chi²(2) = 0.79968 [0.6704]

Hetero test: F(2,17) = 1.0761 [0.3630]

Hetero-X test: F(2,17) = 1.0761 [0.3630]

RESET23 test: F(2,16) = 11.039 [0.0010]**



20. Uzbekistan

EQ(3) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

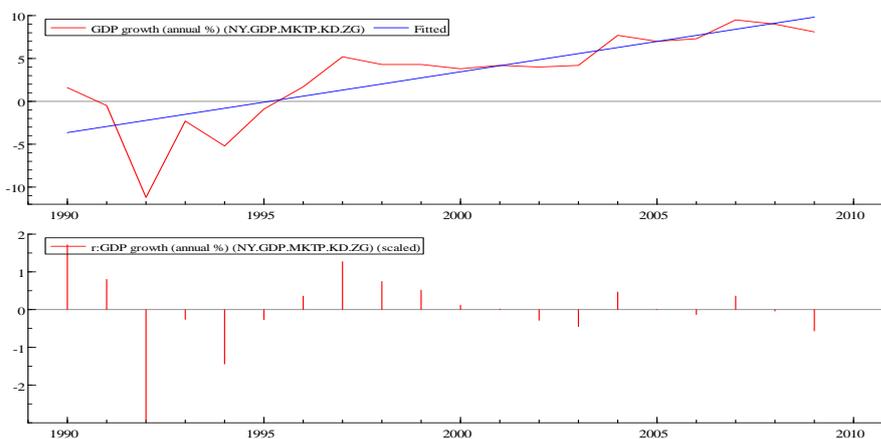
The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\nee data\Uzbekistan.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-4.35011	1.417	-3.07	0.0066	0.3436
Trend	0.708620	0.1183	5.99	0.0000	0.6659

sigma	3.05065	RSS	167.516414
R ²	0.66593	F(1,18) =	35.88 [0.000]**
Adj.R ²	0.64737	log-likelihood	-49.6323
no. of observations	20	no. of parameters	2
mean(Y)	3.0904	se(Y)	5.13728

AR 1-2 test: F(2,16) = 0.17641 [0.8399]
 ARCH 1-1 test: F(1,18) = 0.065479 [0.8009]
 Normality test: Chi²(2) = 8.4282 [0.0148]*
 Hetero test: F(2,17) = 4.0233 [0.0371]*
 Hetero-X test: F(2,17) = 4.0233 [0.0371]*
 RESET23 test: F(2,16) = 0.73478 [0.4951]



Incomplete U-curve countries

21. Georgia

EQ(9) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\L-countries\Georgia.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-33.7392	9.508	-3.55	0.0023	0.4116
Trend	1.64977	0.4676	3.53	0.0024	0.4089

sigma	12.057	RSS	2616.69512
R ²	0.408878	F(1,18) =	12.45 [0.002]**
Adj.R ²	0.376037	log-likelihood	-77.1181
no. of observations	20	no. of parameters	2
mean(Y)	-1.56863	se(Y)	15.2637

AR 1-2 test: F(2,16) = 9.4872 [0.0019]**

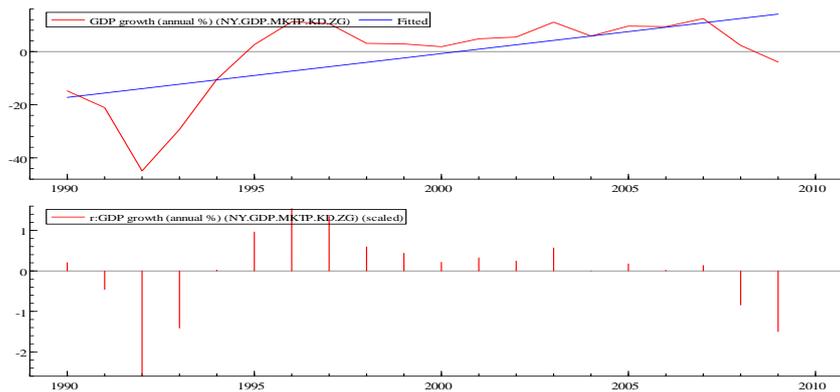
ARCH 1-1 test: F(1,18) = 0.63790 [0.4349]

Normality test: Chi²(2) = 4.0536 [0.1318]

Hetero test: F(2,17) = 1.3468 [0.2865]

Hetero-X test: F(2,17) = 1.3468 [0.2865]

RESET23 test: F(2,16) = 4.9441 [0.0213]*



22. Kyrgyz Republic

EQ(7) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

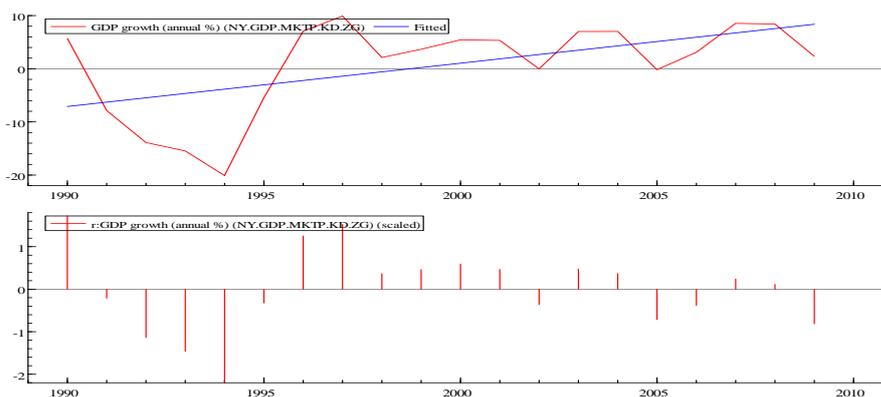
The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\L-countries\Kyrgyz.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-15.2327	5.853	-2.60	0.0180	0.2734
Trend	0.813919	0.2878	2.83	0.0112	0.3076

sigma	7.42279	RSS	991.76072
R ²	0.307574	F(1,18) =	7.996 [0.011]*
Adj.R ²	0.269106	log-likelihood	-67.4163
no. of observations	20	no. of parameters	2
mean(Y)	0.638738	se(Y)	8.6824

AR 1-2 test: $F(2,16) = 3.4394 [0.0572]$
 ARCH 1-1 test: $F(1,18) = 0.44789 [0.5118]$
 Normality test: $\chi^2(2) = 1.0538 [0.5904]$
 Hetero test: $F(2,17) = 3.9637 [0.0386]^*$
 Hetero-X test: $F(2,17) = 3.9637 [0.0386]^*$
 RESET23 test: $F(2,16) = 1.1842 [0.3314]$



23. Moldova

EQ(5) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\L-countries\moldova.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-25.0486	7.270	-3.45	0.0029	0.3974
Trend	1.16182	0.3575	3.25	0.0044	0.3698

sigma	9.21933	RSS	1529.92925
R ²	0.369769	F(1,18) =	10.56 [0.004]**
Adj.R ²	0.334756	log-likelihood	-71.7512
no. of observations	20	no. of parameters	2
mean(Y)	-2.39303	se(Y)	11.3034

AR 1-2 test: F(2,16) = 0.84773 [0.4467]

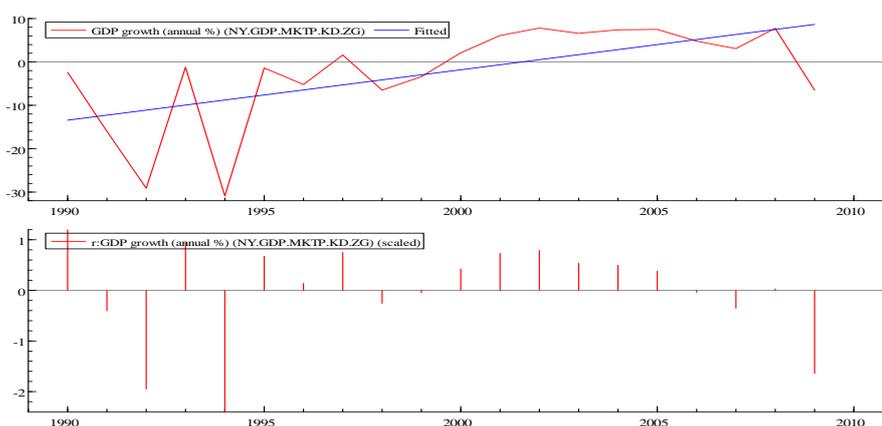
ARCH 1-1 test: F(1,18) = 0.0025267 [0.9605]

Normality test: Chi²(2) = 9.6043 [0.0082]**

Hetero test: F(2,17) = 1.8710 [0.1843]

Hetero-X test: F(2,17) = 1.8710 [0.1843]

RESET23 test: F(2,16) = 3.5994 [0.0512]



24. Serbia

EQ(5) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

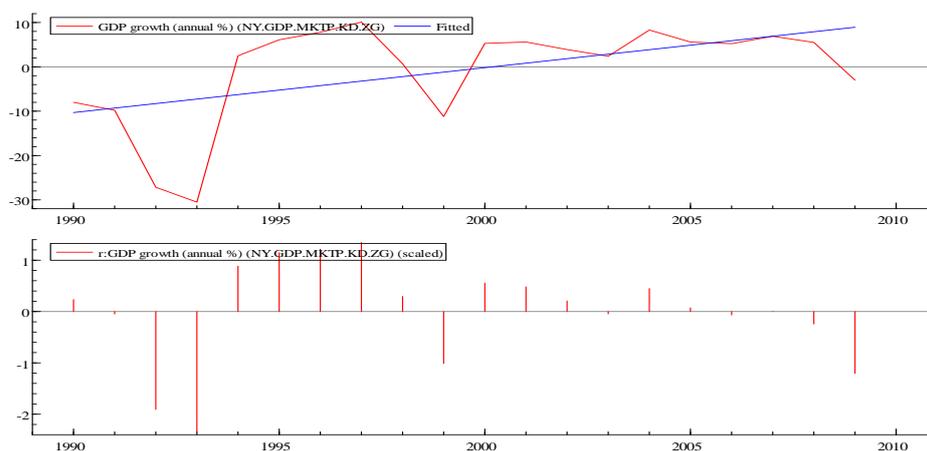
The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\nee data\Serbia.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-11.3190	4.599	-2.46	0.0242	0.2518
Trend	1.01276	0.3839	2.64	0.0167	0.2788

sigma	9.89958	RSS	1764.03
R ²	0.278841	F(1,18) =	6.96 [0.017]*
Adj.R ²	0.238776	log-likelihood	-73.175
no. of observations	20	no. of parameters	2
mean(Y)	-0.685032	se(Y)	11.3465

AR 1-2 test: $F(2,16) = 3.2329 [0.0662]$
 ARCH 1-1 test: $F(1,18) = 3.3714 [0.0829]$
 Normality test: $\chi^2(2) = 3.9116 [0.1415]$
 Hetero test: $F(2,17) = 1.9698 [0.1701]$
 Hetero-X test: $F(2,17) = 1.9698 [0.1701]$
 RESET23 test: $F(2,16) = 1.6865 [0.2165]$



25. Tajikistan

EQ(3) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\L-countries\Tajikistan.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-29.1233	6.857	-4.25	0.0005	0.5006
Trend	1.46376	0.3372	4.34	0.0004	0.5114

sigma	8.69556	RSS	1361.0286
R ²	0.51145	F(1,18) =	18.84 [0.000]**
Adj.R ²	0.484308	log-likelihood	-70.5814
no. of observations	20	no. of parameters	2
mean(Y)	-0.58	se(Y)	12.1088

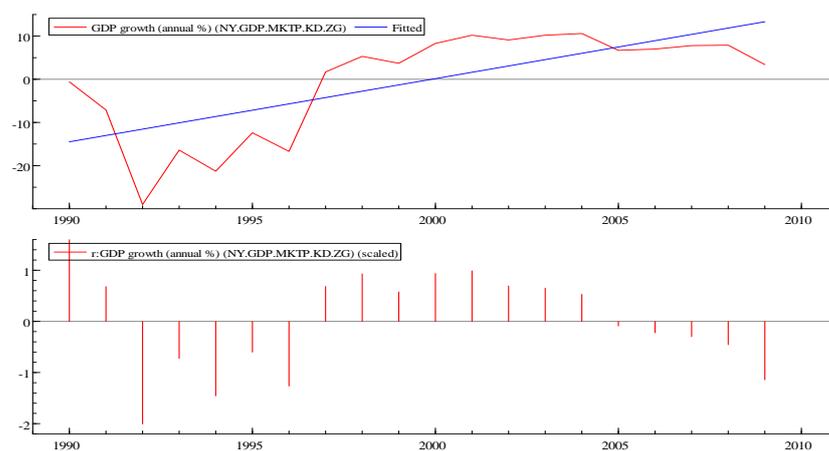
AR 1-2 test: F(2,16) = 2.0940 [0.1557]

ARCH 1-1 test: F(1,18) = 0.30641 [0.5867]

Normality test: Chi²(2) = 1.5719 [0.4557]

Hetero test: F(2,17) = 5.3278 [0.0160]*

Hetero-X test: F(2,17) = 5.3278 [0.0160]* RESET23 test: F(2,16) = 7.1580 [0.0060]**



26. Ukraine

EQ(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by OLS

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\growth accounting_28_03_2011\L-countries\Ukraine.xls

The estimation sample is: 1990 - 2009

	Coefficient	Std.Error	t-value	t-prob	Part.R ²
Constant	-13.8183	4.580	-3.02	0.0074	0.3359
Trend	0.928601	0.3327	2.79	0.0121	0.3021

sigma	8.57906	RSS	1324.8063
R ²	0.302085	F(1,18) =	7.791 [0.012]*
Adj.R ²	0.263312	log-likelihood	-70.3117
no. of observations	20	no. of parameters	2
mean(Y)	-2.21075	se(Y)	9.99536

AR 1-2 test: F(2,16) = 5.2959 [0.0172]*

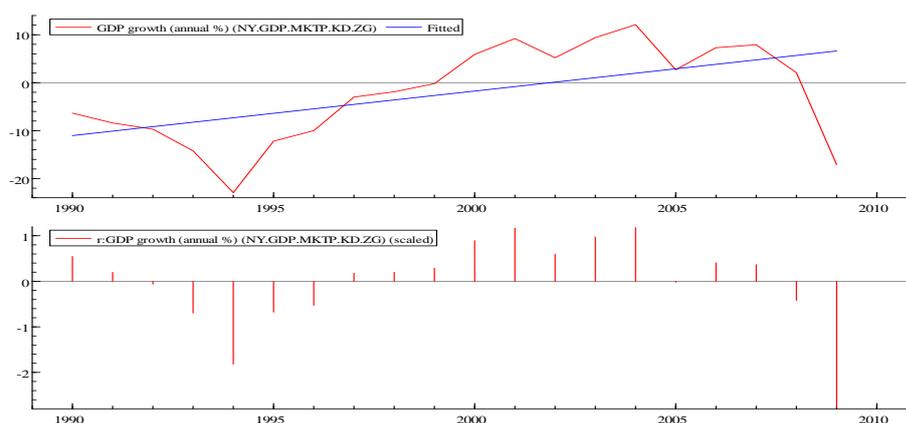
ARCH 1-1 test: F(1,18) = 0.077369 [0.7841]

Normality test: Chi²(2) = 7.0042 [0.0301]*

Hetero test: F(2,17) = 2.0977 [0.1534]

Hetero-X test: F(2,17) = 2.0977 [0.1534]

RESET23 test: F(2,16) = 30.232 [0.0000]**



APPENDICES Chapter 6

Appendix 6. 1 Definition of the MSM

Box 6. 1 Basic definitions of the Markov Switching Models

Since Markov switching Models can be found in many variations, it is useful to emphasize the main definitions and conditions that these models assume. The brief explanation relies largely on the explanation of Frühwirth - Schnatter (2006, p.302-308). In general, Markov Switching Models can be defined with two main conditions, one specifying the hidden process s_t and one related to the y_t variable.

The basic Markov Model, the one used by Hamilton(1989), fulfils the following conditions:

- S4 condition – s_t to be a Markov chain starting with its ergodic distribution
- Y4 condition - conditional on knowing s_t the random variables y_t are stochastically independent.

At each moment, the distribution of y_t depends on the state s_t .

By relaxing these conditions, various extensions of Markov Switching Model were developed.

Firstly, the properties of the hidden process s_t can be altered by allowing:

- S3 – is a first-order homogenous Markov chain that need not to be irreducible or aperiodic, which can start with an arbitrary distribution instead of an ergodic one;
- S2 – is a first-order (inhomogeneous) Markov Chain, with the distribution of s_t being dependant on s_{t-1} and some exogenous variables. Relaxing the assumption of homogeneity results in models with time-varying transition matrixes.
- S1 – s_t is a first-order Markov Chain and the conditional distribution of s_t depends on history, i.e. on past observations y_{t-1} .

Secondly, the extensions might be related to the relation between the two processes. Hence,

- Y3 – the observation density of y_t depends on the present values of s_t , but also on some other exogenous variables.
- Y2 – the present value of s_t and also some limited number of values of $s_{t-1}, s_{t-2}, \dots, s_{t-p}$ influences the observation density of y_t
- Y1 – the observation density of y_t depends on past observations $y_{t-1}, y_{t-2}, \dots, y_{t-p}$ and also on all past values of s_t .

Appendix 6. 2 Univariate MS analysis of GDP growth rates in transition countries

Part I: Rapid-J countries

1. Slovak Republic - 3-regime model

Switching(5) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Slovak Republic\slovak Rep_1.xls
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-3.05798	2.092	-1.46	0.170
Constant(1)	5.11854	0.4995	10.2	0.000
Constant(2)	7.17968	0.8259	8.69	0.000
sigma(0)	5.33554	1.349	3.95	0.002
sigma(1)	0.902378	0.3527	2.56	0.025
sigma(2)	1.87955	0.5315	3.54	0.004
p_{0|0}	0.801875	0.1400	5.73	0.000
p_{1|1}	0.587270	0.2297	2.56	0.025
p_{0|2}	0.322614	0.1823	1.77	0.102

log-likelihood -57.5083906
 no. of observations 21 no. of parameters 9
 AIC.T 133.016781 AIC 6.33413244
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 2.28595 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 35.5384

Linearity LR-test $\chi^2(7) = 19.561$ [0.0066]** approximate upperbound: [0.0041]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.80187	0.00000	0.32261
Regime 1,t+1	0.19813	0.58727	0.00000
Regime 2,t+1	0.00000	0.41273	0.67739

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|j\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:

-4.7625	4.1923	7.4280	4.7557	1.3135	1.5865
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1990 - 1993 4 1.000

1999 - 2000 2 0.999

2009 - 2010 2 1.000

Total: 8 years (38.10%) with average duration of 2.67 years.

Regime 1 years avg.prob.

1994 - 1995 2 0.795

2001 - 2004 4 0.830

Total: 6 years (28.57%) with average duration of 3.00 years.

Regime 2 years avg.prob.

1996 - 1998 3 0.856

2005 - 2008 4 0.912

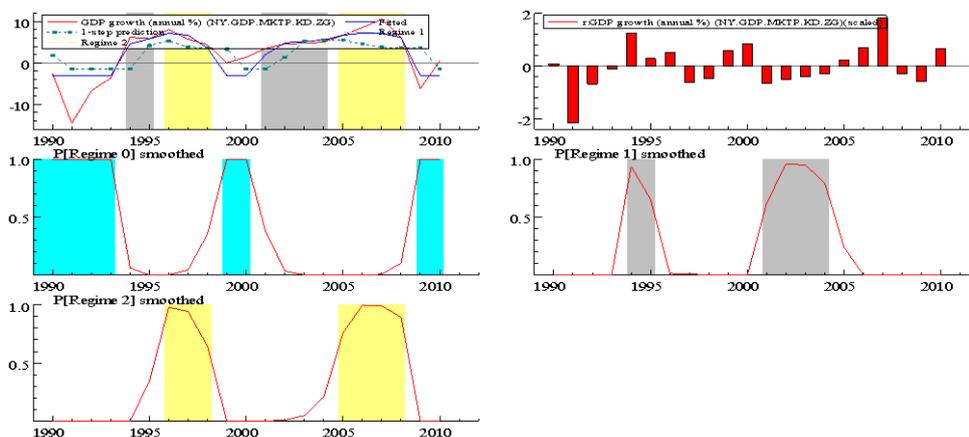
Total: 7 years (33.33%) with average duration of 3.50 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 4.6238$ [0.0991]

ARCH 1-1 test: $F(1,10) = 0.28596$ [0.6045]

Portmanteau(4): $\chi^2(4) = 4.4171$ [0.3525]



2. Slovak Republic – 2-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Slovak Republic\slovak Rep_1.xls
The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-5.34470	2.207	-2.42	0.029
Constant(1)	5.43687	0.6980	7.79	0.000
sigma(0)	4.85770	1.537	3.16	0.006
sigma(1)	2.54888	0.4977	5.12	0.000
p_{0|0}	0.861866	0.1628	5.29	0.000
p_{0|1}	0.109061	0.08304	1.31	0.209

log-likelihood -60.0591395

no. of observations 21 no. of parameters 6

AIC.T 132.118279 AIC 6.29134662

mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 2.28595 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 35.5384

Linearity LR-test $\chi^2(4) = 14.460$ [0.0060]** approximate upperbound: [0.0112]*

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.86187	0.10906
Regime 1,t+1	0.13813	0.89094

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-1.7760 6.7541 5.5306 1.6943 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1993	4	0.999
2009 - 2010	2	0.956

Total: 6 years (28.57%) with average duration of 3.00 years.

Regime 1	years	avg.prob.
1994 - 2008	15	0.985

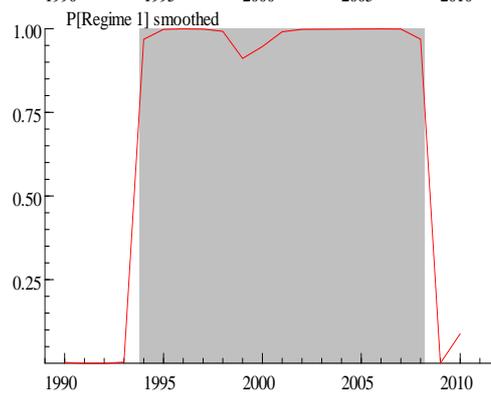
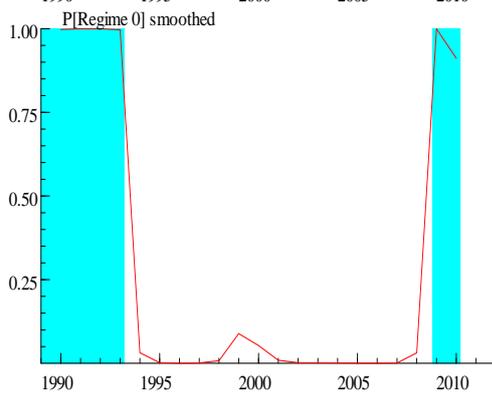
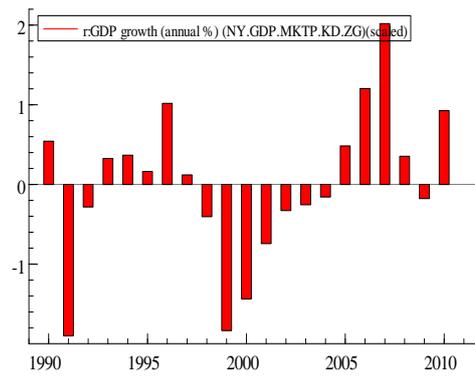
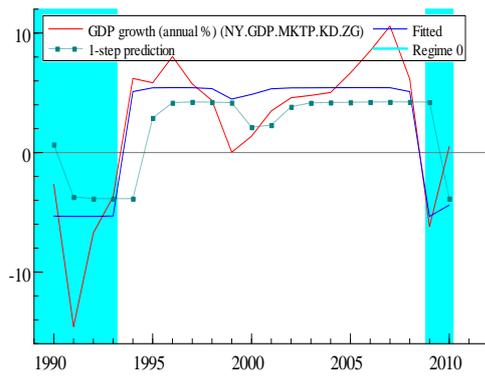
Total: 15 years (71.43%) with average duration of 15.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.5537$ [0.4599]

ARCH 1-1 test: $F(1,13) = 0.011905$ [0.9148]

Portmanteau(4): $\chi^2(4) = 4.9719$ [0.2902]



3. Poland – 3-regime model (preferred model)

Switching(1) Modelling GDP growth by MS(3)

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Poland\Poland_1.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	0.559650	1.685	0.332	0.747
Constant(1)	4.47037	0.2522	17.7	0.000
Constant(2)	6.67112	0.1681	39.7	0.000
sigma(0)	3.60555	1.074	3.36	0.007
sigma(1)	0.672953	0.1984	3.39	0.007
sigma(2)	0.368857	0.1208	3.05	0.012
$p_{\{0|0\}}$	0.530771	0.2699	1.97	0.078
$p_{\{0|1\}}$	0.317676	0.1657	1.92	0.084
$p_{\{1|1\}}$	0.482674	0.1875	2.57	0.028
$p_{\{1|2\}}$	0.430750	0.2165	1.99	0.075

log-likelihood -41.3613917

no. of observations 20 no. of parameters 10

AIC.T 102.722783 AIC 5.13613917

mean(GDP growth) 3.88841 var(GDP growth) 9.24481

Linearity LR-test $\chi^2(8) = 18.516 [0.0177]^*$ approximate upperbound: $[0.0173]^*$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.53077	0.31768	0.00000
Regime 1,t+1	0.46923	0.48267	0.43075
Regime 2,t+1	0.00000	0.19965	0.56925

Transition probability settings (-1: free parameter, -2: $1 - \sum(p_{\{i|\cdot\}})$)

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

1.0451	4.4282	6.2690	3.4204	0.50376	0.70394
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1992	2	0.950
2001 - 2002	2	1.000

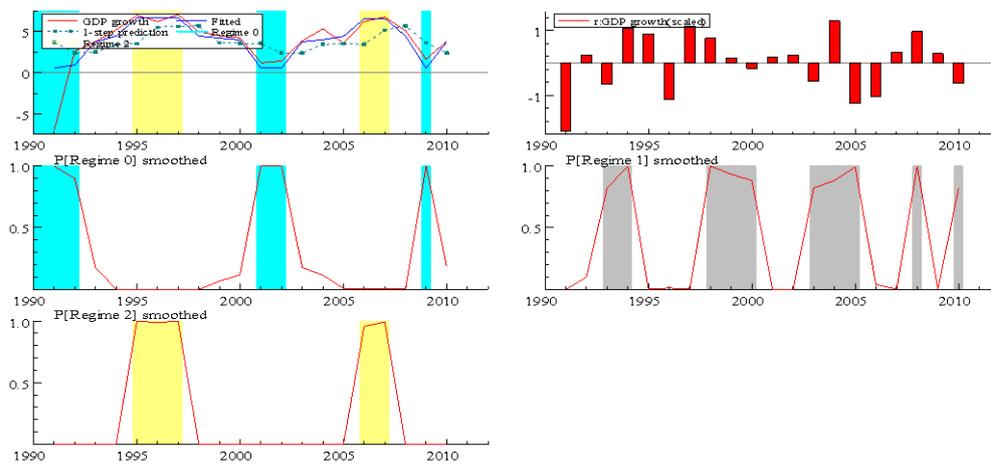
2009 - 2009	1	0.999
Total: 5 years (25.00%) with average duration of 1.67 years.		
Regime 1	years	avg.prob.
1993 - 1994	2	0.911
1998 - 2000	3	0.939
2003 - 2005	3	0.900
2008 - 2008	1	0.999
2010 - 2010	1	0.816
Total: 10 years (50.00%) with average duration of 2.00 years.		
Regime 2	years	avg.prob.
1995 - 1997	3	0.996
2006 - 2007	2	0.975
Total: 5 years (25.00%) with average duration of 2.50 years.		

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.4699$ [0.4795]

ARCH 1-1 test: $F(1,8) = 0.0083343$ [0.9295]

Portmanteau(4): $\chi^2(4) = 1.1610$ [0.8845]



4. Poland - 2-regime model (not converging)

Switching(0) Modelling GDP growth by MS(2)

The dataset is: C:\Documents and Settings\Natasa
Trajkova\Desktop\Data_may_2012\Poland\Poland_1.in7

The estimation sample is: 1991 - 2010

*** Warning: there was no convergence; log-likelihood -29.0750752

parameter values:

-7.0000

4.4724

3.8457e-007

1.7634

0.052341

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

No convergence (no improvement in line search)

Used starting values:

1.9253 5.8515 3.1636 0.87935 0.50000 0.50000

5. Czech Republic – 3-regime model (preferred model)

Switching(7) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Czech Rep\Czech Rep.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-1.59138	1.821	-0.874	0.401
Constant(1)	2.50595	0.4158	6.03	0.000
Constant(2)	5.51133	0.7638	7.22	0.000
sigma(0)	4.33789	1.116	3.89	0.003
sigma(1)	0.788828	0.3333	2.37	0.037
sigma(2)	1.13997	0.5811	1.96	0.076
$p_{\{0|0\}}$	0.694449	0.1958	3.55	0.005
$p_{\{1|1\}}$	0.585718	0.2321	2.52	0.028
$p_{\{0|2\}}$	0.362760	0.2053	1.77	0.105

log-likelihood -49.012851
 no. of observations 20 no. of parameters 9
 AIC.T 116.025702 AIC 5.8012851
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 1.79768 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 16.919

Linearity LR-test $\chi^2(7) = 15.301 [0.0323]^*$ approximate upperbound: $[0.0243]^*$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.69445	0.00000	0.36276
Regime 1,t+1	0.30555	0.58572	0.00000
Regime 2,t+1	0.00000	0.41428	0.63724

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|\cdot\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-2.3376	2.4928	5.3372	4.0877	0.53129	1.1599
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1993	3	0.987
1997 - 1998	2	1.000
2008 - 2009	2	0.938

Total: 7 years (35.00%) with average duration of 2.33 years.

Regime 1	years	avg.prob.
1994 - 1994	1	0.987
1999 - 2003	5	0.829
2010 - 2010	1	0.779

Total: 7 years (35.00%) with average duration of 2.33 years.

Regime 2	years	avg.prob.
1995 - 1996	2	0.877
2004 - 2007	4	0.970

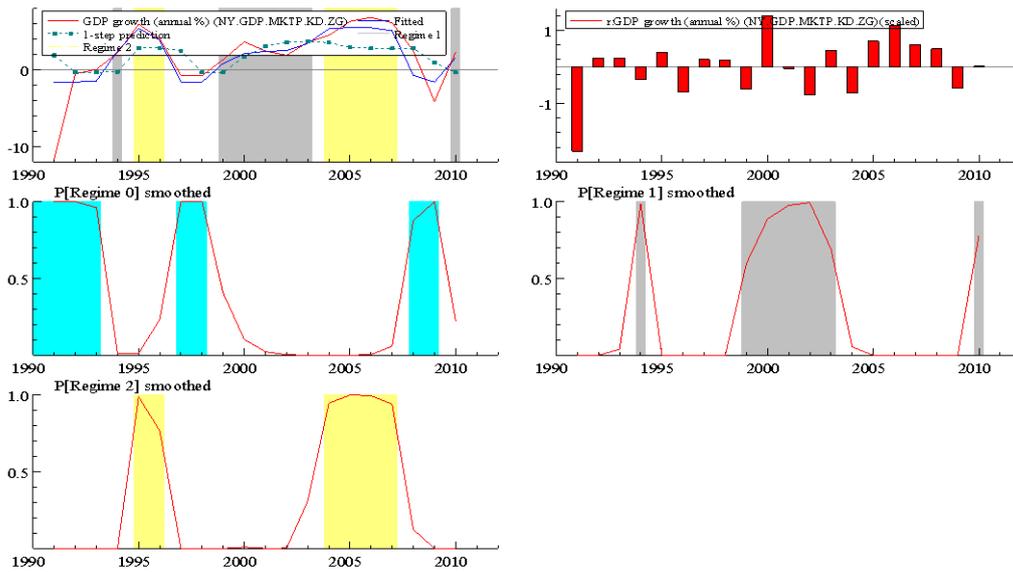
Total: 6 years (30.00%) with average duration of 3.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 5.4574$ [0.0653]

ARCH 1-1 test: $F(1,9) = 0.29395$ [0.6009]

Portmanteau(4): $\chi^2(4) = 4.9780$ [0.2896]



6. Czech Republic – 2-regime model

Switching(6) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
The dataset is: C:\Documents and Settings\Natasa
Trajkova\Desktop\Data_may_2012\Czech Rep\Czech Rep.in7
The estimation sample is: 1991 - 2010

*** Warning: there was no convergence; log-likelihood -35.4386554

parameter values:

-11.612
2.5352
6.0902e-008
2.8509
0.23050
0.049019

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

No convergence (no improvement in line search)

Used starting values:

-0.99290 4.5883 3.9907 1.5289 0.50000 0.50000

7. Hungary – 3 –regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Hungary\Hungary.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-3.42343	1.923	-1.78	0.103
Constant(1)	0.982234	0.1193	8.23	0.000
Constant(2)	4.59233	0.2235	20.5	0.000
sigma(0)	4.68004	1.301	3.60	0.004
sigma(1)	0.247568	0.08504	2.91	0.014
sigma(2)	0.670452	0.1580	4.24	0.001
p_{0|0}	0.774953	0.1768	4.38	0.001
p_{0|1}	0.322803	0.2033	1.59	0.141
p_{1|1}	0.534805	0.2286	2.34	0.039
p_{1|2}	0.139379	0.1082	1.29	0.224

log-likelihood -39.9408451
 no. of observations 21 no. of parameters 10
 AIC.T 99.8816902 AIC 4.75627096
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 1.17126 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 18.4942

Linearity LR-test $\chi^2(8) = 40.980 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.77495	0.32280	0.00000
Regime 1,t+1	0.22505	0.53481	0.13938
Regime 2,t+1	0.00000	0.14239	0.86062

Transition probability settings (-1: free parameter, -2: $1 - \sum(p_{\{i|. \})$)

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:

-3.4561	2.2083	4.7616	4.2379	1.3034	0.66798
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1994	5	1.000
2009 - 2009	1	1.000

Total: 6 years (28.57%) with average duration of 3.00 years.

Regime 1	years	avg.prob.
1995 - 1996	2	0.867
2006 - 2008	3	0.974
2010 - 2010	1	0.869

Total: 6 years (28.57%) with average duration of 2.00 years.

Regime 2	years	avg.prob.
1997 - 2005	9	1.000

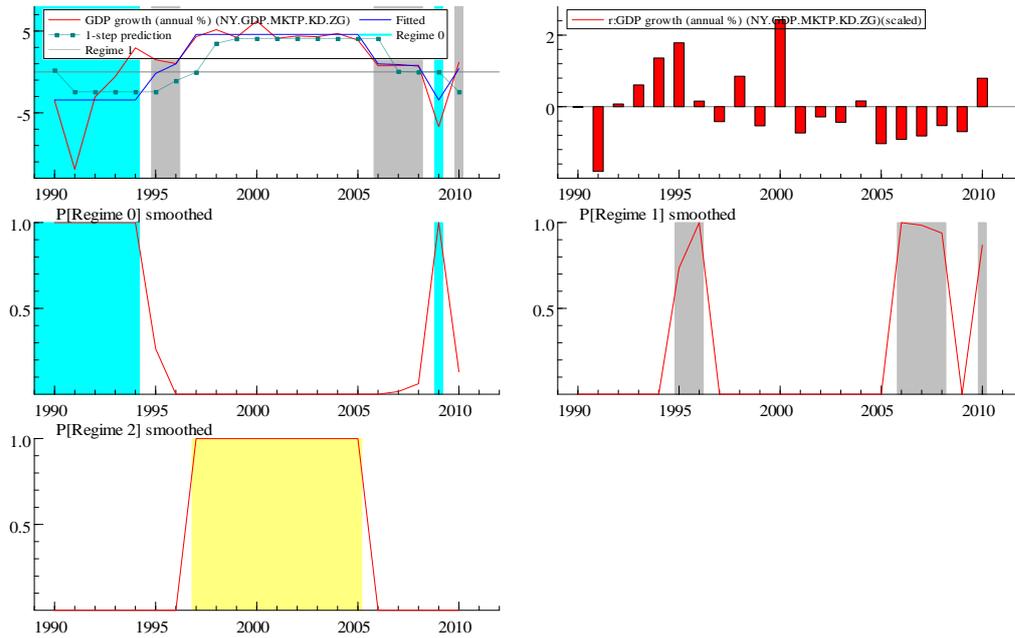
Total: 9 years (42.86%) with average duration of 9.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\text{Chi}^2(2) = 2.3635 [0.3067]$

ARCH 1-1 test: $F(1,9) = 0.21696 [0.6524]$

Portmanteau(4): $\text{Chi}^2(4) = 1.4385 [0.8375]$



8. Hungary 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Hungary\Hungary.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-1.28676	1.201	-1.07	0.301
Constant(1)	4.60208	0.2301	20.0	0.000
sigma(0)	4.11653	0.8360	4.92	0.000
sigma(1)	0.672457	0.1625	4.14	0.001
p_{0|0}	0.934847	0.06793	13.8	0.000
p_{0|1}	0.146361	0.1132	1.29	0.216

log-likelihood -49.8064492
 no. of observations 21 no. of parameters 6
 AIC.T 111.612898 AIC 5.31489992
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 1.17126 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 18.4942

Linearity LR-test $\chi^2(4) = 21.249 [0.0003]**$ approximate upperbound: $[0.0005]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

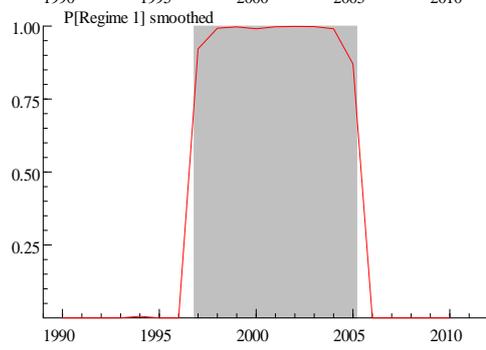
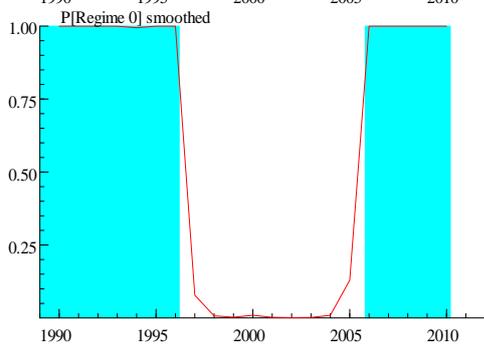
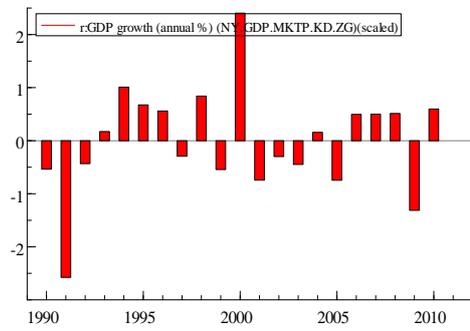
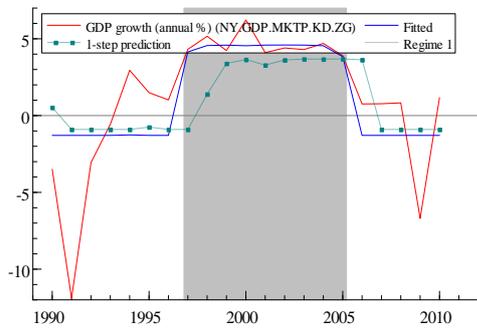
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.93485	0.14636
Regime 1,t+1	0.065153	0.85364

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -1.7892 4.4278 4.0388 0.80508 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime	years	avg.prob.
Regime 0		
1990 - 1996	7	0.999
2006 - 2010	5	1.000
Total: 12 years (57.14%) with average duration of 6.00 years.		
Regime 1		
1997 - 2005	9	0.973
Total: 9 years (42.86%) with average duration of 9.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 7.9469 [0.0188]*$
 ARCH 1-1 test: $F(1,13) = 0.26760 [0.6136]$
 Portmanteau(4): $\chi^2(4) = 2.7128 [0.6070]$



9. Slovenia 3-regime model (preferred model)

Switching(3) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Slovenia\Slovenia.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-5.23574	1.967	-2.66	0.022
Constant(1)	3.18502	0.1606	19.8	0.000
Constant(2)	4.83549	0.3127	15.5	0.000
sigma(0)	3.92249	1.396	2.81	0.017
sigma(1)	0.357942	0.1119	3.20	0.008
sigma(2)	0.934920	0.2163	4.32	0.001
p_{0|0}	0.834322	0.2017	4.14	0.002
p_{0|1}	0.276748	0.1804	1.53	0.153
p_{1|2}	0.459091	0.1865	2.46	0.032

log-likelihood -38.4902755
 no. of observations 20 no. of parameters 9
 AIC.T 94.980551 AIC 4.74902755
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 2.35842 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 18.5028

Linearity LR-test $\chi^2(7) = 38.135 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.83432	0.27675	0.00000
Regime 1,t+1	0.16568	0.00000	0.45909
Regime 2,t+1	0.00000	0.72325	0.54091

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|. \}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	0.00000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-1.7792	3.7558	5.2982	4.9769	0.28298	0.76913
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1992	2	1.000
2009 - 2010	2	1.000

Total: 4 years (20.00%) with average duration of 2.00 years.

Regime 1	years	avg.prob.
1993 - 1993	1	1.000
1996 - 1996	1	0.509
1998 - 1998	1	0.808
2001 - 2001	1	0.947
2003 - 2003	1	0.945
2008 - 2008	1	1.000

Total: 6 years (30.00%) with average duration of 1.00 years.

Regime 2	years	avg.prob.
1994 - 1995	2	0.816
1997 - 1997	1	0.999
1999 - 2000	2	1.000
2002 - 2002	1	0.996
2004 - 2007	4	0.999

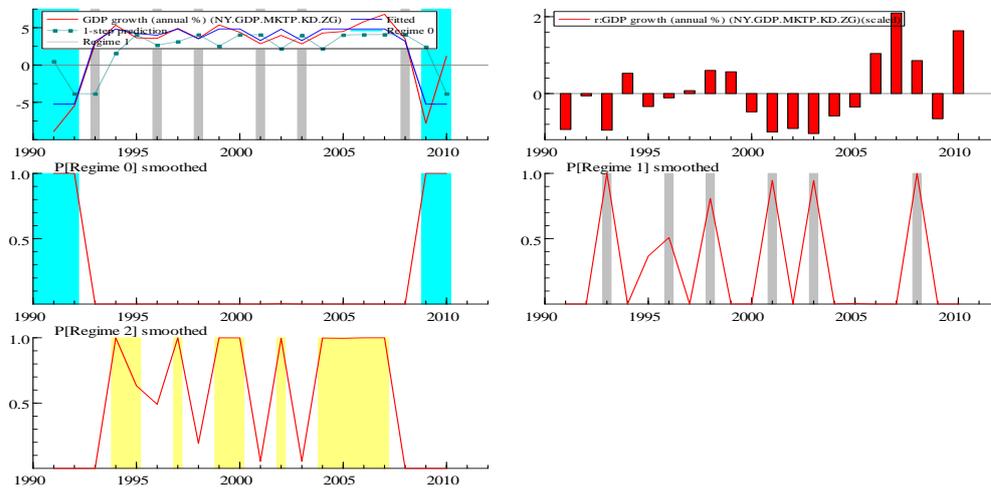
Total: 10 years (50.00%) with average duration of 2.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 3.7093$ [0.1565]

ARCH 1-1 test: $F(1,9) = 0.11605$ [0.7412]

Portmanteau(4): $\chi^2(4) = 2.6372$ [0.6203]



10. Slovenia 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Slovenia\Slovenia.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-5.05731	2.286	-2.21	0.044
Constant(1)	4.25784	0.2879	14.8	0.000
sigma(0)	4.09348	1.632	2.51	0.025
sigma(1)	1.12101	0.2081	5.39	0.000
p_{0|0}	0.827645	0.2193	3.77	0.002
p_{0|1}	0.0996544	0.07135	1.40	0.184

log-likelihood -42.3556192
 no. of observations 20 no. of parameters 6
 AIC.T 96.7112383 AIC 4.83556192
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 2.35842 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 18.5028

Linearity LR-test $\chi^2(4) = 30.405 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

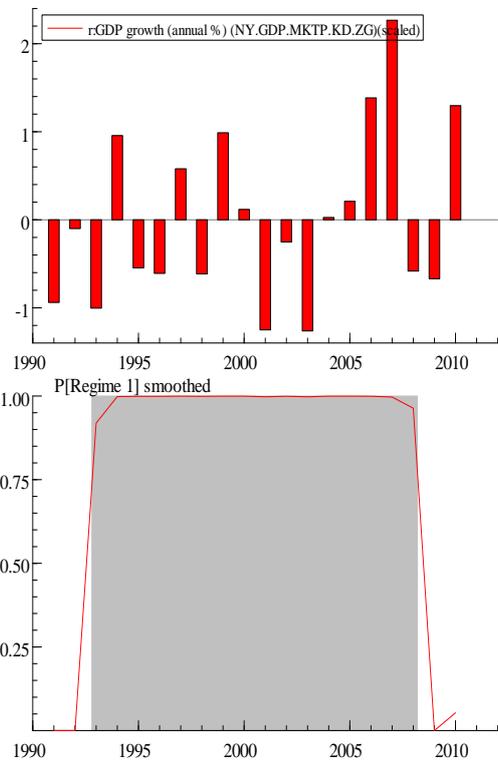
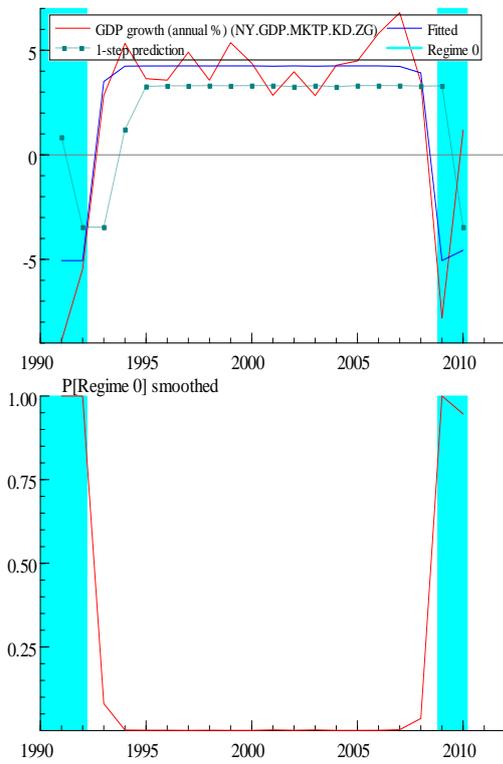
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.82764	0.099654
Regime 1,t+1	0.17236	0.90035

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -0.18218 4.8990 4.8259 0.89813 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1992	2	1.000
2009 - 2010	2	0.973
Total: 4 years (20.00%) with average duration of 2.00 years.		
Regime 1	years	avg.prob.
1993 - 2008	16	0.992
Total: 16 years (80.00%) with average duration of 16.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 2.7728 [0.2500]$
 ARCH 1-1 test: $F(1,12) = 0.00019507 [0.9891]$
 Portmanteau(4): $\chi^2(4) = 1.9437 [0.7461]$



11. Estonia 3-regime model (preferred model)

Switching(2) Modelling GDP_growth_(annual%)(NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Estonia\Estonia_2.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-8.22537	2.878	-2.86	0.014
Constant(1)	4.69249	1.862	2.52	0.027
Constant(2)	8.44320	0.4403	19.2	0.000
sigma(0)	6.65829	1.887	3.53	0.004
sigma(1)	3.81246	1.201	3.18	0.008
sigma(2)	1.20661	0.3086	3.91	0.002
p_{0|0}	0.869766	0.1516	5.74	0.000
p_{1|1}	0.784960	0.1645	4.77	0.000
p_{0|2}	0.165423	0.1243	1.33	0.208

log-likelihood -60.8194376
 no. of observations 21 no. of parameters 9
 AIC.T 139.638875 AIC 6.64947025
 mean(GDP_growth_(annual%)(NY.GDP.MKTP.KD.ZG)) 1.56645
 var(GDP_growth_(annual%)(NY.GDP.MKTP.KD.ZG)) 73.703

Linearity LR-test $\chi^2(7) = 28.257 [0.0002]**$ approximate upperbound: $[0.0001]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.86977	0.00000	0.16542
Regime 1,t+1	0.13023	0.78496	0.00000
Regime 2,t+1	0.00000	0.21504	0.83458

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|. \}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:

-8.9396	4.4427	9.1963	6.0599	2.4877	1.1547
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

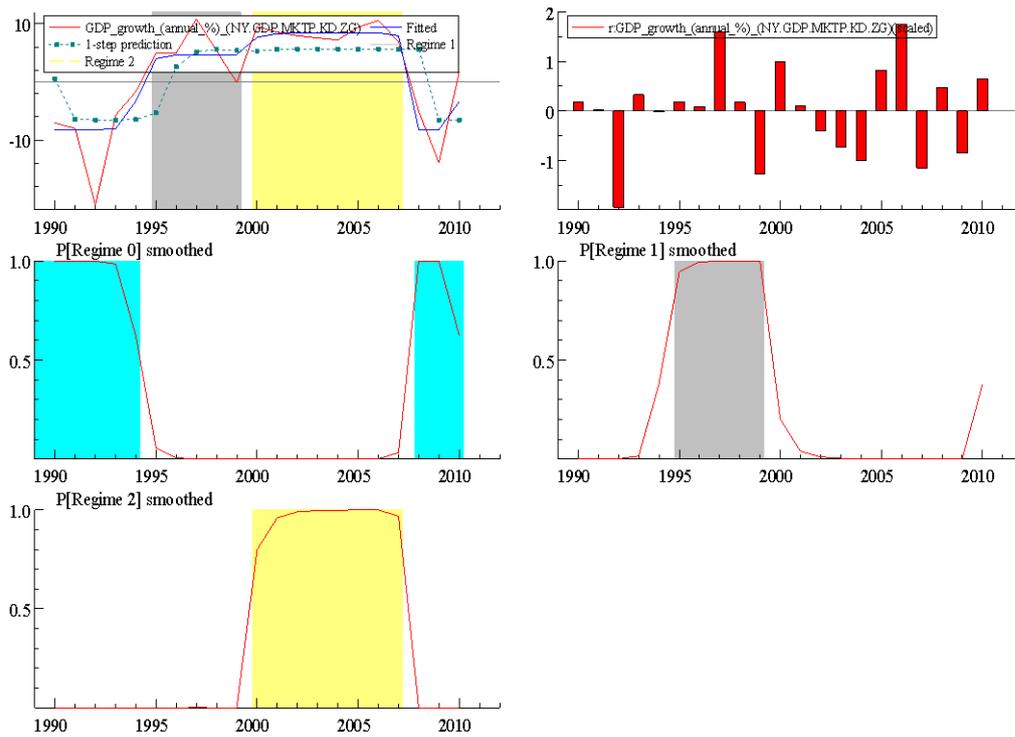
Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1994	5	0.921
2008 - 2010	3	0.874

Total: 8 years (38.10%) with average duration of 4.00 years.
 Regime 1 years avg.prob.
 1995 - 1999 5 0.987
 Total: 5 years (23.81%) with average duration of 5.00 years.
 Regime 2 years avg.prob.
 2000 - 2007 8 0.964
 Total: 8 years (38.10%) with average duration of 8.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.41462$ [0.8128]
 ARCH 1-1 test: $F(1,10) = 0.32936$ [0.5787]
 Portmanteau(4): $\chi^2(4) = 1.8833$ [0.7572]



12. Estonia 2-regime model

Switching(1) Modelling GDP_growth_(annual%)(NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Estonia\Estonia_2.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-5.87908	2.805	-2.10	0.053
Constant(1)	7.92508	0.6370	12.4	0.000
sigma(0)	7.26879	1.860	3.91	0.001
sigma(1)	1.93623	0.4702	4.12	0.001
p_{0|0}	0.811019	0.1344	6.04	0.000
p_{0|1}	0.210943	0.1187	1.78	0.096

log-likelihood -65.1781357
 no. of observations 21 no. of parameters 6
 AIC.T 142.356271 AIC 6.77887007
 mean(GDP_growth_(annual%)(NY.GDP.MKTP.KD.ZG)) 1.56645
 var(GDP_growth_(annual%)(NY.GDP.MKTP.KD.ZG)) 73.703

Linearity LR-test $\chi^2(4) = 19.540 [0.0006]**$ approximate upperbound: $[0.0012]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

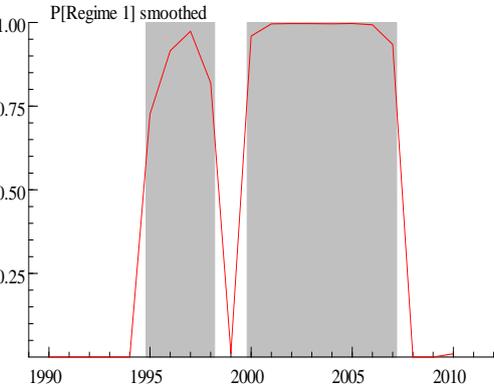
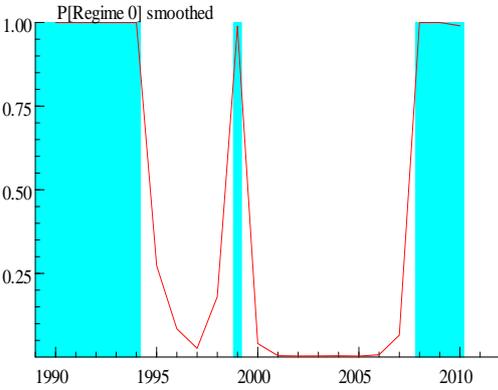
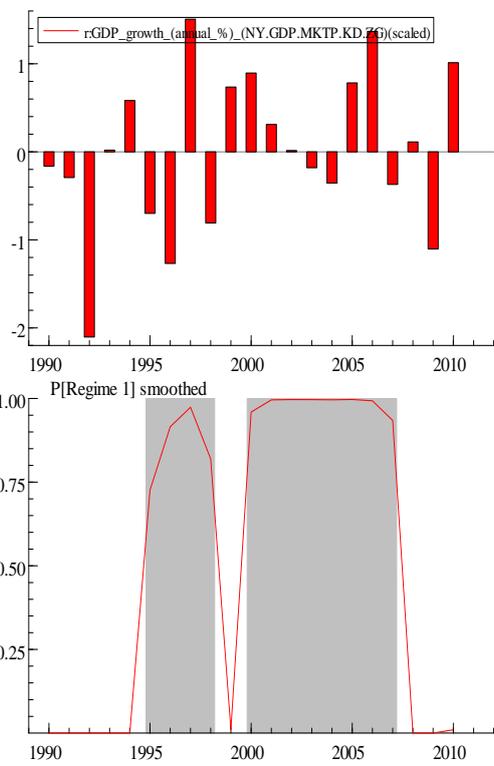
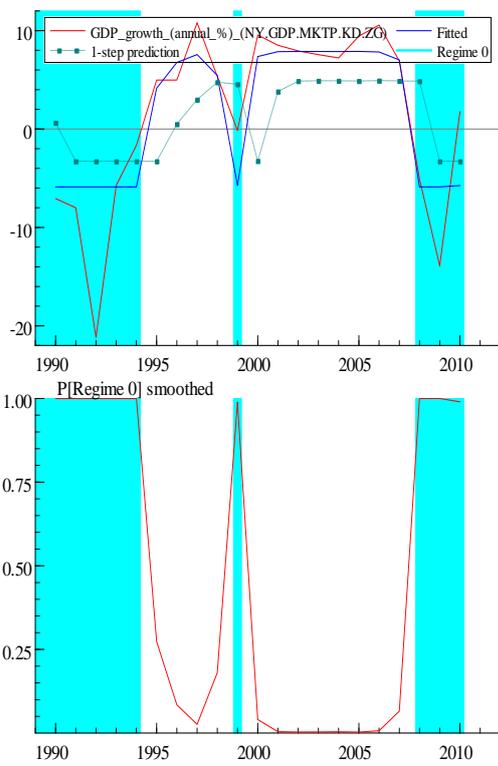
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.81102	0.21094
Regime 1,t+1	0.18898	0.78906

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -4.6345 8.3875 7.5855 1.6310 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime	years	avg.prob.
Regime 0		
1990 - 1994	5	1.000
1999 - 1999	1	0.989
2008 - 2010	3	0.997
Total: 9 years (42.86%) with average duration of 3.00 years.		
Regime 1		
1995 - 1998	4	0.859
2000 - 2007	8	0.984
Total: 12 years (57.14%) with average duration of 6.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.82894 [0.6607]$
 ARCH 1-1 test: $F(1,13) = 0.15854 [0.6970]$
 Portmanteau(4): $\chi^2(4) = 0.98018 [0.9128]$



13. Albania 3-regime model (preferred model)

Switching(5) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Albania.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-13.9298	4.758	-2.93	0.014
Constant(1)	5.37382	0.4936	10.9	0.000
Constant(2)	10.3380	0.8485	12.2	0.000
sigma(0)	9.22267	3.528	2.61	0.024
sigma(1)	1.54855	0.3440	4.50	0.001
sigma(2)	1.94710	0.5736	3.39	0.006
p_{0|0}	0.621737	0.2603	2.39	0.036
p_{0|1}	0.0522955	0.06125	0.854	0.411
p_{0|2}	0.233235	0.1788	1.30	0.219
p_{1|2}	0.110884	0.1307	0.848	0.414

log-likelihood -56.9968962
 no. of observations 21 no. of parameters 10
 AIC.T 133.993792 AIC 6.38065678
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 3.15406 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 92.7958

Linearity LR-test $\chi^2(8) = 40.740 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.62174	0.052295	0.23323
Regime 1,t+1	0.00000	0.94770	0.11088
Regime 2,t+1	0.37826	0.00000	0.65588

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|. \}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	-1.0000
Regime 1,t+1	0.00000	-2.0000	-1.0000
Regime 2,t+1	-2.0000	0.00000	-2.0000

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:

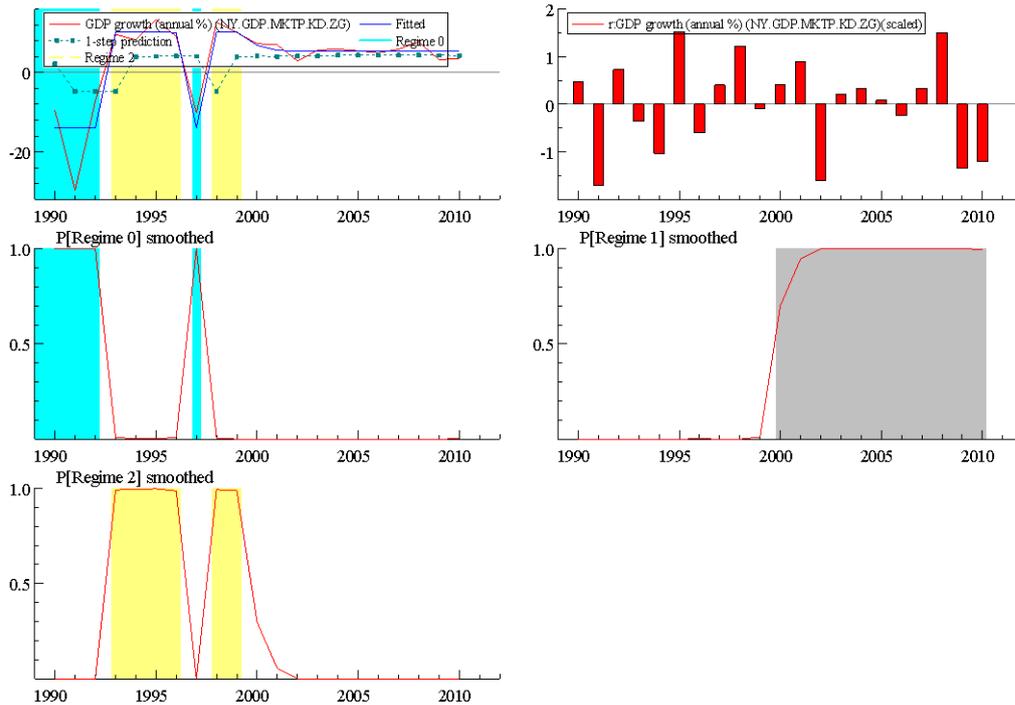
-6.6949	6.0429	10.114	10.960	0.75943	1.9730
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1992	3	1.000
1997 - 1997	1	1.000

Total: 4 years (19.05%) with average duration of 2.00 years.
 Regime 1 years avg.prob.
 2000 - 2010 11 0.968
 Total: 11 years (52.38%) with average duration of 11.00 years.
 Regime 2 years avg.prob.
 1993 - 1996 4 0.993
 1998 - 1999 2 0.991
 Total: 6 years (28.57%) with average duration of 3.00 years.

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.64379$ [0.7248]
 ARCH 1-1 test: $F(1,9) = 0.0052987$ [0.9436]
 Portmanteau(4): $\chi^2(4) = 7.6918$ [0.1035]



14. Albania 2-regime model

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Albania.in7

The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-13.4037	5.534	-2.42	0.029
Constant(1)	7.21836	0.7216	10.0	0.000
sigma(0)	9.70725	4.315	2.25	0.040
sigma(1)	2.93760	0.5088	5.77	0.000
p_{0|0}	0.619869	0.2606	2.38	0.031
p_{0|1}	0.110512	0.07636	1.45	0.168

log-likelihood -65.1862131

no. of observations 21 no. of parameters 6

AIC.T 142.372426 AIC 6.77963934

mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 3.15406 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 92.7958

Linearity LR-test $\chi^2(4) = 24.361$ [0.0001]** approximate upperbound: [0.0001]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.61987	0.11051
Regime 1,t+1	0.38013	0.88949

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-2.2513 9.1000 10.538 2.2878 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1990 - 1992 3 1.000

1997 - 1997 1 1.000

Total: 4 years (19.05%) with average duration of 2.00 years.

Regime 1 years avg.prob.

1993 - 1996 4 0.990

1998 - 2010 13 0.992

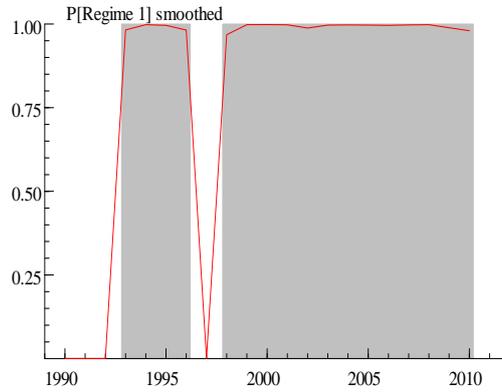
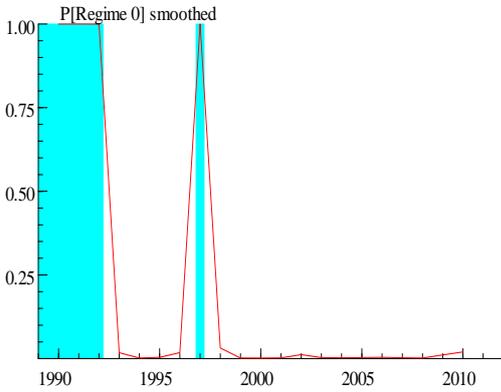
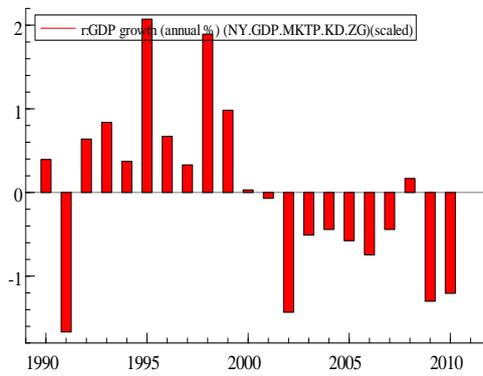
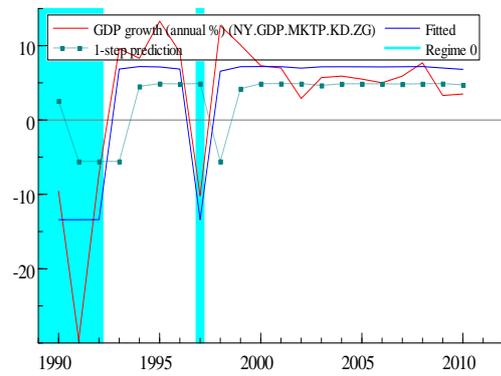
Total: 17 years (80.95%) with average duration of 8.50 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.43659$ [0.8039]

ARCH 1-1 test: $F(1,13) = 0.78362$ [0.3921]

Portmanteau(4): $\chi^2(4) = 7.7547$ [0.1010]



Part II: Slow-J group

15. Latvia – 3-regime model

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Latvia\Latvia.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-10.8723	5.014	-2.17	0.051
Constant(1)	4.29148	3.844	1.12	0.286
Constant(2)	8.88802	2.180	4.08	0.002
sigma(0)	10.2393	2.753	3.72	0.003
sigma(1)	2.93293	1.196	2.45	0.030
sigma(2)	1.98111	0.7920	2.50	0.028
p_{0|0}	0.893254	0.1488	6.00	0.000
p_{1|1}	0.810255	0.2071	3.91	0.002
p_{0|2}	0.172742	0.1810	0.954	0.359

log-likelihood -65.1536145

no. of observations 21 no. of parameters 9

AIC.T 148.307229 AIC 7.062249

mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.603512 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 113.674

Linearity LR-test $\chi^2(7) = 28.688$ [0.0002]** approximate upperbound: [0.0001]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.89325	0.00000	0.17274
Regime 1,t+1	0.10675	0.81026	0.00000
Regime 2,t+1	0.00000	0.18974	0.82726

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-11.541	4.0637	9.2874	9.9079	2.3230	1.6117
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1990 - 1993 4 0.996
 2008 - 2010 3 0.944

Total: 7 years (33.33%) with average duration of 3.50 years.

Regime 1 years avg.prob.

1994 - 2000 7 0.841

Total: 7 years (33.33%) with average duration of 7.00 years.

Regime 2 years avg.prob.

2001 - 2007 7 0.926

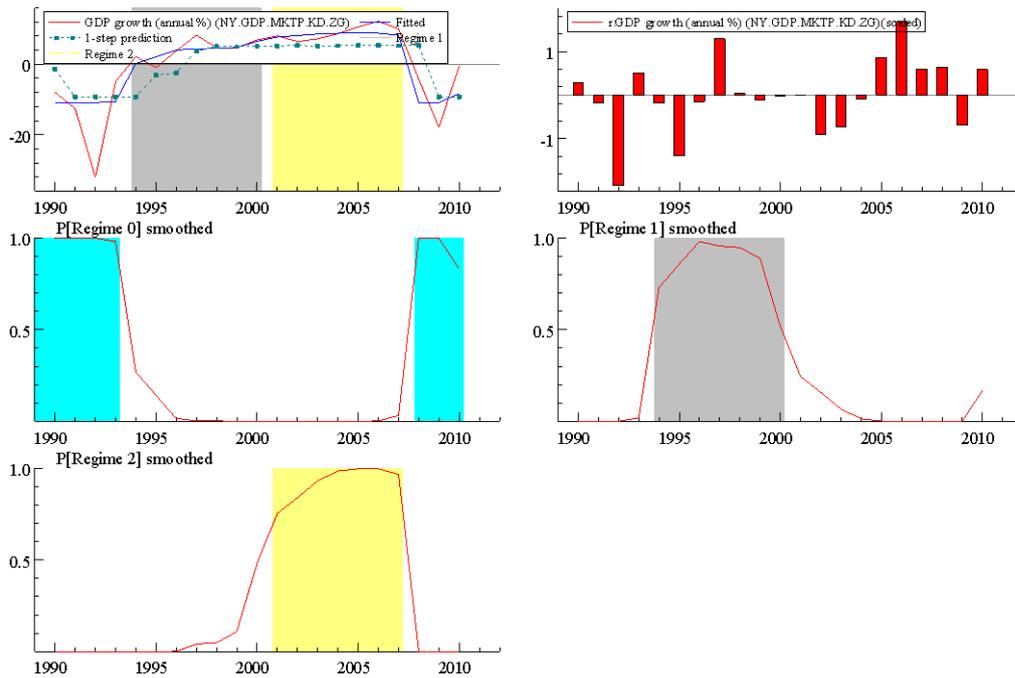
Total: 7 years (33.33%) with average duration of 7.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 2.4563 [0.2928]$

ARCH 1-1 test: $F(1,10) = 0.48947 [0.5001]$

Portmanteau(4): $\chi^2(4) = 0.92055 [0.9216]$



16. Latvia – 2-regime model (preferred model)

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Latvia\Latvia.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-7.99618	3.608	-2.22	0.043
Constant(1)	7.71382	0.7431	10.4	0.000
sigma(0)	10.4481	2.459	4.25	0.001
sigma(1)	2.38754	0.5293	4.51	0.000
p_{0|0}	0.922482	0.08388	11.0	0.000
p_{0|1}	0.119091	0.09062	1.31	0.209

log-likelihood -67.9765829
 no. of observations 21 no. of parameters 6
 AIC.T 147.953166 AIC 7.04538885
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.603512 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 113.674

Linearity LR-test $\chi^2(4) = 23.042 [0.0001]**$ approximate upperbound: $[0.0002]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

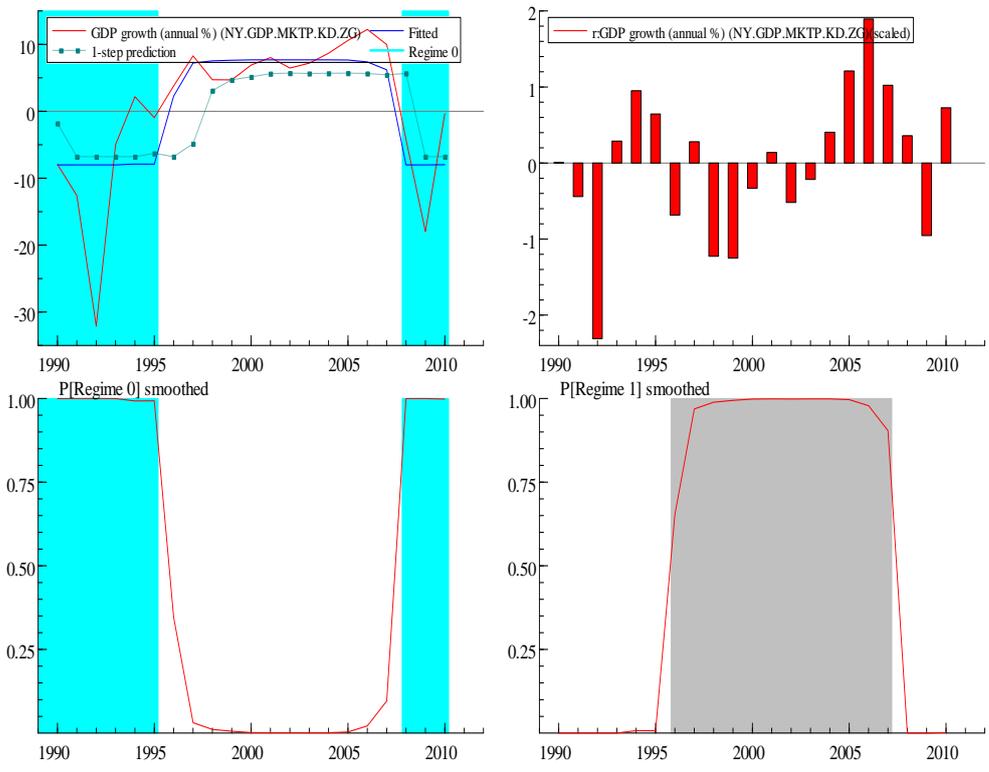
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.92248	0.11909
Regime 1,t+1	0.077518	0.88091

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -6.4043 8.3121 10.487 2.0752 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1995	6	0.998
2008 - 2010	3	0.999
Total: 9 years (42.86%) with average duration of 4.50 years.		
Regime 1	years	avg.prob.
1996 - 2007	12	0.957
Total: 12 years (57.14%) with average duration of 12.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 1.5278 [0.4659]$
 ARCH 1-1 test: $F(1,13) = 0.063122 [0.8056]$
 Portmanteau(4): $\chi^2(4) = 2.8149 [0.5893]$



17. Bulgaria – 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Bulgaria\Bulgaria.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-3.61458	1.478	-2.45	0.031
Constant(1)	4.54748	0.5491	8.28	0.000
Constant(2)	6.44932	0.08156	79.1	0.000
sigma(0)	4.49578	1.028	4.37	0.001
sigma(1)	1.26125	0.3839	3.29	0.007
sigma(2)	0.171707	0.05680	3.02	0.011
p_{0|0}	0.930877	0.07401	12.6	0.000
p_{1|1}	0.803251	0.1541	5.21	0.000
p_{0|2}	0.234441	0.1822	1.29	0.222

log-likelihood -45.9694834
 no. of observations 21 no. of parameters 9
 AIC.T 109.938967 AIC 5.2351889
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 1.02443 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 31.0342

Linearity LR-test $\chi^2(7) = 39.793$ [0.0000]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.93088	0.00000	0.23444
Regime 1,t+1	0.069123	0.80325	0.00000
Regime 2,t+1	0.00000	0.19675	0.76556

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-6.0723	2.9293	6.2163	3.0726	1.5950	0.41222
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

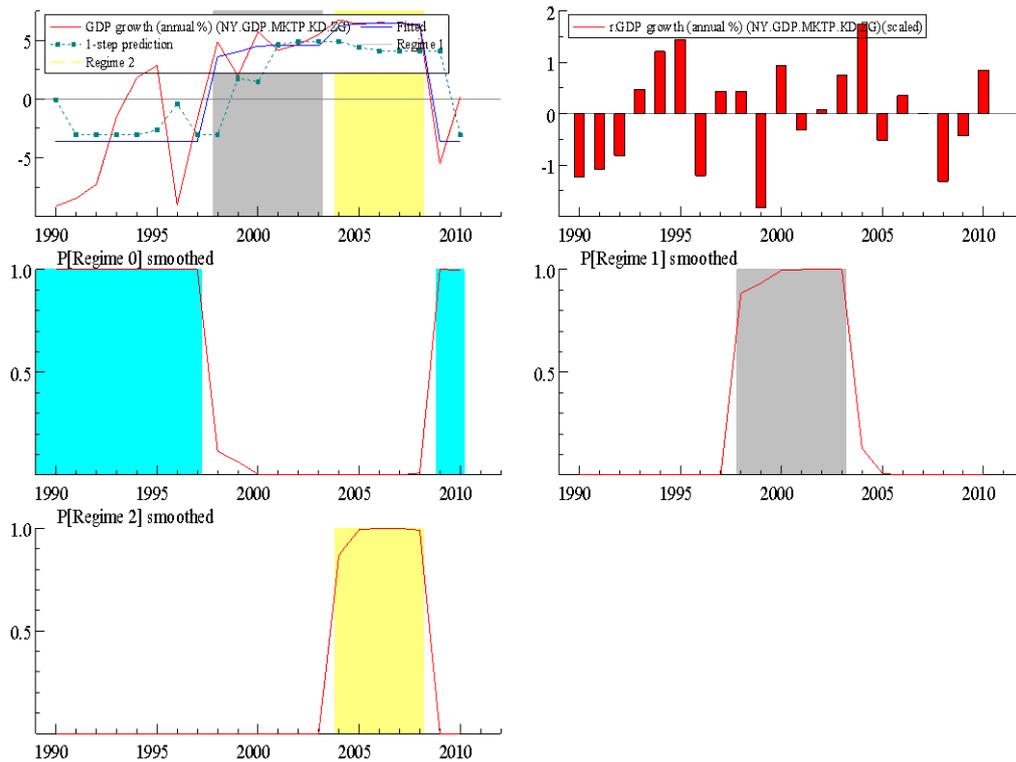
Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1997	8	1.000

2009 - 2010 2 1.000
 Total: 10 years (47.62%) with average duration of 5.00 years.
 Regime 1 years avg.prob.
 1998 - 2003 6 0.969
 Total: 6 years (28.57%) with average duration of 6.00 years.
 Regime 2 years avg.prob.
 2004 - 2008 5 0.970
 Total: 5 years (23.81%) with average duration of 5.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.57383$ [0.7506]
 ARCH 1-1 test: $F(1,10) = 0.069302$ [0.7977]
 Portmanteau(4): $\chi^2(4) = 3.1590$ [0.5316]



18. Bulgaria – 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Bulgaria\Bulgaria.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-2.53761	1.467	-1.73	0.104
Constant(1)	5.80412	0.2912	19.9	0.000
sigma(0)	4.88977	1.016	4.81	0.000
sigma(1)	0.849977	0.2080	4.09	0.001
p_{0|0}	0.924422	0.08162	11.3	0.000
p_{0|1}	0.157023	0.1216	1.29	0.216

log-likelihood -54.0010724
 no. of observations 21 no. of parameters 6
 AIC.T 120.002145 AIC 5.71438785
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 1.02443 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 31.0342

Linearity LR-test $\chi^2(4) = 23.730 [0.0001]**$ approximate upperbound: $[0.0002]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.92442	0.15702
Regime 1,t+1	0.075578	0.84298

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-3.2422 5.7177 4.5121 0.85180 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1999	10	0.988
2009 - 2010	2	1.000

Total: 12 years (57.14%) with average duration of 6.00 years.

Regime 1	years	avg.prob.
2000 - 2008	9	0.983

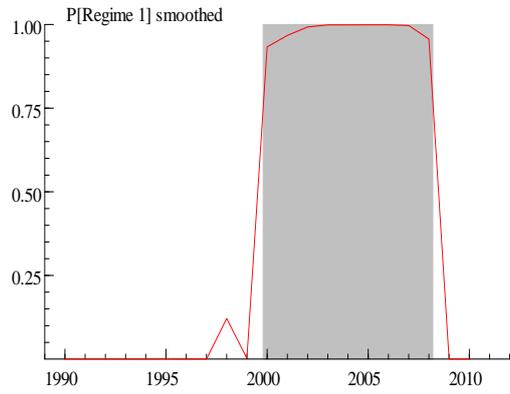
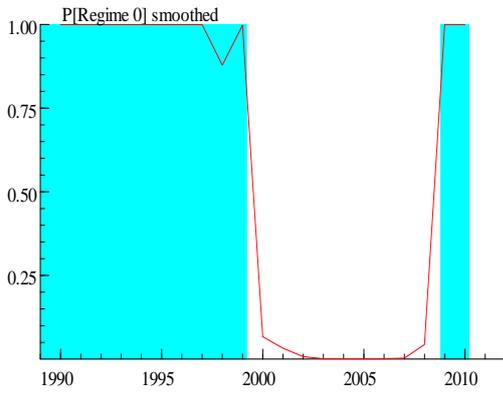
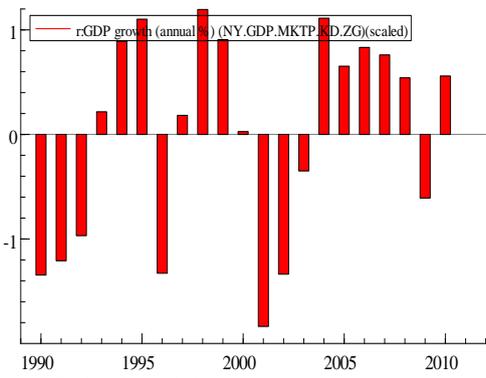
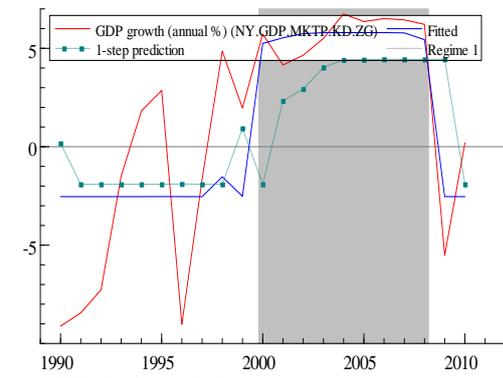
Total: 9 years (42.86%) with average duration of 9.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 6.6911 [0.0352]*$

ARCH 1-1 test: $F(1,13) = 0.017997 [0.8953]$

Portmanteau(4): $\chi^2(4) = 8.6312 [0.0710]$



19. Croatia – 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Croatia\Croatia.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-5.37405	2.693	-2.00	0.074
Constant(1)	4.50945	0.2205	20.4	0.000
Constant(2)	6.27318	0.1946	32.2	0.000
sigma(0)	7.50944	1.867	4.02	0.002
sigma(1)	0.602649	0.1645	3.66	0.004
sigma(2)	0.384021	0.1368	2.81	0.019
p_{0|0}	0.775470	0.1539	5.04	0.001
p_{1|0}	0.104192	0.1064	0.979	0.351
p_{0|1}	0.161483	0.1234	1.31	0.220
p_{0|2}	0.290782	0.2164	1.34	0.209

log-likelihood -47.97857

no. of observations 20 no. of parameters 10

AIC.T 115.95714 AIC 5.797857

mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.811936 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 50.1744

Linearity LR-test $\chi^2(8) = 39.111$ [0.0000]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.77547	0.16148	0.29078
Regime 1,t+1	0.10419	0.83852	0.00000
Regime 2,t+1	0.12034	0.00000	0.70922

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|j\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	-1.0000
Regime 1,t+1	-1.0000	-2.0000	0.00000
Regime 2,t+1	-2.0000	0.00000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-6.7251	3.8104	5.7789	7.2905	0.83491	0.64971
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1991 - 1993 3 1.000
 1998 - 1999 2 1.000
 2008 - 2010 3 0.996

Total: 8 years (40.00%) with average duration of 2.67 years.

Regime 1 years avg.prob.

2000 - 2007 8 0.983

Total: 8 years (40.00%) with average duration of 8.00 years.

Regime 2 years avg.prob.

1994 - 1997 4 0.986

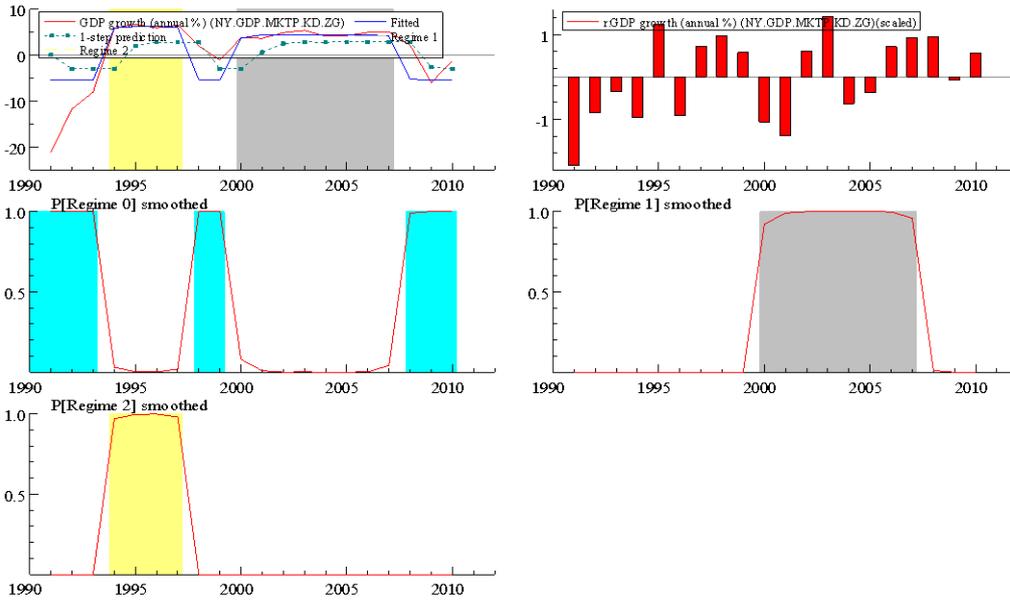
Total: 4 years (20.00%) with average duration of 4.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.9244 [0.3820]$

ARCH 1-1 test: $F(1,8) = 0.043779 [0.8395]$

Portmanteau(4): $\chi^2(4) = 0.97084 [0.9142]$



20. Croatia – 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Croatia\Croatia.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-6.05145	3.428	-1.77	0.099
Constant(1)	4.88545	0.4506	10.8	0.000
sigma(0)	7.55890	2.019	3.74	0.002
sigma(1)	1.22116	0.3689	3.31	0.005
$p_{\{0|0\}}$	0.746320	0.1824	4.09	0.001
$p_{\{0|1\}}$	0.199367	0.1110	1.80	0.094

log-likelihood -53.8961919
 no. of observations 20 no. of parameters 6
 AIC.T 119.792384 AIC 5.98961919
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.811936 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 50.1744

Linearity LR-test $\chi^2(4) = 27.275 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.74632	0.19937
Regime 1,t+1	0.25368	0.80063

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-3.7500 5.3739 7.6168 0.84244 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1993	3	1.000
1998 - 1999	2	0.807
2008 - 2010	3	0.836

Total: 8 years (40.00%) with average duration of 2.67 years.

Regime 1

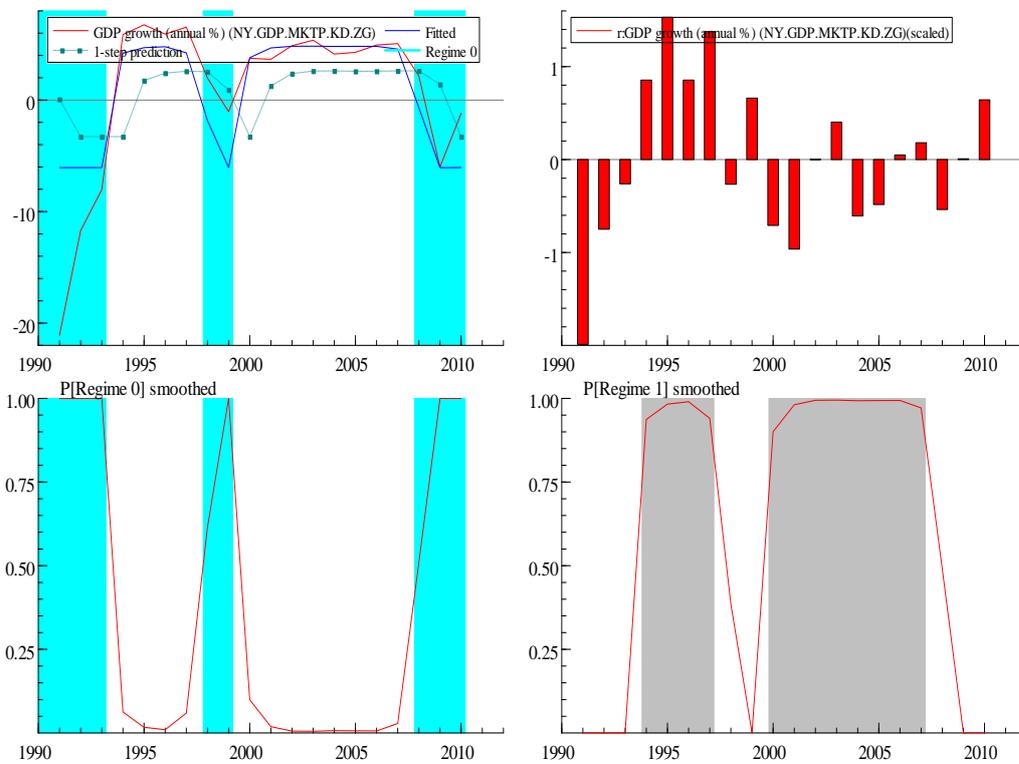
years	avg.prob.
1994 - 1997	4 0.963
2000 - 2007	8 0.978

Total: 12 years (60.00%) with average duration of 6.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.2518 [0.5348]$

ARCH 1-1 test: $F(1,12) = 0.14922 [0.7060]$
 Portmanteau(4): $\chi^2(4) = 5.0622 [0.2810]$



21. Lithuania – 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Lithuania\Lithuania.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-11.0221	3.075	-3.58	0.005
Constant(1)	2.75519	0.4362	6.32	0.000
Constant(2)	7.69354	0.4411	17.4	0.000
sigma(0)	7.06418	2.177	3.25	0.009
sigma(1)	0.772757	0.3057	2.53	0.030
sigma(2)	1.38966	0.3146	4.42	0.001
p_{0|0}	0.592569	0.2241	2.64	0.025
p_{0|1}	0.420970	0.3063	1.37	0.199
p_{0|2}	0.136721	0.1105	1.24	0.244
p_{1|2}	0.0988173	0.09885	1.00	0.341

log-likelihood -55.7812879
 no. of observations 20 no. of parameters 10
 AIC.T 131.562576 AIC 6.57812879
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.951007 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 84.3274

Linearity LR-test $\chi^2(8) = 33.889$ [0.0000]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.59257	0.42097	0.13672
Regime 1,t+1	0.40743	0.00000	0.098817
Regime 2,t+1	0.00000	0.57903	0.76446

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	-1.0000
Regime 1,t+1	-2.0000	0.00000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-9.6303	4.7084	8.3118	7.6893	1.6476	1.1120
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1994	4	1.000

1999 - 1999 1 1.000
 2009 - 2009 1 1.000

Total: 6 years (30.00%) with average duration of 2.00 years.

Regime 1 years avg.prob.

1995 - 1995 1 0.999
 2000 - 2000 1 1.000
 2008 - 2008 1 0.966
 2010 - 2010 1 0.841

Total: 4 years (20.00%) with average duration of 1.00 years.

Regime 2 years avg.prob.

1996 - 1998 3 0.998
 2001 - 2007 7 0.999

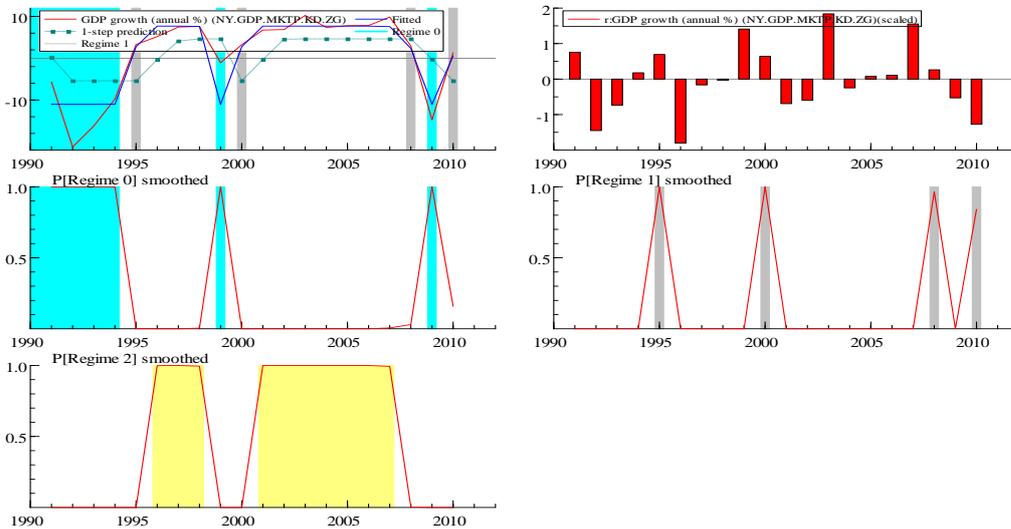
Total: 10 years (50.00%) with average duration of 5.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.11708$ [0.9431]

ARCH 1-1 test: $F(1,8) = 1.0022$ [0.3461]

Portmanteau(4): $\chi^2(4) = 8.1185$ [0.0873]



22. Lithuania – 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Lithuania\Lithuania.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-11.5917	4.594	-2.52	0.024
Constant(1)	6.00130	0.9136	6.57	0.000
sigma(0)	7.12561	3.200	2.23	0.043
sigma(1)	2.99794	0.6050	4.96	0.000
$p_{\{0|0\}}$	0.797918	0.2568	3.11	0.008
$p_{\{0|1\}}$	0.118510	0.08520	1.39	0.186

log-likelihood -61.9835327
 no. of observations 20 no. of parameters 6
 AIC.T 135.967065 AIC 6.79835327
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.951007 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 84.3274

Linearity LR-test $\chi^2(4) = 21.485 [0.0003]**$ approximate upperbound: $[0.0005]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.79792	0.11851
Regime 1,t+1	0.20208	0.88149

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -5.7944 7.6964 8.7023 1.3872 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1994	4	1.000
2009 - 2010	2	0.760

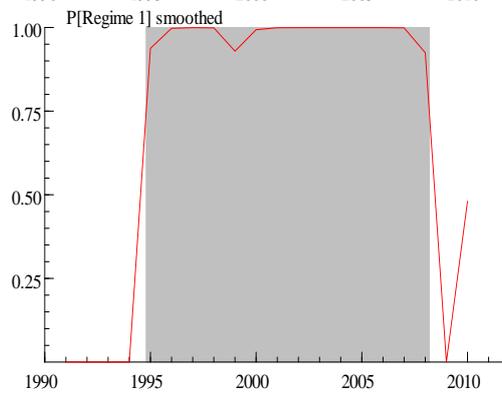
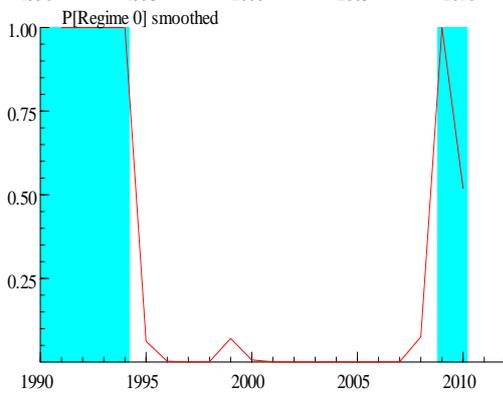
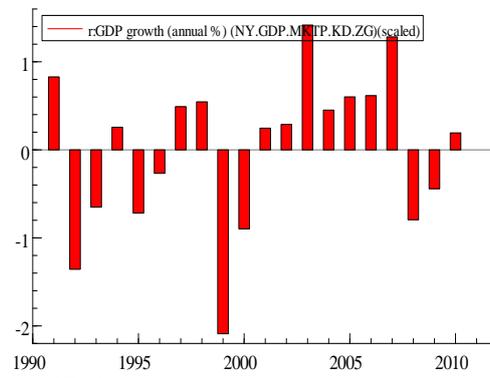
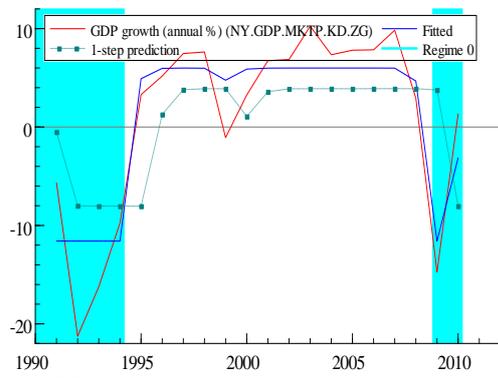
Total: 6 years (30.00%) with average duration of 3.00 years.

Regime 1	years	avg.prob.
1995 - 2008	14	0.984

Total: 14 years (70.00%) with average duration of 14.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.4959 [0.4733]$
 ARCH 1-1 test: $F(1,12) = 0.062993 [0.8061]$
 Portmanteau (4): $\chi^2(4) = 0.89316 [0.9255]$



23. Armenia – 3-regime model (preferred model)

Switching(4) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Armenia.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-9.01194	5.591	-1.61	0.138
Constant(1)	6.38756	0.3016	21.2	0.000
Constant(2)	12.5906	0.6244	20.2	0.000
sigma(0)	14.7315	3.833	3.84	0.003
sigma(1)	0.681129	0.2085	3.27	0.008
sigma(2)	1.65152	0.4420	3.74	0.004
p_{0|0}	0.579175	0.2169	2.67	0.023
p_{0|1}	0.600501	0.2175	2.76	0.020
p_{1|1}	0.270688	0.2124	1.27	0.231
p_{1|2}	0.170953	0.1337	1.28	0.230

log-likelihood -62.1667039
 no. of observations 20 no. of parameters 10
 AIC.T 144.333408 AIC 7.21667039
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 2.87027 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 169.945

Linearity LR-test $\chi^2(8) = 35.134 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.57918	0.60050	0.00000
Regime 1,t+1	0.42082	0.27069	0.17095
Regime 2,t+1	0.00000	0.12881	0.82905

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-9.8567	6.3778	12.591	14.677	0.68850	1.6511
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1993	3	1.000

1997 - 1997	1	1.000
1999 - 1999	1	1.000
2009 - 2010	2	1.000

Total: 7 years (35.00%) with average duration of 1.75 years.

Regime 1		years	avg.prob.
1994 - 1996	3	0.896	
1998 - 1998	1	0.925	
2000 - 2000	1	1.000	
2008 - 2008	1	1.000	

Total: 6 years (30.00%) with average duration of 1.50 years.

Regime 2		years	avg.prob.
2001 - 2007	7	1.000	

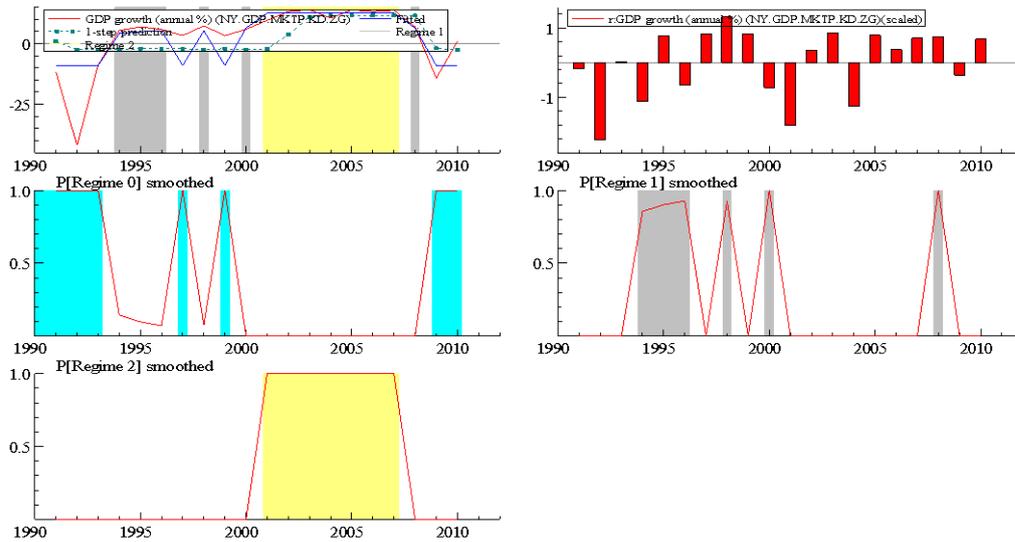
Total: 7 years (35.00%) with average duration of 7.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 5.2717 [0.0717]$

ARCH 1-1 test: $F(1,8) = 1.0767 [0.3298]$

Portmanteau(4): $\chi^2(4) = 0.37104 [0.9848]$



24. Armenia – 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Armenia.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-14.1725	7.175	-1.98	0.068
Constant(1)	8.85193	1.041	8.51	0.000
sigma(0)	14.7956	4.712	3.14	0.007
sigma(1)	3.87777	0.7321	5.30	0.000
p_{0|0}	0.844647	0.1908	4.43	0.001
p_{0|1}	0.107072	0.07801	1.37	0.191

log-likelihood -68.4091362
 no. of observations 20 no. of parameters 6
 AIC.T 148.818272 AIC 7.44091362
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 2.87027 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 169.945

Linearity LR-test $\chi^2(4) = 22.649 [0.0001]**$ approximate upperbound: $[0.0003]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

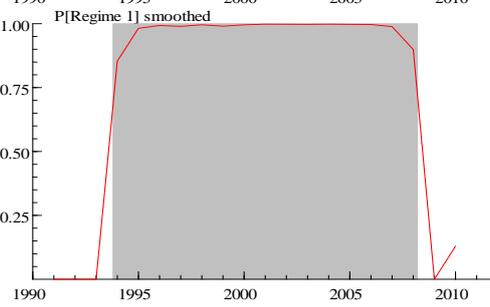
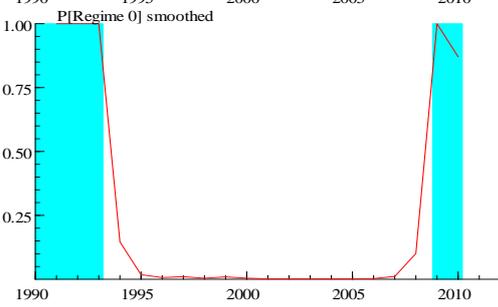
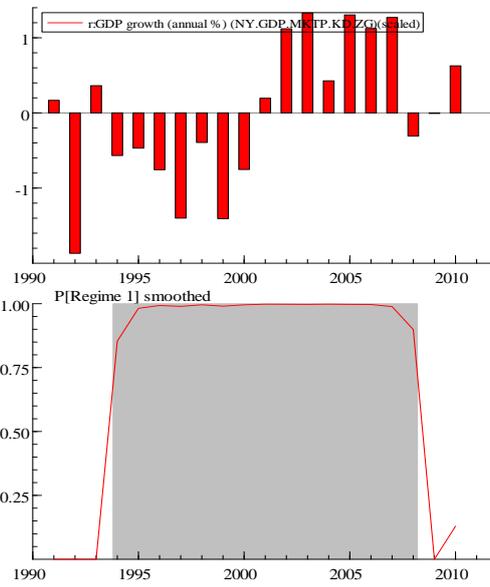
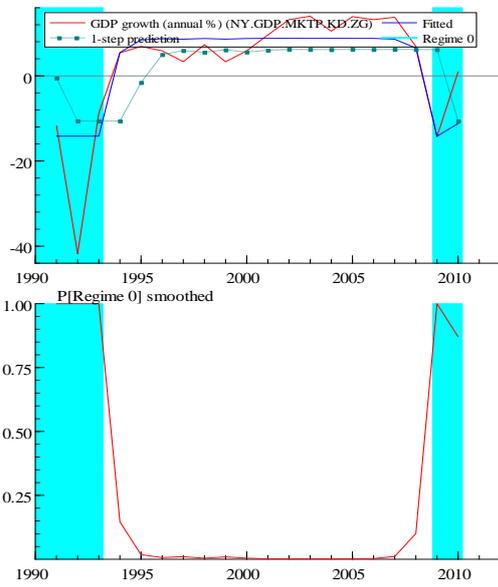
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.84465	0.10707
Regime 1,t+1	0.15535	0.89293

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -5.1832 10.924 14.205 2.8989 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1993	3	1.000
2009 - 2010	2	0.935
Total: 5 years (25.00%) with average duration of 2.50 years.		
Regime 1	years	avg.prob.
1994 - 2008	15	0.978
Total: 15 years (75.00%) with average duration of 15.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.61483 [0.7353]$
 ARCH 1-1 test: $F(1,12) = 1.3454 [0.2686]$
 Portmanteau(4): $\chi^2(4) = 10.715 [0.0300]*$



25. Belarus – 3-regime model

Switching(4) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Belarus.in7

The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-8.17366	1.684	-4.85	0.001
Constant(1)	4.50677	1.284	3.51	0.006
Constant(2)	9.89543	0.8063	12.3	0.000
sigma(0)	3.64806	1.191	3.06	0.012
sigma(1)	2.40581	0.8475	2.84	0.018
sigma(2)	1.55251	0.5215	2.98	0.014
p_{0|0}	0.908904	0.1258	7.22	0.000
p_{0|1}	0.0889537	0.09742	0.913	0.383
p_{1|1}	0.612523	0.2309	2.65	0.024
p_{1|2}	0.338921	0.2015	1.68	0.123

log-likelihood -55.396527

no. of observations 20 no. of parameters 10

AIC.T 130.793054 AIC 6.5396527

mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 3.34124 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 55.4463

Linearity LR-test $\chi^2(8) = 26.273$ [0.0009]** approximate upperbound: [0.0007]**

Transition probabilities $p_{i|j} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.90890	0.088954	0.00000
Regime 1,t+1	0.091096	0.61252	0.33892
Regime 2,t+1	0.00000	0.29852	0.66108

Transition probability settings (-1: free parameter, -2: 1-sum($p_{i|j}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-5.3571	5.6023	10.102	5.3904	1.4163	1.3769
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1991 - 1995 5 0.989
 Total: 5 years (25.00%) with average duration of 5.00 years.

Regime 1 years avg.prob.
 1996 - 1996 1 1.000
 1999 - 2003 5 0.926
 2009 - 2010 2 0.817

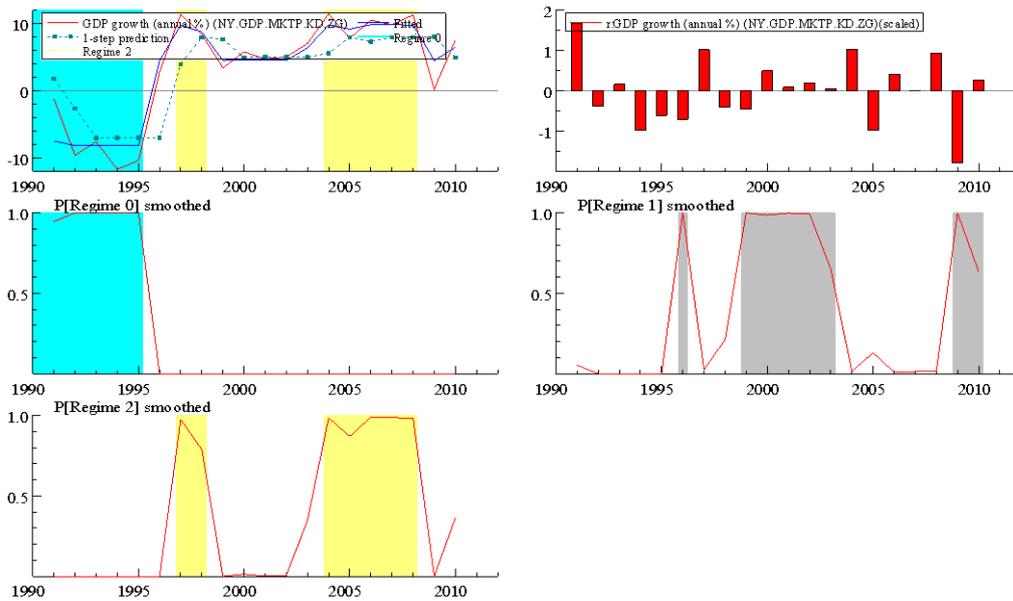
Total: 8 years (40.00%) with average duration of 2.67 years.

Regime 2 years avg.prob.
 1997 - 1998 2 0.881
 2004 - 2008 5 0.963

Total: 7 years (35.00%) with average duration of 3.50 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.89233$ [0.6401]
 ARCH 1-1 test: $F(1,8) = 0.029628$ [0.8676]
 Portmanteau(4): $\chi^2(4) = 5.8078$ [0.2140]



26. Belarus – 2-regime model (preferred model)

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Belarus.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-8.06352	1.756	-4.59	0.000
Constant(1)	7.15149	0.8745	8.18	0.000
sigma(0)	3.76386	1.320	2.85	0.013
sigma(1)	3.35631	0.6211	5.40	0.000
p_{0|0}	0.914852	0.1156	7.91	0.000
p_{0|1}	0.0449602	0.04954	0.907	0.380

log-likelihood -57.5014978
 no. of observations 20 no. of parameters 6
 AIC.T 127.002996 AIC 6.35014978
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 3.34124 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 55.4463

Linearity LR-test $\chi^2(4) = 22.063$ [0.0002]** approximate upperbound: [0.0004]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

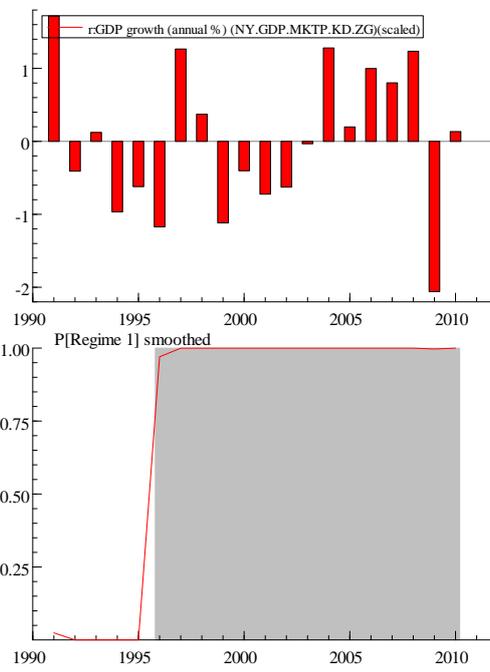
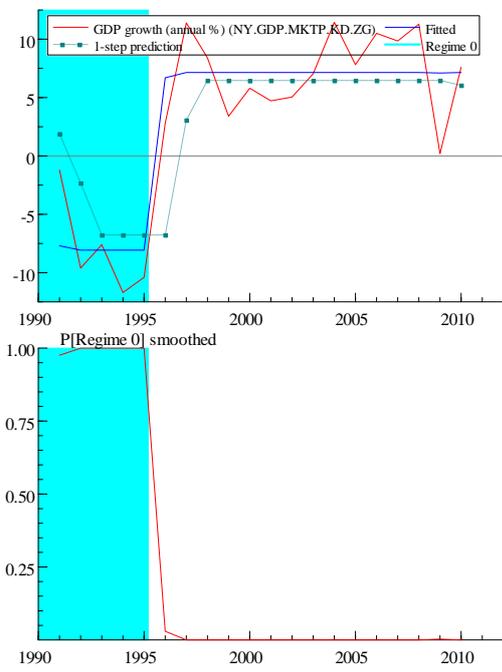
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.91485	0.044960
Regime 1,t+1	0.085148	0.95504

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -2.4329 9.1154 6.3596 1.9407 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1995	5	0.995
Total: 5 years (25.00%) with average duration of 5.00 years.		
Regime 1	years	avg.prob.
1996 - 2010	15	0.998
Total: 15 years (75.00%) with average duration of 15.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.032119$ [0.9841]
 ARCH 1-1 test: $F(1,12) = 0.33123$ [0.5756]
 Portmanteau(4): $\chi^2(4) = 0.85961$ [0.9303]



27. Kazakhstan – 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Kazakhstan\Kazakhstan.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-9.25904	1.115	-8.30	0.000
Constant(1)	1.28139	0.7364	1.74	0.112
Constant(2)	9.82086	0.5425	18.1	0.000
sigma(0)	2.49150	0.7920	3.15	0.010
sigma(1)	1.73145	0.5920	2.92	0.015
sigma(2)	1.60924	0.3846	4.18	0.002
p_{0|0}	0.918469	0.1084	8.47	0.000
p_{1|1}	0.649319	0.1906	3.41	0.007
p_{0|2}	0.0666641	0.07510	0.888	0.396
p_{1|2}	0.103376	0.09924	1.04	0.322

log-likelihood -51.6224894
 no. of observations 20 no. of parameters 10
 AIC.T 123.244979 AIC 6.16224894
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 2.475 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 62.6679

Linearity LR-test $\chi^2(8) = 36.270$ [0.0000]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.91847	0.00000	0.066664
Regime 1,t+1	0.081531	0.64932	0.10338
Regime 2,t+1	0.00000	0.35068	0.82996

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|j\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-6.8143	4.1333	10.343	4.4489	2.8347	1.3489
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

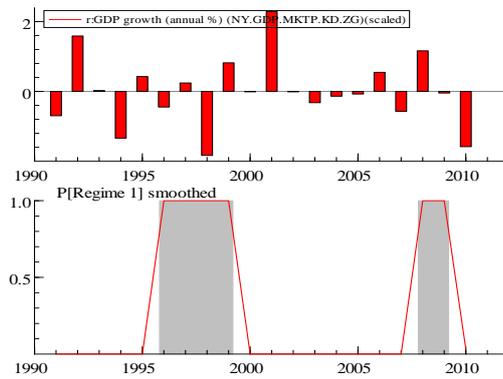
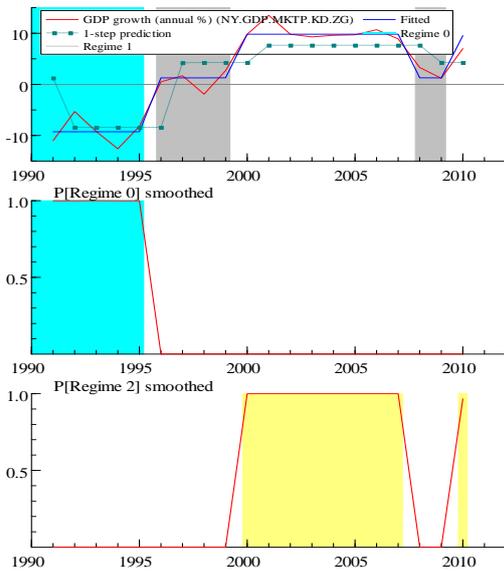
1991 - 1995 5 1.000
 Total: 5 years (25.00%) with average duration of 5.00 years.
 Regime 1 years avg.prob.
 1996 - 1999 4 1.000
 2008 - 2009 2 1.000
 Total: 6 years (30.00%) with average duration of 3.00 years.
 Regime 2 years avg.prob.
 2000 - 2007 8 1.000
 2010 - 2010 1 0.967
 Total: 9 years (45.00%) with average duration of 4.50 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.8085 [0.4049]$

ARCH 1-1 test: $F(1,8) = 0.85465 [0.3823]$

Portmanteau(4): $\chi^2(4) = 2.3702 [0.6680]$



28. Kazakhstan – 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Kazakhstan\Kazakhstan.in7
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-2.59820	1.844	-1.41	0.181
Constant(1)	10.1393	0.5068	20.0	0.000
sigma(0)	6.18626	1.303	4.75	0.000
sigma(1)	1.37952	0.3657	3.77	0.002
$p_{\{0|0\}}$	0.928205	0.07501	12.4	0.000
$p_{\{0|1\}}$	0.160379	0.1225	1.31	0.212

log-likelihood -59.1474918
 no. of observations 20 no. of parameters 6
 AIC.T 130.294984 AIC 6.51474918
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 2.475 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 62.6679

Linearity LR-test $\chi^2(4) = 21.220 [0.0003]**$ approximate upperbound: $[0.0005]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.92821	0.16038
Regime 1,t+1	0.071795	0.83962

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-4.2100 9.1600 5.4587 2.4820 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1999	9	1.000
2008 - 2010	3	0.973

Total: 12 years (60.00%) with average duration of 6.00 years.

Regime 1

years	avg.prob.
2000 - 2007	8 0.986

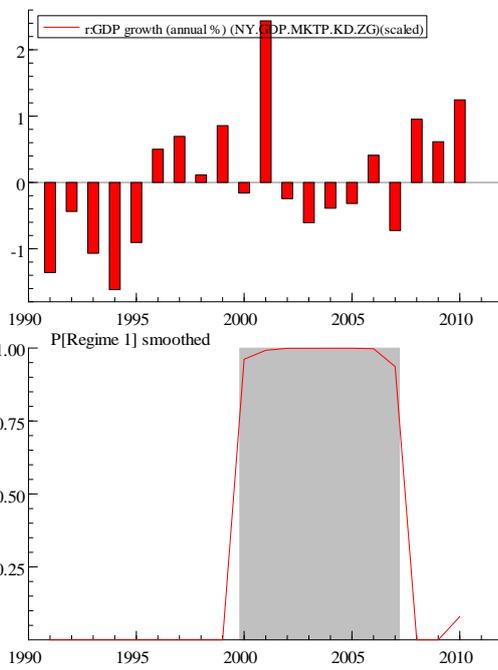
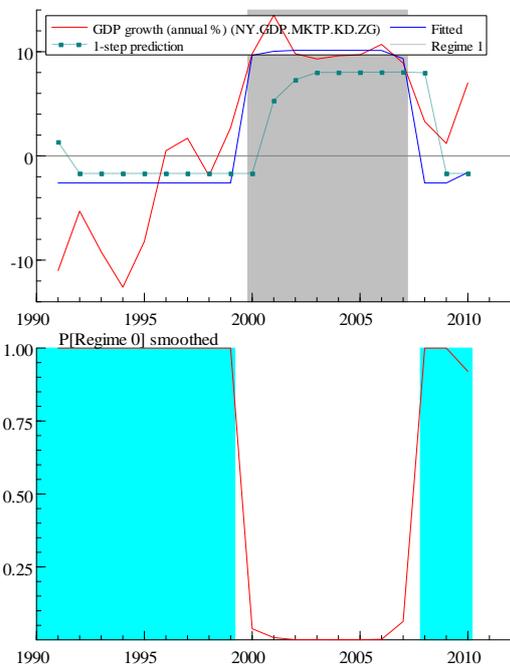
Total: 8 years (40.00%) with average duration of 8.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.8154 [0.4034]$

ARCH 1-1 test: $F(1,12) = 0.40280 [0.5376]$

Portmanteau(4): $\chi^2(4) = 2.3169 [0.6777]$



29. Russian Federation – 3-regime model

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Russ Fed\Russ Fed.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-6.97346	1.462	-4.77	0.000
Constant(1)	2.71443	1.122	2.42	0.032
Constant(2)	6.87038	0.5173	13.3	0.000
sigma(0)	4.05503	1.106	3.67	0.003
sigma(1)	1.31794	0.7222	1.82	0.093
sigma(2)	1.60951	0.3637	4.43	0.001
p_{0|0}	0.731198	0.1646	4.44	0.001
p_{1|0}	0.181915	0.1511	1.20	0.252
p_{0|2}	0.131337	0.09976	1.32	0.213

log-likelihood -58.4356636
 no. of observations 21 no. of parameters 9
 AIC.T 134.871327 AIC 6.42244415
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.465736 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 53.0173

Linearity LR-test $\chi^2(7) = 26.107$ [0.0005]** approximate upperbound: [0.0002]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.73120	1.0000	0.13134
Regime 1,t+1	0.18191	0.00000	0.00000
Regime 2,t+1	0.086888	0.00000	0.86866

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	1.0000	-1.0000
Regime 1,t+1	-1.0000	0.00000	0.00000
Regime 2,t+1	-2.0000	-2.0000	-2.0000

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -8.2963 1.9883 7.7052 3.6701 3.5556 1.1996
 0.33333 0.33333 0.33333 0.33333 0.33333 0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1996	7	1.000

1998 - 1998 1 1.000

2009 - 2009 1 1.000

Total: 9 years (42.86%) with average duration of 3.00 years.

Regime 1 years avg.prob.

1997 - 1997 1 0.843

2010 - 2010 1 0.840

Total: 2 years (9.52%) with average duration of 1.00 years.

Regime 2 years avg.prob.

1999 - 2008 10 0.999

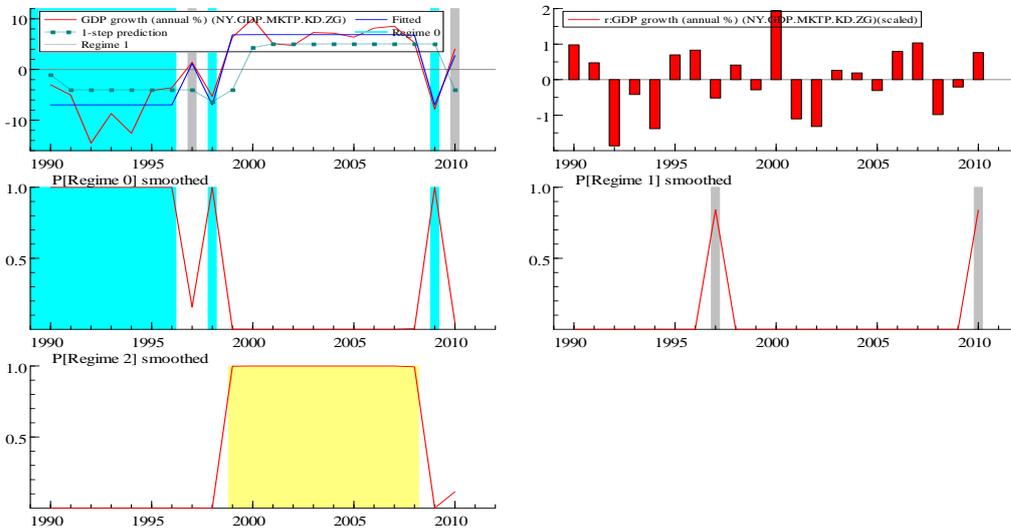
Total: 10 years (47.62%) with average duration of 10.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.10629 [0.9482]$

ARCH 1-1 test: $F(1,10) = 0.25727 [0.6230]$

Portmanteau(4): $\chi^2(4) = 1.9731 [0.7407]$



30. Russian Federation – 2-regime model (preferred model)

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Russ Fed\Russ Fed.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-5.57338	1.702	-3.27	0.005
Constant(1)	6.82471	0.5455	12.5	0.000
sigma(0)	5.09237	1.214	4.19	0.001
sigma(1)	1.64232	0.3762	4.37	0.001
p_{0|0}	0.906135	0.1015	8.93	0.000
p_{0|1}	0.136742	0.1019	1.34	0.200

log-likelihood -59.2312167
 no. of observations 21 no. of parameters 6
 AIC.T 130.462433 AIC 6.21249683
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.465736 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 53.0173

Linearity LR-test $\chi^2(4) = 24.516 [0.0001]**$ approximate upperbound: $[0.0001]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

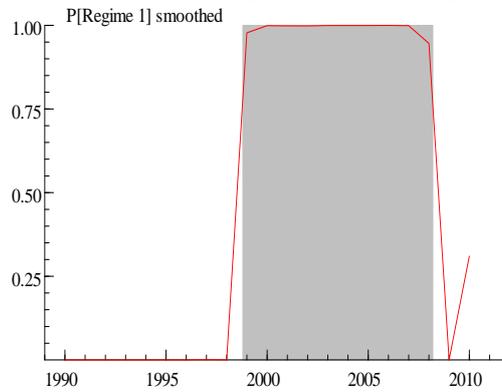
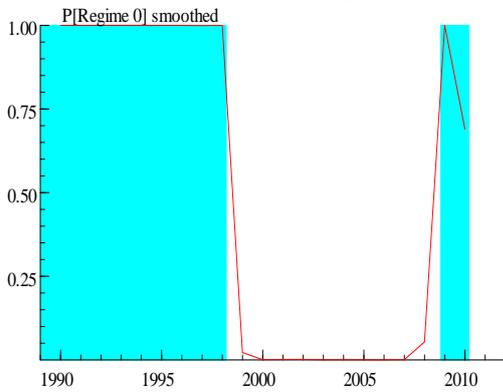
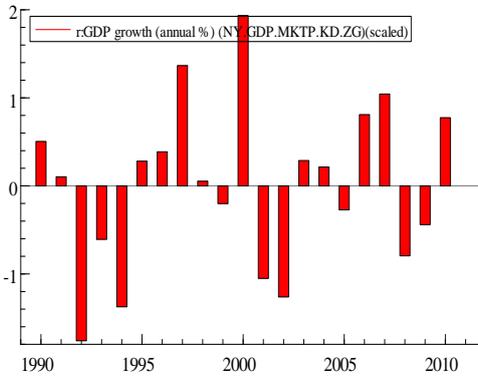
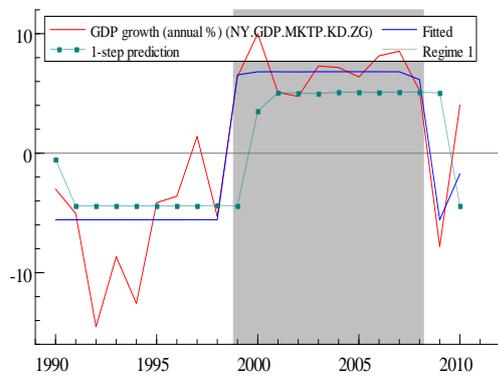
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.90613	0.13674
Regime 1,t+1	0.093865	0.86326

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -5.3854 6.9020 5.1983 1.5893 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1998	9	1.000
2009 - 2010	2	0.845
Total: 11 years (52.38%) with average duration of 5.50 years.		
Regime 1	years	avg.prob.
1999 - 2008	10	0.992
Total: 10 years (47.62%) with average duration of 10.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.12507 [0.9394]$
 ARCH 1-1 test: $F(1,13) = 0.55871 [0.4681]$
 Portmanteau(4): $\chi^2(4) = 1.7863 [0.7750]$



31. Macedonia – 3-regime model (preferred model)

Switching(5) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Macedonia\Macedonia.xls
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-3.98925	1.021	-3.91	0.002
Constant(1)	1.04946	0.1486	7.06	0.000
Constant(2)	4.23340	0.2823	15.0	0.000
sigma(0)	2.63677	0.7248	3.64	0.004
sigma(1)	0.287275	0.1035	2.78	0.018
sigma(2)	0.842642	0.2033	4.15	0.002
p_{0|0}	0.644656	0.1891	3.41	0.006
p_{1|1}	0.305024	0.2616	1.17	0.268
p_{0|2}	0.260988	0.1378	1.89	0.085

log-likelihood -40.9565134

no. of observations 20 no. of parameters 9

AIC.T 99.9130268 AIC 4.99565134

mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.690019 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 16.28

Linearity LR-test $\chi^2(7) = 30.643$ [0.0001]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.64466	0.00000	0.26099
Regime 1,t+1	0.35534	0.30502	0.00000
Regime 2,t+1	0.00000	0.69498	0.73901

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-4.0719	1.7290	4.5614	2.5782	1.0091	0.63697
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1995	5	1.000

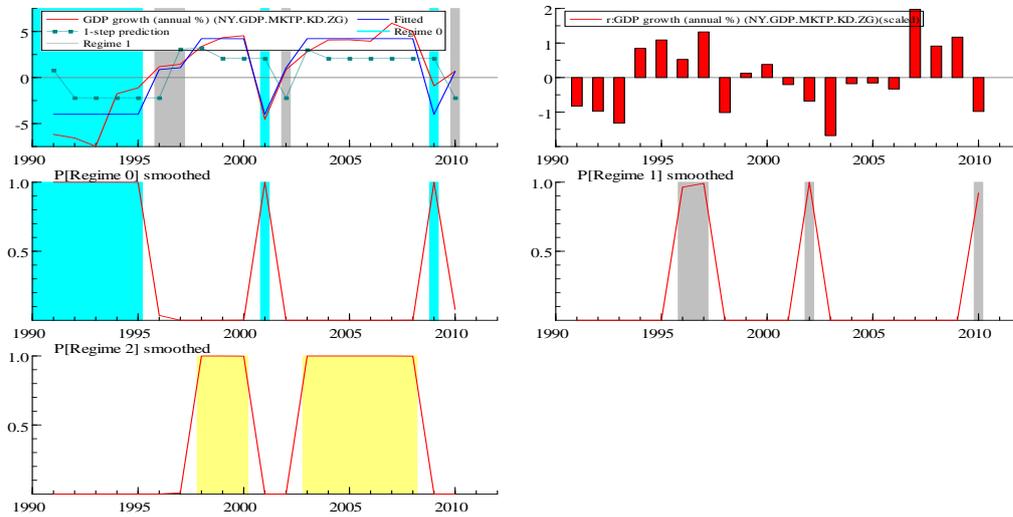
2001 - 2001	1	1.000
2009 - 2009	1	1.000
Total: 7 years (35.00%) with average duration of 2.33 years.		
Regime 1	years	avg.prob.
1996 - 1997	2	0.978
2002 - 2002	1	1.000
2010 - 2010	1	0.921
Total: 4 years (20.00%) with average duration of 1.33 years.		
Regime 2	years	avg.prob.
1998 - 2000	3	0.999
2003 - 2008	6	1.000
Total: 9 years (45.00%) with average duration of 4.50 years.		

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.62167 [0.7328]$

ARCH 1-1 test: $F(1,9) = 0.20791 [0.6592]$

Portmanteau(4): $\chi^2(4) = 5.5497 [0.2354]$



32. Macedonia – 2-regime model

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Macedonia\Macedonia.xls
 The estimation sample is: 1991 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-1.87573	1.096	-1.71	0.109
Constant(1)	4.30262	0.3096	13.9	0.000
sigma(0)	3.39510	0.7475	4.54	0.000
sigma(1)	0.807511	0.2226	3.63	0.003
p_{0|0}	0.839847	0.1101	7.63	0.000
p_{0|1}	0.275457	0.1517	1.82	0.091

log-likelihood -49.3330616
 no. of observations 20 no. of parameters 6
 AIC.T 110.666123 AIC 5.53330616
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.690019 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 16.28

Linearity LR-test $\chi^2(4) = 13.890$ [0.0077]** approximate upperbound: [0.0143]*

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.83985	0.27546
Regime 1,t+1	0.16015	0.72454

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -2.5765 3.9565 3.1437 1.1562 0.50000 0.50000

Regime classification based on smoothed probabilities

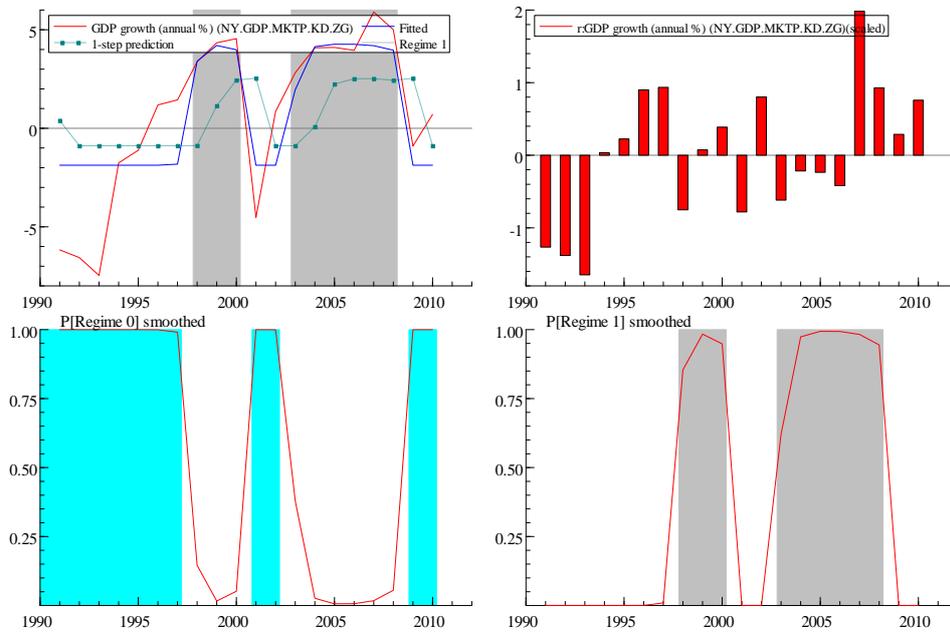
Regime	years	avg.prob.
Regime 0		
1991 - 1997	7	0.999
2001 - 2002	2	1.000
2009 - 2010	2	1.000
Total: 11 years (55.00%) with average duration of 3.67 years.		
Regime 1		
1998 - 2000	3	0.929
2003 - 2008	6	0.918
Total: 9 years (45.00%) with average duration of 4.50 years.		

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.20961$ [0.9005]

ARCH 1-1 test: $F(1,12) = 0.22715$ [0.6422]

Portmanteau(4): $\chi^2(4) = 5.8695$ [0.2091]



33. Romania – 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Romania\Romania.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-6.79079	1.335	-5.09	0.000
Constant(1)	1.52760	0.2756	5.54	0.000
Constant(2)	6.09553	0.5406	11.3	0.000
sigma(0)	3.46885	0.9662	3.59	0.003
sigma(1)	0.468790	0.1929	2.43	0.030
sigma(2)	1.79174	0.3821	4.69	0.000
$p_{\{0|0\}}$	0.638417	0.1881	3.39	0.005
$p_{\{0|2\}}$	0.220615	0.1178	1.87	0.084

log-likelihood -53.712165
 no. of observations 21 no. of parameters 8
 AIC.T 123.42433 AIC 5.87734904
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 1.12686 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 39.7419

Linearity LR-test $\chi^2(6) = 29.502 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.63842	0.00000	0.22062
Regime 1,t+1	0.36158	0.00000	0.00000
Regime 2,t+1	0.00000	1.0000	0.77938

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|. \}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	0.00000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-6.8475	3.1158	7.1122	3.4138	1.4583	1.4403
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1992	3	1.000
1997 - 1999	3	1.000
2009 - 2009	1	1.000

Total: 7 years (33.33%) with average duration of 2.33 years.

Regime 1	years	avg.prob.
1993 - 1993	1	1.000
2000 - 2000	1	1.000
2010 - 2010	1	0.959

Total: 3 years (14.29%) with average duration of 1.00 years.

Regime 2	years	avg.prob.
1994 - 1996	3	0.998
2001 - 2008	8	1.000

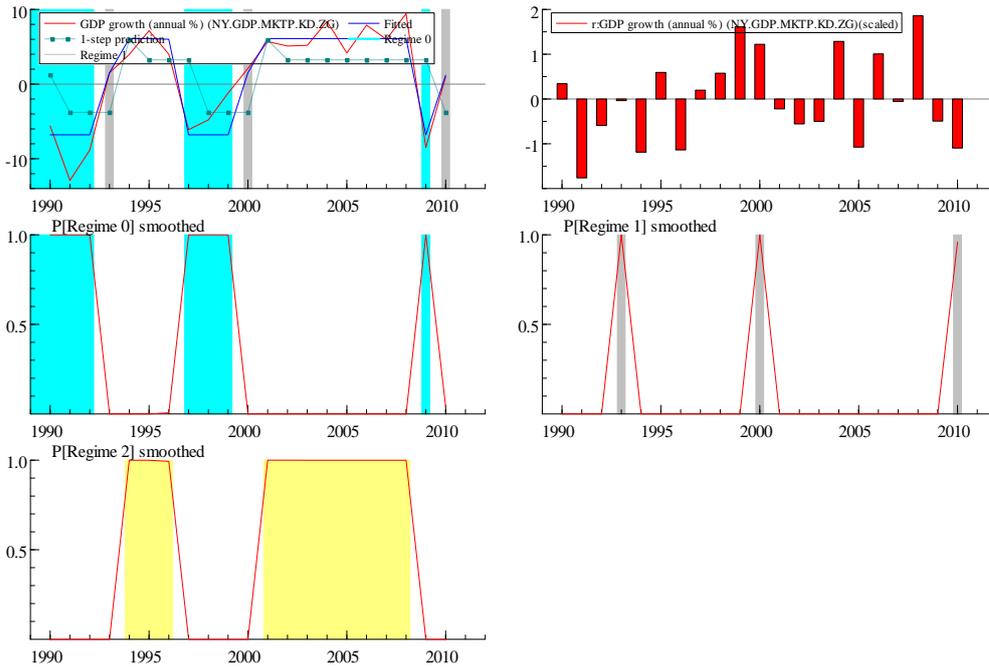
Total: 11 years (52.38%) with average duration of 5.50 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.70768$ [0.7020]

ARCH 1-1 test: $F(1,11) = 1.5959$ [0.2326]

Portmanteau(4): $\chi^2(4) = 1.4407$ [0.8371]



34. Romania – 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Romania\Romania.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-4.85498	2.158	-2.25	0.040
Constant(1)	5.70918	0.7923	7.21	0.000
sigma(0)	4.74510	1.398	3.39	0.004
sigma(1)	2.12821	0.5625	3.78	0.002
$p_{\{0|0\}}$	0.790655	0.1545	5.12	0.000
$p_{\{0|1\}}$	0.205478	0.1147	1.79	0.093

log-likelihood -61.2590594
 no. of observations 21 no. of parameters 6
 AIC.T 134.518119 AIC 6.40562471
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 1.12686 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 39.7419

Linearity LR-test $\chi^2(4) = 14.408 [0.0061]**$ approximate upperbound: $[0.0115]*$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.79065	0.20548
Regime 1,t+1	0.20935	0.79452

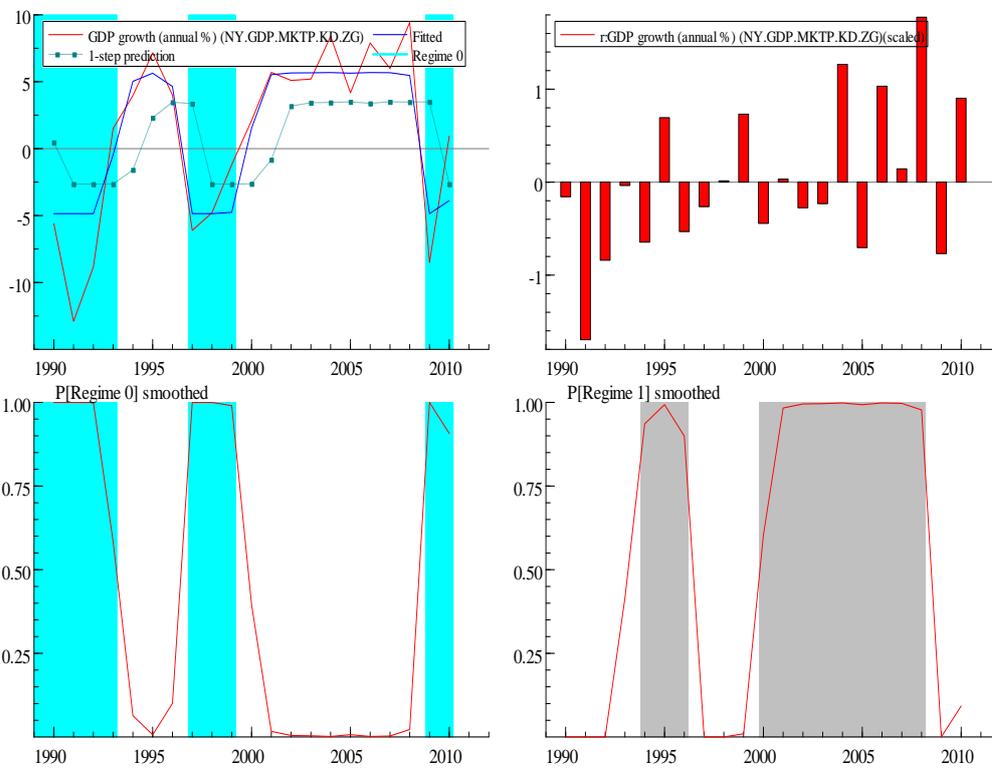
Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -3.5821 6.3067 5.1523 1.7423 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1993	4	0.896
1997 - 1999	3	0.997
2009 - 2010	2	0.954
Total: 9 years (42.86%) with average duration of 3.00 years.		
Regime 1	years	avg.prob.
1994 - 1996	3	0.943
2000 - 2008	9	0.949
Total: 12 years (57.14%) with average duration of 6.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.90638 [0.6356]$

ARCH 1-1 test: $F(1,13) = 0.23695 [0.6345]$
Portmanteau(4): $\chi^2(4) = 5.6803 [0.2243]$



35. Turkmenistan – 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Turkmenistan\Turkmenistan.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-7.71901	1.760	-4.39	0.001
Constant(1)	9.65771	0.9839	9.82	0.000
Constant(2)	17.5559	0.6833	25.7	0.000
sigma(0)	4.97277	1.246	3.99	0.002
sigma(1)	2.51800	0.7160	3.52	0.005
sigma(2)	1.58462	0.5352	2.96	0.013
p_{0|0}	0.938316	0.07625	12.3	0.000
p_{0|1}	0.0860185	0.09869	0.872	0.402
p_{1|1}	0.788463	0.1551	5.08	0.000
p_{1|2}	0.194664	0.1529	1.27	0.229

log-likelihood -61.4468039
 no. of observations 21 no. of parameters 10
 AIC.T 142.893608 AIC 6.80445752
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 5.30553 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 126.243

Linearity LR-test $\chi^2(8) = 38.304$ [0.0000]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.93832	0.086019	0.00000
Regime 1,t+1	0.061684	0.78846	0.19466
Regime 2,t+1	0.00000	0.12552	0.80534

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|j\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-8.9286	7.9058	16.939	4.0682	3.5896	2.1394
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

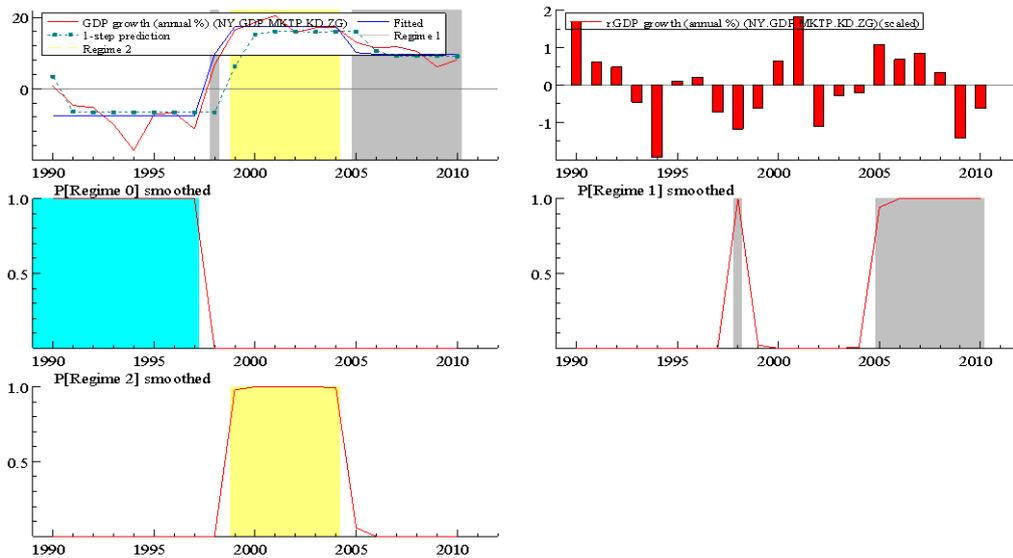
1990 - 1997 8 1.000
 Total: 8 years (38.10%) with average duration of 8.00 years.
 Regime 1 years avg.prob.
 1998 - 1998 1 1.000
 2005 - 2010 6 0.990
 Total: 7 years (33.33%) with average duration of 3.50 years.
 Regime 2 years avg.prob.
 1999 - 2004 6 0.995
 Total: 6 years (28.57%) with average duration of 6.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.0023080$ [0.9988]

ARCH 1-1 test: $F(1,9) = 0.49619$ [0.4990]

Portmanteau(4): $\chi^2(4) = 4.5754$ [0.3337]



36. Turkmenistan -2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Turkmenistan\Turkmenistan.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-7.64114	1.840	-4.15	0.001
Constant(1)	13.3400	1.252	10.7	0.000
sigma(0)	5.07389	1.370	3.70	0.002
sigma(1)	4.47647	0.8852	5.06	0.000
$p_{\{0|0\}}$	0.941161	0.07385	12.7	0.000
$p_{\{0|1\}}$	0.0452374	0.05216	0.867	0.399

log-likelihood -66.7178892
 no. of observations 21 no. of parameters 6
 AIC.T 145.435778 AIC 6.92551326
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 5.30553 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 126.243

Linearity LR-test $\chi^2(4) = 27.762 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

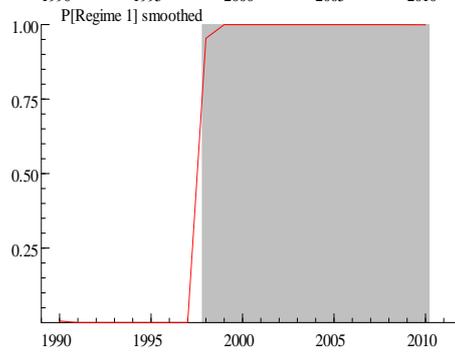
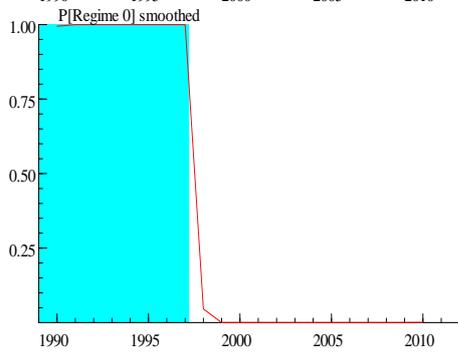
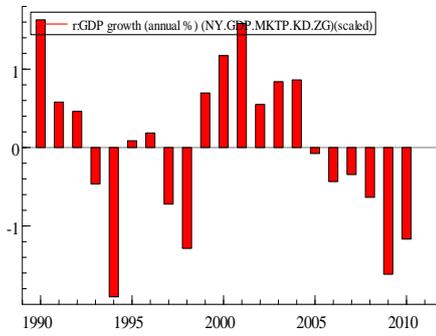
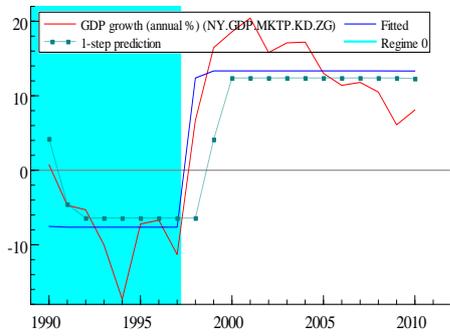
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.94116	0.045237
Regime 1,t+1	0.058839	0.95476

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -3.7145 15.228 7.8066 3.1827 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime	years	avg.prob.
Regime 0	1990 - 1997	8 0.999
Total: 8 years (38.10%) with average duration of 8.00 years.		
Regime 1	1998 - 2010	13 0.996
Total: 13 years (61.90%) with average duration of 13.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.37969 [0.8271]$
 ARCH 1-1 test: $F(1,13) = 0.18437 [0.6747]$
 Portmanteau(4): $\chi^2(4) = 5.2425 [0.2633]$



37. Uzbekistan – 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Uzbekistan\Uzbekistan.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-1.42287	1.656	-0.859	0.407
Constant(1)	4.13240	0.07370	56.1	0.000
Constant(2)	8.15707	0.3169	25.7	0.000
sigma(0)	4.67706	1.168	4.01	0.002
sigma(1)	0.179570	0.05199	3.45	0.005
sigma(2)	0.838202	0.2241	3.74	0.003
p_{0|0}	0.940394	0.07296	12.9	0.000
p_{1|1}	0.813013	0.1521	5.34	0.000
p_{0|2}	0.0644870	0.08111	0.795	0.442

log-likelihood -37.7219731
 no. of observations 21 no. of parameters 9
 AIC.T 93.4439462 AIC 4.44971173
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 3.348 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 25.2053

Linearity LR-test $\chi^2(7) = 51.920 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.94039	0.00000	0.064487
Regime 1,t+1	0.059606	0.81301	0.00000
Regime 2,t+1	0.00000	0.18699	0.93551

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|. \}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -2.3989 4.2857 8.1571 4.2087 0.40858 0.83812
 0.33333 0.33333 0.33333 0.33333 0.33333 0.33333

Regime classification based on smoothed probabilities
 Regime 0 years avg.prob.
 1990 - 1997 8 1.000
 Total: 8 years (38.10%) with average duration of 8.00 years.

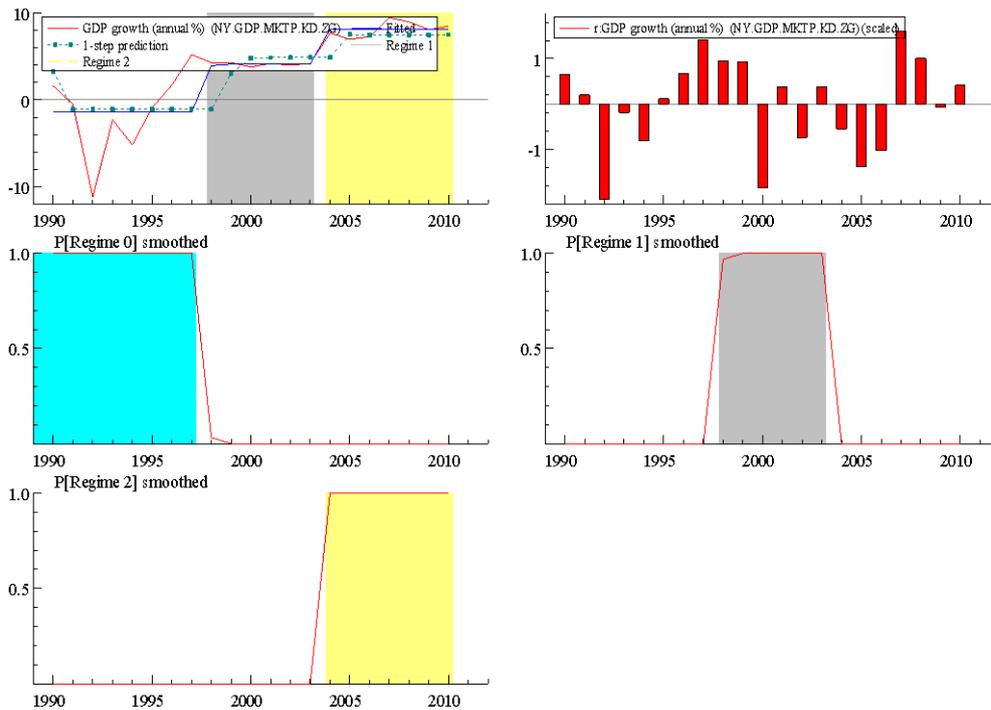
Regime 1 years avg.prob.
 1998 - 2003 6 0.994
 Total: 6 years (28.57%) with average duration of 6.00 years.
 Regime 2 years avg.prob.
 2004 - 2010 7 1.000
 Total: 7 years (33.33%) with average duration of 7.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.4700$ [0.4795]

ARCH 1-1 test: $F(1,10) = 0.47748$ [0.5053]

Portmanteau(4): $\chi^2(4) = 2.6405$ [0.6197]



38. Uzbekistan 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Uzbekistan\Uzbekistan.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-2.42112	1.765	-1.37	0.190
Constant(1)	6.14480	0.5940	10.3	0.000
sigma(0)	4.29689	1.195	3.60	0.003
sigma(1)	2.12518	0.4231	5.02	0.000
$p_{\{0|0\}}$	0.932020	0.08845	10.5	0.000
$p_{\{0|1\}}$	0.0446267	0.05061	0.882	0.392

log-likelihood -54.0896587
 no. of observations 21 no. of parameters 6
 AIC.T 120.179317 AIC 5.72282464
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 3.348 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 25.2053

Linearity LR-test $\chi^2(4) = 19.184 [0.0007]**$ approximate upperbound: $[0.0014]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

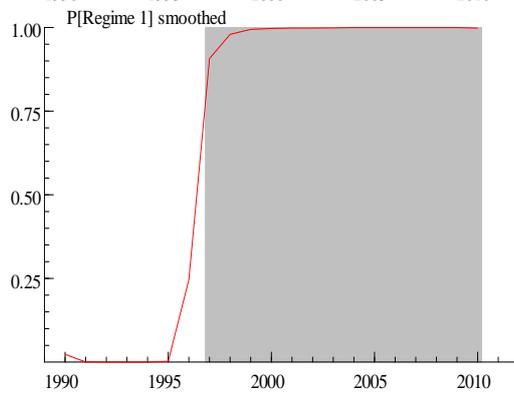
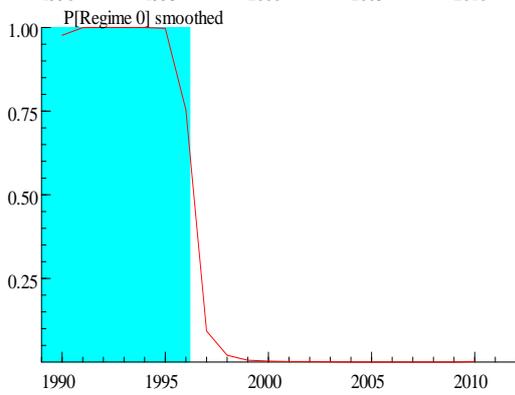
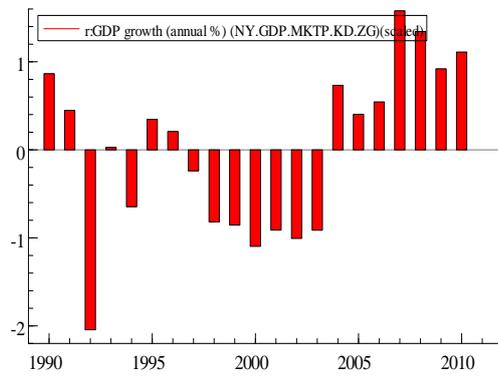
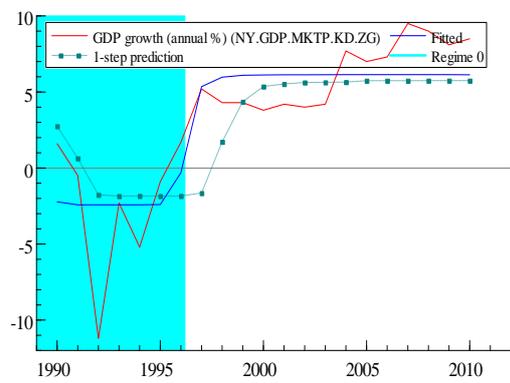
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.93202	0.044627
Regime 1,t+1	0.067980	0.95537

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -0.053818 7.0900 4.5723 1.7897 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime	years	avg.prob.
Regime 0	1990 - 1996	7 0.961
Total: 7 years (33.33%) with average duration of 7.00 years.		
Regime 1	1997 - 2010	14 0.991
Total: 14 years (66.67%) with average duration of 14.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.50885 [0.7754]$
 ARCH 1-1 test: $F(1,13) = 0.098781 [0.7583]$
 Portmanteau (4): $\chi^2(4) = 9.3430 [0.0531]$



39. Azerbaijan 3-regime model (preferred model)

Switching(3) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Azerbaijan\Azerbaijan.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-12.1741	3.754	-3.24	0.008
Constant(1)	9.26129	0.6390	14.5	0.000
Constant(2)	28.6493	2.411	11.9	0.000
sigma(0)	9.54969	2.643	3.61	0.004
sigma(1)	2.03429	0.4586	4.44	0.001
sigma(2)	4.17439	1.708	2.44	0.033
p_{0|0}	0.935553	0.08167	11.5	0.000
p_{0|1}	0.0585076	0.06670	0.877	0.399
p_{1|1}	0.855459	0.1052	8.13	0.000
p_{1|2}	0.357319	0.2651	1.35	0.205

log-likelihood -67.2026437
 no. of observations 21 no. of parameters 10
 AIC.T 154.405287 AIC 7.35263273
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 4.71188 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 225.657

Linearity LR-test $\chi^2(8) = 38.989$ [0.0000]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.93555	0.058508	0.00000
Regime 1,t+1	0.064447	0.85546	0.35732
Regime 2,t+1	0.00000	0.086033	0.64268

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-12.614	8.2286	18.521	9.2345	1.9990	9.1889
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1996	7	0.999

Total: 7 years (33.33%) with average duration of 7.00 years.

Regime 1	years	avg.prob.
1997 - 2004	8	0.981
2008 - 2010	3	0.991

Total: 11 years (52.38%) with average duration of 5.50 years.

Regime 2	years	avg.prob.
2005 - 2007	3	1.000

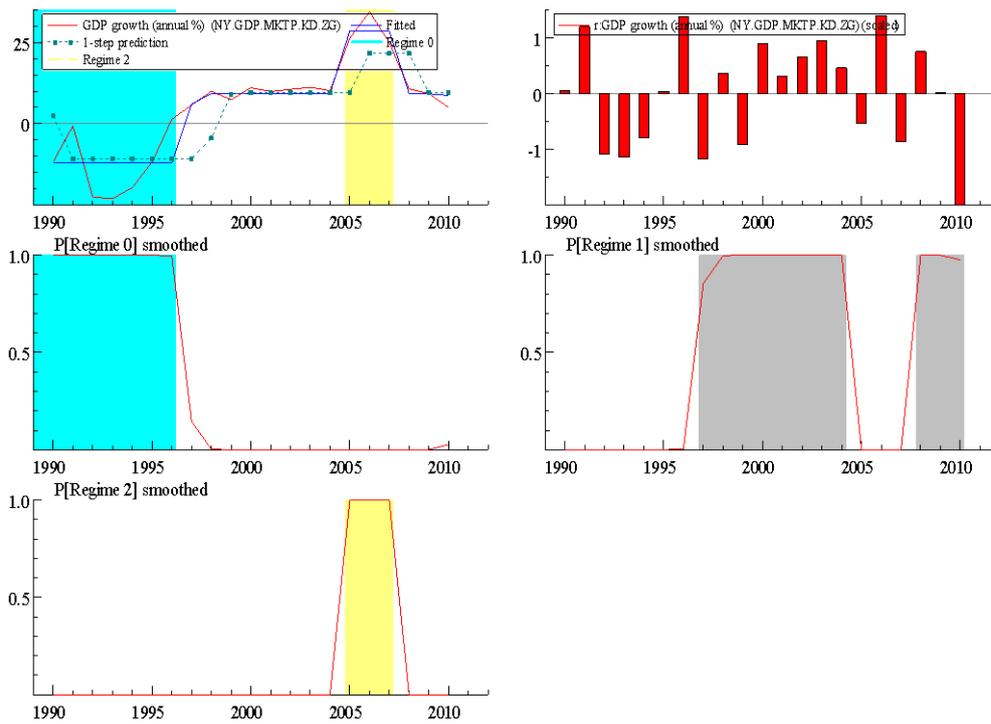
Total: 3 years (14.29%) with average duration of 3.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.2195$ [0.5435]

ARCH 1-1 test: $F(1,9) = 0.74617$ [0.4101]

Portmanteau(4): $\chi^2(4) = 1.4859$ [0.8291]



40. Azerbaijan 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Azerbaijan\Azerbaijan.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-13.9227	3.873	-3.60	0.003
Constant(1)	12.8320	2.329	5.51	0.000
sigma(0)	8.62083	2.728	3.16	0.006
sigma(1)	8.62279	1.623	5.31	0.000
$p_{\{0|0\}}$	0.931317	0.08981	10.4	0.000
$p_{\{0|1\}}$	0.0436676	0.04924	0.887	0.389

log-likelihood -78.7946973
 no. of observations 21 no. of parameters 6
 AIC.T 169.589395 AIC 8.07568545
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 4.71188 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 225.657

Linearity LR-test $\chi^2(4) = 15.805 [0.0033]**$ approximate upperbound: $[0.0062]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.93132	0.043668
Regime 1,t+1	0.068683	0.95633

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -5.5272 15.975 11.964 8.6162 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1995	6	0.997

Total: 6 years (28.57%) with average duration of 6.00 years.

Regime 1	years	avg.prob.
1996 - 2010	15	0.974

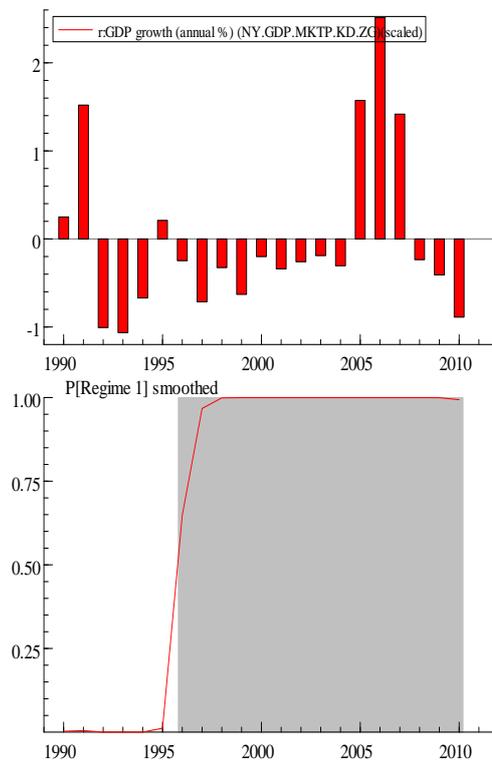
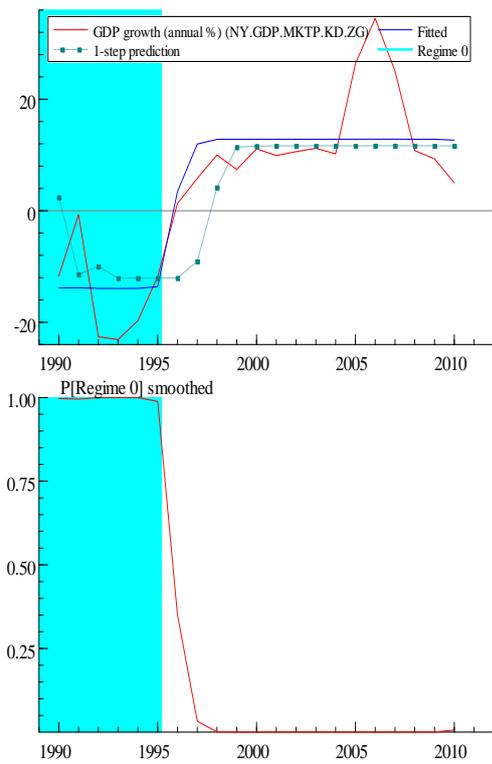
Total: 15 years (71.43%) with average duration of 15.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 12.006 [0.0025]**$

ARCH 1-1 test: $F(1,13) = 2.5197 [0.1364]$

Portmanteau(4): $\chi^2(4) = 6.6010 [0.1585]$



Part III: Incomplete – U group of countries

41. Ukraine 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)

The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Ukraine\Ukraine.in7

The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-9.26402	2.007	-4.62	0.001
Constant(1)	3.97434	0.7662	5.19	0.000
Constant(2)	9.13287	0.7928	11.5	0.000
sigma(0)	6.44473	1.428	4.51	0.001
sigma(1)	1.51035	0.5480	2.76	0.017
sigma(2)	1.70223	0.5713	2.98	0.011
p_{0|0}	0.866349	0.1044	8.30	0.000
p_{0|1}	0.345982	0.2161	1.60	0.135
p_{1|2}	0.604642	0.2221	2.72	0.019

log-likelihood -65.7845751

no. of observations 21 no. of parameters 9

AIC.T 149.56915 AIC 7.12234049

mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.79595 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 89.1676

Linearity LR-test $\chi^2(7) = 22.327$ [0.0022]** approximate upperbound: [0.0012]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.86635	0.34598	0.00000
Regime 1,t+1	0.13365	0.00000	0.60464
Regime 2,t+1	0.00000	0.65402	0.39536

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|\cdot\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	0.00000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-13.181	-0.34932	8.1429	4.5481	3.4100	2.1652
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1990 - 1999 10 0.996

2009 - 2009 1 1.000

Total: 11 years (52.38%) with average duration of 5.50 years.

Regime 1 years avg.prob.

2000 - 2000 1 0.963

2002 - 2002 1 0.967

2005 - 2005 1 0.999

2008 - 2008 1 0.988

2010 - 2010 1 0.852

Total: 5 years (23.81%) with average duration of 1.00 years.

Regime 2 years avg.prob.

2001 - 2001 1 0.999

2003 - 2004 2 1.000

2006 - 2007 2 0.994

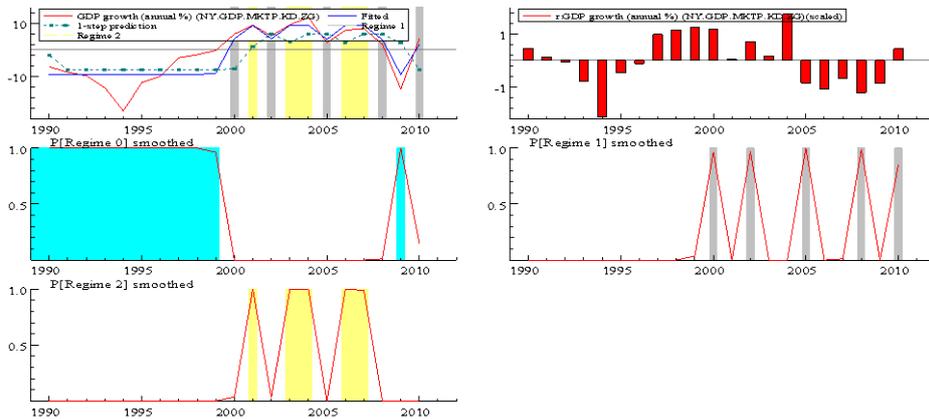
Total: 5 years (23.81%) with average duration of 1.67 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.14572$ [0.9297]

ARCH 1-1 test: $F(1,10) = 0.17075$ [0.6882]

Portmanteau(4): $\chi^2(4) = 7.6706$ [0.1044]



42. Ukraine 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Ukraine\Ukraine.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-8.88142	2.541	-3.49	0.003
Constant(1)	6.54420	1.335	4.90	0.000
sigma(0)	6.82631	1.663	4.10	0.001
sigma(1)	3.25925	0.9386	3.47	0.003
p_{0|0}	0.890705	0.1079	8.26	0.000
p_{0|1}	0.150622	0.1113	1.35	0.196

log-likelihood -69.0366141
 no. of observations 21 no. of parameters 6
 AIC.T 150.073228 AIC 7.1463442
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.79595 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 89.1676

Linearity LR-test $\chi^2(4) = 15.823 [0.0033]**$ approximate upperbound: $[0.0062]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.89071	0.15062
Regime 1,t+1	0.10929	0.84938

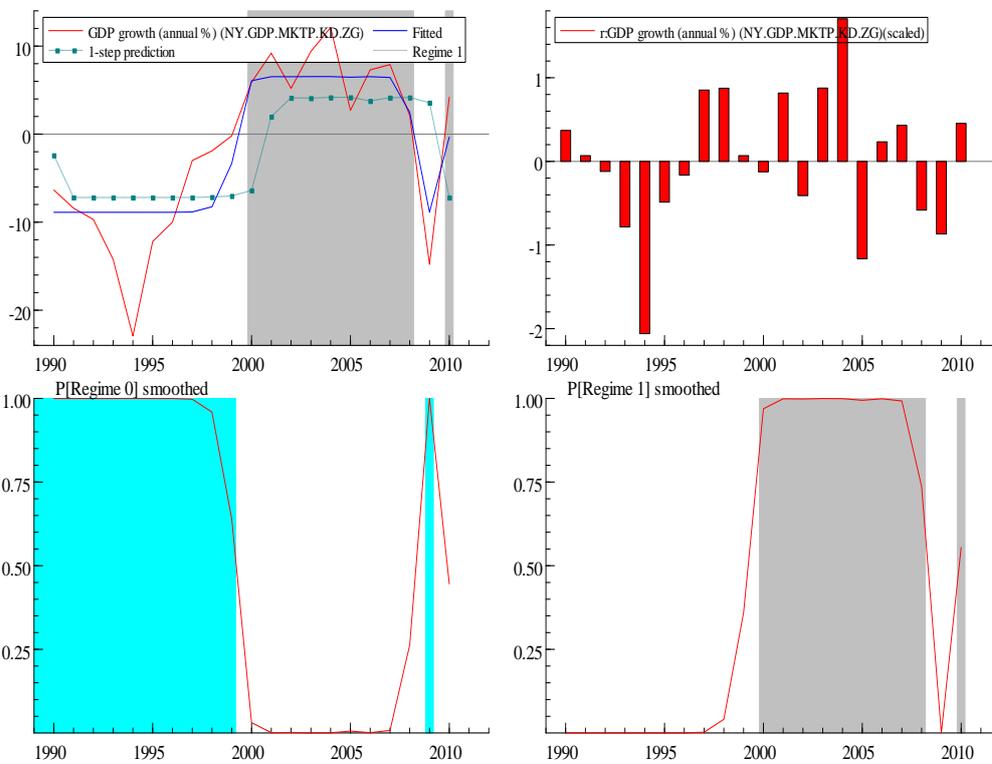
Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -9.4286 6.6000 6.2962 3.0116 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1999	10	0.960
2009 - 2009	1	1.000
Total: 11 years (52.38%) with average duration of 5.50 years.		
Regime 1	years	avg.prob.
2000 - 2008	9	0.965
2010 - 2010	1	0.554
Total: 10 years (47.62%) with average duration of 5.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 2.3034 [0.3161]$

ARCH 1-1 test: $F(1,13) = 0.050626 [0.8255]$
Portmanteau(4): $\chi^2(4) = 2.6097 [0.6251]$



43. Tajikistan 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Tajkisitan\Tajikistan.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-14.0116	3.668	-3.82	0.003
Constant(1)	6.01074	0.8103	7.42	0.000
Constant(2)	10.1127	0.2610	38.7	0.000
sigma(0)	9.09550	2.533	3.59	0.004
sigma(1)	2.10771	0.5865	3.59	0.004
sigma(2)	0.544177	0.2057	2.65	0.023
p_{0|0}	0.935320	0.08171	11.4	0.000
p_{0|1}	0.0704354	0.08023	0.878	0.399
p_{1|1}	0.825576	0.1281	6.44	0.000
p_{1|2}	0.236659	0.1879	1.26	0.234

log-likelihood -58.3272086
 no. of observations 21 no. of parameters 10
 AIC.T 136.654417 AIC 6.5073532
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -0.0340245 var(GDP growth (annual %)
 (NY.GDP.MKTP.KD.ZG)) 138.351

Linearity LR-test $\chi^2(8) = 46.467 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.93532	0.070435	0.00000
Regime 1,t+1	0.064680	0.82558	0.23666
Regime 2,t+1	0.00000	0.10399	0.76334

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -14.786 5.1429 9.5408 8.5919 2.0247 1.0219
 0.33333 0.33333 0.33333 0.33333 0.33333 0.33333

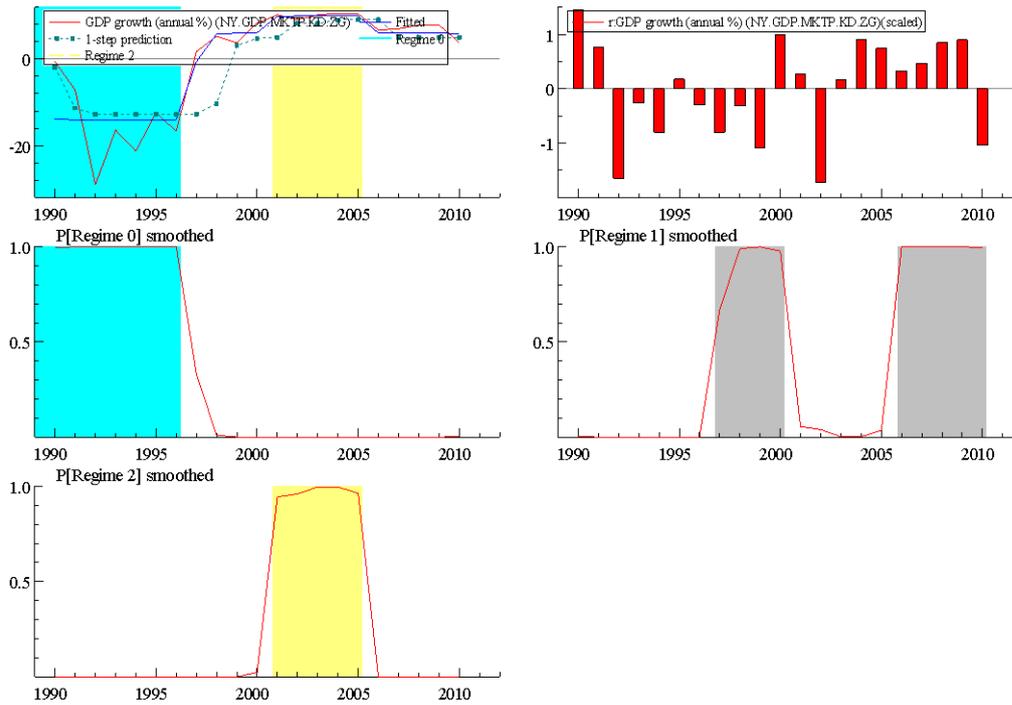
Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1996	7	0.999

Total: 7 years (33.33%) with average duration of 7.00 years.
 Regime 1 years avg.prob.
 1997 - 2000 4 0.909
 2006 - 2010 5 0.999
 Total: 9 years (42.86%) with average duration of 4.50 years.
 Regime 2 years avg.prob.
 2001 - 2005 5 0.972
 Total: 5 years (23.81%) with average duration of 5.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.9458$ [0.3780]
 ARCH 1-1 test: $F(1,9) = 0.92083$ [0.3623]
 Portmanteau(4): $\chi^2(4) = 1.3152$ [0.8588]



44. Tajikistan 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Tajkisitan\Tajikistan.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-13.5440	3.798	-3.57	0.003
Constant(1)	7.56635	0.7629	9.92	0.000
sigma(0)	9.36237	2.585	3.62	0.003
sigma(1)	2.53496	0.5692	4.45	0.000
$p_{\{0|0\}}$	0.938718	0.07773	12.1	0.000
$p_{\{0|1\}}$	0.0449402	0.05154	0.872	0.397

log-likelihood -62.9904238
 no. of observations 21 no. of parameters 6
 AIC.T 136.980848 AIC 6.57051655
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -0.0340245 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 138.351

Linearity LR-test $\chi^2(4) = 37.140$ [0.0000]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

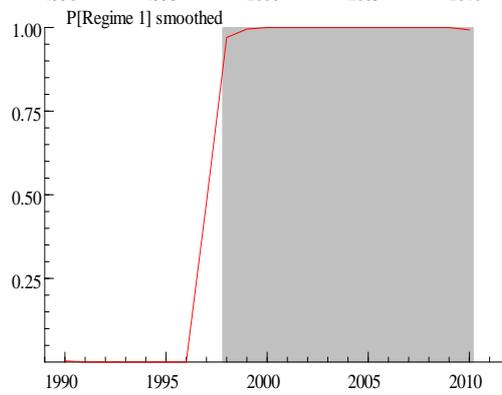
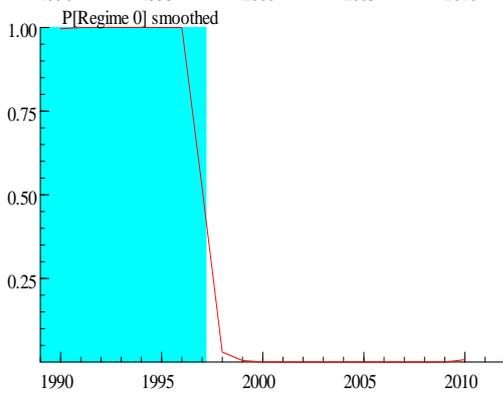
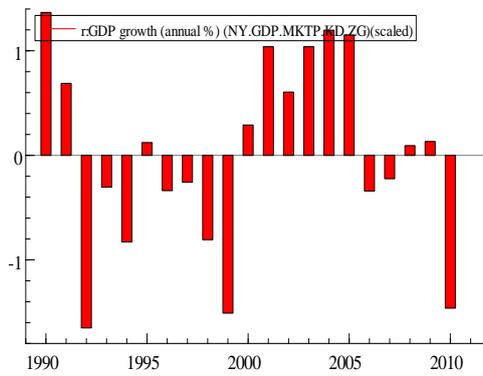
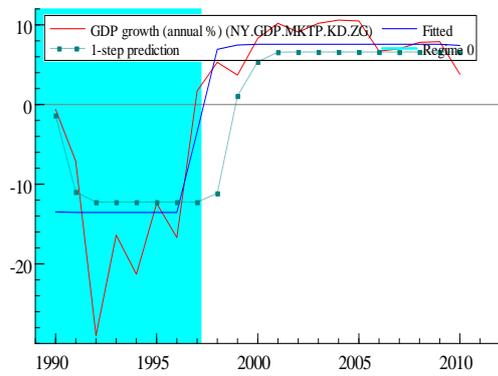
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.93872	0.044940
Regime 1,t+1	0.061282	0.95506

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -8.0909 8.8285 11.225 1.4069 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime	years	avg.prob.
Regime 0	1990 - 1997	8 0.940
Total: 8 years (38.10%) with average duration of 8.00 years.		
Regime 1	1998 - 2010	13 0.997
Total: 13 years (61.90%) with average duration of 13.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.73429$ [0.6927]
 ARCH 1-1 test: $F(1,13) = 0.29848$ [0.5941]
 Portmanteau(4): $\chi^2(4) = 2.1443$ [0.7092]



45. Moldova 3-regime model (preferred model)

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Moldova\Moldova.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-25.2055	4.093	-6.16	0.000
Constant(1)	-1.14997	1.207	-0.953	0.361
Constant(2)	7.17020	0.2352	30.5	0.000
sigma(0)	6.82150	3.153	2.16	0.053
sigma(1)	3.79583	0.8864	4.28	0.001
sigma(2)	0.585199	0.1734	3.38	0.006
p_{0|0}	0.317222	0.2616	1.21	0.251
p_{0|1}	0.175876	0.1145	1.54	0.153
p_{1|1}	0.583404	0.1563	3.73	0.003
p_{1|2}	0.373195	0.1945	1.92	0.081

log-likelihood -63.1409966
 no. of observations 21 no. of parameters 10
 AIC.T 146.281993 AIC 6.9658092
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.92467 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 119.343

Linearity LR-test $\chi^2(8) = 33.735 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.31722	0.17588	0.00000
Regime 1,t+1	0.68278	0.58340	0.37319
Regime 2,t+1	0.00000	0.24072	0.62681

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|j\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-13.870	0.93609	7.1594	10.874	2.4583	0.59043
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1991 - 1992	2	0.998

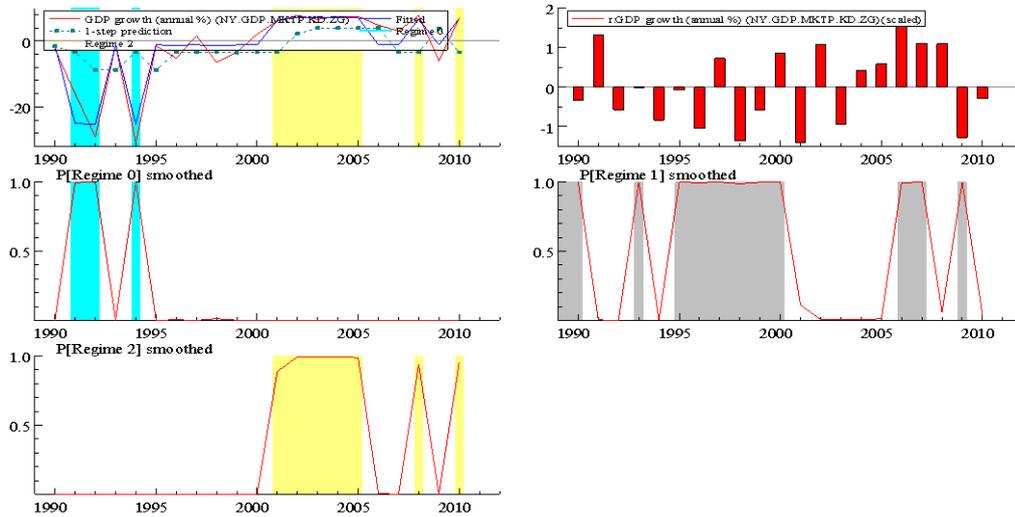
1994 - 1994	1	1.000
Total: 3 years (14.29%) with average duration of 1.50 years.		
Regime 1	years	avg.prob.
1990 - 1990	1	0.999
1993 - 1993	1	0.999
1995 - 2000	6	0.997
2006 - 2007	2	0.997
2009 - 2009	1	1.000
Total: 11 years (52.38%) with average duration of 2.20 years.		
Regime 2	years	avg.prob.
2001 - 2005	5	0.972
2008 - 2008	1	0.942
2010 - 2010	1	0.960
Total: 7 years (33.33%) with average duration of 2.33 years.		

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 3.1001 [0.2122]$

ARCH 1-1 test: $F(1,9) = 0.19925 [0.6659]$

Portmanteau(4): $\chi^2(4) = 3.5233 [0.4743]$



46. Moldova 2-regime model

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Moldova\Moldova.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-7.64588	3.334	-2.29	0.037
Constant(1)	6.30153	0.6669	9.45	0.000
sigma(0)	10.9835	2.223	4.94	0.000
sigma(1)	1.65751	0.5411	3.06	0.008
$p_{\{0|0\}}$	0.889298	0.09704	9.16	0.000
$p_{\{0|1\}}$	0.170667	0.1272	1.34	0.200

log-likelihood -70.2251507
 no. of observations 21 no. of parameters 6
 AIC.T 152.450301 AIC 7.25953816
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.92467 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 119.343

Linearity LR-test $\chi^2(4) = 19.567 [0.0006]**$ approximate upperbound: $[0.0012]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.88930	0.17067
Regime 1,t+1	0.11070	0.82933

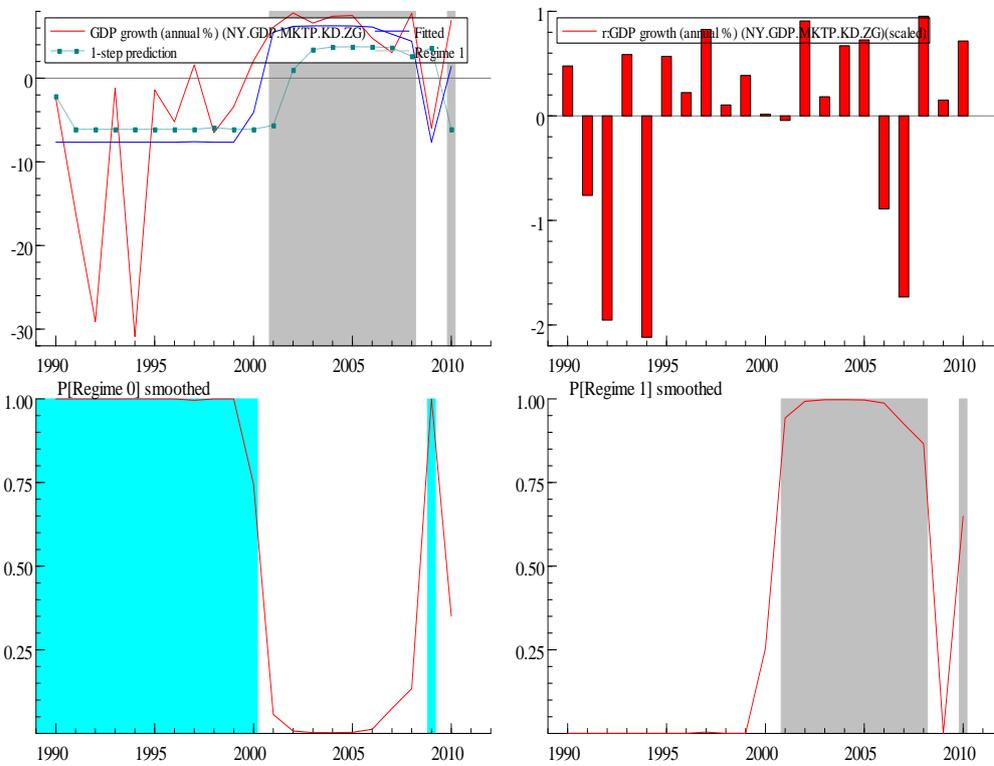
Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -9.1352 6.0069 10.737 1.9270 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 2000	11	0.976
2009 - 2009	1	1.000
Total: 12 years (57.14%) with average duration of 6.00 years.		
Regime 1	years	avg.prob.
2001 - 2008	8	0.963
2010 - 2010	1	0.649
Total: 9 years (42.86%) with average duration of 4.50 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 14.112 [0.0009]**$

ARCH 1-1 test: $F(1,13) = 0.080866 [0.7806]$
 Portmanteau(4): $\chi^2(4) = 1.1496 [0.8863]$



47. Kyrgyz Republic 3-regime model

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Kyrgyz Rep\Kyrgyz Rep.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-12.4332	2.485	-5.00	0.000
Constant(1)	3.25221	1.170	2.78	0.018
Constant(2)	8.04918	0.6390	12.6	0.000
sigma(0)	5.40890	1.856	2.92	0.014
sigma(1)	2.78299	0.7775	3.58	0.004
sigma(2)	1.11404	0.4208	2.65	0.023
p_{0|0}	0.770723	0.1781	4.33	0.001
p_{0|1}	0.0775955	0.08026	0.967	0.354
p_{1|1}	0.759933	0.1885	4.03	0.002
p_{1|2}	0.601689	0.2478	2.43	0.034

log-likelihood -61.3534605
 no. of observations 21 no. of parameters 10
 AIC.T 142.706921 AIC 6.79556767
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.569551 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 68.4923

Linearity LR-test $\chi^2(8) = 25.650$ [0.0012]** approximate upperbound: [0.0009]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.77072	0.077596	0.00000
Regime 1,t+1	0.00000	0.75993	0.60169
Regime 2,t+1	0.22928	0.16247	0.39831

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|j\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	0.00000	-1.0000	-1.0000
Regime 2,t+1	-2.0000	-2.0000	-2.0000

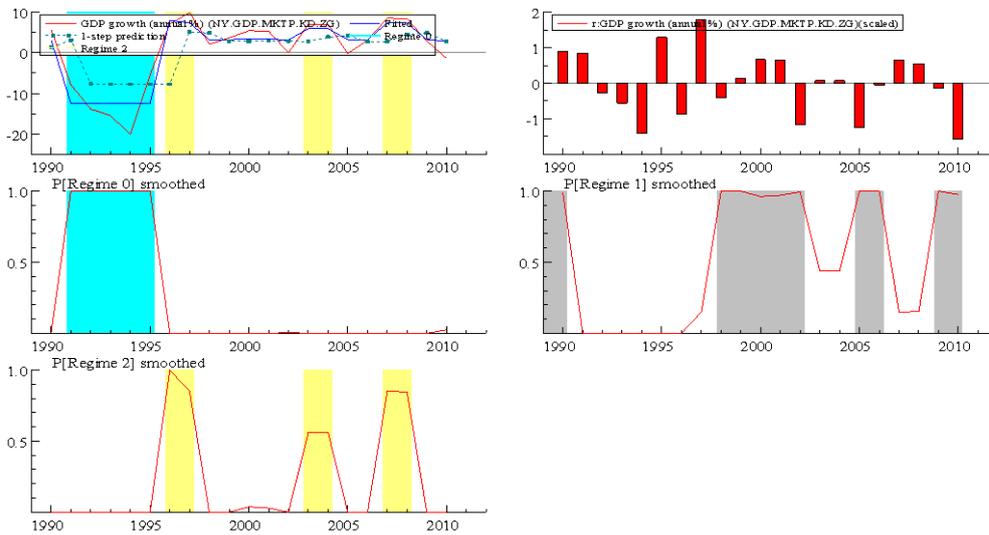
Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -9.1774 3.2173 7.6688 6.9555 1.7478 1.2763
 0.33333 0.33333 0.33333 0.33333 0.33333 0.33333

Regime classification based on smoothed probabilities
 Regime 0 years avg.prob.

1991 - 1995	5	1.000
Total: 5 years (23.81%) with average duration of 5.00 years.		
Regime 1	years	avg.prob.
1990 - 1990	1	0.991
1998 - 2002	5	0.985
2005 - 2006	2	0.999
2009 - 2010	2	0.988
Total: 10 years (47.62%) with average duration of 2.50 years.		
Regime 2	years	avg.prob.
1996 - 1997	2	0.925
2003 - 2004	2	0.562
2007 - 2008	2	0.849
Total: 6 years (28.57%) with average duration of 2.00 years.		

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.055675$ [0.9725]
 ARCH 1-1 test: $F(1,9) = 0.090735$ [0.7701]
 Portmanteau(4): $\chi^2(4) = 2.5942$ [0.6279]



48. Kyrgyz Republic 2-regime model (preffered model)

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Kyrgyz Rep\Kyrgyz Rep.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-12.5170	2.489	-5.03	0.000
Constant(1)	4.64656	0.8397	5.53	0.000
sigma(0)	5.36749	1.827	2.94	0.010
sigma(1)	3.29832	0.6186	5.33	0.000
$\rho_{\{0|0\}}$	0.768663	0.1795	4.28	0.001
$\rho_{\{0|1\}}$	0.0559887	0.05626	0.995	0.335

log-likelihood -63.3928433

no. of observations 21 no. of parameters 6

AIC.T 138.785687 AIC 6.60884222

mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 0.569551 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 68.4923

Linearity LR-test $\chi^2(4) = 21.571$ [0.0002]** approximate upperbound: [0.0005]**

Transition probabilities $\rho_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.76866	0.055989
Regime 1,t+1	0.23134	0.94401

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-5.1043 6.8108 7.7700 1.7488 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1991 - 1995 5 0.991

Total: 5 years (23.81%) with average duration of 5.00 years.

Regime 1 years avg.prob.

1990 - 1990 1 0.993

1996 - 2010 15 0.998

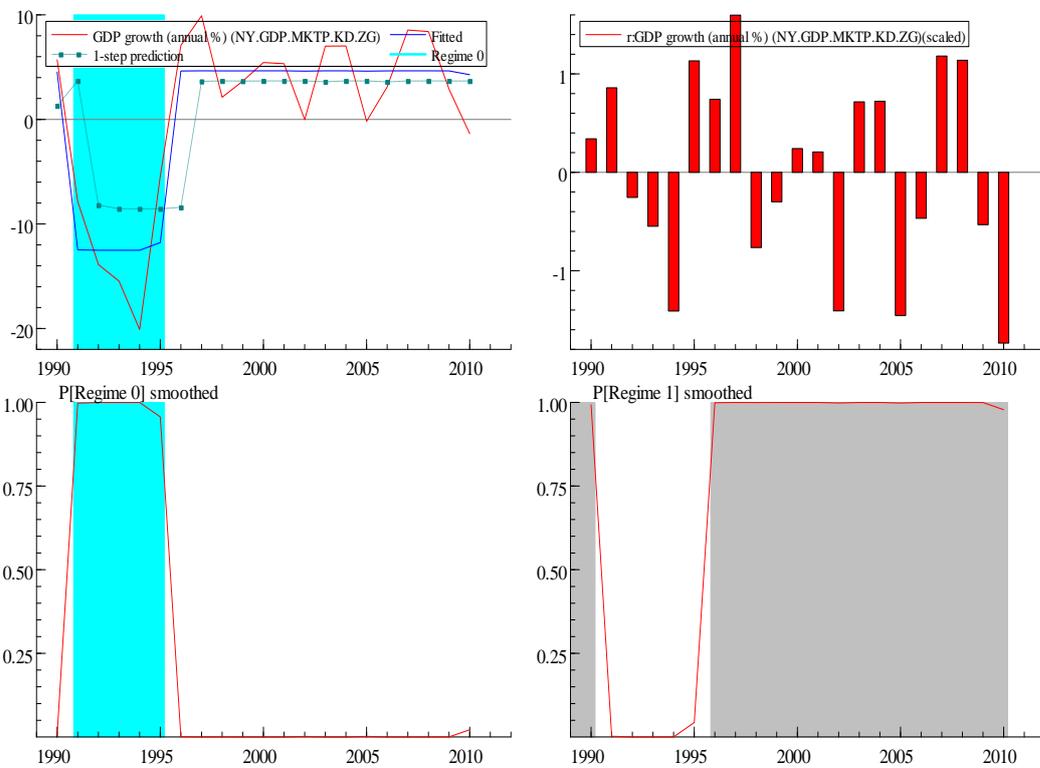
Total: 16 years (76.19%) with average duration of 8.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.6157$ [0.4458]

ARCH 1-1 test: $F(1,13) = 0.68587$ [0.4225]

Portmanteau(4): $\chi^2(4) = 8.3262 [0.0803]$



49. Georgia 3-regime model

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Georgia\Georgia.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-19.7083	6.101	-3.23	0.008
Constant(1)	3.86599	0.5616	6.88	0.000
Constant(2)	10.6847	0.4107	26.0	0.000
sigma(0)	14.1431	4.259	3.32	0.007
sigma(1)	1.59358	0.3983	4.00	0.002
sigma(2)	1.00477	0.2905	3.46	0.005
p_{0|0}	0.779696	0.1895	4.11	0.002
p_{0|1}	0.200097	0.1339	1.49	0.163
p_{1|1}	0.471013	0.1739	2.71	0.020
p_{1|2}	0.520557	0.1980	2.63	0.023

log-likelihood -66.669407
 no. of observations 21 no. of parameters 10
 AIC.T 153.338814 AIC 7.30184829
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.18767 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 213.512

Linearity LR-test $\chi^2(8) = 38.894$ [0.0000]** approximate upperbound: [0.0000]**

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.77970	0.20010	0.00000
Regime 1,t+1	0.22030	0.47101	0.52056
Regime 2,t+1	0.00000	0.32889	0.47944

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|j\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-17.493	3.8607	10.069	14.747	1.3637	1.7702
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1990 - 1994 5 1.000
 2009 - 2009 1 0.999

Total: 6 years (28.57%) with average duration of 3.00 years.

Regime 1 years avg.prob.

1995 - 1995 1 1.000
 1998 - 2002 5 0.994
 2004 - 2004 1 1.000
 2008 - 2008 1 1.000
 2010 - 2010 1 0.798

Total: 9 years (42.86%) with average duration of 1.80 years.

Regime 2 years avg.prob.

1996 - 1997 2 1.000
 2003 - 2003 1 0.998
 2005 - 2007 3 0.998

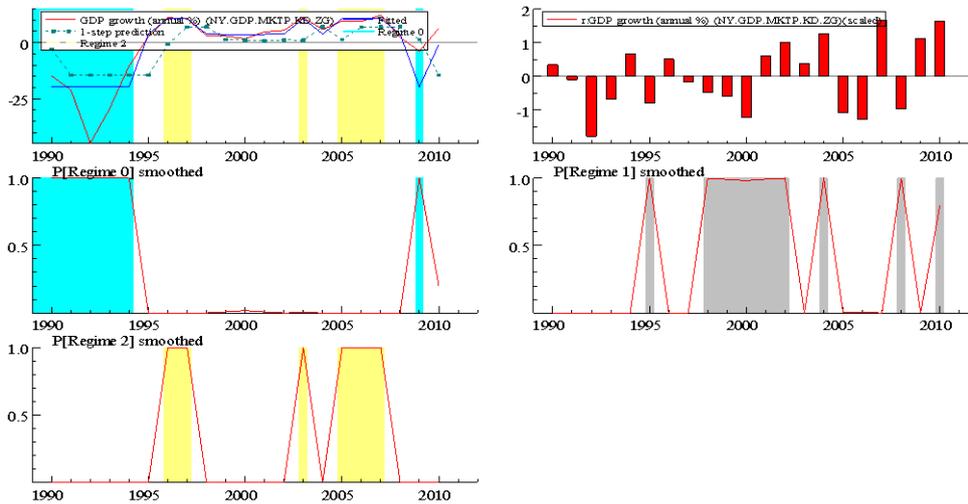
Total: 6 years (28.57%) with average duration of 2.00 years.

Descriptive statistics for scaled residuals:

Normality test: $\text{Chi}^2(2) = 1.1675 [0.5578]$

ARCH 1-1 test: $F(1,9) = 0.023956 [0.8804]$

Portmanteau(4): $\text{Chi}^2(4) = 6.0625 [0.1945]$



50. Georgia 2-regime model (preferred model)

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa
 Trajkova\Desktop\Data_may_2012\Georgia\Georgia.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-23.8185	5.691	-4.19	0.001
Constant(1)	5.98102	1.083	5.52	0.000
sigma(0)	12.4317	4.065	3.06	0.008
sigma(1)	4.30904	0.7724	5.58	0.000
$p_{\{0|0\}}$	0.919862	0.1087	8.46	0.000
$p_{\{0|1\}}$	0.0424182	0.04690	0.904	0.380

log-likelihood -70.1636766
 no. of observations 21 no. of parameters 6
 AIC.T 152.327353 AIC 7.25368349
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.18767 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 213.512

Linearity LR-test $\chi^2(4) = 31.906 [0.0000]**$ approximate upperbound: $[0.0000]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.91986	0.042418
Regime 1,t+1	0.080138	0.95758

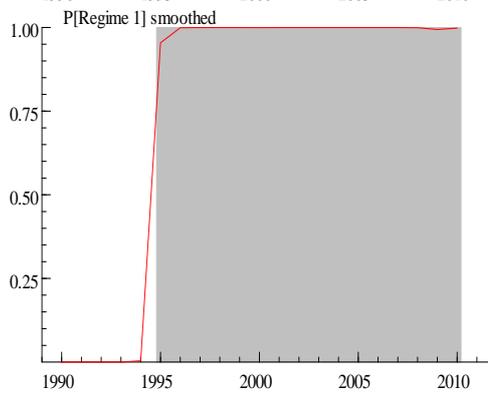
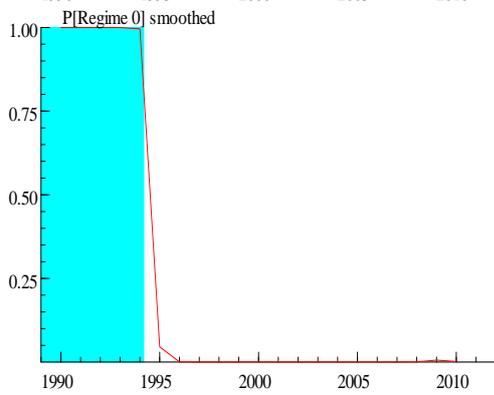
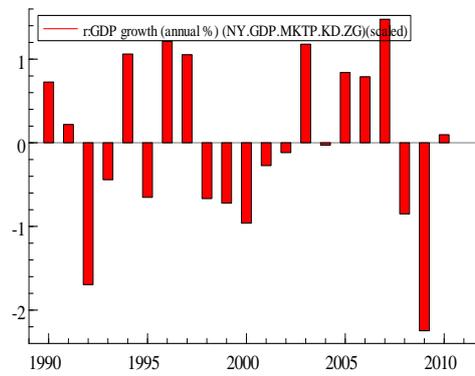
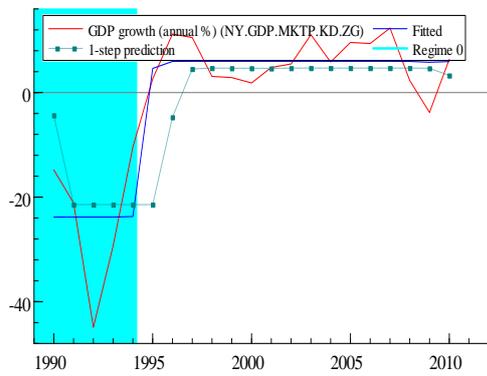
Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -10.142 8.6621 15.264 2.6210 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1994	5	0.999
Total: 5 years (23.81%) with average duration of 5.00 years.		
Regime 1	years	avg.prob.
1995 - 2010	16	0.997
Total: 16 years (76.19%) with average duration of 16.00 years.		

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.96275 [0.6179]$
 ARCH 1-1 test: $F(1,13) = 1.2614 [0.2817]$
 Portmanteau(4): $\chi^2(4) = 3.4672 [0.4829]$



51. Serbia 3-regime model

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Serbia_short data on employment.xls
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-11.2085	4.694	-2.39	0.034
Constant(1)	3.80785	0.8164	4.66	0.001
Constant(2)	6.87315	0.6640	10.4	0.000
sigma(0)	11.5723	3.117	3.71	0.003
sigma(1)	1.56031	0.5549	2.81	0.016
sigma(2)	1.60829	0.5349	3.01	0.011
p_{0|0}	0.686176	0.1917	3.58	0.004
p_{1|1}	0.575009	0.2271	2.53	0.026
p_{0|2}	0.305296	0.1663	1.84	0.091

log-likelihood -65.505278
 no. of observations 21 no. of parameters 9
 AIC.T 149.010556 AIC 7.09574076
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -0.574464 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 116.782

Linearity LR-test $\chi^2(7) = 28.551 [0.0002]**$ approximate upperbound: $[0.0001]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.68618	0.00000	0.30530
Regime 1,t+1	0.31382	0.57501	0.00000
Regime 2,t+1	0.00000	0.42499	0.69470

Transition probability settings (-1: free parameter, -2: 1-sum($p_{\{i|.\}}$))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	0.00000	-1.0000
Regime 1,t+1	-2.0000	-1.0000	0.00000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -12.725 3.8016 7.2000 10.891 1.4670 1.5306
 0.33333 0.33333 0.33333 0.33333 0.33333 0.33333

Regime classification based on smoothed probabilities

Regime	years	avg.prob.
Regime 0	1990 - 1993	4 1.000

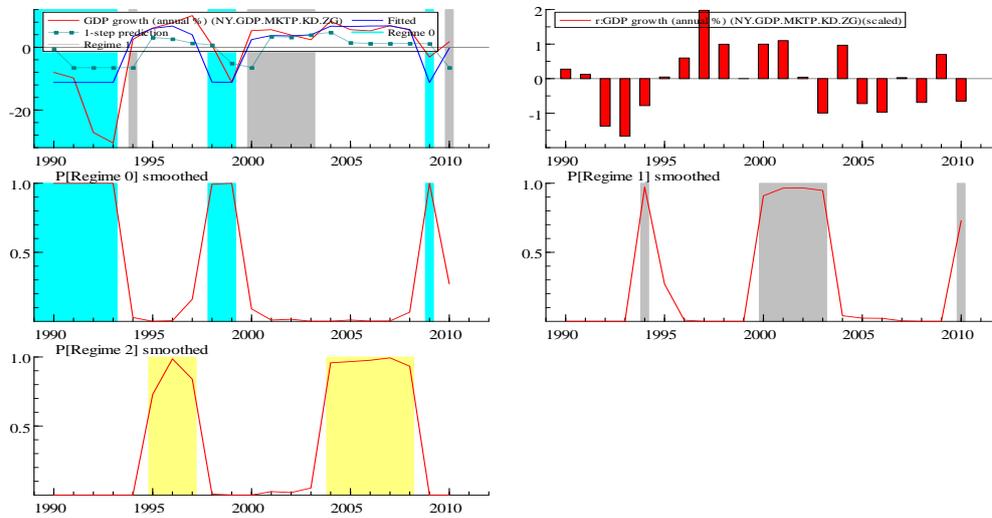
1998 - 1999	2	0.997
2009 - 2009	1	1.000
Total: 7 years (33.33%) with average duration of 2.33 years.		
Regime 1	years	avg.prob.
1994 - 1994	1	0.972
2000 - 2003	4	0.947
2010 - 2010	1	0.729
Total: 6 years (28.57%) with average duration of 2.00 years.		
Regime 2	years	avg.prob.
1995 - 1997	3	0.852
2004 - 2008	5	0.966
Total: 8 years (38.10%) with average duration of 4.00 years.		

Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.083061 [0.9593]$

ARCH 1-1 test: $F(1,10) = 0.014748 [0.9057]$

Portmanteau(4): $\chi^2(4) = 3.2012 [0.5247]$



52. Serbia 2- regime model (preferred model)

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Serbia_short data on employment.xls
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-15.1658	6.348	-2.39	0.030
Constant(1)	4.86876	0.9414	5.17	0.000
sigma(0)	10.6635	3.727	2.86	0.012
sigma(1)	2.97928	0.7604	3.92	0.001
p_{0|0}	0.684484	0.2224	3.08	0.008
p_{0|1}	0.134983	0.1104	1.22	0.240

log-likelihood -67.618726
 no. of observations 21 no. of parameters 6
 AIC.T 147.237452 AIC 7.01130724
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -0.574464 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 116.782

Linearity LR-test $\chi^2(4) = 24.324 [0.0001]**$ approximate upperbound: $[0.0001]**$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

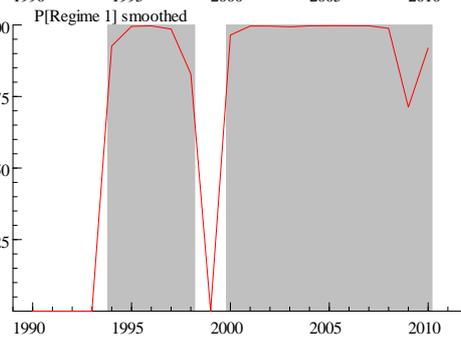
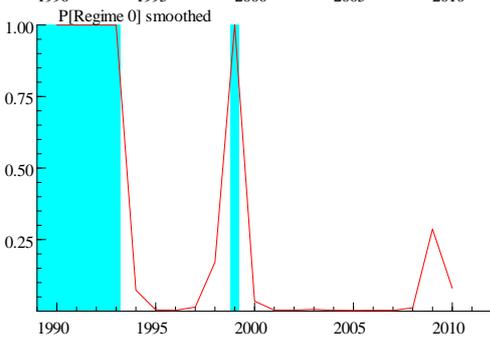
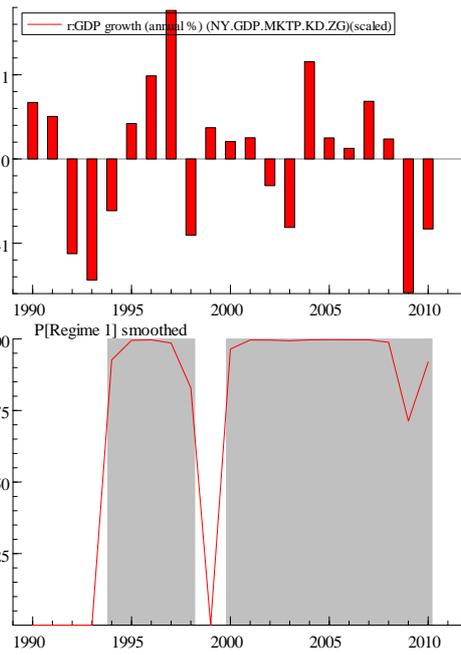
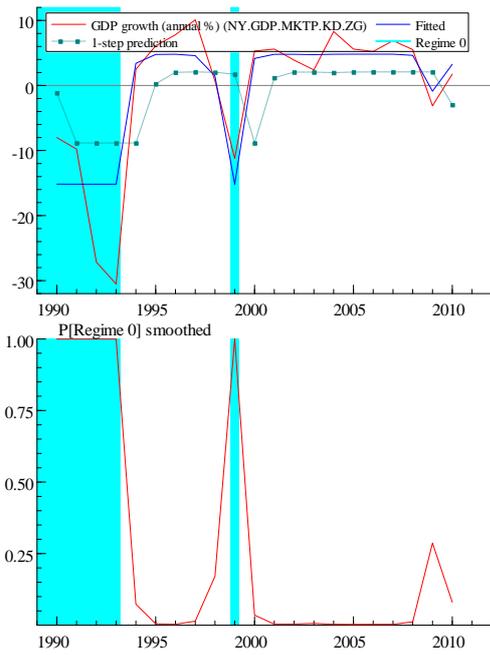
	Regime 0,t	Regime 1,t
Regime 0,t+1	0.68448	0.13498
Regime 1,t+1	0.31552	0.86502

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 -7.1376 6.6450 11.417 1.5373 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0	years	avg.prob.
1990 - 1993	4	1.000
1999 - 1999	1	1.000
Total: 5 years (23.81%) with average duration of 2.50 years.		
Regime 1	years	avg.prob.
1994 - 1998	5	0.947
2000 - 2010	11	0.960
Total: 16 years (76.19%) with average duration of 8.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.082084 [0.9598]$
 ARCH 1-1 test: $F(1,13) = 0.10446 [0.7517]$
 Portmanteau(4): $\chi^2(4) = 4.7026 [0.3192]$



Appendix 6. 3 Example of the testing down procedure performed in the case of Georgia

I.Step One - Three-regime model with constant and variance switching terms and non-switching autoregressive parameter with one lag

Switching(3) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS_ARMA(3, 1, 0)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Georgia\Georgia.in7
 The estimation sample is: 1990 - 2010

*** Warning: there was no convergence; log-likelihood -51.4762407
 parameter values:

0.10341
 -25.201
 -9.9761
 5.9046
 21.365
 4.9982e-006
 4.1645
 0.90026
 0.099687
 0.013393
 0.026384
 0.00026989

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

No convergence (no improvement in line search)

Used starting values:

0.16157	-10.473	0.79846	6.1117	16.331	12.753
7.4020	0.33333	0.33333	0.33333	0.33333	0.33333
0.33333					

II.Step Two – Three-regime model with switching constant and variance

Switching(2) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(3)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Georgia\Georgia.in7
 The estimation sample is: 1990 - 2010

Coefficient	Std.Error	t-value	t-prob
Constant(0)	-19.7083	6.101	-3.23 0.008
Constant(1)	3.86599	0.5616	6.88 0.000
Constant(2)	10.6847	0.4107	26.0 0.000
sigma(0)	14.1431	4.259	3.32 0.007
sigma(1)	1.59358	0.3983	4.00 0.002

sigma(2)	1.00477	0.2905	3.46	0.005
p_{0|0}	0.779696	0.1895	4.11	0.002
p_{0|1}	0.200097	0.1339	1.49	0.163
p_{1|1}	0.471013	0.1739	2.71	0.020
p_{1|2}	0.520557	0.1980	2.63	0.023

log-likelihood -66.669407
no. of observations 21 no. of parameters 10
AIC.T 153.338814 AIC 7.30184829
mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.18767 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 213.512

1.Linearity LR-test Chi²(8) = 38.894 [0.0000]** approximate upperbound: [0.0000]**

3.Transition probabilities p_{i|j} = P(Regime i at t+1 | Regime j at t)

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	0.77970	0.20010	0.00000
Regime 1,t+1	0.22030	0.47101	0.52056
Regime 2,t+1	0.00000	0.32889	0.47944

Transition probability settings (-1: free parameter, -2: 1-sum(p_{i|.}))

	Regime 0,t	Regime 1,t	Regime 2,t
Regime 0,t+1	-1.0000	-1.0000	0.00000
Regime 1,t+1	-2.0000	-1.0000	-1.0000
Regime 2,t+1	0.00000	-2.0000	-2.0000

Used ergodic probabilities to start recursion

Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-17.493	3.8607	10.069	14.747	1.3637	1.7702
0.33333	0.33333	0.33333	0.33333	0.33333	0.33333

4.Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1990 - 1994	5	1.000
2009 - 2009	1	0.999

Total: 6 years (28.57%) with average duration of 3.00 years.

Regime 1 years avg.prob.

1995 - 1995	1	1.000
1998 - 2002	5	0.994
2004 - 2004	1	1.000
2008 - 2008	1	1.000
2010 - 2010	1	0.798

Total: 9 years (42.86%) with average duration of 1.80 years.

Regime 2 years avg.prob.

1996 - 1997	2	1.000
2003 - 2003	1	0.998
2005 - 2007	3	0.998

Total: 6 years (28.57%) with average duration of 2.00 years.



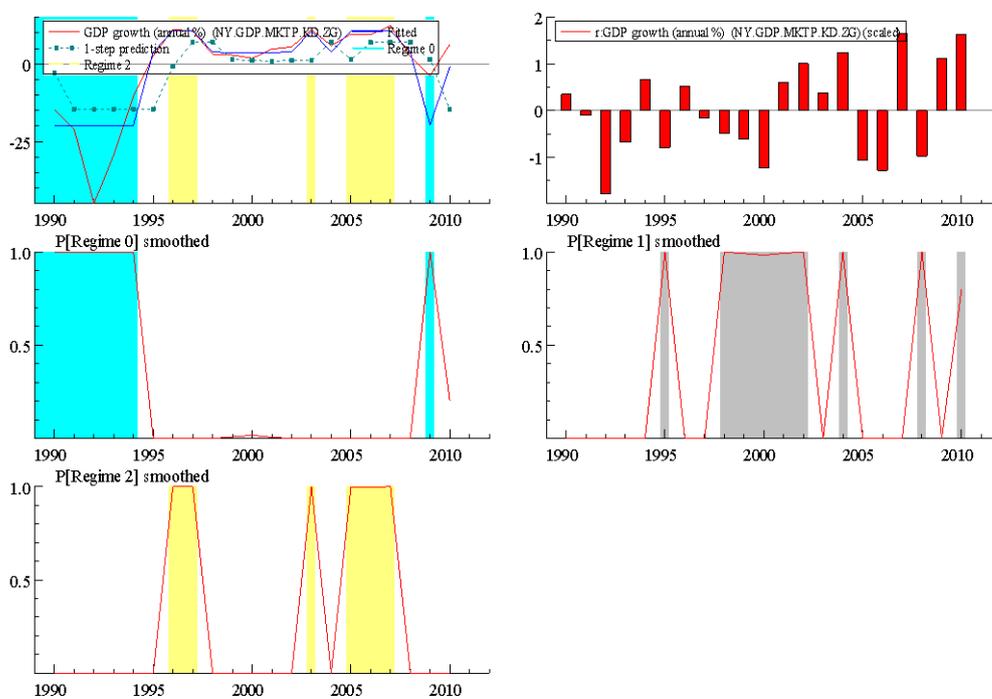
2.Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 1.1675$ [0.5578]

ARCH 1-1 test: $F(1,9) = 0.023956$ [0.8804]

Portmanteau(4): $\chi^2(4) = 6.0625$ [0.1945]

5.Graphic presentation:



III.Step Three – Two-regime model with constant and variance switching terms and non-switching autoregressive parameter with one lag

Switching(3) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS_ARMA(2, 1, 0)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Georgia\Georgia.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
AR-1	0.462081	0.1964	2.35	0.035
Constant(0)	-6.51003	13.59	-0.479	0.640
Constant(1)	5.79754	2.238	2.59	0.022
sigma(0)	17.1905	7.591	2.26	0.041
sigma(1)	4.30468	0.8203	5.25	0.000
$p_{\{0|0\}}$	0.887130	0.1630	5.44	0.000
$p_{\{0|1\}}$	0.0512647	0.05752	0.891	0.389

log-likelihood -66.3494572
 no. of observations 20 no. of parameters 7
 AIC.T 146.698914 AIC 7.33494572
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.18767 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 213.512

Linearity LR-test $\chi^2(4) = 11.711 [0.0196]^*$ approximate upperbound: $[0.0364]^*$

Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 \mid \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.88713	0.051265
Regime 1,t+1	0.11287	0.94874

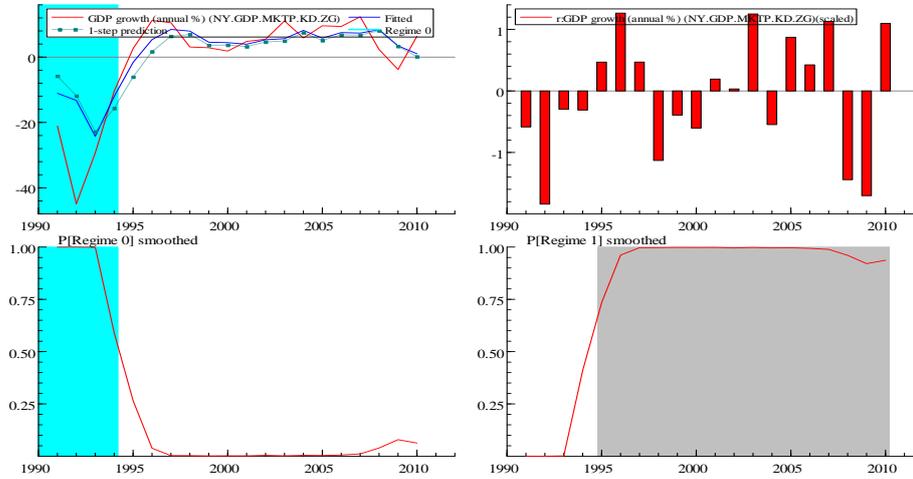
Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix
 SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):
 Strong convergence
 Used starting values:
 0.38065 -4.7829 2.7670 14.216 11.652 0.50000
 0.50000

Regime classification based on smoothed probabilities

Regime	years	avg.prob.
Regime 0	1991 - 1994	4 0.897
Total: 4 years (20.00%) with average duration of 4.00 years.		
Regime 1	1995 - 2010	16 0.967
Total: 16 years (80.00%) with average duration of 16.00 years.		

Descriptive statistics for scaled residuals:
 Normality test: $\chi^2(2) = 0.90303 [0.6367]$

ARCH 1-2 test: $F(2,9) = 0.081504 [0.9224]$
 Portmanteau(4): $\chi^2(4) = 2.1182 [0.0714]$



IV.Step Four – Two-regime model with switching constant and variance

Switching(1) Modelling GDP growth (annual %) (NY.GDP.MKTP.KD.ZG) by MS(2)
 The dataset is: C:\Documents and Settings\Natasa Trajkova\Desktop\Data_may_2012\Georgia\Georgia.in7
 The estimation sample is: 1990 - 2010

	Coefficient	Std.Error	t-value	t-prob
Constant(0)	-23.8185	5.691	-4.19	0.001
Constant(1)	5.98102	1.083	5.52	0.000
sigma(0)	12.4317	4.065	3.06	0.008
sigma(1)	4.30904	0.7724	5.58	0.000
$p_{\{0|0\}}$	0.919862	0.1087	8.46	0.000
$p_{\{0|1\}}$	0.0424182	0.04690	0.904	0.380

log-likelihood -70.1636766
 no. of observations 21 no. of parameters 6
 AIC.T 152.327353 AIC 7.25368349
 mean(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) -1.18767 var(GDP growth (annual %) (NY.GDP.MKTP.KD.ZG)) 213.512

1.Linearity LR-test $\chi^2(4) = 31.906 [0.0000]**$ approximate upperbound: $[0.0000]**$

3.Transition probabilities $p_{\{i|j\}} = P(\text{Regime } i \text{ at } t+1 | \text{Regime } j \text{ at } t)$

	Regime 0,t	Regime 1,t
Regime 0,t+1	0.91986	0.042418
Regime 1,t+1	0.080138	0.95758

Used ergodic probabilities to start recursion
 Std.Error based on numerical Hessian matrix

SQPF using numerical derivatives (eps1=0.0001; eps2=0.005):

Strong convergence

Used starting values:

-10.142 8.6621 15.264 2.6210 0.50000 0.50000

Regime classification based on smoothed probabilities

Regime 0 years avg.prob.

1990 - 1994 5 0.999

Total: 5 years (23.81%) with average duration of 5.00 years.

Regime 1 years avg.prob.

1995 - 2010 16 0.997

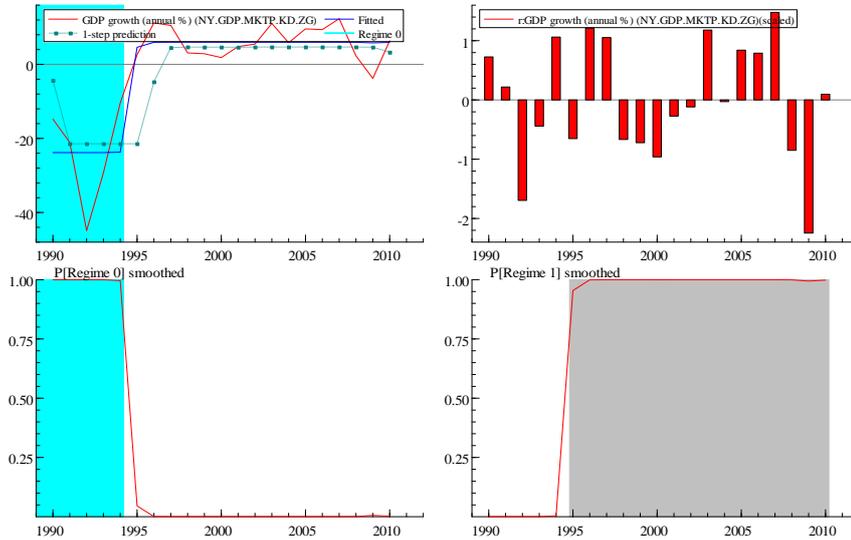
Total: 16 years (76.19%) with average duration of 16.00 years.

2.Descriptive statistics for scaled residuals:

Normality test: $\chi^2(2) = 0.96275 [0.6179]$

ARCH 1-1 test: $F(1,13) = 1.2614 [0.2817]$

Portmanteau(4): $\chi^2(4) = 3.4672 [0.4829]$



APPENDICES Chapter 7

Appendix 7. 1 Testing for stationarity the control variables included in the
multivariate model

1. Albania

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Lothman-Stock DF-GLS test statistic	-3.168660
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Lothman-Stock (1996, Table 1)
Warning: Test critical values calculated for 50 observations
and may not be accurate for a sample size of 20

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 03/31/13 Time: 16:46
Sample (adjusted): 1990 2009
Included observations: 20 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.620845	0.195933	-3.168660	0.0051
R-squared	0.345081	Mean dependent var		-21.23300
Adjusted R-squared	0.345081	S.D. dependent var		686.8000
S.E. of regression	555.8071	Akaike info criterion		15.52743
Sum squared resid	5869509.	Schwarz criterion		15.57721
Log likelihood	-154.2743	Hannan-Quinn criter.		15.53715
Durbin-Watson stat	1.255298			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-0.704170
Test critical values:	
1% level	-2.685718
5% level	-1.959071
10% level	-1.607456

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 16:49
 Sample (adjusted): 1990 2009
 Included observations: 20 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.107301	0.152379	-0.704170	0.4899
R-squared	-0.001653	Mean dependent var		111.6000
Adjusted R-squared	-0.001653	S.D. dependent var		686.8000
S.E. of regression	687.3673	Akaike info criterion		15.95232
Sum squared resid	8977003.	Schwarz criterion		16.00211
Log likelihood	-158.5232	Hannan-Quinn criter.		15.96204
Durbin-Watson stat	1.350118			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.546191
Test critical values:	
1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 16:51

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.836173	0.235795	-3.546191	0.0023
R-squared	0.393538	Mean dependent var		144.3684
Adjusted R-squared	0.393538	S.D. dependent var		854.0861
S.E. of regression	665.1254	Akaike info criterion		15.88902
Sum squared resid	7963053.	Schwarz criterion		15.93873
Log likelihood	-149.9457	Hannan-Quinn criter.		15.89744
Durbin-Watson stat	1.831138			

1. Albania

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.547131
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
 Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 16:52
 Sample (adjusted): 1992 2009
 Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.625450	0.176326	-3.547131	0.0025
R-squared	0.419183	Mean dependent var		-3033.591
Adjusted R-squared	0.419183	S.D. dependent var		30183.90
S.E. of regression	23003.56	Akaike info criterion		22.97864
Sum squared resid	9.00E+09	Schwarz criterion		23.02810
Log likelihood	-205.8077	Hannan-Quinn criter.		22.98546
Durbin-Watson stat	1.773531			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.405110
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 16:52

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.247074	0.175839	-1.405110	0.1804
D(GLSRESID(-1))	-0.102213	0.208653	-0.489870	0.6313
R-squared	0.126270	Mean dependent var		-3738.967
Adjusted R-squared	0.068022	S.D. dependent var		26975.30
S.E. of regression	26041.69	Akaike info criterion		23.28292
Sum squared resid	1.02E+10	Schwarz criterion		23.38094
Log likelihood	-195.9048	Hannan-Quinn criter.		23.29266
Durbin-Watson stat	2.102990			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-4.268536
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 16:53

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.992047	0.232409	-4.268536	0.0006
R-squared	0.530557	Mean dependent var		2782.796
Adjusted R-squared	0.530557	S.D. dependent var		45170.40
S.E. of regression	30948.91	Akaike info criterion		23.57509
Sum squared resid	1.53E+10	Schwarz criterion		23.62410
Log likelihood	-199.3882	Hannan-Quinn criter.		23.57996
Durbin-Watson stat	2.128801			

2. Bulgaria

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.359340
Test critical values: 1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 20

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 16:57

Sample (adjusted): 1990 2009

Included observations: 20 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.309178	0.131044	-2.359340	0.0292
R-squared	0.219218	Mean dependent var		-187.0345
Adjusted R-squared	0.219218	S.D. dependent var		1965.649
S.E. of regression	1736.884	Akaike info criterion		17.80628
Sum squared resid	57318585	Schwarz criterion		17.85607
Log likelihood	-177.0628	Hannan-Quinn criter.		17.81600
Durbin-Watson stat	1.061545			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.088052
Test critical values:	
1% level	-2.685718
5% level	-1.959071
10% level	-1.607456

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 16:57
 Sample (adjusted): 1990 2009
 Included observations: 20 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.209044	0.100114	-2.088052	0.0505
R-squared	0.118818	Mean dependent var		-553.2500
Adjusted R-squared	0.118818	S.D. dependent var		1965.649
S.E. of regression	1845.181	Akaike info criterion		17.92725
Sum squared resid	64689131	Schwarz criterion		17.97704
Log likelihood	-178.2725	Hannan-Quinn criter.		17.93697
Durbin-Watson stat	1.011533			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rootenber-Stock DF-GLS test statistic	-2.570338
Test critical values:	
1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 16:57

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.524096	0.203902	-2.570338	0.0193
R-squared	0.268157	Mean dependent var		43.63158
Adjusted R-squared	0.268157	S.D. dependent var		2100.997
S.E. of regression	1797.357	Akaike info criterion		17.87722
Sum squared resid	58148837	Schwarz criterion		17.92692
Log likelihood	-168.8336	Hannan-Quinn criter.		17.88563
Durbin-Watson stat	1.875854			

2. Bulgaria

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.169224
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 16:59

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.381074	0.175673	-2.169224	0.0465
D(GLSRESID(-1))	0.364960	0.247344	1.475519	0.1608
R-squared	0.250163	Mean dependent var		-3498.100
Adjusted R-squared	0.200173	S.D. dependent var		172190.9
S.E. of regression	153995.6	Akaike info criterion		26.83737
Sum squared resid	3.56E+11	Schwarz criterion		26.93539
Log likelihood	-226.1176	Hannan-Quinn criter.		26.84711
Durbin-Watson stat	1.273045			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.096862
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 16:59

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.301199	0.143643	-2.096862	0.0534
D(GLSRESID(-1))	0.267893	0.234496	1.142421	0.2712
R-squared	0.225700	Mean dependent var		-22505.50
Adjusted R-squared	0.174080	S.D. dependent var		172190.9
S.E. of regression	156487.3	Akaike info criterion		26.86947
Sum squared resid	3.67E+11	Schwarz criterion		26.96749
Log likelihood	-226.3905	Hannan-Quinn criter.		26.87921
Durbin-Watson stat	1.176770			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.478812
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 16:59

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.864137	0.248400	-3.478812	0.0031
R-squared	0.427001	Mean dependent var		-17761.17
Adjusted R-squared	0.427001	S.D. dependent var		228754.7
S.E. of regression	173159.7	Akaike info criterion		27.01884
Sum squared resid	4.80E+11	Schwarz criterion		27.06785
Log likelihood	-228.6601	Hannan-Quinn criter.		27.02371
Durbin-Watson stat	1.152492			

3. Czech Republic

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-4.088219
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
 Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 17:00
 Sample (adjusted): 1991 2009
 Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.639697	0.156473	-4.088219	0.0008
D(GLSRESID(-1))	0.656340	0.199401	3.291566	0.0043
R-squared	0.539973	Mean dependent var		-242.6326
Adjusted R-squared	0.512912	S.D. dependent var		1772.136
S.E. of regression	1236.803	Akaike info criterion		17.17775
Sum squared resid	26004603	Schwarz criterion		17.27716
Log likelihood	-161.1886	Hannan-Quinn criter.		17.19457
Durbin-Watson stat	1.768289			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.396203
Test critical values:	
1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:01

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.128307	0.091897	-1.396203	0.1806
D(GLSRESID(-1))	0.538810	0.253539	2.125156	0.0485
R-squared	0.190617	Mean dependent var		354.5263
Adjusted R-squared	0.143006	S.D. dependent var		1772.136
S.E. of regression	1640.537	Akaike info criterion		17.74274
Sum squared resid	45753136	Schwarz criterion		17.84215
Log likelihood	-166.5560	Hannan-Quinn criter.		17.75956
Durbin-Watson stat	1.446170			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.540379
Test critical values:	
1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:01

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.624906	0.245989	-2.540379	0.0205
R-squared	0.256107	Mean dependent var		-194.8947
Adjusted R-squared	0.256107	S.D. dependent var		1944.861
S.E. of regression	1677.427	Akaike info criterion		17.73911
Sum squared resid	50647725	Schwarz criterion		17.78881
Log likelihood	-167.5215	Hannan-Quinn criter.		17.74752
Durbin-Watson stat	1.283142			

3. Czech Republic

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.625301
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:02

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.316011	0.120371	-2.625301	0.0191
D(GLSRESID(-1))	0.777451	0.234296	3.318248	0.0047
R-squared	0.453759	Mean dependent var		4960.303
Adjusted R-squared	0.417343	S.D. dependent var		79574.72
S.E. of regression	60740.95	Akaike info criterion		24.97675
Sum squared resid	5.53E+10	Schwarz criterion		25.07478
Log likelihood	-210.3024	Hannan-Quinn criter.		24.98650
Durbin-Watson stat	1.481807			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-0.991396
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:02

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.078275	0.078954	-0.991396	0.3372
D(GLSRESID(-1))	0.561052	0.243481	2.304294	0.0359
R-squared	0.211985	Mean dependent var		-26784.04
Adjusted R-squared	0.159451	S.D. dependent var		79574.72
S.E. of regression	72955.26	Akaike info criterion		25.34321
Sum squared resid	7.98E+10	Schwarz criterion		25.44124
Log likelihood	-213.4173	Hannan-Quinn criter.		25.35296
Durbin-Watson stat	1.225643			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.718575
Test critical values:	
1% level	-2.717511
5% level	-1.964418
10% level	-1.605603

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 16

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:02

Sample (adjusted): 1994 2009

Included observations: 16 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.697561	0.256591	-2.718575	0.0166
D(GLSRESID(-1))	0.685390	0.377097	1.817543	0.0906
R-squared	0.351733	Mean dependent var		-7508.241
Adjusted R-squared	0.305429	S.D. dependent var		82125.25
S.E. of regression	68443.96	Akaike info criterion		25.22189
Sum squared resid	6.56E+10	Schwarz criterion		25.31846
Log likelihood	-199.7751	Hannan-Quinn criter.		25.22683
Durbin-Watson stat	1.832745			

4. Hungary

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rootenber-Stock DF-GLS test statistic	-2.868640
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rootenber-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:08

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.272005	0.094820	-2.868640	0.0106
D(GLSRESID(-1))	0.622418	0.173099	3.595735	0.0022
R-squared	0.527243	Mean dependent var		-113.1155
Adjusted R-squared	0.499434	S.D. dependent var		867.4846
S.E. of regression	613.7516	Akaike info criterion		15.77636
Sum squared resid	6403747.	Schwarz criterion		15.87577
Log likelihood	-147.8754	Hannan-Quinn criter.		15.79318
Durbin-Watson stat	1.929258			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.746366
Test critical values:	
1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:08

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.128919	0.073821	-1.746366	0.0988
D(GLSRESID(-1))	0.687727	0.202427	3.397410	0.0034
R-squared	0.409410	Mean dependent var		81.94737
Adjusted R-squared	0.374670	S.D. dependent var		867.4846
S.E. of regression	685.9881	Akaike info criterion		15.99890
Sum squared resid	7999854.	Schwarz criterion		16.09831
Log likelihood	-149.9895	Hannan-Quinn criter.		16.01572
Durbin-Watson stat	1.908432			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rootenber-Stock DF-GLS test statistic	-2.001601
Test critical values:	
1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:09

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.389157	0.194423	-2.001601	0.0606
R-squared	0.181115	Mean dependent var		-26.63158
Adjusted R-squared	0.181115	S.D. dependent var		806.3215
S.E. of regression	729.6588	Akaike info criterion		16.07423
Sum squared resid	9583235.	Schwarz criterion		16.12393
Log likelihood	-151.7052	Hannan-Quinn criter.		16.08264
Durbin-Watson stat	1.688878			

4. Hungary

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.068961
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:10

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.432099	0.140796	-3.068961	0.0078
D(GLSRESID(-1))	0.373397	0.204777	1.823429	0.0882
R-squared	0.390682	Mean dependent var		-20957.69
Adjusted R-squared	0.350061	S.D. dependent var		103173.3
S.E. of regression	83177.13	Akaike info criterion		25.60546
Sum squared resid	1.04E+11	Schwarz criterion		25.70349
Log likelihood	-215.6464	Hannan-Quinn criter.		25.61521
Durbin-Watson stat	1.114198			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.775936
Test critical values: 1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:10

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.387382	0.139550	-2.775936	0.0141
D(GLSRESID(-1))	0.377532	0.209542	1.801701	0.0917
R-squared	0.311002	Mean dependent var		-35425.84
Adjusted R-squared	0.265068	S.D. dependent var		103173.3
S.E. of regression	88448.61	Akaike info criterion		25.72836
Sum squared resid	1.17E+11	Schwarz criterion		25.82639
Log likelihood	-216.6911	Hannan-Quinn criter.		25.73811
Durbin-Watson stat	1.047712			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.209645
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:10

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.786999	0.245198	-3.209645	0.0055
R-squared	0.387984	Mean dependent var		-9860.281
Adjusted R-squared	0.387984	S.D. dependent var		130440.4
S.E. of regression	102045.4	Akaike info criterion		25.96125
Sum squared resid	1.67E+11	Schwarz criterion		26.01026
Log likelihood	-219.6706	Hannan-Quinn criter.		25.96612
Durbin-Watson stat	0.968637			

5. Latvia

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 3 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.534738
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 16

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:11

Sample (adjusted): 1994 2009

Included observations: 16 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.151953	0.059948	-2.534738	0.0262
D(GLSRESID(-1))	0.722211	0.191143	3.778390	0.0026
D(GLSRESID(-2))	-0.457624	0.186686	-2.451307	0.0305
D(GLSRESID(-3))	0.405018	0.132641	3.053498	0.0100
R-squared	0.586094	Mean dependent var		114.1719
Adjusted R-squared	0.482618	S.D. dependent var		285.1041
S.E. of regression	205.0733	Akaike info criterion		13.69693
Sum squared resid	504660.8	Schwarz criterion		13.89008
Log likelihood	-105.5754	Hannan-Quinn criter.		13.70682
Durbin-Watson stat	1.472687			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 3 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.282875
Test critical values:	
1% level	-2.717511
5% level	-1.964418
10% level	-1.605603

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 16

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:12

Sample (adjusted): 1994 2009

Included observations: 16 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.103512	0.045343	-2.282875	0.0415
D(GLSRESID(-1))	0.651487	0.195198	3.337568	0.0059
D(GLSRESID(-2))	-0.434318	0.189934	-2.286677	0.0412
D(GLSRESID(-3))	0.363398	0.130575	2.783067	0.0166
R-squared	0.577548	Mean dependent var		85.75000
Adjusted R-squared	0.471935	S.D. dependent var		285.1041
S.E. of regression	207.1796	Akaike info criterion		13.71737
Sum squared resid	515080.7	Schwarz criterion		13.91051
Log likelihood	-105.7389	Hannan-Quinn criter.		13.72726
Durbin-Watson stat	1.431759			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 3 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rootenberg-Stock DF-GLS test statistic	-1.591791
Test critical values: 1% level	-2.728252
5% level	-1.966270
10% level	-1.605026

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 15

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:13

Sample (adjusted): 1995 2009

Included observations: 15 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.266181	0.167221	-1.591791	0.1397
D(GLSRESID(-1))	0.540285	0.222445	2.428844	0.0335
D(GLSRESID(-2))	-0.304085	0.161696	-1.880596	0.0867
D(GLSRESID(-3))	0.341356	0.172186	1.982479	0.0730
R-squared	0.491439	Mean dependent var		-13.06667
Adjusted R-squared	0.352741	S.D. dependent var		296.7439
S.E. of regression	238.7376	Akaike info criterion		14.01179
Sum squared resid	626952.0	Schwarz criterion		14.20060
Log likelihood	-101.0884	Hannan-Quinn criter.		14.00977
Durbin-Watson stat	2.075793			

5. Latvia

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.652767
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
 Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 17:13
 Sample (adjusted): 1992 2009
 Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.209116	0.126525	-1.652767	0.1167
R-squared	0.126133	Mean dependent var		-6396.486
Adjusted R-squared	0.126133	S.D. dependent var		55072.75
S.E. of regression	51482.46	Akaike info criterion		24.58982
Sum squared resid	4.51E+10	Schwarz criterion		24.63929
Log likelihood	-220.3084	Hannan-Quinn criter.		24.59664
Durbin-Watson stat	1.311649			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.413413
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:14

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.143506	0.101532	-1.413413	0.1756
R-squared	-0.067254	Mean dependent var		-23492.75
Adjusted R-squared	-0.067254	S.D. dependent var		55072.75
S.E. of regression	56894.56	Akaike info criterion		24.78974
Sum squared resid	5.50E+10	Schwarz criterion		24.83920
Log likelihood	-222.1077	Hannan-Quinn criter.		24.79656
Durbin-Watson stat	1.130712			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.408662
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:14

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.672814	0.279331	-2.408662	0.0284
R-squared	0.258169	Mean dependent var		-6545.503
Adjusted R-squared	0.258169	S.D. dependent var		64857.54
S.E. of regression	55861.55	Akaike info criterion		24.75616
Sum squared resid	4.99E+10	Schwarz criterion		24.80518
Log likelihood	-209.4274	Hannan-Quinn criter.		24.76103
Durbin-Watson stat	1.731434			

6. Estonia

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rootenberg-Stock DF-GLS test statistic	-2.301201
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rootenberg-Stock (1996, Table 1)
 Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 17:17
 Sample (adjusted): 1991 2009
 Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.309053	0.134301	-2.301201	0.0335
R-squared	0.216954	Mean dependent var		-61.69624
Adjusted R-squared	0.216954	S.D. dependent var		547.2747
S.E. of regression	484.2828	Akaike info criterion		15.25441
Sum squared resid	4221537.	Schwarz criterion		15.30412
Log likelihood	-143.9169	Hannan-Quinn criter.		15.26282
Durbin-Watson stat	1.298939			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.403430
Test critical values:	
1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:17

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.177126	0.126209	-1.403430	0.1775
R-squared	0.097452	Mean dependent var		-19.26316
Adjusted R-squared	0.097452	S.D. dependent var		547.2747
S.E. of regression	519.9249	Akaike info criterion		15.39644
Sum squared resid	4865794.	Schwarz criterion		15.44615
Log likelihood	-145.2662	Hannan-Quinn criter.		15.40485
Durbin-Watson stat	1.245227			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.874574
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:17

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.662977	0.230635	-2.874574	0.0105
R-squared	0.326573	Mean dependent var		-17.33333
Adjusted R-squared	0.326573	S.D. dependent var		647.6290
S.E. of regression	531.4610	Akaike info criterion		15.44309
Sum squared resid	4801663.	Schwarz criterion		15.49255
Log likelihood	-137.9878	Hannan-Quinn criter.		15.44991
Durbin-Watson stat	1.374228			

6. Estonia

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.496170
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:18

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.201713	0.080809	-2.496170	0.0247
D(GLSRESID(-1))	0.728116	0.168291	4.326516	0.0006
R-squared	0.600212	Mean dependent var		-2541.530
Adjusted R-squared	0.573559	S.D. dependent var		32042.05
S.E. of regression	20924.23	Akaike info criterion		22.84533
Sum squared resid	6.57E+09	Schwarz criterion		22.94336
Log likelihood	-192.1853	Hannan-Quinn criter.		22.85508
Durbin-Watson stat	1.759256			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-0.620822
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:19

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.041686	0.067146	-0.620822	0.5440
D(GLSRESID(-1))	0.723909	0.183941	3.935549	0.0013
R-squared	0.425597	Mean dependent var		-15995.52
Adjusted R-squared	0.387303	S.D. dependent var		32042.05
S.E. of regression	25080.89	Akaike info criterion		23.20773
Sum squared resid	9.44E+09	Schwarz criterion		23.30576
Log likelihood	-195.2657	Hannan-Quinn criter.		23.21748
Durbin-Watson stat	1.399789			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.530215
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:19

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.270402	0.176708	-1.530215	0.1455
R-squared	0.127355	Mean dependent var		-476.9463
Adjusted R-squared	0.127355	S.D. dependent var		26096.65
S.E. of regression	24378.31	Akaike info criterion		23.09780
Sum squared resid	9.51E+09	Schwarz criterion		23.14681
Log likelihood	-195.3313	Hannan-Quinn criter.		23.10267
Durbin-Watson stat	1.444280			

7. Macedonia

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.702307
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:20

Sample (adjusted): 1991 2008

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.328058	0.192714	-1.702307	0.1069
R-squared	0.143692	Mean dependent var		14.55574
Adjusted R-squared	0.143692	S.D. dependent var		314.0088
S.E. of regression	290.5739	Akaike info criterion		14.23555
Sum squared resid	1435365.	Schwarz criterion		14.28501
Log likelihood	-127.1199	Hannan-Quinn criter.		14.24237
Durbin-Watson stat	1.988490			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-0.128281
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:21

Sample (adjusted): 1991 2008

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.017257	0.134523	-0.128281	0.8994
R-squared	-0.146587	Mean dependent var		117.2778
Adjusted R-squared	-0.146587	S.D. dependent var		314.0088
S.E. of regression	336.2368	Akaike info criterion		14.52746
Sum squared resid	1921939.	Schwarz criterion		14.57693
Log likelihood	-129.7472	Hannan-Quinn criter.		14.53428
Durbin-Watson stat	2.034846			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-4.834441
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:22

Sample (adjusted): 1992 2008

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.186977	0.245525	-4.834441	0.0002
R-squared	0.593593	Mean dependent var		3.764706
Adjusted R-squared	0.593593	S.D. dependent var		498.6526
S.E. of regression	317.8912	Akaike info criterion		14.41832
Sum squared resid	1616877.	Schwarz criterion		14.46733
Log likelihood	-121.5557	Hannan-Quinn criter.		14.42319
Durbin-Watson stat	1.859020			

7. Macedonia

B) Employment

Null Hypothesis: EMPPPOP_100 has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.963347
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
 Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 16

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 17:23
 Sample (adjusted): 1993 2008
 Included observations: 16 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.728479	0.183804	-3.963347	0.0014
D(GLSRESID(-1))	0.708110	0.196878	3.596685	0.0029
R-squared	0.583107	Mean dependent var		947.6671
Adjusted R-squared	0.553328	S.D. dependent var		21336.80
S.E. of regression	14260.13	Akaike info criterion		22.08479
Sum squared resid	2.85E+09	Schwarz criterion		22.18136
Log likelihood	-174.6783	Hannan-Quinn criter.		22.08974
Durbin-Watson stat	2.143433			

Null Hypothesis: EMPPOP_100 has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.692778
Test critical values:	
1% level	-2.717511
5% level	-1.964418
10% level	-1.605603

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 16

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:23

Sample (adjusted): 1993 2008

Included observations: 16 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.657697	0.178104	-3.692778	0.0024
D(GLSRESID(-1))	0.666838	0.200341	3.328521	0.0050
R-squared	0.552784	Mean dependent var		157.9329
Adjusted R-squared	0.520840	S.D. dependent var		21336.80
S.E. of regression	14769.62	Akaike info criterion		22.15500
Sum squared resid	3.05E+09	Schwarz criterion		22.25157
Log likelihood	-175.2400	Hannan-Quinn criter.		22.15995
Durbin-Watson stat	2.038636			

Null Hypothesis: D(EMPPOP_100) has a unit root

Exogenous: Constant

Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.426929
Test critical values:	
1% level	-2.728252
5% level	-1.966270
10% level	-1.605026

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 15

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:24

Sample (adjusted): 1994 2008

Included observations: 15 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.972766	0.283859	-3.426929	0.0045
D(GLSRESID(-1))	0.466261	0.246183	1.893960	0.0807
R-squared	0.472438	Mean dependent var		1644.078
Adjusted R-squared	0.431856	S.D. dependent var		25089.40
S.E. of regression	18911.22	Akaike info criterion		22.65646
Sum squared resid	4.65E+09	Schwarz criterion		22.75087
Log likelihood	-167.9235	Hannan-Quinn criter.		22.65546
Durbin-Watson stat	2.004272			

8. Moldova

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.863681
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:25

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.266498	0.093061	-2.863681	0.0113
D(GLSRESID(-1))	0.498808	0.183333	2.720779	0.0151
R-squared	0.425109	Mean dependent var		-117.9863
Adjusted R-squared	0.389178	S.D. dependent var		738.1954
S.E. of regression	576.9372	Akaike info criterion		15.65778
Sum squared resid	5325705.	Schwarz criterion		15.75671
Log likelihood	-138.9200	Hannan-Quinn criter.		15.67142
Durbin-Watson stat	1.439809			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.043277
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:25

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.142231	0.069609	-2.043277	0.0579
D(GLSRESID(-1))	0.533845	0.192144	2.778357	0.0134
R-squared	0.197624	Mean dependent var		-447.2222
Adjusted R-squared	0.147475	S.D. dependent var		738.1954
S.E. of regression	681.5926	Akaike info criterion		15.99118
Sum squared resid	7433096.	Schwarz criterion		16.09011
Log likelihood	-141.9206	Hannan-Quinn criter.		16.00482
Durbin-Watson stat	1.226226			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rootenber-Stock DF-GLS test statistic	-2.699558
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:26

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.578726	0.214378	-2.699558	0.0152
R-squared	0.287932	Mean dependent var		-107.3889
Adjusted R-squared	0.287932	S.D. dependent var		839.6574
S.E. of regression	708.5375	Akaike info criterion		16.01824
Sum squared resid	8534432.	Schwarz criterion		16.06770
Log likelihood	-143.1641	Hannan-Quinn criter.		16.02506
Durbin-Watson stat	1.092508			

8. Moldova

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.021220
Test critical values: 1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
 Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 17:26
 Sample (adjusted): 1992 2009
 Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.382759	0.189370	-2.021220	0.0593
R-squared	0.183941	Mean dependent var		5688.879
Adjusted R-squared	0.183941	S.D. dependent var		53064.44
S.E. of regression	47936.30	Akaike info criterion		24.44709
Sum squared resid	3.91E+10	Schwarz criterion		24.49655
Log likelihood	-219.0238	Hannan-Quinn criter.		24.45391
Durbin-Watson stat	1.700367			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-0.253930
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:27

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.017861	0.070340	-0.253930	0.8026
R-squared	-0.337572	Mean dependent var		-30186.59
Adjusted R-squared	-0.337572	S.D. dependent var		53064.44
S.E. of regression	61370.85	Akaike info criterion		24.94121
Sum squared resid	6.40E+10	Schwarz criterion		24.99068
Log likelihood	-223.4709	Hannan-Quinn criter.		24.94803
Durbin-Watson stat	1.481025			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-4.035590
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:27

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.005827	0.249239	-4.035590	0.0010
R-squared	0.504334	Mean dependent var		-1043.536
Adjusted R-squared	0.504334	S.D. dependent var		77661.69
S.E. of regression	54676.59	Akaike info criterion		24.71328
Sum squared resid	4.78E+10	Schwarz criterion		24.76229
Log likelihood	-209.0629	Hannan-Quinn criter.		24.71815
Durbin-Watson stat	2.001213			

9. Poland

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.883584
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 20

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:29

Sample (adjusted): 1990 2009

Included observations: 20 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.361488	0.125361	-2.883584	0.0095
R-squared	0.286803	Mean dependent var		-580.8496
Adjusted R-squared	0.286803	S.D. dependent var		3745.440
S.E. of regression	3163.061	Akaike info criterion		19.00517
Sum squared resid	1.90E+08	Schwarz criterion		19.05496
Log likelihood	-189.0517	Hannan-Quinn criter.		19.01489
Durbin-Watson stat	0.886998			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.682478
Test critical values: 1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:29

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.130015	0.077276	-1.682478	0.1108
D(GLSRESID(-1))	0.628340	0.201368	3.120364	0.0062
R-squared	0.326381	Mean dependent var		867.0000
Adjusted R-squared	0.286756	S.D. dependent var		3424.832
S.E. of regression	2892.400	Akaike info criterion		18.87686
Sum squared resid	1.42E+08	Schwarz criterion		18.97628
Log likelihood	-177.3302	Hannan-Quinn criter.		18.89369
Durbin-Watson stat	2.143104			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.178055
Test critical values:	
1% level	-2.692358
5% level	-1.960171
10% level	-1.607051

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations

and may not be accurate for a sample size of 19

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:30

Sample (adjusted): 1991 2009

Included observations: 19 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.388786	0.178502	-2.178055	0.0429
R-squared	0.207962	Mean dependent var		97.15789
Adjusted R-squared	0.207962	S.D. dependent var		3572.706
S.E. of regression	3179.584	Akaike info criterion		19.01808
Sum squared resid	1.82E+08	Schwarz criterion		19.06779
Log likelihood	-179.6718	Hannan-Quinn criter.		19.02650
Durbin-Watson stat	1.867928			

9. Poland

B) Employment

Null Hypothesis: EMPL_POP has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.203542
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:30

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.297187	0.092768	-3.203542	0.0059
D(GLSRESID(-1))	0.891848	0.174428	5.112977	0.0001
R-squared	0.640505	Mean dependent var		51217.63
Adjusted R-squared	0.616539	S.D. dependent var		489504.5
S.E. of regression	303121.8	Akaike info criterion		28.19179
Sum squared resid	1.38E+12	Schwarz criterion		28.28981
Log likelihood	-237.6302	Hannan-Quinn criter.		28.20153
Durbin-Watson stat	1.819263			

Null Hypothesis: EMPL_POP has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.658430
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:31

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.113348	0.068347	-1.658430	0.1180
D(GLSRESID(-1))	0.672658	0.186354	3.609581	0.0026
R-squared	0.482278	Mean dependent var		-96449.70
Adjusted R-squared	0.447763	S.D. dependent var		489504.5
S.E. of regression	363763.8	Akaike info criterion		28.55653
Sum squared resid	1.98E+12	Schwarz criterion		28.65455
Log likelihood	-240.7305	Hannan-Quinn criter.		28.56627
Durbin-Watson stat	1.394776			

Null Hypothesis: D(EMPL_POP) has a unit root

Exogenous: Constant

Lag Length: 3 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-3.489137
Test critical values: 1% level	-2.740613
5% level	-1.968430
10% level	-1.604392

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 14

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:31

Sample (adjusted): 1996 2009

Included observations: 14 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.141700	0.327216	-3.489137	0.0058
D(GLSRESID(-1))	0.806075	0.366905	2.196962	0.0527
D(GLSRESID(-2))	1.021829	0.420083	2.432445	0.0353
D(GLSRESID(-3))	0.782611	0.442618	1.768143	0.1075
R-squared	0.560659	Mean dependent var		-27796.65
Adjusted R-squared	0.428857	S.D. dependent var		455876.4
S.E. of regression	344524.1	Akaike info criterion		28.57267
Sum squared resid	1.19E+12	Schwarz criterion		28.75526
Log likelihood	-196.0087	Hannan-Quinn criter.		28.55577
Durbin-Watson stat	1.789895			

10. Turkmenistan

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 3 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rootenber-Stock DF-GLS test statistic	-1.566668
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rootenber-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 16

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:32

Sample (adjusted): 1994 2009

Included observations: 16 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.183369	0.117044	-1.566668	0.1432
D(GLSRESID(-1))	-0.202079	0.245273	-0.823893	0.4261
D(GLSRESID(-2))	0.407993	0.136013	2.999659	0.0111
D(GLSRESID(-3))	0.324688	0.157285	2.064335	0.0613

R-squared	0.531100	Mean dependent var	94.18200
Adjusted R-squared	0.413875	S.D. dependent var	636.3496
S.E. of regression	487.1818	Akaike info criterion	15.42747
Sum squared resid	2848153.	Schwarz criterion	15.62062
Log likelihood	-119.4198	Hannan-Quinn criter.	15.43736
Durbin-Watson stat	1.919458		

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 3 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.763875
Test critical values:	
1% level	-2.717511
5% level	-1.964418
10% level	-1.605603

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 16

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:33

Sample (adjusted): 1994 2009

Included observations: 16 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.152342	0.086368	-1.763875	0.1032
D(GLSRESID(-1))	-0.149924	0.236412	-0.634163	0.5379
D(GLSRESID(-2))	0.474628	0.143373	3.310443	0.0062
D(GLSRESID(-3))	0.355150	0.169923	2.090061	0.0586
R-squared	0.494424	Mean dependent var		200.8750
Adjusted R-squared	0.368031	S.D. dependent var		636.3496
S.E. of regression	505.8757	Akaike info criterion		15.50278
Sum squared resid	3070923.	Schwarz criterion		15.69592
Log likelihood	-120.0222	Hannan-Quinn criter.		15.51267
Durbin-Watson stat	1.940589			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-4.798431
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:34

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.158003	0.241329	-4.798431	0.0002
R-squared	0.574994	Mean dependent var		34.88889
Adjusted R-squared	0.574994	S.D. dependent var		1421.123
S.E. of regression	926.4659	Akaike info criterion		16.55458
Sum squared resid	14591763	Schwarz criterion		16.60405
Log likelihood	-147.9913	Hannan-Quinn criter.		16.56140
Durbin-Watson stat	1.350588			

10. Turkmenistan

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.597220
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
 Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 17:34
 Sample (adjusted): 1993 2009
 Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.363522	0.139966	-2.597220	0.0202
D(GLSRESID(-1))	0.553507	0.211919	2.611877	0.0196
R-squared	0.404606	Mean dependent var		-2888.023
Adjusted R-squared	0.364914	S.D. dependent var		34452.01
S.E. of regression	27455.60	Akaike info criterion		23.38866
Sum squared resid	1.13E+10	Schwarz criterion		23.48668
Log likelihood	-196.8036	Hannan-Quinn criter.		23.39840
Durbin-Watson stat	2.216637			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Lothman-Stock DF-GLS test statistic	0.150836
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:35

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	0.005246	0.034776	0.150836	0.8821
D(GLSRESID(-1))	0.814078	0.162481	5.010288	0.0002
R-squared	-0.133293	Mean dependent var		48819.71
Adjusted R-squared	-0.208846	S.D. dependent var		34452.01
S.E. of regression	37879.13	Akaike info criterion		24.03232
Sum squared resid	2.15E+10	Schwarz criterion		24.13034
Log likelihood	-202.2747	Hannan-Quinn criter.		24.04206
Durbin-Watson stat	2.127383			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.616975
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:35

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.615263	0.235105	-2.616975	0.0187
R-squared	0.298853	Mean dependent var		1317.886
Adjusted R-squared	0.298853	S.D. dependent var		38226.63
S.E. of regression	32008.90	Akaike info criterion		23.64244
Sum squared resid	1.64E+10	Schwarz criterion		23.69145
Log likelihood	-199.9607	Hannan-Quinn criter.		23.64731
Durbin-Watson stat	1.843846			

11. Ukraine

A) Electricity

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 2 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.810827
Test critical values: 1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)
 Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 17:36
 Sample (adjusted): 1993 2009
 Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.218611	0.077775	-2.810827	0.0139
D(GLSRESID(-1))	0.484485	0.236270	2.050558	0.0595
D(GLSRESID(-2))	0.412058	0.260458	1.582053	0.1360
R-squared	0.635418	Mean dependent var		-248.6301
Adjusted R-squared	0.583334	S.D. dependent var		8849.757
S.E. of regression	5712.487	Akaike info criterion		20.29748
Sum squared resid	4.57E+08	Schwarz criterion		20.44452
Log likelihood	-169.5286	Hannan-Quinn criter.		20.31210
Durbin-Watson stat	1.857645			

Null Hypothesis: ELECTRICITY has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.386082
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:37

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.071495	0.051581	-1.386082	0.1847
D(GLSRESID(-1))	0.722295	0.174248	4.145207	0.0008
R-squared	0.450992	Mean dependent var		-4404.000
Adjusted R-squared	0.416679	S.D. dependent var		8689.418
S.E. of regression	6636.581	Akaike info criterion		20.54302
Sum squared resid	7.05E+08	Schwarz criterion		20.64195
Log likelihood	-182.8872	Hannan-Quinn criter.		20.55666
Durbin-Watson stat	1.966435			

Null Hypothesis: D(ELECTRICITY) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.751175
Test critical values:	
1% level	-2.699769
5% level	-1.961409
10% level	-1.606610

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 18

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:37

Sample (adjusted): 1992 2009

Included observations: 18 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.331036	0.189037	-1.751175	0.0979
R-squared	0.148840	Mean dependent var		-477.6111
Adjusted R-squared	0.148840	S.D. dependent var		7169.025
S.E. of regression	6614.021	Akaike info criterion		20.48572
Sum squared resid	7.44E+08	Schwarz criterion		20.53519
Log likelihood	-183.3715	Hannan-Quinn criter.		20.49254
Durbin-Watson stat	1.879916			

11. Ukraine

B) Employment

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant, Linear Trend
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-2.234824
Test critical values:	
1% level	-3.770000
5% level	-3.190000
10% level	-2.890000

*Elliott-Rothenberg-Stock (1996, Table 1)

Warning: Test critical values calculated for 50 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals
 Dependent Variable: D(GLSRESID)
 Method: Least Squares
 Date: 03/31/13 Time: 17:37
 Sample (adjusted): 1993 2009
 Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.202894	0.090788	-2.234824	0.0411
D(GLSRESID(-1))	0.728183	0.195769	3.719606	0.0021
R-squared	0.500825	Mean dependent var		21281.14
Adjusted R-squared	0.467547	S.D. dependent var		462727.5
S.E. of regression	337649.4	Akaike info criterion		28.40753
Sum squared resid	1.71E+12	Schwarz criterion		28.50556
Log likelihood	-239.4640	Hannan-Quinn criter.		28.41728
Durbin-Watson stat	2.254872			

Null Hypothesis: EMPLOYMENT has a unit root
 Exogenous: Constant
 Lag Length: 1 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-0.672017
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
 and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:38

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.032684	0.048635	-0.672017	0.5118
D(GLSRESID(-1))	0.737209	0.185153	3.981628	0.0012
R-squared	0.289940	Mean dependent var		-312788.4
Adjusted R-squared	0.242603	S.D. dependent var		462727.5
S.E. of regression	402705.1	Akaike info criterion		28.75993
Sum squared resid	2.43E+12	Schwarz criterion		28.85795
Log likelihood	-242.4594	Hannan-Quinn criter.		28.76967
Durbin-Watson stat	1.866492			

Null Hypothesis: D(EMPLOYMENT) has a unit root

Exogenous: Constant

Lag Length: 0 (Automatic based on SIC, MAXLAG=3)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-1.961933
Test critical values:	
1% level	-2.708094
5% level	-1.962813
10% level	-1.606129

*MacKinnon (1996)

Warning: Test critical values calculated for 20 observations
and may not be accurate for a sample size of 17

DF-GLS Test Equation on GLS Detrended Residuals

Dependent Variable: D(GLSRESID)

Method: Least Squares

Date: 03/31/13 Time: 17:38

Sample (adjusted): 1993 2009

Included observations: 17 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.405896	0.206886	-1.961933	0.0674
R-squared	0.192121	Mean dependent var		-19254.89
Adjusted R-squared	0.192121	S.D. dependent var		419974.1
S.E. of regression	377481.5	Akaike info criterion		28.57745
Sum squared resid	2.28E+12	Schwarz criterion		28.62647
Log likelihood	-241.9084	Hannan-Quinn criter.		28.58233
Durbin-Watson stat	1.797945			

Appendix 7.2 MS-VAR Estimation procedure for one country – Czech Republic

Estimation I: MSIH (3) - VAR (1) model for Czech Republic

EQ(1) MSIH (3)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

----- Error occured! EM algorithm was stopped after 7 iterations -----

----- regime classification -----

Regime 1

Regime 2

Regime 3

*** Warning: run first StdErr().

Estimation II: MSI (3) – VAR (1) model for Czech Republic

EQ(1) MSI(3)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 30 linear system : 18
 no. restrictions : 6
 no. nuisance p. : 6

1. log-likelihood : -74.2657 linear system : -87.7090

AIC criterion : 12.2666 linear system : 12.4364

HQ criterion : 12.4127 linear system : 12.5240

SC criterion : 13.7369 linear system : 13.3186

LR linearity test: 26.8866 Chi(6)=[0.0002] ** Chi(12)=[0.0080] ** DAVIES=[0.0037]
 **

2. ----- matrix of transition probabilities -----

	Regime 1	Regime 2	Regime 3
Regime 1	0.5858	0.4142	6.250e-028
Regime 2	0.1021	0.7958	0.1021
Regime 3	0.2500	3.099e-006	0.7500

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	4.0	0.2593	2.41
Regime 2	9.0	0.5260	4.90
Regime 3	4.0	0.2148	4.00

3. ----- coefficients -----

	DY	DE	DC
Const(Reg.1)	-1.628366	-2.128235	-2.637959

Const(Reg.2)	2.592606	-0.168104	2.774283
Const(Reg.3)	7.328583	2.211964	4.013359
DY_1	-0.444389	-0.213149	-0.537391
DE_1	-0.814495	0.070449	-0.441579
DC_1	0.633066	0.164961	0.641237
SE	1.290023	0.377167	1.605292

----- standard errors -----

	DY	DE	DC
Const(Reg.1)	0.8243	0.2410	1.0258
Const(Reg.2)	0.8263	0.2416	1.0283
Const(Reg.3)	1.8219	0.5327	2.2671
DY_1	0.3767	0.1101	0.4687
DE_1	0.3522	0.1030	0.4383
DC_1	0.2498	0.0730	0.3108

----- t - values -----

	DY	DE	DC
Const(Reg.1)	-1.9754	-8.8307	-2.5717
Const(Reg.2)	3.1376	-0.6958	2.6981
Const(Reg.3)	4.0225	4.1526	1.7702
DY_1	-1.1797	-1.9354	-1.1465
DE_1	-2.3125	0.6841	-1.0075
DC_1	2.5345	2.2588	2.0630

4. ----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	-0.2438	0.6384
DE	-0.2438	1.0000	-0.0421
DC	0.6384	-0.0421	1.0000

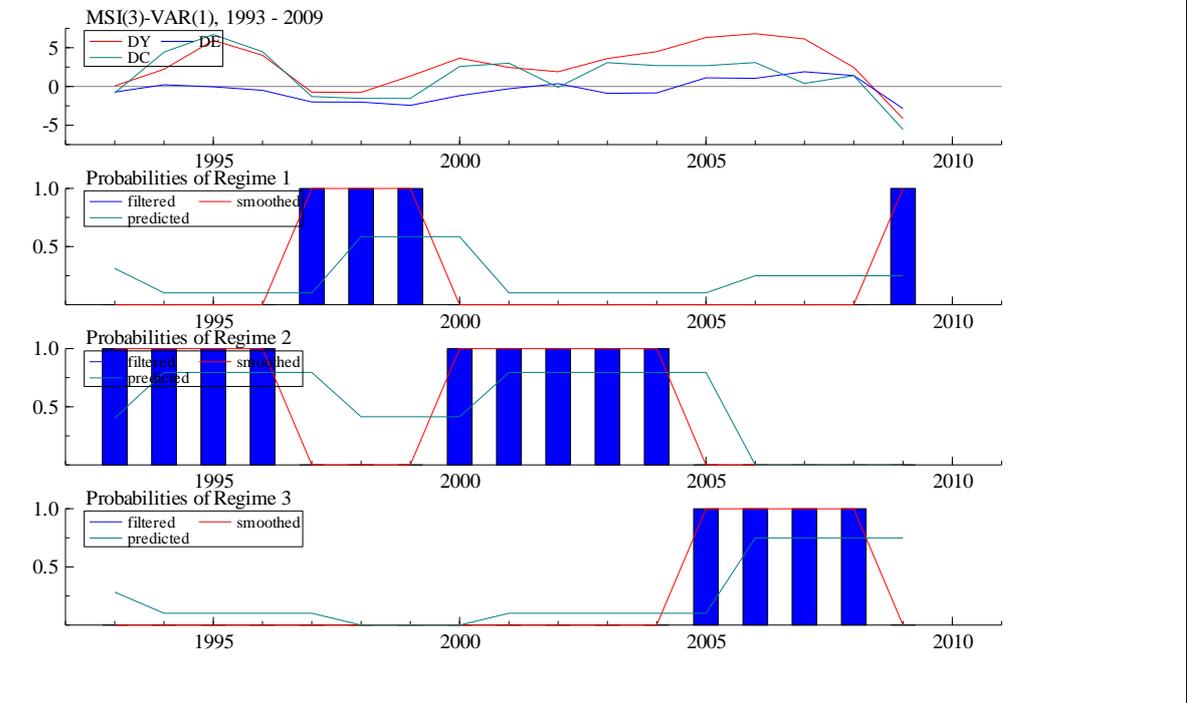
5. ----- regime classification -----

Regime 1
 1997:1 - 1999:1 [1.0000]
 2009:1 - 2009:1 [1.0000]

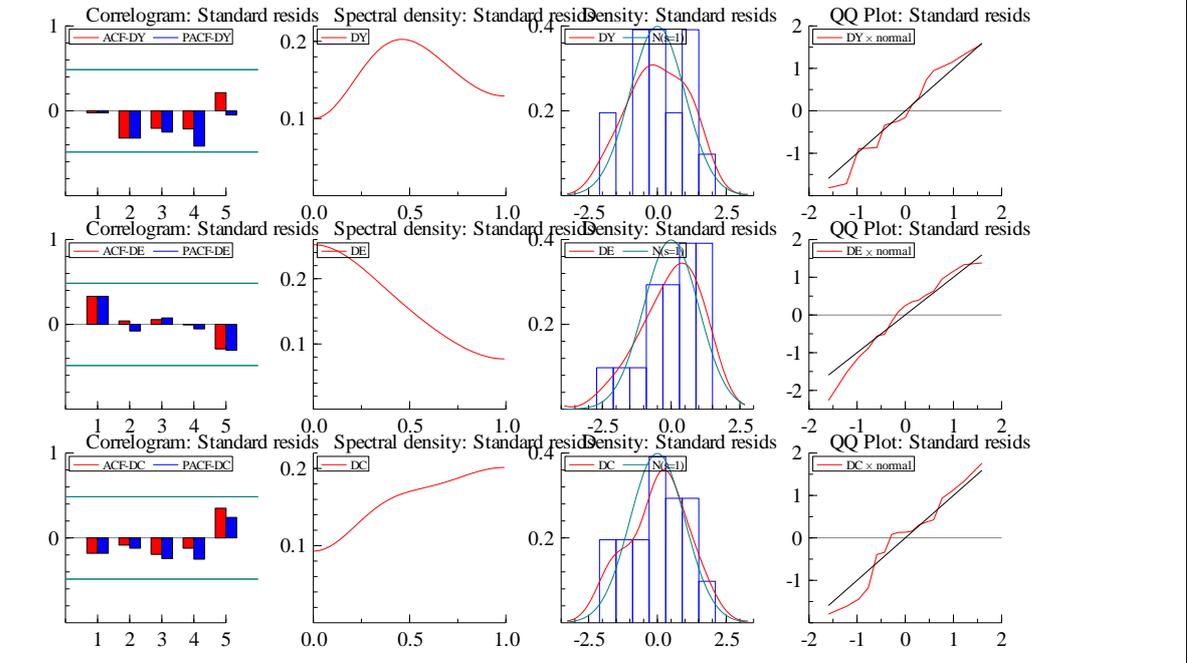
Regime 2
 1993:1 - 1996:1 [1.0000]
 2000:1 - 2004:1 [1.0000]

Regime 3

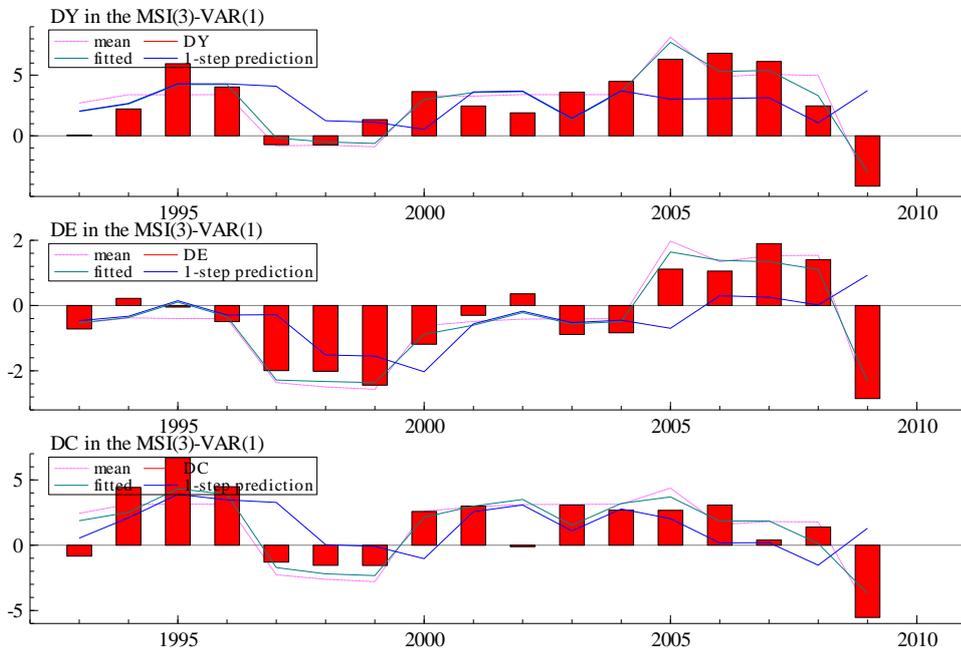
2005:1 - 2008:1 [1.0000]



6. Diagnostics



7. Actual and Fited values



Appendix 7.3 Multivariate analysis results for selected transition countries

1. Latvia

----- EM algorithm converged after 9 iterations -----

EQ(1) MSI(3)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 30 linear system : 18
 no. restrictions : 6
 no. nuisance p. : 6

log-likelihood : -113.6779 linear system : -132.7990

AIC criterion : 16.9033 linear system : 17.7411

HQ criterion : 17.0494 linear system : 17.8288

SC criterion : 18.3737 linear system : 18.6233

LR linearity test: 38.2423 Chi(6)=[0.0000] ** Chi(12)=[0.0001] ** DAVIES=[0.0000]
 **

----- matrix of transition probabilities -----

	Regime 1	Regime 2	Regime 3
Regime 1	0.7913	0.2087	1.030e-027
Regime 2	1.370e-006	0.8334	0.1666
Regime 3	0.1926	1.409e-008	0.8074

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	5.0	0.2998	4.79
Regime 2	6.0	0.3754	6.00
Regime 3	6.0	0.3248	5.19

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	-7.912985	-3.985096	-4.886863
Const(Reg.2)	4.249161	-5.463654	-5.123122
Const(Reg.3)	8.884651	1.364536	-0.255488
DY_1	0.306384	0.138637	0.828697
DE_1	-0.159589	-0.507739	-0.525244
DC_1	-0.404581	0.032872	-0.017901
SE	2.841133	3.015869	1.489907

----- contemporaneous correlation -----

DY	DE	DC
----	----	----

DY	1.0000	0.7763	-0.2779
DE	0.7763	1.0000	0.0764
DC	-0.2779	0.0764	1.0000

----- standard errors -----

	DY	DE	DC
Const(Reg.1)	1.5584	1.6542	0.8172
Const(Reg.2)	1.6457	1.7485	0.8653
Const(Reg.3)	1.4530	1.5424	0.7624
DY_1	0.1120	0.1189	0.0587
DE_1	0.3482	0.3699	0.1830
DC_1	0.1354	0.1438	0.0711

----- t - values -----

	DY	DE	DC
Const(Reg.1)	-5.0777	-2.4090	-5.9798
Const(Reg.2)	2.5820	-3.1248	-5.9204
Const(Reg.3)	6.1149	0.8847	-0.3351
DY_1	2.7364	1.1663	14.1092
DE_1	-0.4584	-1.3727	-2.8700
DC_1	-2.9882	0.2287	-0.2519

----- regime classification -----

Regime 1

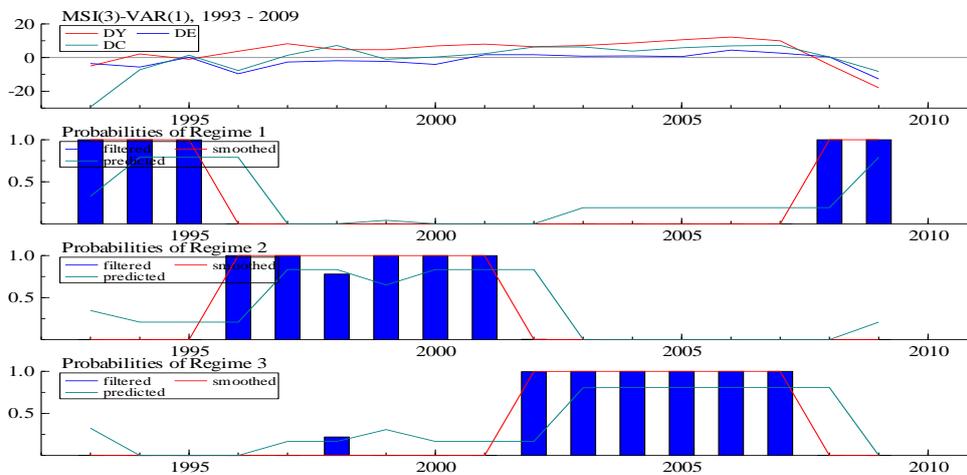
1993:1 - 1995:1 [1.0000]
 2008:1 - 2009:1 [1.0000]

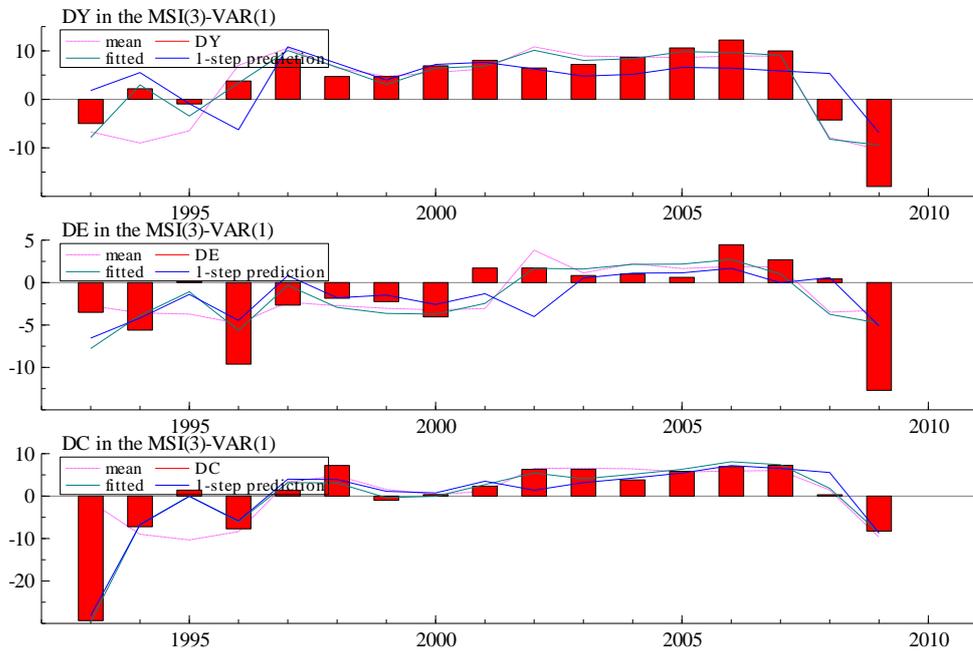
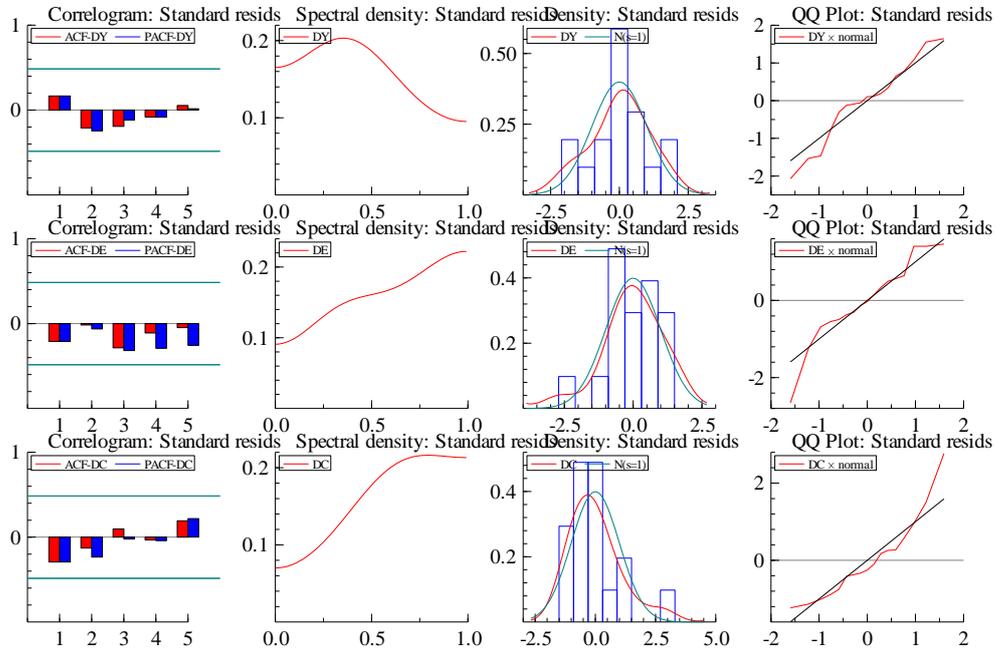
Regime 2

1996:1 - 2001:1 [1.0000]

Regime 3

2002:1 - 2007:1 [0.9999]





2. Hungary

----- EM algorithm converged after 10 iterations -----

EQ(1) MSI(2)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 22 linear system : 18
 no. restrictions : 3
 no. nuisance p. : 2

log-likelihood : -82.0779 linear system : -94.4608

AIC criterion : 12.3621 linear system : 13.2307
 HQ criterion : 12.4742 linear system : 13.3184
 SC criterion : 13.4894 linear system : 14.1129

LR linearity test: 24.7657 Chi(3)=[0.0000] ** Chi(5)=[0.0002] ** DAVIES=[0.0004] **

----- matrix of transition probabilities -----

	Regime 1	Regime 2
Regime 1	0.6973	0.3027
Regime 2	0.1557	0.8443

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	5.0	0.3397	3.30
Regime 2	12.0	0.6603	6.42

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	-1.428672	-2.575761	-0.046736
Const(Reg.2)	2.196270	-2.963463	-1.371512
DY_1	0.500424	0.716313	0.653968
DE_1	0.007420	-0.123145	-0.325640
DC_1	-0.002679	0.148041	-0.018929
SE	1.856596	1.122190	1.543238

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	0.5170	0.7706
DE	0.5170	1.0000	-0.0290
DC	0.7706	-0.0290	1.0000

----- standard errors -----

	DY	DE	DC
Const(Reg.1)	0.9605	0.5806	0.7984
Const(Reg.2)	0.9652	0.5834	0.8023
DY_1	0.2657	0.1606	0.2208
DE_1	0.2367	0.1430	0.1967
DC_1	0.2738	0.1655	0.2276

----- t - values -----

	DY	DE	DC
Const(Reg.1)	-1.4874	-4.4365	-0.0585
Const(Reg.2)	2.2754	-5.0795	-1.7094
DY_1	1.8837	4.4609	2.9615
DE_1	0.0314	-0.8609	-1.6554
DC_1	-0.0098	0.8946	-0.0832

----- regime classification -----

Regime 1

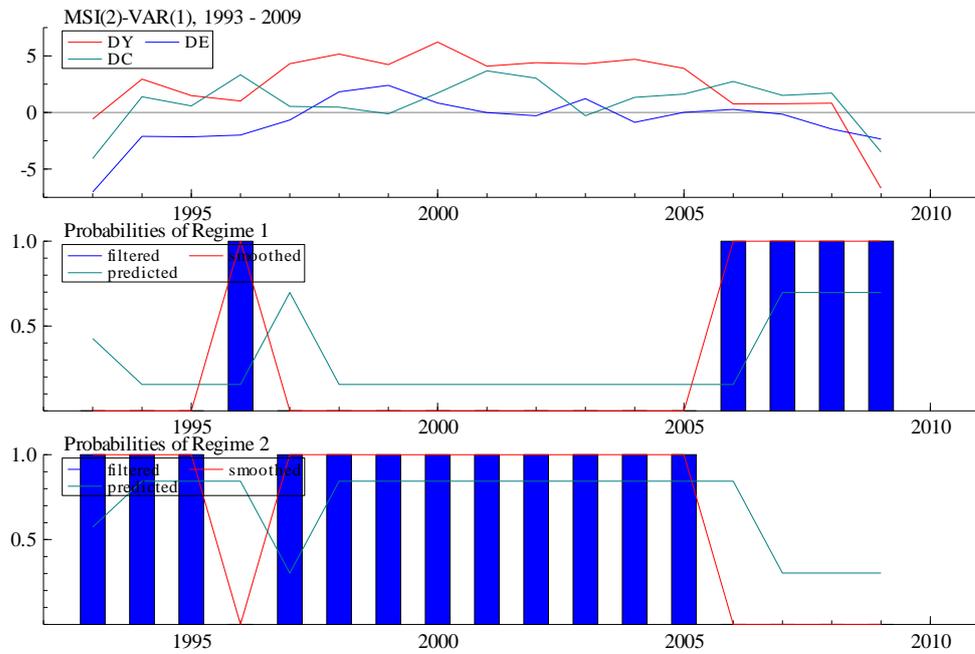
1996:1 - 1996:1 [1.0000]

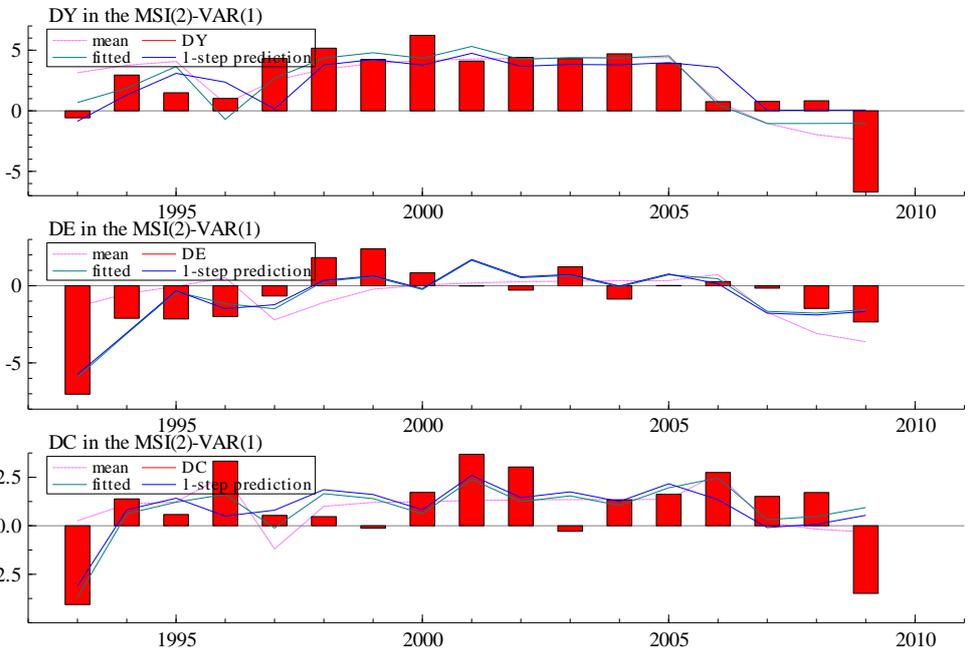
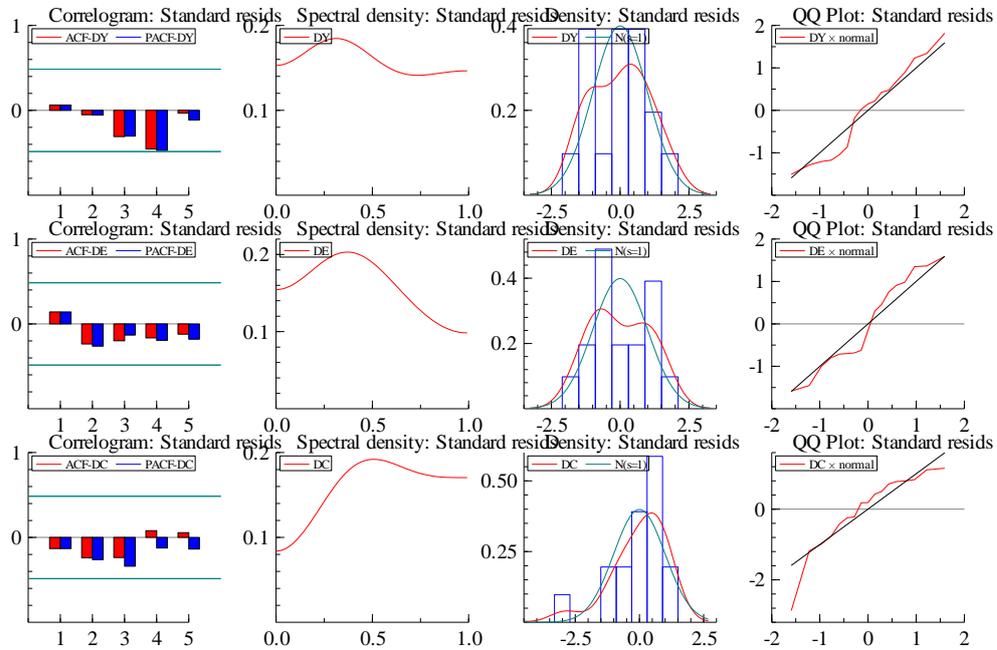
2006:1 - 2009:1 [1.0000]

Regime 2

1993:1 - 1995:1 [1.0000]

1997:1 - 2005:1 [1.0000]





3. Poland

----- EM algorithm converged after 10 iterations -----

EQ(1) MSI(3)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 30 linear system : 18
 no. restrictions : 6
 no. nuisance p. : 6

log-likelihood : -75.8753 linear system : -93.7180

AIC criterion : 12.4559 linear system : 13.1433

HQ criterion : 12.6021 linear system : 13.2310

SC criterion : 13.9263 linear system : 14.0255

LR linearity test: 35.6854 Chi(6) =[0.0000] ** Chi(12)=[0.0004] ** DAVIES=[0.0001]
 **

----- matrix of transition probabilities -----

	Regime 1	Regime 2	Regime 3
Regime 1	0.6972	0.3028	4.616e-023
Regime 2	0.1140	0.7720	0.1140
Regime 3	0.2500	4.606e-006	0.7500

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	5.0	0.3409	3.30
Regime 2	8.0	0.4527	4.39
Regime 3	4.0	0.2064	4.00

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	0.953050	-3.740907	-2.999491
Const(Reg.2)	3.523618	-1.097301	-0.024068
Const(Reg.3)	3.323692	2.531674	2.345801
DY_1	0.420961	0.078188	0.391064
DE_1	-0.015788	0.068701	-0.546385
DC_1	-0.050773	0.119873	-0.061519
SE	1.120783	0.520451	1.889078

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	0.1802	0.5693
DE	0.1802	1.0000	0.6773
DC	0.5693	0.6773	1.0000

----- standard errors -----

	DY	DE	DC
Const(Reg.1)	1.0815	0.5022	1.8229
Const(Reg.2)	1.1581	0.5378	1.9520
Const(Reg.3)	1.1040	0.5127	1.8608
DY_1	0.2256	0.1047	0.3802
DE_1	0.1646	0.0764	0.2774
DC_1	0.1391	0.0646	0.2345

----- t - values -----

	DY	DE	DC
Const(Reg.1)	0.8812	-7.4487	-1.6454
Const(Reg.2)	3.0425	-2.0404	-0.0123
Const(Reg.3)	3.0106	4.9384	1.2607
DY_1	1.8662	0.7465	1.0286
DE_1	-0.0959	0.8988	-1.9694
DC_1	-0.3649	1.8554	-0.2623

----- regime classification -----

Regime 1

1999:1 - 2002:1 [1.0000]

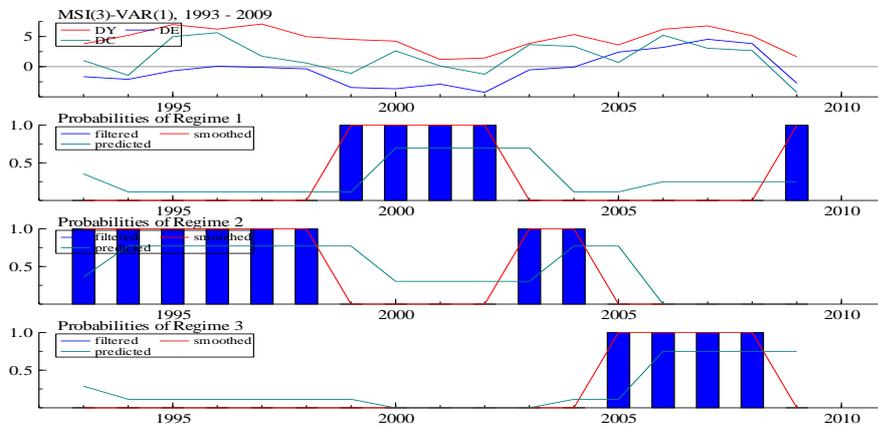
2009:1 - 2009:1 [1.0000]

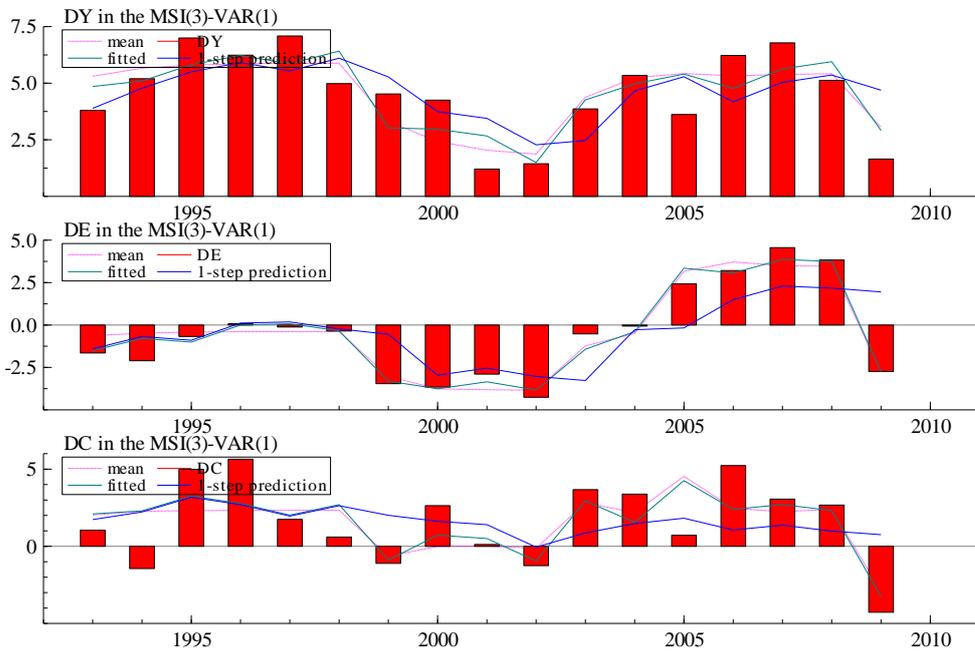
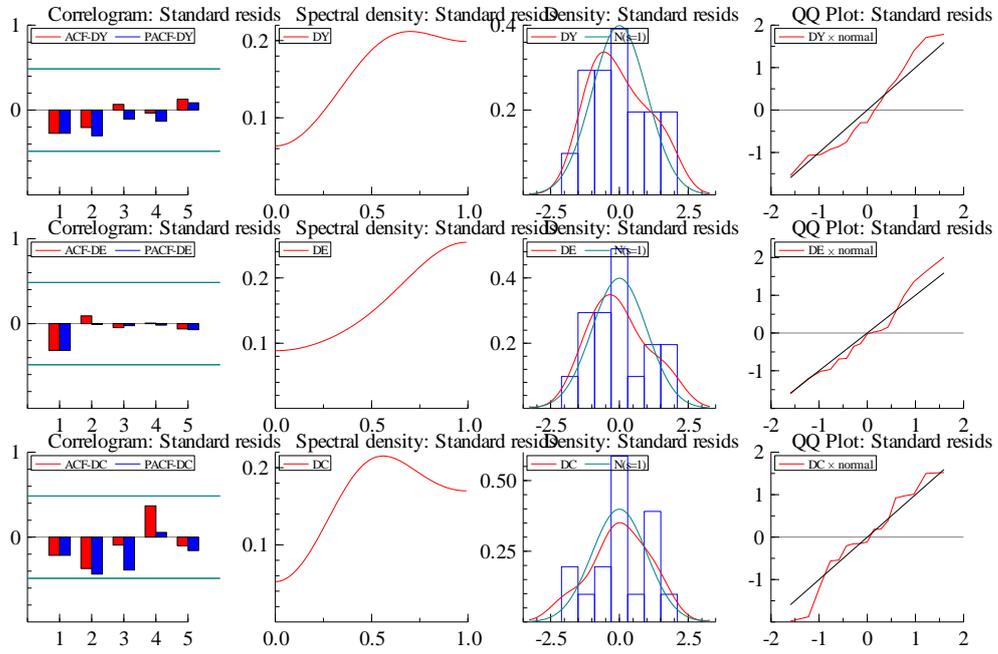
Regime 2

1993:1 - 1998:1 [1.0000]

2003:1 - 2004:1 [1.0000]

Regime 3 2005:1 - 2008:1 [1.0000]





4. Estonia

----- EM algorithm converged after 16 iterations -----

EQ(1) MSI(3)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 30 linear system : 18
 no. restrictions : 6
 no. nuisance p. : 6

log-likelihood : -121.4260 linear system : -134.8289

AIC criterion : 17.8148 linear system : 17.9799

HQ criterion : 17.9610 linear system : 18.0676

SC criterion : 19.2852 linear system : 18.8621

LR linearity test: 26.8058 Chi(6)=[0.0002] ** Chi(12)=[0.0082] ** DAVIES=[0.0038]
 **

----- matrix of transition probabilities -----

	Regime 1	Regime 2	Regime 3
Regime 1	0.5000	0.5000	9.820e-005
Regime 2	8.484e-016	0.8480	0.1520
Regime 3	0.2740	5.966e-012	0.7260

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	3.0	0.1636	2.00
Regime 2	7.4	0.5380	6.58
Regime 3	6.6	0.2985	3.65

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	-7.797388	-5.048011	1.350008
Const(Reg.2)	-0.198287	-5.206596	-12.637166
Const(Reg.3)	3.981354	-1.435323	-4.581126
DY_1	0.647416	0.468754	1.336275
DE_1	-0.930655	-0.089356	-2.052697
DC_1	0.006582	-0.079507	0.083351
SE	2.946008	1.569989	4.238274

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	0.5773	0.7334
DE	0.5773	1.0000	0.3139
DC	0.7334	0.3139	1.0000

----- standard errors -----

	DY	DE	DC
Const(Reg.1)	1.8116	0.9659	2.6081
Const(Reg.2)	2.5419	1.3912	3.7991
Const(Reg.3)	1.2751	0.6874	1.8402
DY_1	0.1488	0.0796	0.2148
DE_1	0.4658	0.2529	0.6904
DC_1	0.1316	0.0709	0.1923

----- t - values -----

	DY	DE	DC
Const(Reg.1)	-4.3042	-5.2263	0.5176
Const(Reg.2)	-0.0780	-3.7425	-1.3264
Const(Reg.3)	3.1224	-2.0880	-1.4895
DY_1	4.3523	5.8857	6.2225
DE_1	-1.9979	-0.3534	-2.9734
DC_1	0.0500	-1.1208	0.4334

----- regime classification -----

Regime 1

1994:1 - 1994:1 [1.0000]

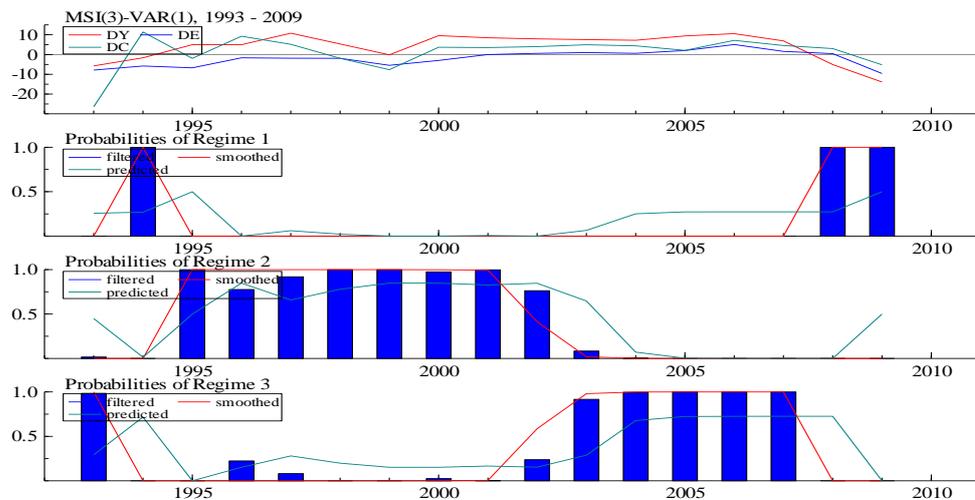
2008:1 - 2009:1 [1.0000]

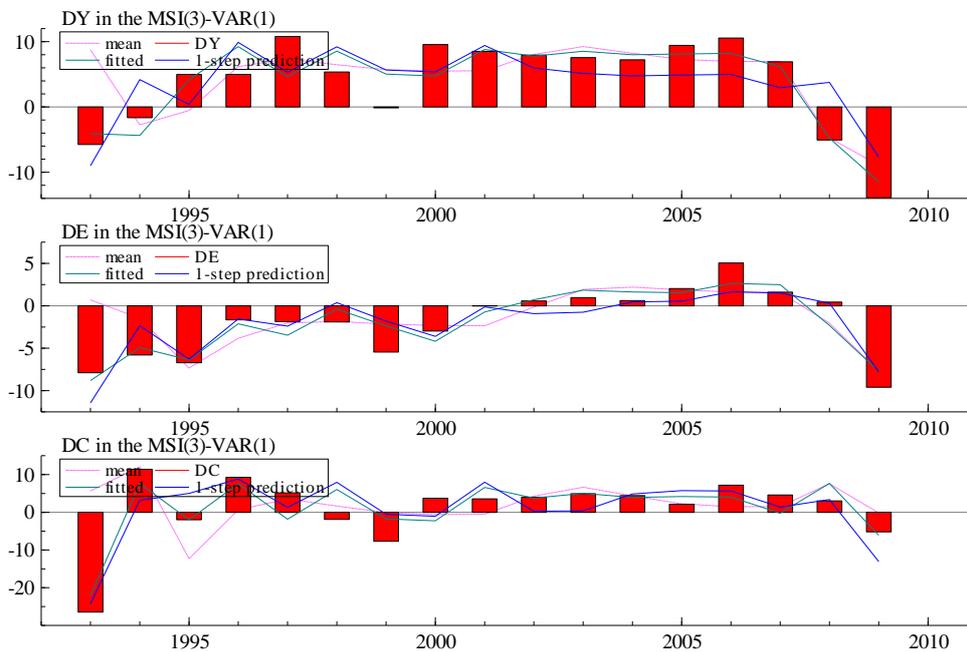
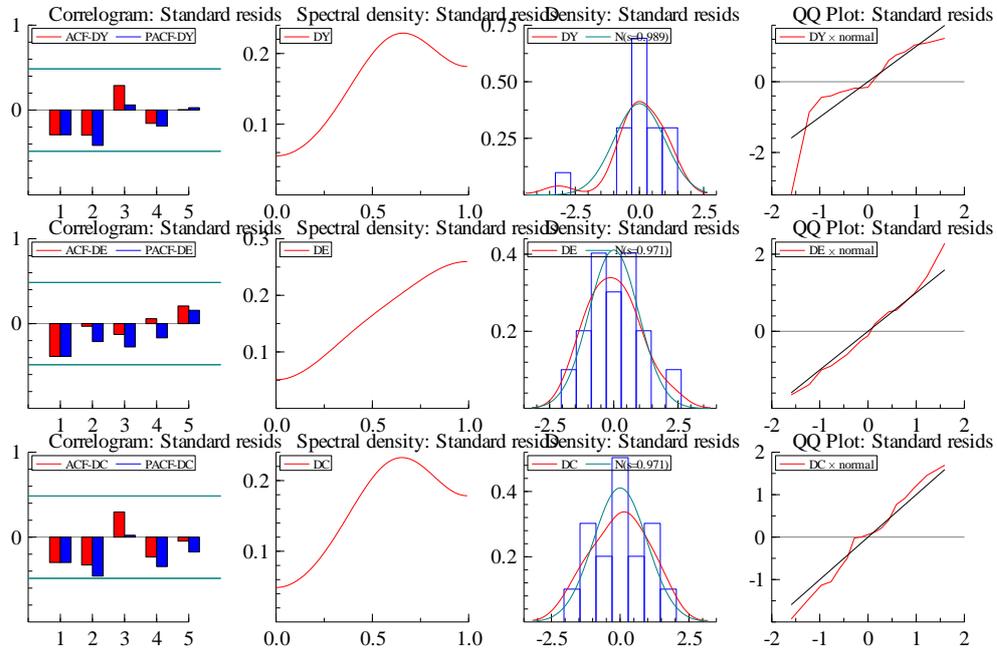
Regime 2

1995:1 - 2001:1 [0.9991]

Regime 3

1993:1 - 1993:1 [1.0000] 2002:1 - 2007:1 [0.9277]





5. Albania

----- EM algorithm converged after 21 iterations -----

EQ(1) MSI(2)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 22 linear system : 18
 no. restrictions : 3
 no. nuisance p. : 2

log-likelihood : -141.6965 linear system : -144.9430

AIC criterion : 19.3761 linear system : 19.1698
 HQ criterion : 19.4881 linear system : 19.2575
 SC criterion : 20.5034 linear system : 20.0520

LR linearity test: 6.4930 Chi(3)=[0.0899] Chi(5)=[0.2612] DAVIES=[0.6036]

----- matrix of transition probabilities -----

	Regime 1	Regime 2
Regime 1	0.2996	0.7004
Regime 2	0.3779	0.6221

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	6.0	0.3505	1.43
Regime 2	11.0	0.6495	2.65

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	3.187881	-1.056746	-18.485048
Const(Reg.2)	5.858638	-0.242005	12.141004
DY_1	0.270213	0.103770	1.613600
DE_1	-1.346022	-0.279088	-0.550097
DC_1	-0.092731	-0.064427	-0.444252
SE	4.141489	1.356956	10.684696

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	0.5526	0.4872
DE	0.5526	1.0000	-0.2342
DC	0.4872	-0.2342	1.0000

----- standard errors -----

	DY	DE	DC
--	----	----	----

Const(Reg.1)	2.4343	0.7972	6.3496
Const(Reg.2)	2.1451	0.7022	5.8548
DY_1	0.2778	0.0910	0.7720
DE_1	0.7624	0.2496	2.1898
DC_1	0.0630	0.0206	0.1635

----- t - values -----

	DY	DE	DC
Const(Reg.1)	1.3096	-1.3255	-2.9112
Const(Reg.2)	2.7311	-0.3446	2.0737
DY_1	0.9728	1.1408	2.0901
DE_1	-1.7655	-1.1183	-0.2512
DC_1	-1.4730	-3.1237	-2.7165

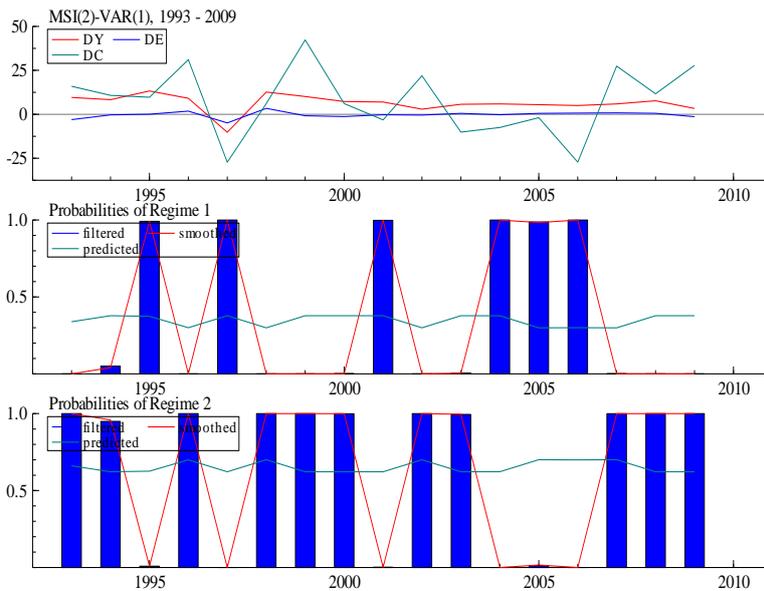
----- regime classification -----

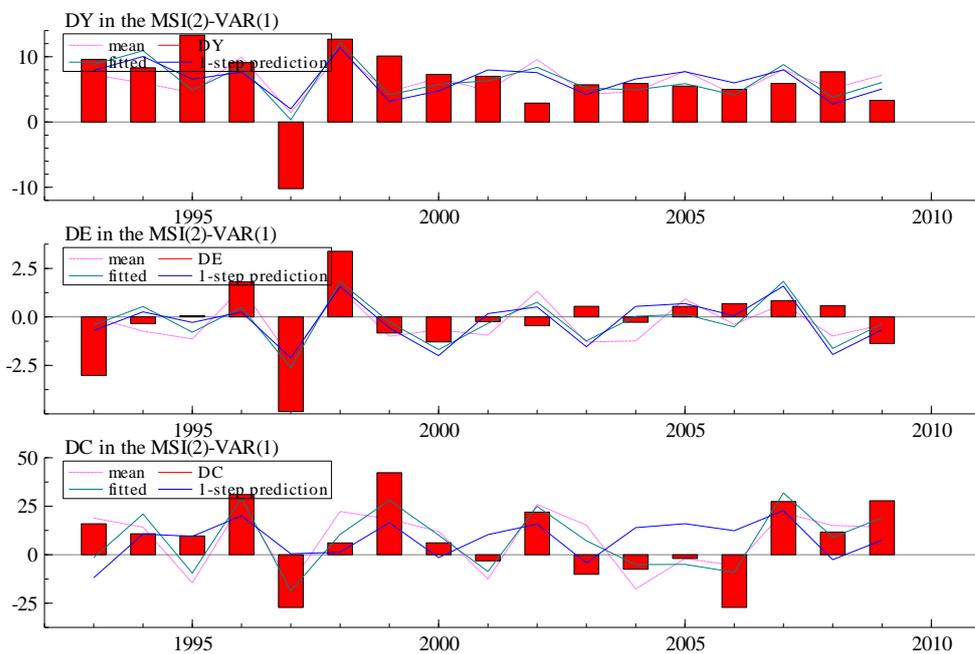
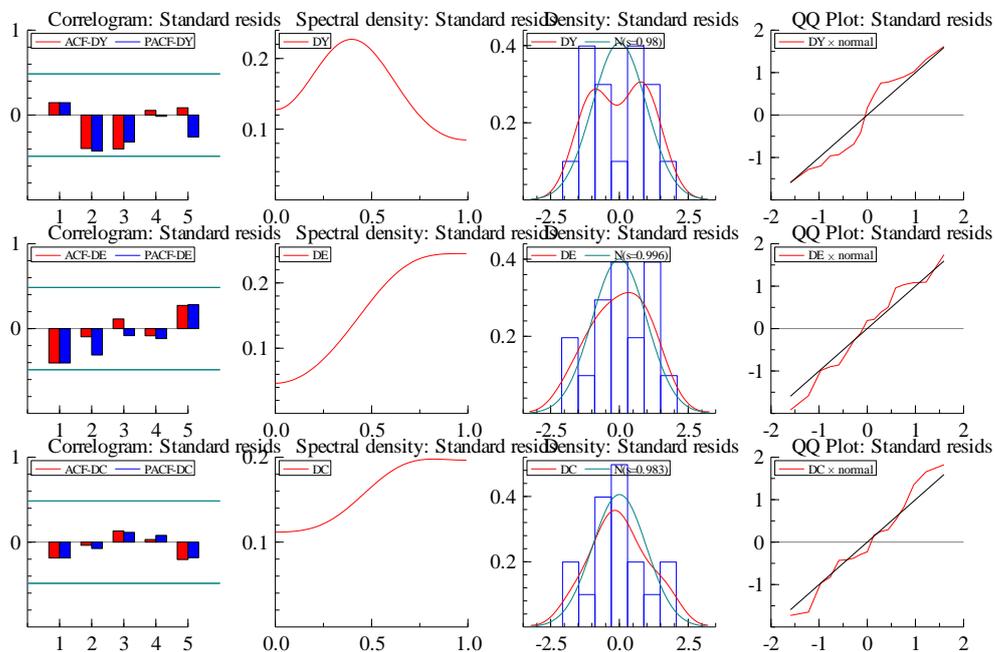
Regime 1

- 1995:1 - 1995:1 [0.9922]
- 1997:1 - 1997:1 [0.9999]
- 2001:1 - 2001:1 [0.9980]
- 2004:1 - 2006:1 [0.9946]

Regime 2

- 1993:1 - 1994:1 [0.9796]
- 1996:1 - 1996:1 [1.0000]
- 1998:1 - 2000:1 [0.9997]
- 2002:1 - 2003:1 [0.9978]
- 2007:1 - 2009:1 [0.9998]





Slow-J group of countries

6. Bulgaria

----- EM algorithm converged after 5 iterations -----

EQ(1) MSI(2)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. :	17	in the system :	51
no. parameters :	22	linear system :	18
no. restrictions :	3		
no. nuisance p. :	2		

log-likelihood : -128.7843 linear system : -136.6829

AIC criterion : 17.8570 linear system : 18.1980

HQ criterion : 17.9690 linear system : 18.2857

SC criterion : 18.9843 linear system : 19.0802

LR linearity test: 15.7973 Chi(3) =[0.0012] ** Chi(5)=[0.0074] ** DAVIES=[0.0198] *

----- matrix of transition probabilities -----

	Regime 1	Regime 2
Regime 1	0.7958	0.2042
Regime 2	0.3166	0.6834

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	10.0	0.6080	4.90
Regime 2	7.0	0.3920	3.16

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	-1.158596	-3.081923	-3.152303
Const(Reg.2)	6.392100	3.784821	3.893242
DY_1	0.226866	-0.089566	0.123010
DE_1	-0.526731	-0.224044	-0.297860
DC_1	-0.361408	0.311944	-0.149642
SE	2.195730	2.445118	3.733549

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	0.0152	-0.6167
DE	0.0152	1.0000	-0.0656
DC	-0.6167	-0.0656	1.0000

----- standard errors -----

DY	DE	DC
----	----	----

Const(Reg.1)	0.7621	0.8487	1.2959
Const(Reg.2)	1.1744	1.3077	1.9968
DY_1	0.1423	0.1584	0.2419
DE_1	0.1361	0.1515	0.2314
DC_1	0.1021	0.1137	0.1736

----- t - values -----

	DY	DE	DC
Const(Reg.1)	-1.5202	-3.6313	-2.4325
Const(Reg.2)	5.4430	2.8942	1.9497
DY_1	1.5944	-0.5653	0.5084
DE_1	-3.8713	-1.4787	-1.2875
DC_1	-3.5400	2.7439	-0.8620

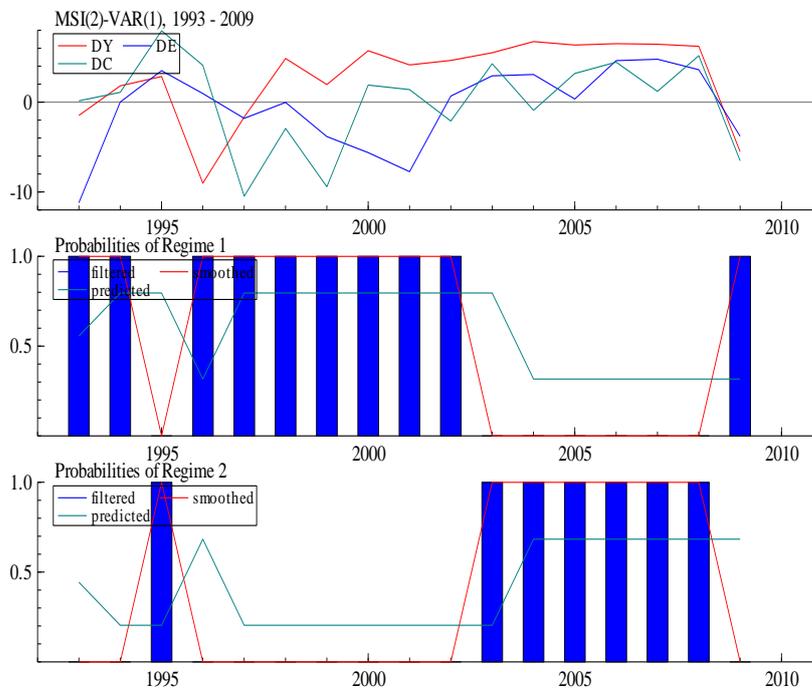
----- regime classification -----

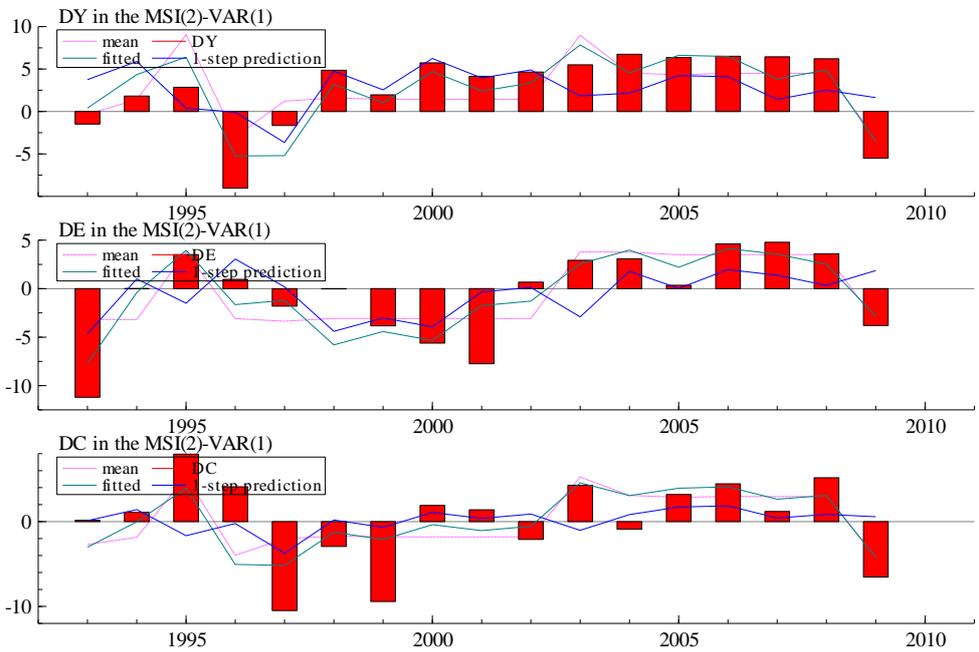
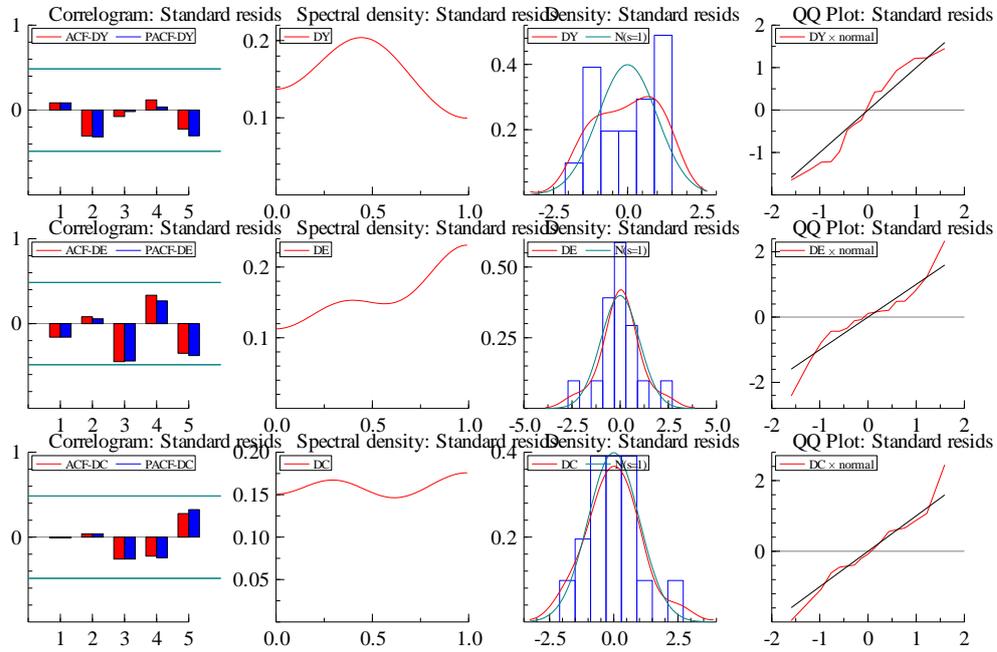
Regime 1

1993:1 - 1994:1 [1.0000]
 1996:1 - 2002:1 [1.0000]
 2009:1 - 2009:1 [1.0000]

Regime 2

1995:1 - 1995:1 [1.0000]
 2003:1 - 2008:1 [1.0000]





7. Macedonia

----- EM algorithm converged after 9 iterations -----

EQ(1) MSI(2)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 22 linear system : 18
 no. restrictions : 3
 no. nuisance p. : 2

log-likelihood : -123.4625 linear system : -129.4346

AIC criterion : 17.2309 linear system : 17.3452
 HQ criterion : 17.3429 linear system : 17.4329
 SC criterion : 18.3582 linear system : 18.2275

LR linearity test: 11.9443 Chi(3)=[0.0076]** Chi(5)=[0.0356]* DAVIES=[0.0915]

----- matrix of transition probabilities -----

	Regime 1	Regime 2
Regime 1	0.8151	0.1849
Regime 2	0.3725	0.6275

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	11.0	0.6683	5.41
Regime 2	6.0	0.3317	2.68

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	0.193243	-1.194447	0.784437
Const(Reg.2)	3.730264	2.539142	2.943068
DY_1	0.367135	0.075538	0.199757
DE_1	-0.170456	0.293016	-0.693836
DC_1	-0.161499	-0.042219	-0.284530
SE	2.415076	2.281005	4.699608

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	-0.7616	0.4365
DE	-0.7616	1.0000	-0.7029
DC	0.4365	-0.7029	1.0000

----- standard errors -----

	DY	DE	DC
--	----	----	----

Const(Reg.1)	0.7493	0.7077	1.4580
Const(Reg.2)	1.2639	1.1937	2.4614
DY_1	0.1681	0.1587	0.3270
DE_1	0.2035	0.1922	0.3959
DC_1	0.1262	0.1192	0.2457

----- t - values -----

	DY	DE	DC
Const(Reg.1)	0.2579	-1.6877	0.5380
Const(Reg.2)	2.9514	2.1272	1.1957
DY_1	2.1846	0.4759	0.6109
DE_1	-0.8378	1.5248	-1.7528
DC_1	-1.2792	-0.3541	-1.1582

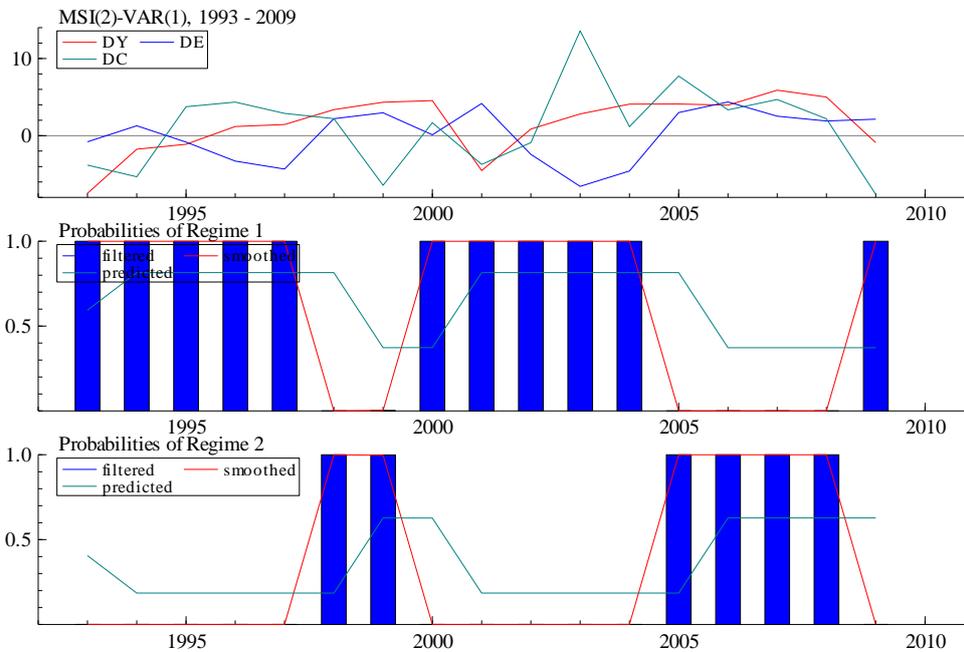
----- regime classification -----

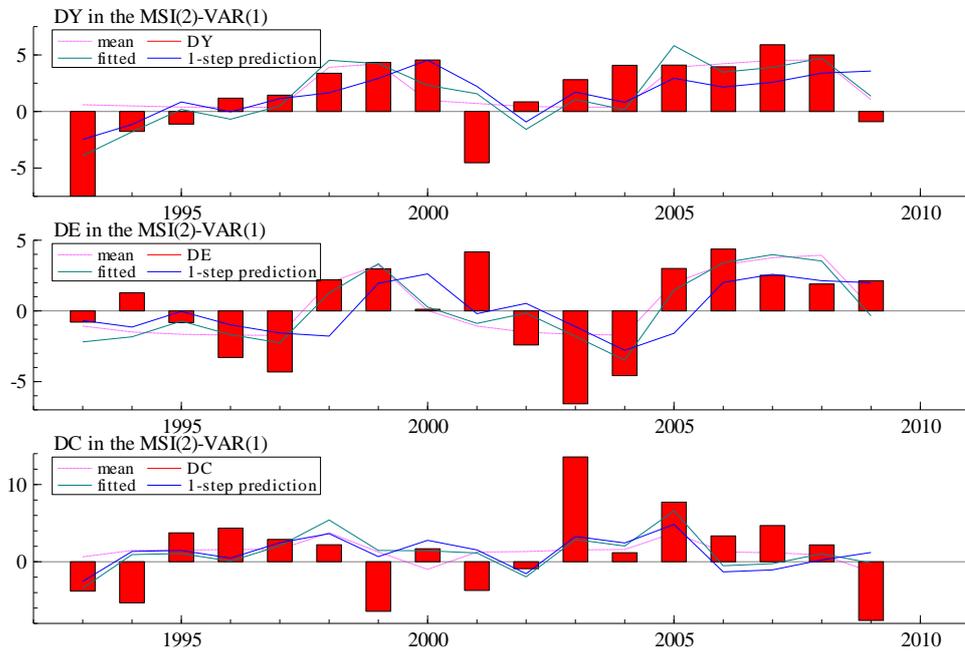
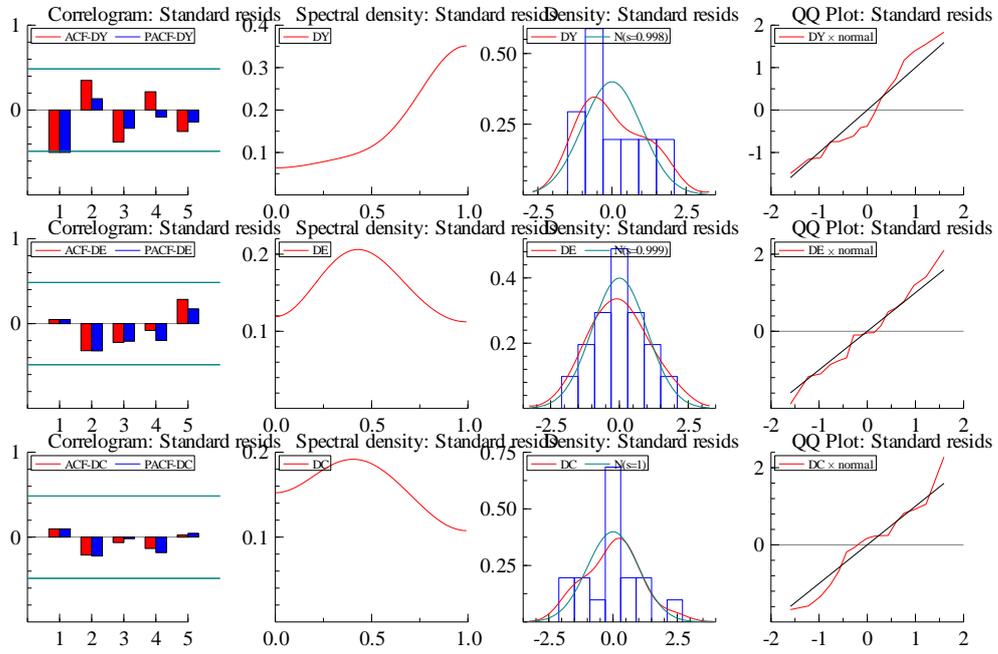
Regime 1

1993:1 - 1997:1 [1.0000]
 2000:1 - 2004:1 [1.0000]
 2009:1 - 2009:1 [1.0000]

Regime 2

1998:1 - 1999:1 [0.9985]
 2005:1 - 2008:1 [1.0000]





8. Turkmenistan

----- EM algorithm converged after 6 iterations -----

EQ(1) MSI(2)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 22 linear system : 18
 no. restrictions : 3
 no. nuisance p. : 2

log-likelihood : -111.9118 linear system : -122.3435

AIC criterion : 15.8720 linear system : 16.5110

HQ criterion : 15.9840 linear system : 16.5987

SC criterion : 16.9993 linear system : 17.3932

LR linearity test: 20.8635 Chi(3)=[0.0001] ** Chi(5)=[0.0009] ** DAVIES=[0.0024] **

----- matrix of transition probabilities -----

	Regime 1	Regime 2
Regime 1	0.8284	0.1716
Regime 2	7.207e-007	1.000

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	5.0	0.0000	5.83
Regime 2	12.0	1.0000	1387573.84

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	-12.686898	-2.287292	-17.917959
Const(Reg.2)	9.346283	2.644296	13.080624
DY_1	0.082825	-0.163999	-0.337843
DE_1	1.725927	0.889459	0.686113
DC_1	-0.028783	-0.015633	-0.591941
SE	3.261421	0.685069	4.551110

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	0.3695	0.2862
DE	0.3695	1.0000	0.4416
DC	0.2862	0.4416	1.0000

----- standard errors -----

	DY	DE	DC
Const(Reg.1)	2.9574	0.6212	4.1269
Const(Reg.2)	1.6966	0.3564	2.3675
DY_1	0.1543	0.0324	0.2153
DE_1	0.8220	0.1727	1.1471
DC_1	0.0604	0.0127	0.0843

----- t - values -----

	DY	DE	DC
Const(Reg.1)	-4.2898	-3.6819	-4.3417
Const(Reg.2)	5.5088	7.4199	5.5250
DY_1	0.5368	-5.0604	-1.5692
DE_1	2.0996	5.1512	0.5981
DC_1	-0.4767	-1.2325	-7.0249

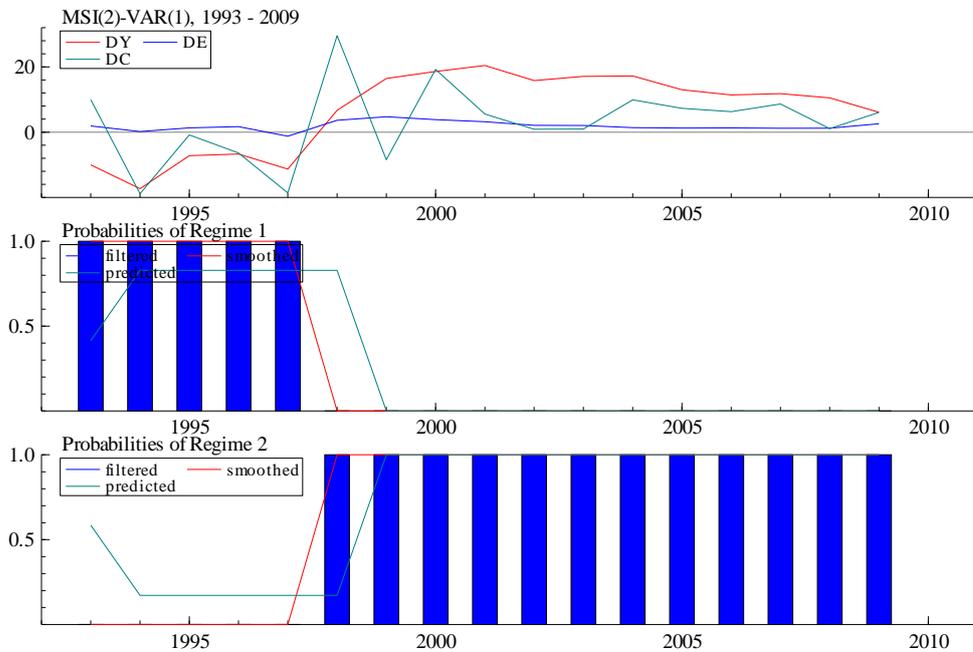
----- regime classification -----

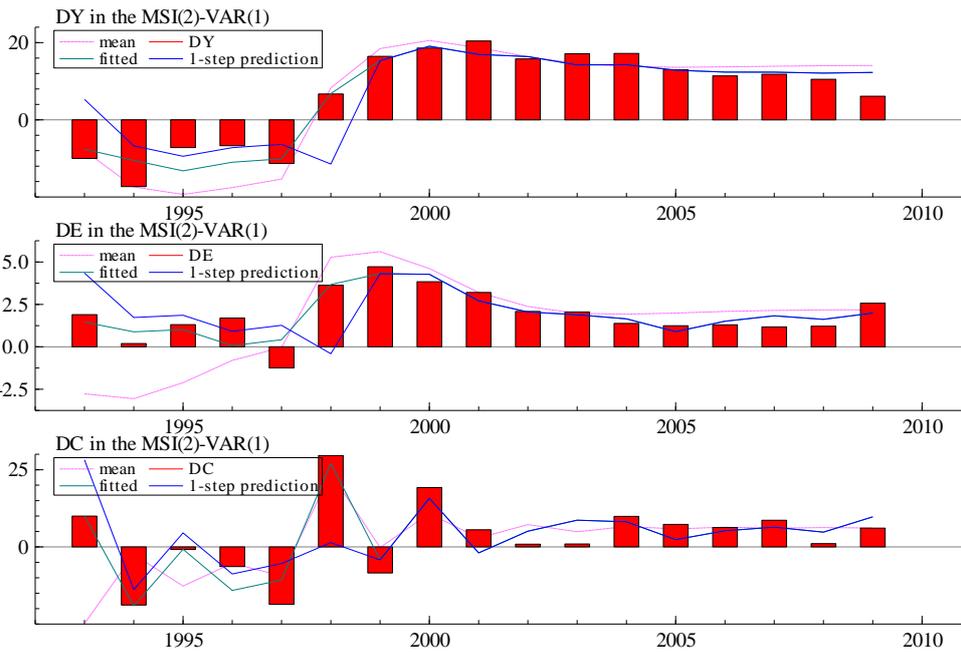
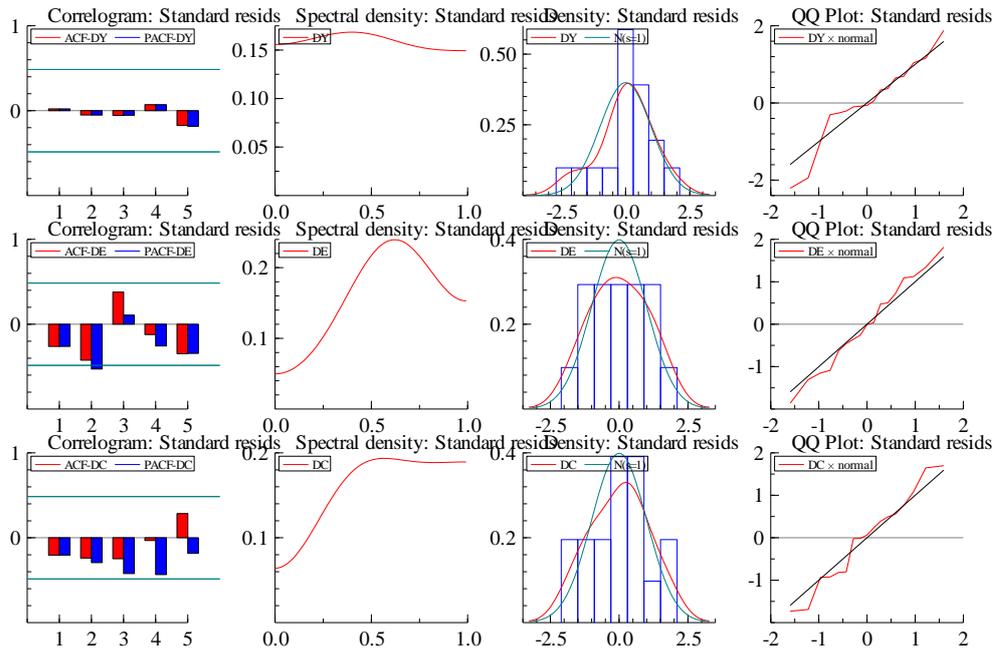
Regime 1

1993:1 - 1997:1 [1.0000]

Regime 2

1998:1 - 2009:1 [1.0000]





Incomplete-U group

9. Ukraine

----- EM algorithm converged after 4 iterations -----

EQ(1) MSI(2)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. :	17	in the system :	51
no. parameters :	22	linear system :	18
no. restrictions :	3		
no. nuisance p. :	2		

log-likelihood : -113.5606 linear system : -120.0999

AIC criterion : 16.0660 linear system : 16.2470

HQ criterion : 16.1780 linear system : 16.3347

SC criterion : 17.1932 linear system : 17.1293

LR linearity test: 13.0784 Chi(3)=[0.0045] ** Chi(5)=[0.0227] * DAVIES=[0.0590]

----- matrix of transition probabilities -----

	Regime 1	Regime 2
Regime 1	0.8730	0.1270
Regime 2	0.1231	0.8769

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	8.0	0.4923	7.87
Regime 2	9.0	0.5077	8.12

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	-13.046018	-1.626842	-7.308175
Const(Reg.2)	6.052816	-0.235860	1.527131
DY_1	-0.138831	0.077718	-0.012107
DE_1	-2.583818	0.553448	-0.262555
DC_1	0.404278	-0.161121	0.135545
SE	4.215476	1.127022	3.595439

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	-0.4479	0.7788

DE -0.4479 1.0000 -0.0072
 DC 0.7788 -0.0072 1.0000

----- standard errors -----

	DY	DE	DC
Const(Reg.1)	2.8340	0.7577	2.4172
Const(Reg.2)	1.9959	0.5336	1.7023
DY_1	0.3090	0.0826	0.2636
DE_1	0.8657	0.2315	0.7384
DC_1	0.4332	0.1158	0.3695

----- t - values -----

	DY	DE	DC
Const(Reg.1)	-4.6033	-2.1471	-3.0234
Const(Reg.2)	3.0326	-0.4420	0.8971
DY_1	-0.4492	0.9406	-0.0459
DE_1	-2.9845	2.3911	-0.3556
DC_1	0.9331	-1.3910	0.3668

----- regime classification -----

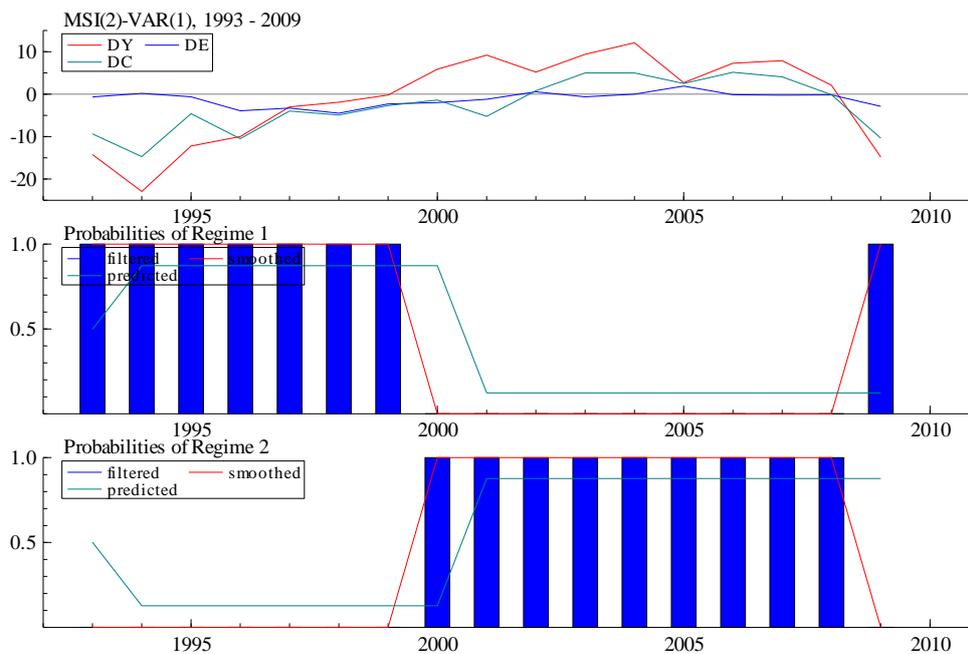
Regime 1

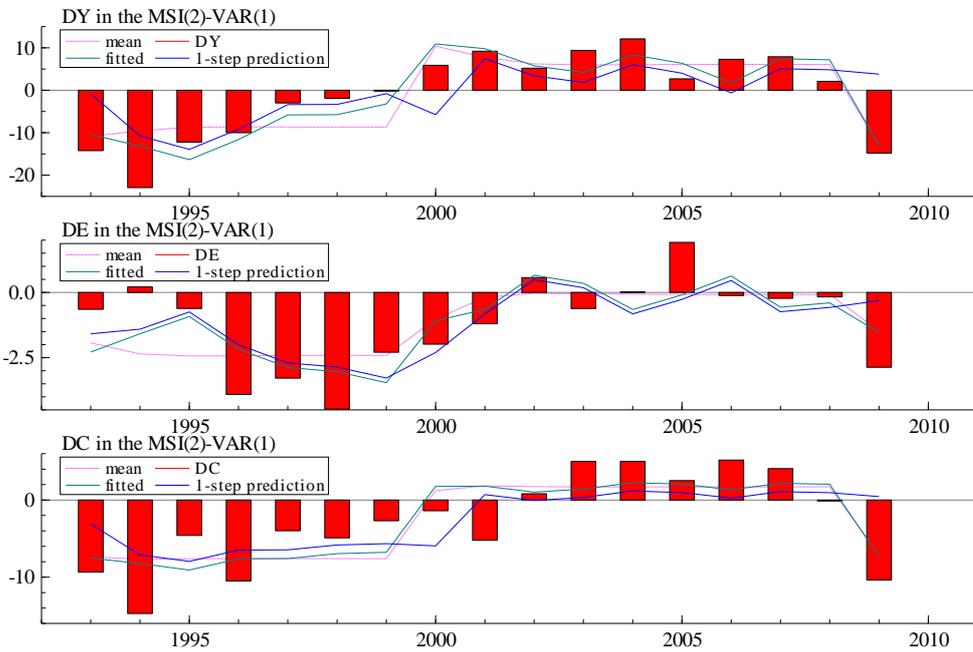
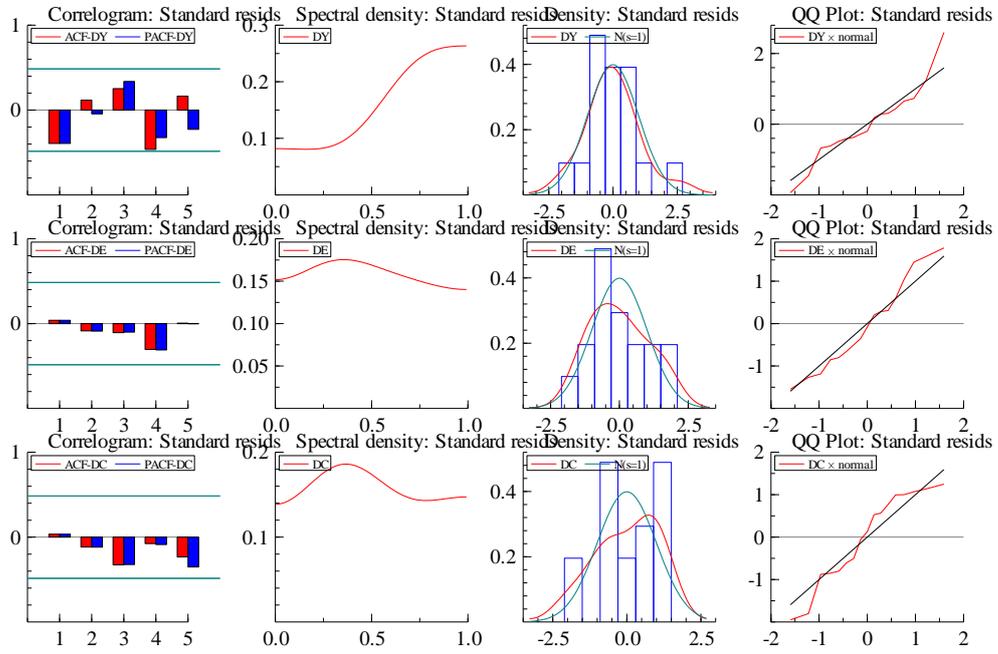
1993:1 - 1999:1 [1.0000]

2009:1 - 2009:1 [1.0000]

Regime 2

2000:1 - 2008:1 [1.0000]





10. Moldova

----- EM algorithm converged after 12 iterations -----

EQ(1) MSI(2)-VAR(1) model of (DY,DE,DC)

Estimation sample: 1993 - 2009

no. obs. per eq. : 17 in the system : 51
 no. parameters : 22 linear system : 18
 no. restrictions : 3
 no. nuisance p. : 2

log-likelihood : -161.8351 linear system : -162.9420

AIC criterion : 21.7453 linear system : 21.2873

HQ criterion : 21.8574 linear system : 21.3750

SC criterion : 22.8726 linear system : 22.1695

LR linearity test: 2.2138 Chi(3)=[0.5292] Chi(5)=[0.8188] DAVIES=[1.0000]

----- matrix of transition probabilities -----

	Regime 1	Regime 2
Regime 1	0.8577	0.1423
Regime 2	0.1342	0.8658

----- regime properties -----

	nObs	Prob.	Duration
Regime 1	7.9	0.4855	7.03
Regime 2	9.1	0.5145	7.45

----- coefficients -----

	DY	DE	DC
Const(Reg.1)	-6.025843	-2.565376	-14.835952
Const(Reg.2)	9.076950	-1.801688	3.744728
DY_1	-0.359388	0.040503	-0.143311
DE_1	0.564507	0.045164	0.314474
DC_1	0.280291	-0.111409	0.234525
SE	5.754342	2.549006	9.477140

----- contemporaneous correlation -----

	DY	DE	DC
DY	1.0000	-0.0764	0.2169
DE	-0.0764	1.0000	-0.2270
DC	0.2169	-0.2270	1.0000

----- standard errors -----

	DY	DE	DC
Const(Reg.1)	2.6691	1.1904	4.3500
Const(Reg.2)	2.6939	1.1614	4.4662
DY_1	0.1693	0.0747	0.2778
DE_1	0.5631	0.2416	0.9228
DC_1	0.1431	0.0621	0.2327

----- t - values -----

	DY	DE	DC
Const(Reg.1)	-2.2577	-2.1550	-3.4106
Const(Reg.2)	3.3694	-1.5513	0.8385
DY_1	-2.1229	0.5424	-0.5159
DE_1	1.0025	0.1869	0.3408
DC_1	1.9581	-1.7942	1.0077

----- regime classification -----

Regime 1

1993:1 - 1999:1 [0.9867]

2009:1 - 2009:1 [0.9865]

Regime 2

2000:1 - 2008:1 [0.9949]

