Banking Sector Competition and its Impact on Banks' Risk-Taking and Interest Margins in the Central and East European Countries

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Abstract

This thesis provides empirical evidence on the degree of banking sector competition in the Central and East European (CEE) countries and the impact of competition on banks' risk-taking and interest margins. The thesis uses data on around 300 banks from 17 CEE countries for the period 1999-2009, and employs a variety of estimation methodologies. The first objective of the thesis is to measure the degree of banking sector competition in CEE countries. Using the Panzar-Rosse approach, we found that the banking sectors of the CEE countries have been characterized by monopoly behaviour. By distinguishing between the non-EU and EU countries of the region, we found that banks operating in the non-EU countries faced a lower degree of competition compared to banks operating in the EU members of the region. The separate estimation for Kosovo indicated that the competitive behaviour of banks operating in this country was consistent with monopolistic competition. The second objective of the thesis is to estimate the impact of banking sector competition on the degree of banks' risk-taking. Using country-level Panzar-Rosse H-statistic estimates as a measure of competition, for the overall sample, we found that competition enhances the quality of the loan portfolio, thus providing evidence against the mainstream view on the trade-off between competition and stability. However, for the non-EU countries of our sample the impact of competition on banks' risk-taking appeared positive, which implies that more effective authorities are needed in these countries to oversee the banks' behaviour when competitive pressures increase. The third objective of the thesis is to estimate the impact of banking sector competition on banks' interest margins. The results suggest that competition had a negative impact on net interest margins. The impact of competition in reducing the net interest margins was stronger in the non-EU countries compared to the EU countries of the sample. Overall, the results suggest that the banking sectors of the CEE countries are characterized by low levels of competition, implying higher risk and larger interest margin.

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« *I dedicate this dissertation to my parents*»

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List of Abbreviations

AC	Average Costs
AR	Average Revenues
CBK	Central Bank of the Republic of Kosovo
CEE	Central and Eastern Europe
CFR	Common Factor Restrictions
CR_5	Five-firm concentration ratio
DIS	Deposit Insurance Scheme
EBRD	European Bank for Reconstruction and Development
ES	Efficiency Structure hypothesis
EU	European Union
FE	Fixed Effects
FEVD	Fixed Effect Vector Decomposition
GDP	Gross Domestic Product
GMM	General Method of Moments
H	Panzar –Rosse H-statistic
HHI	Herfindahl-Hirschman Index
IMF	International Monetary Fund
LRAC	Long-Run Average Costs
LRMC	Long-Run Marginal Costs
MC	Marginal Costs
MR	Marginal Revenues
NIM	Net Interest Margin
NPL	Non Performing Loans
OLS	Ordinary Least Squares

P-R	Panzar-Rosse
RE	Random Effects
RMP	Relative Market Power hypothesis
ROA	Return on Assets
SCP	Structure Conduct Performance
SOCB	State Owned Commercial Banks
SOE	State Owned Enterprises
TA	Total Assets

CHAPTER 1

Introduction

This thesis aims at exploring the degree of banking sector competition in the Central and East European (CEE) countries, and the economic effects that have been associated with banking sector competition. More specifically, the main objectives of the thesis are: a) to estimate the degree of banking sector competition in the CEE countries; b) to estimate the relationship between banking sector competition and banks' loan portfolio quality as a proxy of banks' risk-taking; and c) to estimate the relationship between banking sector competition and net interest margin which is a measure of financial intermediation cost and efficiency. A more extensive elaboration and justification of the objectives of this thesis is provided in the rest of this chapter.

The primary role of a banking system is to "bridge" the resources from savers to borrowers, i.e. to transform savers' deposits into loans for the investors. This role makes the banking system to be considered among the most important sectors that determine the performance of a country's economy. In the empirical literature there is a broad consensus that well-functioning financial intermediaries lead to higher economic growth (Bonin and Wachtel, 2002). However, the credit allocation role does not necessarily lead to higher economic growth if it is not based on prudential lending principles that secure an efficient allocation of resources (Wachtel, 2001). Such banking systems - able to provide efficient financial intermediation - have been operating in the modern economies for quite a long time; whereas in the transition economies of the Central and Eastern Europe (CEE) they are relatively new.[1]

The creation of modern commercial banking sectors in the CEE countries started to take place mainly after the beginning of the transition process in the early 1990s, when the monobank systems were broken up and two-tier banking systems were established. However, the creation of the two-tier banking systems, composed of a central bank and commercial banks, was not sufficient to build stable banking systems that could efficiently exercise their financial intermediation role. The new banking systems mainly consisted of state-owned banks that inherited large stocks of bad loans from the previous monobank system, while continued to base their new activity on the "old" practices by lending to inefficient state-owned enterprises and without following adequate risk-management procedures. The imprudent behaviour of banks, associated also with macroeconomic instability and weak institutions, led to banking crises in almost all the CEE countries. The situation was normalized after a decade of costly restructuring programmes by the governments, and deep reforms which eventually led to a large-scale privatization of state-owned banks to foreign banks. Progress was recorded also in restoring macroeconomic stability and in developing the legal and regulatory institutions which, nevertheless, might be considered to have recorded a rather slow progress. As a result, during the second decade of transition, the banking sectors of the CEE countries became both more stable and more efficient, which was reflected in a continuous decline of non-performing loans and interest rate spreads. The banking sectors in the CEE countries have become a driving force of economic activity, especially given the underdeveloped equity markets, which makes the economy much more dependent on

[1] Central and Eastern Europe in this study is referred to the following European transition economies: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Kosovo, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, and Slovenia.

financial intermediation from the banking sector. However, in spite of the progress, the banking sectors of the CEE countries (especially those of the non-EU countries) continue to lag behind the banking sectors of the Euro Area both in terms of the depth of financial intermediation and the financial intermediation efficiency.

One of the factors that are considered to be highly relevant for the development and efficiency of the banking sector is the degree of banking sector competition. Competition is generally viewed as the driving force of efficiency and a promoter of wider financial inclusion. However, the relevance of competition is attributed also to its potential role in the stability of the banking system, with the mainstream view claiming that competition leads banks to higher risk-taking. The interest of both academics and policy makers in banking sector competition has been reignited by the recent global financial crisis, with many believing that competition has contributed to the incidence of the crisis. The increased attention on banking sector competition can be noticed also by the changing mandate of the central banks which, apart from their traditional mandate to maintain price and financial stability, are increasingly broadening their agenda on areas dealing with other effects of banking activity that, in a way or the other, are related to competition. For example, the World Bank's Bank Regulation and Supervision Survey, updated in 2011, reports that 71 percent of the central banks claim that financial inclusion and economic development are included in their mandate (World Bank, 2013). In addition, 65 percent of the central banks report dealing with market conduct issues, and 25 percent report that competition policy is included in their agenda.

Before the transition process began, competition in the banking sectors of the CEE countries may be considered to have been non-existent or very limited, and the break-up of the monobank systems in the beginning of transition mainly resulted in the creation of oligopolistic market structures (Papi and Revloltella, 1999). The entry of private banks and the eventual privatization of the state-owned banks to foreign banks led to a substantial increase in the number of banks, while the degree of market concentration started to decline, which might potentially be interpreted as an increase of competition. However, these structural features of the banking market may not adequately indicate whether the banking sectors of the CEE countries became competitive, given that they do not represent a direct measure of competitive behaviour.

The rapid changes that took place in the banking sectors of the CEE countries after the break-up of the centrally-planned monobank systems, which were associated with deep reforms that led to substantial changes in bank behaviour and the market structure of the banking sectors, as well as the pivotal role of the banking sector as an important driver of economic activity in these countries, make the banking sectors of the CEE countries an interesting area of research. One of the least explored dimensions of the banking sectors of the CEE countries, but which is viewed as a highly important determinant for the way in which a banking sector serves the economy, is banking sector competition. Therefore, as presented at the beginning of this chapter, this thesis aims at estimating the degree of banking sector competition in the CEE countries, and the impact of competition on the degree of banks' risk-taking and interest margins. Apart from contributing to the broadly inconclusive literature on the economic effects of competition, the findings of this thesis may also be important for shaping the attitude of the regulatory authorities towards the banking sector competition.

Before starting to explore banking sector competition and its effects in the CEE countries, the thesis initially addresses the issues related to the measurement of competition. The literature on the measurement of competition is divided into two streams, consisting of the structural approach for the measurement of competition and the non-structural approach. The structural approach is mainly based on the Structure-Conduct-Performance (SCP) paradigm, which uses the degree of market concentration as a measure of market power. According to this approach, firms operating in more concentrated markets are more likely to exert market power and to collude with each other, thus charging higher prices and generating higher profits. However, this approach has been seriously challenged by different theories. For example, the efficient-structure hypothesis argues that higher profits in more concentrated markets are a result of the superior efficiency of larger firms rather than a result of market power. Another example is the contestability theory, according to which highly concentrated markets can behave competitively if the markets are contestable.

The critiques directed at the SCP paradigm led to the development of the non-structural approaches for the measurement of competition, which directly quantify the competitive behaviour of the banks and do not appeal to structural features of the market to infer the competitive behaviour. The most widely used non-structural approach is the method of Panzar and Rosse (1987) which measures competition by estimating the elasticity of bank revenues with respect to changes of input prices. The sum of elasticities of the bank revenues to a range of input prices produces the Panzar-Rosse H-statistic which indicates whether banks' behaviour is consistent with monopoly, monopolistic competition, or perfect competition. The value of the Panzar-Rosse approach is that it directly quantifies the competitive behaviour of the banks. Taking into account the critiques directed at the SCP paradigm on the one hand and, on the other hand, the advantages of the Panzar-Rosse method which produces a direct measure of the competitive behaviour, and in line with the recent literature that uses the Panzar-Rosse method to assess banking sector competition, we treat the Panzar-Rosse approach as the main method for measuring banking sector competition in this thesis.

In line with the main objectives of the thesis, in chapter 4 we apply the Panzar-Rosse method to estimate the extent of banking sector competition in 16 CEE countries for the period 1999-2009. As emphasized above, banking sector competition in the CEE countries represents a relatively recent phenomenon that was introduced after the transition process began and, as such, has not extensively been addressed in the banking sector literature. Despite the liberalization of entry criteria and the subsequent increase in the number of banks operating in the CEE countries, which might be an indication of the increase of competition, still these countries countinue to be characterized by a lower depth of financial intermediation and higher interest margins than the more advanced EU countries, which may signal the presence of market power in the banking market. Therefore, in this chapter, our objective is to shed more light on the competitive behaviour of banks operating in the CEE countries. Competition is a highly important factor for determining the beneficial role of banks to the economy with respect to both financial intermediation efficiency and financial stability. These are important factors for the economic development and macroeconomic stability of every country. Given that the sample of countries consists both of countries that have joined the EU and of countries that are still in the EU integration process, we expect that potential differences with regard to the banks' operating environment between these two categories of countries may affect the competitive behaviour of the banks. Therefore, apart from estimating the average degree of competition for the overall sample, we also include interaction terms in the regression in order to test whether the competitive behaviour of banks in the non-EU countries is significantly different from the competitive behaviour of banks in the EU countries of the region.

In addition, this is the first study to conduct a separate estimation for measuring the degree of competition in the banking sector of Kosovo, which is the youngest country in the region and has the most-recently developed banking sector. The separate estimation of banking sector competition for Kosovo is undertaken, because no previous study has explicitly dealt with this dimension of banking activity in Kosovo, and also because of data limitations that imposed a slight modification to the original Panzar-Rosse approach. The estimation of banking sector competition for Kosovo is particularly important given that it represents the country with the smallest number of banks in the region, the highest degree of concentration in the banking market, and the highest level of interest margins, all of which have induced a wide public debate on whether the market is sufficiently competitive and whether measures that intensify banking sector competition are needed to be undertaken by the central bank.

In both estimations, we follow Bikker et al. (2007, 2009), who make two related suggestions: not to scale the dependent variable to total assets; and not to include total assets as an explanatory variable in a Panzar-Rosse model. By doing so, we aim at eliminating the misspecification bias that is present in most of the studies that have applied the Panzar-Rosse approach to the banking sector, which are thus considered to have inadequately estimated the degree of competition. Both estimations will be conducted using panel data and dynamic models. The estimation for the CEE countries uses annual bank-level data and will be conducted using General Method of Moments (GMM) estimation, whereas the estimation for Kosovo is based on quarterly bank-level data and uses the Unobserved Components model.

The second objective of this thesis, which is to estimate the relationship between banking sector competition and risk-taking, is addressed in chapter 5. The issue of bank risks is considered as highly important both in the literature and among the regulators primarily because banks' bankruptcies are expected to be associated with much larger negative consequences for the economy compared to the bankruptcy of other types of firms. As a consequence, the economic literature has dealt extensively with the determinants of banks' risk-taking. In this context, considerable attention has been paid to the relationship between banking sector competition and the risk-taking behaviour of banks, with the mainstream view arguing that competition pushes banks to undertake higher risks (Keeley, 1990; Hellman et al., 2000; Marques, 2002; Repullo, 2003). Based on this view, regulators, especially in the past, have often undertaken measures to restrict banking sector competition, aiming at safeguarding banking system stability. However, the other strand of the literature argues that competition has a negative impact on risk, suggesting that banks operating in more competitive markets tend to undertake lower levels of risk (Boyd and de Nicoló, 2005; Chen, 2007).

The high ratios of non-performing loans in all the CEE countries, which reflected the high degree of risk-taking by banks, represented the main challenge during the transition process of the banking sector in these countries. The reasons for the high non-performing loans were multiple, starting from the legacies inherited from the centrally-planned economies, to the poor corporate management of the newly created banks and the weak institutions. In such an environment, where banks lacked the capacities to perform adequate risk-management and the institutions lacked the capacities to provide adequate regulation and supervision, the increase of competition might have further exacerbated the risks taken by the banks. Given that banking sector competition in these countries is expected to increase further as the non-EU countries of the CEE move towards EU membership and the quality of institutions in many of the CEE countries is still considered to be weak, the investigation of the relationship between competition and risk-taking in the banking sector is very important for a better understanding of the impact of competition in these countries in the past and for a better tailoring of banking sector competition policies in the future.

We investigate the relationship between banking sector competition and risk-taking in the CEE countries by following an estimation strategy that consists of two stages. The first stage consists of the estimation of the degree of competition (i.e. H-statistic) for each country/year using the Panzar-Rosse approach. In the second stage, we use the H-statistics that were produced in the first stage to estimate the impact of competition on banks' risk taking in the CEE countries. To our knowledge, this is the first study to use the Panzar-Rosse H-statistic in estimating the impact of banking sector competition on risk-taking for the CEE countries, while the previous studies have mostly used market concentration indices, which might not represent adequate measures of competition. For comparison, we use also the Lerner Index as a measure of market power and the Herfindahl-Hirschman Index as a measure of market concentration. The degree of banks' risk (i.e. the dependent variable) in this study is proxied by the loan-loss provisions to total loans ratio, which reflects the quality of the bank's loan portfolio. The estimation will be conducted using the Fixed Effects Vector Decomposition method, which is a recently introduced extension of traditional fixed effects estimation.

The third objective of the thesis is addressed in chapter 6 and investigates the relationship between banking sector competition and financial intermediation costs. Financial intermediation costs play a highly important role for the overall economic activity of a country, since they directly affect the cost of capital formation and, hence, the level of investments. This is particularly important for the CEE and other countries that lack well-functioning equity markets. In the absence of developed equity markets, financing options for enterprises are much more limited, so the economy is more dependent on financing from the banking sector and thus more sensitive to banks' interest margins. In the CEE countries, interest margins continue to be higher than in the more advanced EU countries, thus negatively affecting the efficiency of financial intermediation. The theoretical and empirical literature emphasizes a number of factors that are considered to have an important role in determining the level of interest margins. One of the most important factors is the degree of market competition, with most of the literature arguing that higher competition leads to lower interest margins (Ho and Saunders, 1981; Berger and Hannan, 1998). A few studies have investigated this relationship for the CEE region and have similarly found that competition reduces interest margins. However, the majority of empirical studies that have investigated the determinants of interest margins did not use a direct measure of competition but, instead, have relied on the market concentration indices, which have been largely criticised for not representing adequate measures of competition.

Therefore, for estimating the relationship between banking sector competition and interest margins in the CEE countries, as a measure of competition we use the Panzar-Rosse H-statistic for each country/year that we estimated in chapter 5. To the best of our knowledge, this is the first study to use the Panzar-Rosse H-statistic in estimating the relationship between banking sector competition and interest margins for the CEE countries and will enable a better understanding of the role of banking sector competition in the determination of financial intermediation efficiency in the CEE countries. For comparison, we use also the Lerner Index, which is a measure of market power, and the Herfindahl-Hirschman Index as a market concentration index that enables our results to be comparable with the results obtained from other studies. The regression controls also for the impact of other variables, including bank-specific variables, macroeconomic variables, and institutional variables. For the dependent variable, we follow the majority of the studies in this field that use the net interest margin, which is considered to be a measure of financial intermediation cost. The estimation will be conducted on panel data, using the General Method of Moments approach to dynamic panel modelling.

The thesis uses the data on around 300 banks from 17 CEE countries for the period 1999-2009. The bank-specific data in this thesis are sourced from the Fitch-IBCA Bankscope database, which provides annual data on banks operating all around the globe. For Kosovo, the data are obtained from the Central Bank of the Republic of Kosovo, given that the Bankscope database includes few Kosovo banks. The data on the macroeconomic and institutional indicators are obtained from different sources, including the International Monetary Fund, World Bank, European Commission, European Bank for Reconstruction and Development and the Heritage Foundation.

The thesis is organized as follows. Chapter 2 presents an overview of the evolution of the banking sector in the CEE countries, including the pre-transition period and the transition process. Special attention is paid to the evolution of competitive conditions, risk-taking, and intermediation costs, which are the key areas covered by this thesis. Chapter 3 presents a critical review of the approaches for the measurement of competition, focusing on the Structure-Conduct-Performance paradigm and the Panzar-Rosse approach. In chapter 4, we apply the Panzar-Rosse approach to estimate the degree of banking sector competition in the CEE countries, and separately measure the degree of banking sector competition for Kosovo. In chapter 5 we estimate the relationship between banking sector competition and risk-taking in the CEE countries. Chapter 6 presents the estimation of the relationship between banking sector competition and financial intermediation costs in the CEE countries. Finally, chapter 7 presents the main findings of the thesis and presents corresponding policy implications that may help policymakers to better shape their policies with regard to banking sector competition and, in turn, with regard to the general improvement of banking sector stability and efficiency. This chapter also summarizes the main contributions to knowledge provided by the thesis as well as some potential topics for further research in this field.

CHAPTER 2

Evolution of the Banking Sector in the Transition Economies of the Central and Eastern Europe

2.1 Introduction

Until the beginning of the 1990s, when the process of transition from the centrally planned to market oriented economies started, the banking systems of the CEE countries (except the former Yugoslavia) consisted of monobanks which collected deposits that were renumerated at regulated interest rates, and extended loans based on the Government's central plan. The banking system in its present form did not exist, with the monobanks having a rather administrative role, serving as record-keepers for the implementation of the payments plan between the state entities. Unlike that in other CEE countries, the banking system in former Yugoslavia since the 1950s consisted of the central bank and the commercial banks but, given that commercial banks were not privately-owned, there were no big differences compared to the banking sectors of other CEE countries.

When the transition from to the market system started, the monobanks were broken up in order to form a two-tier banking system, consisting of the central bank and the commercial banks. However, for most of the countries the transition process entailed difficulties that resulted in banking crises in these countries. It took a decade of restructuring and reforms to stabilise the banking systems of these countries and make them capable of converging towards the banking systems of Western economies. During the second decade of the transition process, the privatization of state-owned banks led to a dominant presence of foreign banks in almost all the CEE countries which brought the modern commercial banking experiences and boosted the banking sector development in these countries. Meanwhile, macroeconomic stability was restored in most countries and progress was recorded with regard to the development of legal and regulatory institutions. These developments created the conditions for the development of banking sector competition, while banking stability and financial intermediation efficiency improved, albeit lagging behind the Euro Area countries.

This chapter aims at presenting an overview of the evolution of the banking sector in the CEE countries and the developments during the transition process. The chapter is organized as follows. The next section presents an overview of the banking systems of CEE countries in the pre-transition period and the transition from the monobank system to a two-tier banking system. Section 2.2 presents the banking sector developments, especially the restructuring process, during the transition. Section 2.3 analyses the developments of the banking system in the second decade of transition by focusing on the banking reforms and the evolution of banking system competition, loan-portfolio quality, and interest rate spreads. Section 2.4 concludes.

2.2 The Transition process and the banking system in the CEE countries

The banking systems of the CEE countries have passed through a long process of transition from the monobank system into a well-functioning two-tier banking system. In the CEE region (except in former Yugoslavia), each country had a monobank which exercised the functions of the Central Bank and also some of the functions of commercial bank such as the settlement of payments, the collection of deposits, and the allocation of credit. However, these functions were not related to market-based financial intermediation. Deposits were remunerated at regulated interest rates, whereas loans were disbursed to State Owned Enterprises (SOE) based on the central plan (Caviglia et al., 2002). In other words, the financial intermediation was not market-based, but deposits were used to produce directed loans to SOEs. Loans to the SOEs were allocated to finance investment projects as well as in the form of budget allocations to fulfil working capital requirements necessary for meeting the output plan (Bonin and Wachtel, 2002).

In some of the countries, the banking activity was organized in separate segments operated by specialist banks. The specialist banks had a subservient role to central planning and carried specific functions without interfering with each other, meaning that there was no competition between them. For example, a state saving bank was responsible only for the collection of deposits; a trade bank was responsible for handling foreign trade transactions; an agricultural bank allocated loans to the agriculture sector; and a construction bank allocated loans for infrastructure development. All these banks were part of a single state banking apparatus and served the fulfilment of the output plan.

In the former Yugoslavia, the situation was somewhat different. The two-tier banking system existed since the 1950s, consisting of the National Bank of Yugoslavia that had the role of the central bank, and the republic-level commercial banks (Bonin, 2001). Most of the republics had a main commercial bank which controlled the majority of the banking sector assets. These commercial banks had a collective ownership, similar to all enterprises in Yugoslavia.

With the transition from centrally planned economies to free market economies, which started in the beginning of the 1990s, the banking sector , like other sectors, had to embark on the reform process. For most of the CEE countries, the first step of the reform was to break up the monobank system and establish a two-tier banking system which included the Central Bank and commercial banks. Under the new system, the central banks were responsible for the monetary policy and for regulating and supervising the commercial banks. The newly created commercial banks were mostly state-owned. In some countries, the entire commercial portfolio of the monobank was transformed into a single state-owned commercial bank. Also the previous specialist banks were transformed into state-owned commercial banks. Hence, even though the first step of reform was undertaken, the state retained its influence on the banks' decisions. A similar situation was created also in the republics of the former

Yugoslavia, where the problems with capitalization and bad loans had led governments to nationalize many of the commercial banks, creating state-owned banks.

A common feature of all the CEE countries at the beginning of the transition was the high presence of the state-ownership in the banking system and the high degree of the market concentration. In order to induce domestic competition, almost all countries applied lax licensing criteria which enabled private banks to enter the market, thus leading to a rapid increase in the overall number of commercial banks. In Yugoslavia, the number of banks started to increase in the 1970s upon the establishment of many domestic company-banks which led to an excessive number of small and unhealthy banks (Sevic, 2000).

However, the transition to a two-tier system and the increase of the number of banks was not sufficient to ensure well-functioning banking systems in the CEE countries. The substantial deterioration of the loan quality and the subsequent problems with the degree of banks' capitalization made the banking systems of these countries far from efficient and sustainable. These problems derived from the legacies of the pre-transition period as well as the flaws that occurred during the transition process.

Before the transition process began, bank loans were issued to the SOEs as directed credits based on central planning. The bank credit policy was just another government instrument to fulfil the needs of the centrally planned economy, while the evaluation of the credit risk was not relevant (Stubos and Tsikripis, 2004). Hence, many of these loans were of dubious quality from the moment they were issued (i.e. before the transition). When the break-up of the monobank system took place, these loans were inherited by the newly created state-owned commercial banks (SOCB) - thus, SOCBs started their operation with a stock of bad loans in their portfolios. However, the problem was not limited to the existing stock of bad loans and was exacerbated by the inflow of new dubious-quality loans in the banks' portfolios.

Most of these dubious quality loans were the result of lending to SOEs which was either motivated politically, given that both banks and enterprises were state-owned, or because banks wanted to maintain their lending relationships with their clients (Bonin et al., 2008). At this stage, banks lacked adequate capacities in terms of technology and human resources to assess the viability of projects. Risk assessment techniques were relatively new to banks because they became relevant only after the break-up of the monobank system. Hence, the initial lending by the SOCBs mainly consisted of loans issued to borrowers whose quality was unknown to the banks. These loans, in fact, carried a high level of risk due to the increased fragility of SOEs at the outset of transition.

The transition process in CEE countries was characterized by a sharp decline of output of SOEs (Blanchard, 1996), largely due to the elimination of government subsidies to the state enterprises and the market liberalization that subjected SOEs to domestic and foreign competition. As a consequence, the profitability of many SOEs declined and so did their ability to repay bank loans. According to Gorton and Winston (1998), when the market-oriented reforms began, many enterprises had sufficient funds to cover their operating expenses but not enough to cover their interest payments. As a consequence, most loans issued by SOCBs to SOEs were translated into non-performing loans. Another macroeconomic problem impeding the efficient functioning of the banking system in the beginning of the transition process was the high inflation rates which in many countries had turned into hyperinflation. In some countries, such as Estonia (1992), Macedonia (1992), Latvia (1993), and Czech Republic (1996), the monetary policy element of the macroeconomic stabilization programs aimed at reducing inflation led to higher nominal interest rates which, in turn, led to an increase in real interest rates. This had a negative impact on the loan repayment capacity of the borrowers and led to a further increase in non-performing loans (Tang et al., 2000).

In order for the banking system to operate prudently, adequate regulation and supervision capacities are required. When the transition process started, prudential regulation and supervision in CEE countries was extremely poor (Tang et al., 2000). The banking laws had many deficiencies with regard to the regulation of loan collection and the rules on collateral, and the conflict of interest between the bank and the bank's shareholders was not properly defined. In addition, the central banks lacked trained personnel and the supporting infrastructure to perform adequate banking supervision. This mainly reflected the lack of experience in dealing with commercial banking in the previous system. The weak institutional environment left room for the installation of poor internal governance practices in banks which represented a serious impediment to the development of the banking systems of these economies (Tang et al., 2000). Fraud, corruption and insider lending became common in banks. Some of the new banks were used to lend improperly to their owners; indeed, this might have been the reason why some of these banks were created (Bonin et al., 2008).

Another institutional obstacle for banks in the transition economies was the legal framework for the protection of creditor rights. In the previous regime, lending meant the channelling of investment funds or subsidies to the state-owned enterprises, while there was no bankruptcy law and no legal framework for the protection of creditor rights and, as such, the repayment of loans was often based on bargaining between enterprises and state-owned banks (Fries and

Taci, 2002). As such, the protection of creditor rights was not considered to be relevant.[2] However, with the separation from the centrally-planned system and their subsequent privatization, banks and enterprises no longer belonged to the same owner, so banks needed assurance that they would be able to enforce loan repayments; i.e. the protection of creditor rights became a necessity.

These institutional deficiencies, coupled with the policy of lax licensing criteria for new banks, led to a rapid increase in the number of banks, most of which were undercapitalized. The entry of new banks, instead of increasing competition and being beneficial for the efficiency of the banking system and the pool of bank services, only exacerbated the fragility of the banking system. Lacking commercial banking experience and operating in a poorly regulated and supervised banking environment, these banks engaged in excessive risk-taking (Bonin and Wachtel, 2002). As a consequence, there was a dramatic increase in the volume of non-performing loans which threatened the stability of the banking system. As shown in Table 2.1, non-performing loans reached two-digit figures in most of these countries, and in many of them a substantial part of the banking system faced solvency problems. In order to address the systemic risk, the authorities encouraged state-owned banks to take over the smaller private banks that were likely to fail. However, this did not result to be an adequate solution, because these acquisitions further worsened the already weak balance sheets of the state-owned banks.

[2] Creditor rights include the ability of the banks to hold and seize collateral, and the ability to recover loans fully or partially through the bankruptcy procedures when the loans are not repaid by the borrowers (Riess et al., 2002).

Table 2.1 Summary of non-performing loans in selected CEE countries

Country	Period	Scope of crisis
Albania	1992-	31% of loans granted after the cleanup of 1992 were nonperforming.
Bosnia and H.	1992-	Loans issued in late 1980s and early 1990s were in default.
Bulgaria	1991-	In 1995, 75% of non-government loans were non-performing.
Croatia	1995	Banks accounting for 47% of bank credits were insolvent.
Czech Rep.	1994-1995	38% of loans were non-performing; many banks were closed down after year 1993.
Estonia	1992-1995	Insolvent banks held 41% of banking system assets; licenses of 5 banks were revoked; 2 banks were nationalized and merged; 2 banks were merged and converted to a loan recovery agency.
Hungary	1987-	8 banks accounting for 25% of financial system assets became insolvent.
Latvia	1995-	2/3 of the banks recorded losses in 1994; 23 licenses were revoked in 1994-1995; 3 major banks were closed down in 1995; 10 banks accounting for 40% of banking system assets were in crisis.
Lithuania	1995	12 small banks were liquidated; 4 larger ones did not meet capital adequacy requirements; the fourth largest bank was closed down.
Macedonia	1993-1994	70% of loans were non-performing; the second largest bank was closed down.

Source: Tang et al. (2000).

The discussion above shows that the transformation of the monobank system to a two-tier system was not sufficient to ensure efficient financial intermediation in transition economies of the CEE. The problem was not only prevalent in the initial stages transition but continued due to the ongoing improper behaviour of the banks as well as the absence of strong regulatory and supervisory institutions. This situation called for deep restructuring with regard to both the commercial banks and the relevant institutions.

2.2.1 Restructuring of the banking system

The newly created SOCBs inherited poor-quality loans from the previous centrally-planned system while the continued state ownership of banks allowed them to continue to apply poor banking practices. This was also a consequence of the lack of personnel with the knowledge and experience of market-oriented banking and the weak regulatory and supervisory institutions. Therefore, the restructuring of the banking system implied a complex process which had to tackle both the problems inherited from the past as well as the current behaviour of the banks. In addition, the institutional restructuring was another important task that had to be done in parallel with bank restructuring.

However, the approach of authorities in most CEE countries was not so comprehensive. The initial focus was on cleaning the balance sheets from the existing bad loans, but not addressing the current improper behaviour of banks which was generating new non-performing loans in the banks' balance sheets. After the elimination of fiscal subsidies to SOEs, the SOCBs were viewed as an alternative source of financial support to SOEs (Bonin and Wachtel, 2004). The SOCBs continued to lend to the still-not-restructured SOEs which had also been hit by the decline of output since the beginning of transition. The stock of bad loans was not static but kept increasing partly due to the gradual recognition of the quality of the previously issued loans and partly due to the continuation of bad lending practices by the banks (Bonin and Wachtel, 2002). The lending process was not based on the modern banking techniques which include the screening of borrowers and the evaluation of project risks.

In order to preserve the banks from failing, many governments intervened by recapitalizing the problematic banks or by removing the bad loans from their portfolios (Bonin, 2001; Bonin and Wachtel, 2004). For example, Hungary and Bulgaria embarked on waves of recapitalization. The Czech Republic, Croatia, and Slovenia created state-owned hospital banks or other asset management companies that took over the bad loans from the ailing banks. Poland adopted a programme in which the restructuring of the SOEs and banks were tackled at the same time. Estonia, Latvia and Lithuania followed a combined approach that consisted of bank restructuring when the problems were not very deep and bank liquidation for the more problematic banks.

However, these methods of intervention proved to be insufficient because they targeted only the existing stock of the bad loans while not addressing the flow of new bad loans (Bonin et al., 2008). In fact, these forms of intervention might have even contributed to a larger flow of new bad loans because of their impact in inducing moral hazard in the behaviour of banks. The subsequent waves of recapitalizations and the creation of "hospital" banks and other government agencies for bad loans collection led to the expectation that the government would continue to do so in future too. In the case of Poland, banks did not prove to have the necessary expertise to restructure enterprises and ended up extending continuous credit to weak SOEs (Gray and Holle, 1996; Bonin and Leven, 1996).

The normalization of the situation in the banking systems called for a more complex approach which, in addition to addressing the existing stock of the bad loans, also helped eliminate the banks'incentive to lend to weak clients. As Bonin and Wachtel (2004) emphasize, freeing banks from the inherited bad clients was more important than cleaning the banks' balance sheets from the inherited bad loans. This primarily implied the need for the SOCBs to quit lending to weak SOEs. As Bonin and Wachtel (2002) point out, one of the key pillars of an efficient banking sector is to have financially strong banks which are independent of the state (through privatization) and independent of the legacies of the past (i.e. from the inherited bad loans and bad clients).

Therefore, the way ahead for all CEE countries was to proceed towards the privatization of their state-owned banks. The benefits from privatization were expected to be multidimensional, including the creation of better incentives for bank managers to change to a more disciplined risk-taking behaviour, the reduction of the government's influence on lending decisions of commercial banks, and the improvement of incentives for the acquisition of better screening and monitoring technologies by banks (Reininger et al., 2002). Although most countries embarked on the privatization process, the expectations were not met immediately. In many countries privatization resulted in the bank ownership being dispersed among many small owners or in cross-ownership between enterprises and the government (Tang et al., 2000). This obviously did not lead banks away from their previous lending relationships and did not improve their corporate governance. In addition, in sosme countries, the owners of many banks were their main clients and possessed no banking experience or know-how to run banks (Kraft, 2004). Therefore, the best way for privatization to produce the desired results was their privatization to reputable foreign banks, given the lack of domestic commercial banking experience and the lack of sufficient capital in CEE countries (Bonin et al., 1999).

The governments of transition countries initially hesitated to allow foreign banks enter their markets, claiming that the foreign direct investments in the banking sector were less desirable than in other sectors of the economy (Bonin et al., 2008). The concerns were mainly related to the possibility that the foreign-owned banks would facilitate capital flight from transition economies and whether they would be committed to provide loans for the local economic development. An exception was Hungary which sold the SOCBs to the foreign banks in early transition. Other countries did eventually open up to the foreign investors, but only after their initial costly bank restructuring programs failed. Afterwards, foreign ownership dominated the banking systems in most of CEE countries while state ownership gradually disappeared in most of them. The entry of foreign banks helped the modernization of the banking systems in these countries by bringing modern practices of commercial banking. Foreign banks may also be considered to have introduced competition in the banking sector which led to more prudent and efficient financial intermediation (Tang et al., 2000).

During the transition process, most countries recorded progress in institution building which included the introduction of prudential regulations (e.g. capital adequacy requirements, loan classification and provisioning), upgrading the local accounting standards in line with the international standards, strengthening banking supervision, tightening the licensing criteria, and strengthening the legal framework (e.g. bankruptcy and collateral laws) (Tang et al., 2000). However, the creation of the legal framework was not complete without effective implementation. Despite the significant progress in the early stage, most countries lagged behind with respect to the implementation of the legal framework. Hence, more effort was needed in closing the gap between the extensiveness and the effectiveness of the legal framework (EBRD, 2001).

2.3 The banking systems of CEE countries in the later stage of transition (1999-2009)

A decade after the transition began, the CEE countries successfully established market-oriented banking systems and overcame the banking crises that occurred during the early transition process. This was achieved by successful restructuring of the banks which was mainly achieved after their privatization to foreign banks, and the establishment of a more favourable operating environment.

In the next section we focus on the second decade of the transition, i.e. the period 1999-2009 (to which we refer as the post-transition period). This section initially elaborates the operating environment for the banks in CEE countries. The section then elaborates the banking sector reform and development during the post-transition period, focusing on three specific aspects of the banking sector in the region which include banking system competition, risk-taking, and interest rate spreads.

2.3.1 Operating environment

The poor macroeconomic environment at the beginning of the transition process that was characterized by a sharp decline of output and excessively high inflation rates represented a serious impediment to the efficient functioning of the banking system. However, the stabilization programmes during the first decade of transition, which included sound monetary and fiscal policies, resulted in macroeconomic stability. The economic activity in the old unproductive sectors gradually declined while the new sectors that were able to compete in an open market economy started to grow (Fischer and Sahay, 2000). As a result, by 1999 almost all CEE countries recorded positive real GDP growth rates which generally remained quite steady until 2009 when the global crisis resulted in most CEE countries recording negative growth rates (Table 2.2). Despite the similarities in growth rates, a wide gap remains when GDP per capita of CEE countries are compared with each other. The more advanced CEE countries, namely the EU member countries, have considerably higher GDP per capita compared to other countries of the region, thus reflecting substantial divergences in terms of the degree of economic development. The country with the lowest GDP per capita is

Kosovo (1,814 US dollars), while the country with the highest GDP per capita is Slovenia (16,486 US dollars).

The CEE countries were successful also in bringing down their inflation rates which had represented a serious macroeconomic problem at the beginning of the transition. All countries except Serbia and Romania were successful in reducing the inflation to one-digit rates by 1999. By 2007, inflation rates had dropped to one-digit rates in Serbia and Romania, too.

Table 2.2 Selected macroeconomic indicators, average values for 1999-2009

	Real GDP growth rates (in %)	GDP per capita (in US dollars)	Annual average inflation rates (in %)
Albania	6.5	2,367	2.4
Bosnia and Herzegovina	4.7	2,960	1.7
Bulgaria	4.7	3,581	6.2
Croatia	2.8	9,266	3.3
Czech Republic	3.4	11,705	3.3
Estonia	4.5	9,404	4.2
Hungary	2.4	9,430	6.5
Kosovo	4.5	1,814	1.6
Latvia	4.6	7,191	5.7
Lithuania	4.3	7,197	2.8
Macedonia	2.9	2,830	2.4
Montenegro	3.8	3,736	21.2
Poland	4.0	7,683	3.9
Romania	4.1	4,441	19.1
Serbia	4.0	3,438	27.3
Slovakia	4.2	10,389	5.9
Slovenia	3.3	16,486	5.0

Source: EU Commission, IMF, EBRD
Note: See Appendix 1.1 for the time series of each indicator for the period 1999-2009.

The progress has been slower with regard to the effectiveness of the legal framework which created uncertainties regarding the ability of banks to enforce their creditor rights (Kraft, 2004; Hasselmann and Wachtel, 2007). Taking into account the fact that the design of the legal framework in all CEE countries was based on the contemporary practices of the free-market economies, the lack of effectiveness might mostly be attributed to the inefficiency of the court system in enforcing the legal framework. The Heritage Foundation produces the Property Rights Index which measures the degree to which laws in a country protect private property and the extent to which these laws are implemented. The index pays special attention to the presence of corruption within the judicial system, and the ability of businesses and individuals to enforce contracts. Table 2.3 shows that most CEE countries have a low index of property rights protection and the progress, if any, has been very slow. As expected, the countries that were more advanced in terms of the EU integration such as the Czech Republic, Estonia, Hungary, Poland, and Slovenia had higher indices, suggesting that the degree of property rights protection in these countries was higher than in the other countries of the region.

Table 2.3 Protection of property rights index

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Albania	30	30	30	30	30	30	30	30	30	30	30
Bosnia and H.	10	10	10	10	10	10	10	10	10	10	10
Bulgaria	50	50	50	50	50	30	30	30	30	30	30
Croatia	30	30	30	30	30	30	30	30	30	30	30
Czech Rep.	70	70	70	70	70	70	70	70	70	70	70
Estonia	70	70	70	70	70	70	70	70	90	90	90
Hungary	70	70	70	70	70	70	70	70	70	70	70
Kosovo	-	-	-	-	-	-	-	-	-	-	-
Latvia	50	50	50	50	50	50	50	50	50	55	55
Lithuania	50	50	50	50	50	50	50	50	50	50	50
Macedonia				30	30	30	30	30	30	30	30
Montenegro	-	-	-	30	30	-	-	-	-	-	40
Poland	70	70	70	70	70	50	50	50	50	50	50
Romania	30	30	30	30	30	30	30	30	30	30	35
Serbia	-	-	-	30	30	-	-	-	-	-	40
Slovakia	50	50	50	50	50	50	50	50	50	50	50
Slovenia	70	70	70	50	50	50	50	50	50	50	60

Source: Heritage Foundation.
Note: The index takes values from 0-100. Higher values indicate a higher level of property rights protection.

2.3.2 Banking sector reform and development

The second decade of the transition process was mainly characterized by the reduced role of the state in the banking system, their privatisation and the rapid increase in foreign ownership of banks. This is the period when the banking system stability, in the sense of the banking sector being capable of withstanding the shocks and allocating the savings into profitable investment projects (ECB's definition of financial stability), was more clearly achieved.

As shown in Table 2.4, by 2009 state ownership of the banks in CEE countries was almost entirely replaced by foreign ownership as the privatization process, together with low barriers to entry for the foreign investors, led to a massive influx of foreign banks. The significant presence of foreign banks started to occur from 2000 onwards, and by 2009 foreign ownership heavily dominated the banking sectors in all the CEE countries (except Slovenia). For example, in Estonia foreign-owned banks controlled 98.3% of total banking system assets, followed by Bosnia and Herzegovina where the market share of foreign-owned banks was 94.5% in 2009.

The entry of foreign banks may be considered to have contributed most to the development of functional market-based banking systems in CEE countries; directly, as providers of the banking services, and indirectly through competition and other positive spill-over effects (Litan et al., 2001). The expertise and the information technology brought by foreign banks enhanced the efficiency of the banking system and provided better risk-management techniques, thus contributing to the stability of the banking system too. In addition, the entry of foreign banks benefited domestic banks especially in terms of improvements in human capital (Papi and Revoltella, 1999). The entry of foreign banks was beneficial also for the development of banking regulations and supervision, because the authorities needed to adjust to the more advanced level of foreign bank operations (Hermes and Lensink, 2004).

Table 2.4 Banking system ownership and reform indicators, 2009

	Asset share of state banks (in %)	Asset share of foreign banks (in %)	EBRD index of banking reform
Albania	0.0	92.4	3.0
Bosnia and Herzegovina	0.8	94.5	3.0
Bulgaria	2.4	84.0	3.7
Croatia	4.1	91.0	4.0
Czech Republic	-	-	4.0
Estonia	0.0	98.3	4.0
Hungary	3.9	81.3	4.0
Kosovo	0.0	90.0	-
Latvia	17.1	69.3	3.7
Lithuania	0.0	91.5	3.7
Macedonia	1.4	93.3	3.0
Montenegro	0.0	87.1	3.0
Poland	22.1	72.3	3.7
Romania	7.9	84.3	3.3
Serbia	-	-	3.0
Slovakia	0.9	91.6	3.7
Slovenia	16.7	29.5	3.3

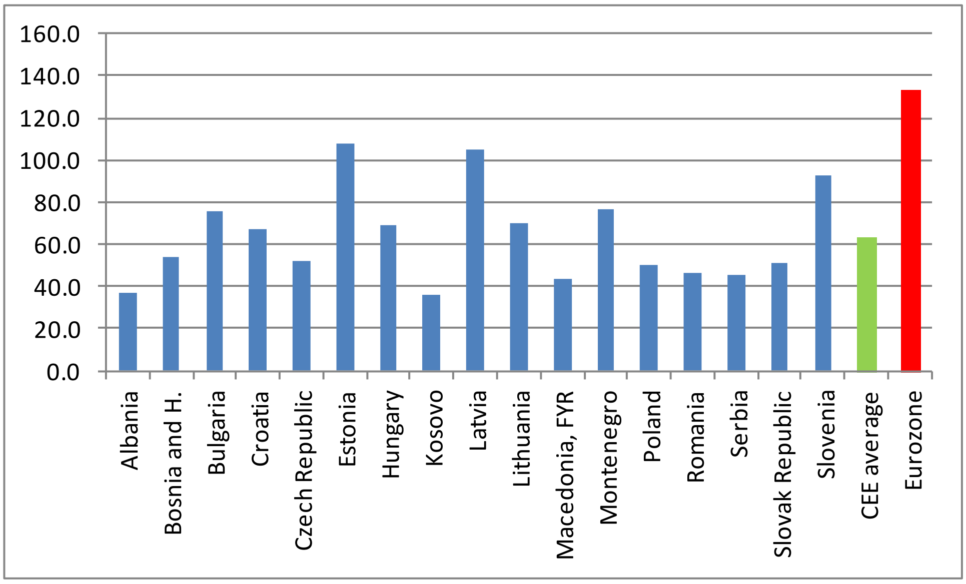
Source: EBRD Transition Reports; World Bank
Note a): See Appendix 1.2 for the times series of each indicator for the period 1999-2009.
Note b): The EBRD index of banking reform takes values from 1 to 4+. A score of 1 means little progress compared to the previous centrally-planned banking system, apart from the creation of the two-tier banking system. A score of 2 means significant progress with regard to the interest rate liberalization and credit allocation, suggesting that there is only a limited presence of directed credits and interest rate ceilings. Score 3 implies that significant progress was achieved in terms of the development of regulatory and supervisory capacities; almost full liberalization of the interest rates; significant lending to the private enterprises and a substantial presence of the private banks. Score 4 implies significant progress towards the harmonization of the banking laws and regulation with the Bank for International Settlements (BIS) standards; effective banking regulation and supervision; and substantial financial deepening. Score 4+ means that the banking system has reached a maturity level similar to the standards of advanced industrial economies.

Apart from the privatization of state-owned banks, transition countries also needed to develop adequate regulatory and supervisory institutions to regulate and supervise the commercial banks effectively. In this respect, most CEE countries have recorded substantial progress, although there are still divergences between these countries. The European Bank for Reconstruction and Development (EBRD) produces the Banking Reform and Interest Rate Liberalization index which covers many aspects of banking reform, including the liberalization of banking operations (e.g. interest rates, credit allocation, etc.) and the development of banking regulations and supervision. Table 2.4 shows that by 2009 all CEE countries had reached a banking sector reform index of 3 or higher, implying that all of them countries had achieved significant progress in the development of regulatory and supervisory capacities; the commercial banking activity was substantially liberalized; and lending to the private sector had increased significantly. In some countries, such as Croatia, Czech Republic, Estonia, and Hungary, the banking sector reform index reached the value of 4, suggesting that the banking systems of these countries are almost as developed as the banking systems of the developed countries. The highest banking reform indices are observed in the EU member countries, suggesting that the EU integration process might have had an important role in inducing the banking reform process.[3]

The banking reform process in CEE countries was associated with a rapid increase in lending, as measured by the ratio of 'domestic credit to private sector to GDP'. From an average of 27.3% in 1999, the ratio reached an average of 63.5% in 2009, though there was wide variations in different countries, with the more advanced reformers having also higher credit to GDP ratios, while the non-EU countries generally having lower ratios. The country with the highest ratio is Estonia at 108% in 2009, whereas the lowest ratio of 35.7% was recorded by Kosovo which is the country with the youngest banking system in the region (Box 2.1).

[3] Croatia was always like the more developed transition economies, similar to those that were in the EU, even before it formally joined the EU on July 2013.

Figure 2.1 Domestic credit to private sector (% of GDP), 2009



Source: World Bank

Note: see Appendix 1.3 for the times series of this indicator for the period 1999-2009.

Box 2.1 The creation of the Kosovo's banking system and its challenges

At the end of the war in 1999, when the Yugoslav banks left Kosovo, the old banking sector in Kosovo ceased to exist. In fact, even before the war, the utilization of banking services had been at a very low level and the banking system was mainly focused on the administration of the payment system rather than providing financial intermediation services. This was a consequence of the financial and political developments that took place in the former Yugoslavia, and especially Kosovo, during the 1990s. The freezing (i.e. confiscation) of the foreign currency deposits of the citizens by the Yugoslav National Bank in the beginning of the 1990s led to a substantial loss of confidence in the banking system. This loss of confidence, together with the excessively high inflation rates and the general mistrust of the Serbian regime, led Kosovo's citizens away from depositing their money in banks. At the same time, the possibility of obtaining bank credit from the banks was almost non-existent.

Hence, after the end of the war, Kosovo had to establish its banking system from the scratch. The first step was to establish a regulatory and supervisory authority which would create the preconditions for the forthcoming entry of commercial banks. The Banking and Payments Authority of Kosovo (which in 2008 became the Central Bank of the Republic of Kosovo) was established in 1999 and was responsible for licensing, regulation, and supervision of all the financial institutions in Kosovo. The first commercial bank entered the market in December 1999, and by 2009 the number of banks operating in Kosovo reached eight, with most of them being foreign-owned.

Despite the loss of confidence in the banking system during the 1990s, the new banking system of Kosovo showed an impressive performance in gaining the public's trust. However, banks still faced many challenges which, among others, included the insufficient protection of creditor rights by the newly-created judicial system, inadequate financial reporting and poor business planning capacities by the firms. In spite of these challenges, the banking system of Kosovo has become a modern system, providing contemporary financial services and maintaining a high level of sustainability.

In spite of remarkable progress, the degree of banking sector development in CEE countries is far below that of the Euro area, where the ratio of domestic credit to the private sector to GDP averaged 133.8% in 2009 (Figure 2.1). The relatively low degree of financial intermediation in the CEE region compared to the Euro area is mainly attributed to the "stagnation" of lending to enterprises, while most of the credit growth consisted of lending to households (EBRD, 2006). The reluctance of banks to expand lending to enterprises is primarily related to uncertainties arising from the institutional fragility and, especially, to the need for the better protection of creditor rights. According to Haselmann and Wachtel (2007), in an uncertain legal environment banks tend to be more conservative in terms of accepting different types of assets as collateral and are less likely to lend to information-opaque borrowers. Hence, banks in the CEE region have focused more on lending to households which is a form of lending that does not require investments in information gathering and is viewed as less risky compared to lending to enterprises. Apart from the weak legal environment, other factors that have precluded a more rapid expansion of lending to enterprises may include the weak corporate governance within the enterprises, poor implementation of accounting standards, and the poor financial disclosure by the firms which increase the level of risk perceived by banks (World Bank, 2003).

In order to shed more light on the development of the banking sector in CEE countries, in the next sections, we focus on three specific aspects of banking sector activity, including: banking sector competition, loan-portfolio quality, and intermediation efficiency (more specifically interest rate spreads). These three aspects represent the main focus of this thesis and will be investigated empirically in the chapters 4, 5 and 6 respectively.

2.3.3 Competitive conditions in the banking sectors of the CEE countries

Competition in the banking system is highly important in all countries because of its impact on several dimensions of banking system activities. Competition is considered to be a driving force of the banking system efficiency and a promoter of innovations in financial products. Increased competition is also considered to be beneficial in terms of financial inclusion by increasing the access of firms and individuals to financial services. Another dimension of the impact of competition is financial stability, with the traditional view claiming that competition is detrimental to the stability of the banking system - but there are also opposing views claiming that competition enhances stability.

At the beginning of transition i.e. the creation of the two-tier banking system, the banking system experienced the creation of oligopolistic market structures in most of transition economies (Papi and Revloltella, 1999). In some countries, the asset portfolio of the monobank was inherited by a single state-owned commercial bank, whereas in other countries the previous specialist banks were transformed into state-owned commercial banks, implying that in general the banking systems were dominated by a small number of large banks (Bonin, 2001). Considering that all these banks were state-owned, large in size, segmented in different sectors of the economy (e.g. trade, agriculture, and infrastructure) and that the market was still not open to foreign-owned banks, it may be taken that they possessed substantial market power and the likelihood of competition taking place between those banks was non-existent or very low. The possibility of these banks competing with each other was limited, particularly due to the lack of commercial banking experience which prohibited them from differentiating their products or introducing new financial products in the market.

The privatization process and the entry of new banks in the market created conditions for the evolution of banking system competition. This especially happened after the foreign banks started to enter the banking markets of the transition economies which reduced the market power of the domestic banks and introduced modern commercial banking practices. The new banking technologies and products that are usually introduced by the foreign banks are expected to induce local banks to engage in more competition (World Bank, 2013). By the end of the first decade of transition, the number of banks in all CEE countries had substantially increased and foreign banks were present in all the countries (Table 2.5).

However, from 2000, a wave of banking consolidation engulfed the region, thus leading to a decline in the number of banks in most countries. The consolidation trend was driven by the stronger banks being encouraged to take over the weaker banks in order to preserve financial stability, bank shareholders that decided to exit the market, and the mergers of the parent banks of some of the foreign banks operating in the region (Gelos and Roldos, 2004).

Table 2.5 Number of domestic and foreign banks

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	13 (11)	13 (12)	13 (12)	13 (12)	15 (13)	16 (14)	16 (14)	17 (14)	17 (15)	16 (14)	16 (14)
Bosnia and H.	61 (9)	56 (14)	49 (20)	40 (21)	37 (19)	33 (17)	33 (20)	32 (22)	32 (21)	30 (21)	30 (21)
Bulgaria	34(22)	35(25)	35(26)	34(26)	35(25)	35 (24)	34 (23)	32 (23)	29 (21)	30 (22)	30 (22)
Croatia	53(13)	43(21)	43(24)	46(23)	41(19)	37 (15)	34 (13)	33 (15)	33 (16)	33 (16)	32 (15)
Czech Rep.	42(27)	40(26)	38(26)	37(26)	35(26)	35(26)	36(27)	37(28)	-	-	-
Estonia	7 (3)	7 (4)	7 (4)	7 (4)	7 (4)	9 (6)	13 (10)	14 (12)	15 (13)	17 (15)	17 (14)
Hungary	43(29)	42(33)	41(31)	37(27)	36(29)	38 (27)	38 (27)	40 (28)	40 (27)	39 (25)	38 (23)
Kosovo	1(1)	2(2)	5(2)	6(2)	6(2)	6(2)	6(2)	6(2)	9(5)	8(6)	8(6)
Latvia	23 (12)	21 (12)	23 (10)	23 (9)	23 (10)	23 (9)	23 (9)	24 (12)	25 (14)	27 (16)	27 (18)
Lithuania	13 (4)	13 (6)	13 (6)	14 (7)	13 (7)	12 (6)	12 (6)	11 (6)	14 (6)	17 (5)	17 (5)
Macedonia	23 (5)	22 (7)	21 (8)	20 (7)	21 (8)	21 (8)	20 (8)	19 (8)	18 (11)	18 (14)	18 (14)
Montenegro	-	-	-	-	-	10 (3)	10 (7)	10 (8)	11 (8)	11 (9)	11 (9)
Poland	77(39)	73(46)	69(46)	59(45)	58(46)	57 (44)	61 (50)	63 (52)	64 (54)	70 (60)	67 (57)
Romania	41(26)	41(29)	41(32)	39(32)	38(29)	32 (23)	33 (24)	31 (26)	31 (26)	32 (27)	31 (25)
Serbia	75(3)	81(3)	54(8)	50(12)	47(16)	43 (11)	40 (17)	37 (22)	35 (21)	34 (20)	-
Slovakia	25(11)	23(14)	21(13)	20(15)	21(16)	21 (16)	23 (16)	24 (16)	26 (15)	26 (16)	26 (13)
Slovenia	31 (5)	28 (6)	24 (5)	22 (6)	22 (6)	22 (7)	25 (9)	25 (10)	27 (11)	24 (11)	25 (11)

Source: EBRD transition reports; CBK statistics.
Note: Numbers in bracktes represent foreign banks.

The consolidation process created concerns about a potential increase of the degree of market concentration which, according to the Structure-Conduct-Performance (SCP) paradigm, would imply a decline in the banking system competition, assuming that a market with fewer and larger banks is more likely to be characterized by uncompetitive behaviour.[4] However, the degree of market concentration does not appear to have increased after the consolidation process. Market concentration, measured by the Herfindahl-Hirschman Index, appears to have followed a gradually declining trend after 2000 (see Table 2.6). The reason why the consolidation process has not led to increased market concentration may be due to the fact that the taken-over banks or the banks that exited the market were mostly small banks. Estonia is the country which recorded an increasing trend of market concentration index, but the increase does not appear to have been related to the decline in the number of banks in this country.

[4] The Structure-Conduct-Performance paradigm and the market concentration indices will be explained in more detail in Chapter 3.

Table 2.6 Herfindahl-Hirschman Index (deposits market)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	8,859	6,978	7,672	4,696	4,019	3,618	2,957	2,631	2,342	2,311	2,358
Bosnia and H.	3,069	3,273	2,005	1,254	1,165	1,264	1,252	1,327	1,162	1,302	1,527
Bulgaria	2,305	1,947	1,482	980	968	990	858	865	1,077	1,084	1,210
Croatia	1,457	1,440	1,873	1,143	1,258	1,206	1,204	1,158	1,034	1,233	1,269
Czech Rep.	4,213	1,559	1,707	1,725	1,690	1,570	1,626	1,657	1,669	1,701	1,844
Estonia	-	-	4,926	3,773	3,743	5,092	5,483	5,948	5,791	6,500	7,751
Hungary	2,103	1,732	2,078	1,416	1,361	1,250	1,169	1,186	1,206	1,154	1,311
Kosovo	-	-	5,388	4,239	3,005	2,639	2,642	3,043	3,121	2,933	2,545
Latvia	-	-	-	1,101	1,033	998	1,178	1,083	978	1,099	1,228
Lithuania	-	-	-	2,625	2,582	2,338	2,050	2,109	2,115	2,031	1,950
Macedonia	3,892	3,781	3,722	2,614	2,601	2,397	2,403	2,225	2,145	2,023	2,218
Montenegro	-	-	-	3,705	3,141	2,597	3,924	3,616	3,079	2,785	2,390
Poland	1,568	1,311	1,262	1,198	1,007	915	885	886	950	781	831
Romania	1,830	2,169	2,624	1,432	1,513	1,283	1,122	1,210	1,192	1,098	1,051
Serbia	5,236	5,813	2,749	1,238	1,115	832	854	835	793	821	811
Slovakia	1,701	1,445	1,609	1,767	1,680	1,616	1,355	1,546	1,370	1,447	1,496
Slovenia	1,964	1,990	-	2,289	1,767	1,727	1,579	1,533	1,548	1,354	1,421

Source: Bankscope database and own calculations.

Even though market concentration is largely regarded as a measure of competition, this view has increasingly been criticized. For example, the contestability theory maintains that a concentrated market will be characterized by competitive behaviour if there is a credible threat of entry by new entrants (i.e. if there are no or low barriers to entry for potential new entrants). Another argument as to why market concentration may not be an adequate measure of competition is related to the fact that it does not take into account the potential competition from other non-bank financial institutions, such as the micro-finance institutions which, in CEE countries, compete with banks especially in the credit market (Riess et al., 2002). In addition, banks operating in a country face competition also from banks operating in other countries. For example, in 2005, the cross-border loans to firms in CEE countries averaged at 7.6% of GDP (Herzberg and Watson, 2007).[5] However, access to cross-border loans is more likely to be available for large multi-national companies, while small and medium sized enterprises are not likely to have easy access to cross-border financing since they are more prone to asymmetric information problems that stem from the lack of credit record and the lack of adequate collateral (Caviglia et al., 2002). Based on this, it may be assumed that banks operating in larger economies, which have a larger pool of foreign companies, are likely to face more competition than banks operating in smaller economies where competition is more likely to be limited within the country boundaries.

The observable factors such as the number of banks, degree of market concentration and the cross-border lending discussed above may, to some extent, serve as indicators of banking system competition, but these do not necessarily measure the degree of competition. In spite of the fact that foreign banks are considered to have induced competition in the banking systems, it should not be taken for granted that a high level of competition will persist in these markets. According to Kraft (2004), foreign banks are becoming increasingly accommodated to high profits, especially in South-Eastern Europe countries which may make them unwilling to engage in aggressive competition that could eventually undermine their profits.

[5] This figure does not include the data on Albania, Bosnia and Herzegovina, Kosovo, Macedonia, Montenegro, and Serbia.

Therefore, in chapter 3 of this thesis we present an overview of the main measures of banking system competition; and in chapter 4 we estimate the degree of competition in the banking systems of CEE countries using the Panzar-Rosse approach which directly quantifies the competitive behaviour of banks. In addition, in chapter 5 we estimate the banking system competition for each country and each year to show the evolution of competition over the 1999-2009 period, which is later used to estimate the impact of competition on banks' risk-taking and financial intermediation cost.

Regulatory issues with regard to banking sector competition

The creation of the conditions for banking sector competition in the transition economies was largely effected by the regulatory policies. Up to the beginning of the transition process, the banking systems of the transition economies were mainly in the form of monobank systems, where banking sector competition may be considered to have been inexistent. The first preconditions for the introduction of competition in the banking sector were created with the breaking-up of the monobank systems, which led to an increase of the number of banks. However, most of these banks remained state-owned and large in size due to the inheritance of large portfolios from the previous monobanks which, accompanied with a lack of commercial banking expertise, could not engage in proper competition in the sense of being able to compete through prices and product innovations.

As discussed in the previous sections of this chapter, the state ownership of the commercial banks was associated with many difficulties that hampered the efficient and stable functioning of the banking sectors in the transition economies. As a means to avoid these problems was considered the privatization of the commercial banks. However, due to the restrictions on foreign ownership, most of the banks were sold domestically. In addition, in order to induce competition, regulators applied lax licensing criteria, which led to a large inflow of new banks that were mostly undercapitalized and lacked commercial banking experience. These developments further worsened the deficiencies inherited from the previous monobank system and failed to establish competitive and sustainable banking systems that could provide efficient financial intermediation to the economy.

Despite the initial hesitation to allow the entry of foreign banks, eventually all the CEE countries opened-up to foreign investors, which helped the modernization of the banking systems in these countries by bringing modern commercial banking practices. According to Tang et al. (2000), the entry of the foreign banks may also be considered to have introduced banking sector competition in the CEE countries. The entry of foreign banks represents the beginning of a new era for the development of the banking sector, which was marked also by strengthening of the prudential regulation including the tightening of the licensing criteria for the new banks.

As was shown in Tables 2.4 and 2.5, during the second decade of transition the banking sectors of the CEE countries were dominated by foreign ownership and substantial progress was recorded in banking reform. Regulators acknowledged the importance of creating the regulatory preconditions for the development of competition through the entry of foreign banks and also acknowledged the importance of prudent licensing criteria in order to ensure a healthy development of competition. Based on the World Bank's Bank Regulation and Supervision Survey, it appears that all the CEE countries have broadly eliminated the limitations on the foreign bank entry or ownership and have also established prudent entry requirements for the licensing process (Table 2.7).

Table 2.7 Limitations on foreign bank entry and entry requirements, 2006/2007

	Limitations on Foreign Bank Entry/Ownership	Entry into Banking Requirements
Albania	n.a	n.a
Bosnia and Herzegovina	3	8
Bulgaria	3	8
Croatia	3	8
Czech Republic	3	8
Estonia	3	8
Kosovo	3	8
Hungary	3	8
Latvia	3	8
Lithuania	3	8
Macedonia	2	8
Montenegro	n.a	n.a
Poland	3	8
Romania	3	7
Serbia	n.a	n.a
Slovakia	3	8
Slovenia	3	8

Source: World Bank (2007)

The first column in Table 2.7 shows the respective countries' bank regulator responses to the question as to whether foreign banks may own domestic banks and whether foreign banks may enter a country's banking industry in the form of acquisition, subsidiary or branch. As shown in the table, almost all countries have a score of 3, which implies that none of the above mentioned forms of foreign bank entry is prohibited. The second column presents the responses to the question on whether various types of legal submissions are required to obtain a banking license.[6] The responses presented in Table 2.7 show that almost all the countries have a score of 8, suggesting that they have established all the listed prudential criteria for the licensing process.

[6] The question includes a list of potential requirements that regulators may request to be submitted before the issuance of a banking licence, including: draft by-laws; intended organization chart; financial projections for the first three years; financial information on the main potential shareholders; background/experience of future directors; background/experience of future managers; sources of funds to be disbursed in the capitalization of new bank; and market differentiation intended for the new bank.

The results presented in Table 2.7 show a highly homogenous picture for the CEE countries regarding the limitations on foreign bank entry and the entry requirement during the licensing process. Nevertheless, regarding the entry requirements, the survey results present the extensiveness of the regulations rather than their effectiveness, meaning that still there might be substantial differences between the EU countries and the non-EU countries with regard to the degree of the implementation of regulations, which largely depends on the overall quality of institutions in these countries.

The CEE countries have recorded progress also in the establishment of competition legislation and institutions, but the progress may be considered to have been rather slow and there are differences between the EU and non-EU countries of the sample. The Competition Policy Index produced by the EBRD suggests that, by 2009, competition policy legislation and institutions had been set up in all CEE countries and that there has been progress in reducing the entry restrictions and in undertaking enforcement actions against dominant firms (Table 2.8). However, as shown in the table, the progress of reforms appears to have been quite slow during the 1999-2009 period. The competition policy indices in Albania, Bosnia and Herzegovina, Macedonia, Montenegro, and Serbia appear to be lower compared to other CEE countries, which are either EU members or more advanced in the EU integration process. However, in none of the more advanced reformers of the CEE region has the competition policy index reached the value of 4 or 4+, implying that the competitive conditions in the whole region remain below the level of advanced industrial economies.

Table 2.8 Competition Policy Index

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	1.7	1.7	1.7	1.7	1.7	2.0	2.0	2.0	2.0	2.0	2.0
Bosnia and H.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	2.0	2.0	2.0
Bulgaria	2.3	2.3	2.3	2.3	2.3	2.3	2.7	2.7	2.7	3.0	3.0
Croatia	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.7	2.7	3.0
Czech Rep.	-	-	-	-	-	-	-	-	-	-	-
Estonia	2.7	2.7	3.0	3.0	3.0	3.3	3.3	3.7	3.7	3.7	3.7
Hungary	3.0	3.0	3.0	3.0	3.0	3.3	3.3	3.3	3.3	3.3	3.3
Kosovo	-	-	-	-	-	-	-	-	-	-	-
Latvia	2.3	2.3	2.3	2.3	2.7	2.7	3.0	3.0	3.0	3.0	3.3
Lithuania	2.3	2.7	3.0	3.0	3.0	3.0	3.3	3.3	3.3	3.3	3.3
Macedonia	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.3	2.3	2.3
Montenegro	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	1.7	2.0
Poland	2.7	2.7	3.0	3.0	3.0	3.0	3.3	3.3	3.3	3.3	3.3
Romania	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.7	2.7	2.7	2.7
Serbia	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.7	2.0	2.0	2.0
Slovakia	3.0	3.0	3.0	3.0	3.0	3.3	3.3	3.3	3.3	3.3	3.3
Slovenia	2.3	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7

Source: EBRD Transition Report (various issues).
Note: The competition policy index ranges from 1 to 4+. The value of 1 implies that no competition policy and legislation is in place. The value of 2 implies that competition policy legislation and institutions are set up, and some reduction of entry restrictions or enforcement action on dominant firms has taken place. The value of 3 implies that some enforcement actions to reduce abuse of market power and to promote a competitive environment, including break-ups of dominant conglomerates, and a substantial reduction of entry restrictions have taken place. The value of 4 implies significant enforcement actions to reduce abuse of market power and to promote a competitive environment. The value of 4+ implies standards and performance typical of advanced industrial economies: effective enforcement of competition policy; and unrestricted entry to most markets.

An implication of tables 2.7 and 2.8 taken together is that the CEE countries are quite homogenous with respect to the regulatory framework, but there may be differences with respect to the implementation of the regulatory framework. For this reason, in all our empirical chapters we control for the potential impact of the quality of institutions, which embraces implementation, and which serves as a proxy for the extent to which regulations are implemented.

2.3.4 Non-performing loans during the 1999-2009 period

Despite the improvements, in 1999, most the CEE countries still had two-digit non-performing loans to total loans ratios (Table 2.9). This was a period when state-ownership still represented a considerable share of the banking system, and in some countries it even dominated the ownership structure of the banking system (Appendix 1.2). In addition, even though the privatization to foreign banks had begun, some domestically-owned weak banks were still in operation - those licensed in the beginning of transition when lax licensing criteria were applied in order to induce the domestic competition in the banking system.

Table 2.9 Non-performing loans (as % of total loans)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	32.7	42.6	6.9	5.6	4.6	4.2	2.3	3.1	3.4	6.6	10.5
Bosnia and H.	58.7	15.8	20.7	11.4	8.3	6.1	5.4	4.1	3.0	3.1	6.0
Bulgaria	17.5	10.9	7.9	10.4	4.4	3.7	3.8	3.2	2.5	3.2	6.7
Croatia	20.6	19.8	15	11.6	9.4	7.5	6.2	5.2	4.8	4.8	7.8
Czech Rep.	24.5	20.4	14.1	8.5	5.0	4.1	4.0	3.8	2.8	2.8	4.6
Estonia	2.9	1.3	1.2	0.8	0.5	0.3	0.2	0.2	0.5	1.9	5.3
Hungary	4.4	3.1	3	4.9	3.8	3.6	3.1	2.9	2.8	3.3	6.7
Kosovo	-	-	-	1.2	1.1	2.4	3.5	4.1	4.1	3.3	4.3
Latvia	6.8	5	3.1	2.1	1.5	1.1	0.7	0.5	0.4	2.4	16.4
Lithuania	11.9	10.8	7.4	5.8	2.6	2.4	3.4	3.1	2.7	4.6	20.8
Macedonia	62.6	46.5	44.4	35.7	34.9	27.5	22.2	15.1	10.9	10.1	12.6
Montenegro	-	-	-	-	-	5.7	5.2	2.8	3.2	6.0	13.5
Poland	14.9	16.8	20.5	24.7	25.1	17.4	11.6	7.7	5.4	4.7	8.0
Romania	35.4	3.8	3.4	2.3	1.6	1.7	1.7	1.8	3.0	4.5	8.5
Serbia	-	-	-	-	9.1	7.2	5.5	7.1	2.6	3.5	8.5
Slovakia	32.9	26.2	24.3	11.2	9.1	7.2	5.5	7.1	2.6	3.5	5.2
Slovenia	9.3	9.3	10	10	9.4	7.5	6.4	5.5	3.9	3.6	6.0
Euro Area	-	-	-	-	3.0	2.9	2.5	2.4	2.3	3.0	4.7

Source: EBRD Transition Reports (various issues); World Bank development indicators, CBK statistics.

However, after 2001, when the state-ownership of the banks recorded a massive decline in all CEE countries and foreign-ownership started to dominate the banking systems, the quality of loan portfolio improved substantially in all CEE countries except Macedonia, where the high level of non-performing loans persisted during the whole decade.

The improvement of the loan portfolio quality is considered to have primarily reflected the improved management practices brought in by foreign banks which relied on more advanced risk-management techniques. The improvement of the loan quality may also reflect the more conservative lending approach in all CEE countries, where the lending activity was mainly focused on household loans that are considered to be less risky compared to the loans issued to enterprises (see Section 2.3.2). In addition, the bank consolidation process that took place after the year 2000, consisting of stronger banks taking-over weaker banks and some of the weak banks leaving the market, further contributed to the decline of non-performing loans. Also, the strengthening of the regulatory framework and the bank supervision authorities played a key role in disciplining the risk-taking behaviour of the banks. Furthermore, the steady economic growth and the low inflation rate, alongside a better protection of creditor rights, enhanced the overall operating environment for banks by increasing loan repayment capacities and borrowers' discipline.

However, the rapid credit growth that was taking place in most CEE countries started to be viewed with concern for the potential deterioration of the loan-portfolio quality (Barisitz, 2005). The concerns were related to the fact that, under high credit growth rates, the screening of individuals is likely to deteriorate, hence increasing the likelihood of 'bad' borrowers being granted access to bank loans. The credit expansion might partly be attributed to the supposedly increased banking system competition after the entry of the foreign banks which might have led to a more aggressive behaviour by banks in the credit market. In addition, credit growth was also fuelled by the macroeconomic stability in CEE countries which increased the demand for loans and enhanced the banks' confidence in the domestic markets.

The rapid growth of credit was initially seen by the authorities as satisfactory in terms of catching-up with the more developed countries, given the low degree of financial intermediation during the first decade of transition. Hence, the implementation of supervisory actions was delayed, thus allowing excessive credit growth to take place (Barisitz, 2009). Even though the non-performing loans ratio in most countries remained relatively stable for most years under consideration, the main concern was that some of these loans could become non-performing in the next economic downturn (Barisitz, 2005).

The favourable macroeconomic conditions that persisted for most of the second-decade of transition started to deteriorate by mid-2007, when the global financial crisis started to erupt. The financial and macroeconomic environment in all CEE countries started to worsen, thus threatening the stability of the financial sector (EBRD, 2008). In most CEE countries the GDP growth slowed-down in 2008, and by 2009 all countries except Albania, Kosovo and Poland experienced negative growth rates (see Appendix 1.1). As a consequence, the loan repayment capacity of the borrowers was negatively affected, leading to a substantial increase of non-performing loans in all CEE countries. The highest increase of the non-performing loans ratio was recorded in Latvia and Lithuania which were also the countries with the highest rate of real GDP decline. In Latvia, the share of non-performing loans to total loans reached 16.4% in 2009 (2.4% in 2008), whereas in Lithuania it reached 20.8% (4.6% in 2008). In spite of the fact that there was no deep recession in CEE countries in 2009, the NPL ratio in all the countries, except Kosovo and the Czech Republic, has reached a higher level compared to the Euro Area average.

Chapter 5 of this thesis investigates empirically the determinants of the quality of loan-portfolio (measured by the ratio of loan-loss provisions to total loans) in CEE countries during the 1999-2009 period, taking into account especially the impact of banking system competition.

2.3.5 Interest rate spreads during the period 1999-2009

The intermediation cost, measured by interest margin, had remained high during the first decade of transition but this started to decline as competition began to develop and the overall environment improved. The interest rate spread, apart from indicating the intermediation cost, is considered also as an important indicator of the efficiency of intermediation and as a potential signal of market power.

The interest rate spread, which measures the difference between lending interest rate and deposit interest rate, followed a declining trend in all CEE countries (see Table 2.10). The decline is consistent with the increasing presence of foreign banks in the region which seems to have increased the degree of banking efficiency by increasing the number of banks, especially foreign-owned banks, and increasing the degree of banking system competition, thus leading to lower interest rate spreads. Moreover, this period was also characterized by a more favourable macroeconomic performance, steady economic growth and low inflation and improvements in property rights protection, albeit at a slow pace. These improvements in the banks' operating environment led to a reduction of the risk perceived by banks, based also on the decline of non-performing loans during this period, thus leading to lower risk premiums in the interest rates.

Table 2.10 Interest rate spread (lending rate minus deposit rate, in percentage points)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	8.7	13.8	11.9	6.8	5.9	5.2	8.0	7.7	8.4	6.2	5.9
Bosnia and H.	15.2	15.8	-	8.2	6.8	6.6	6.0	4.3	3.6	3.5	4.3
Bulgaria	10.3	8.2	8.2	6.4	5.6	5.8	5.6	5.7	6.3	6.4	5.2
Croatia	10.6	8.3	6.3	11.0	10.1	9.9	9.5	8.2	7.0	7.2	8.4
Czech Rep.	4.2	3.7	4.3	4.7	4.6	4.7	4.6	4.4	4.5	4.6	4.7
Estonia	6.9	3.7	3.7	4.0	3.1	3.5	2.8	2.2	2.1	2.8	4.6
Hungary	4.4	3.1	3.7	2.8	-1.4	3.7	3.4	0.6	2.3	0.3	5.2
Kosovo	-	-	-	-	-	12.4	11.4	11.6	10.1	9.4	10.1
Latvia	9.2	7.5	5.9	4.7	2.4	4.2	3.3	3.8	4.8	5.5	8.2
Lithuania	8.1	8.3	6.6	5.1	4.6	4.5	2.9	2.1	1.5	0.8	3.6
Macedonia	9.1	7.7	9.4	8.8	8.0	5.9	6.9	6.6	5.4	3.8	3.0
Montenegro	-	-	-	-	-	-	-	6.1	4.1	5.4	5.5
Poland	5.7	5.8	6.6	5.8	3.6	3.8	4.0	3.3	-	-	3.9
Romania	19.8	20.7	18.5	16.2	14.4	14.1	13.2	9.2	6.6	5.5	5.3
Serbia	42.7	-72.4	30.4	17.1	12.7	11.9	13.1	11.5	7.1	8.8	6.7
Slovakia	6.7	6.4	4.8	3.6	3.1	4.9	4.2	4.1	4.3	2.0	-
Slovenia	5.1	5.7	5.2	4.9	4.8	4.8	4.6	4.6	2.3	2.6	4.5
Euro Area	-	-	-	-	3.2	3.2	3.0	2.7	2.3	2.3	3.5

Source: World Bank; European Central Bank, CBK statistics.

However, with the beginning of the global crisis in mid-2007, the environment for banks started to become more uncertain. The declining growth rates in most CEE countries substantially increased concerns regarding the capability of borrowers to repay their loans. Hence, by 2009, the interest rates spreads had increased in most countries, reflecting the increase in risk premiums.

As Table 2.10 shows, there are significant differences between the spreads in EU member states and other countries, with the latter having higher interest rate spreads during the whole period. An exception is Romania which, until lately, had quite high interest rate spreads which might reflect the persistingly high inflation in this country until 2006. The differences in the interest rate spreads between the EU and non-EU countries appear to have narrowed in

2009 when the spreads increased in most EU members. However, despite the continuously declining trend of the interest rate spreads in all CEE countries, they remained above the Euro Area average, thus suggesting that, in erms of financial intermediation efficiency, CEE countries continue to lag behind the more advanced financial sectors of the Euro Area.

In order to clarify the factors that have contributed to the financial intermediation costs in CEE countries during the 1999-2009 period, chapter 6 of this thesis presents the results of the empirical estimation of the determinants of net interest margins. The main focus of this exercise will be on estimating the impact of banking system competition on the net interest margins using bank-level data.

2.4 Conclusions

The transition from the monobank system, which was an integral component of the centrally-planned economies, to the market-based banking system was the initial stage of the creation of a modern banking system in CEE countries. However, it took almost a decade for the new banking system to be adequately operational in the sense of providing efficient financial intermediation and being stable. Bad loans inherited from the previous system, together with imprudent banking practices, weak institutions, and macroeconomic instability led most CEE countries into banking crises which required long and costly restructuring programs. The most substantial improvement occurred after the beginning of the privatization of state-owned banks to foreign banks which introduced modern commercial banking know-how and technology, thus improving the risk management procedures and renhancing the efficienc of the banking systems in these countries. However, the development of an efficient and stable banking system also requires effective regulatory, supervisory and judiciary institutions able to enforce prudent behaviour by banks and to protect their creditor rights. The quality of the institutions in the beginning of the transition process was generally poor in all CEE countries, partly reflecting the lack of commercial banking experience and the continuing legacy of the previous sytem.

During the second decade of transition, state-ownership of banks gradually diminished and was replaced by dominant foreign-ownership in all CEE countries. At the same time, substantial reforms were implemented in order to develop the regulatory and supervisory institutions, and improve the protection of creditor rights (the last one progressed at a slower pace). The EU members of the CEE region recorded a faster progress in the banking and institutional reforms than the non-EU countries. This has been reflected in the development of their banking systems. Despite this progress, the degree of banking development in CEE countries remains well below the average of the Euro Area.

The transition process created the conditions for the evolution of banking system competition that were lacking in the centrally-planned economic system. Initially, the regulators took measures to induce banking competition by applying lax licensing criteria for the domestic banks, which led to a rapid increase in the number of undercapitalized banks that also lacked commercial banking experience. This policy proved inadequate and failed to introduce proper competition that would be beneficial for the development of the banking sector in these countries. The next steps of the regulators that took place during the second decade of the transition process, most importantly the liberalization of the foreign bank entry and the introduction of the prudential licensing criteria, were fundamental for the evolution of the banking sector competition in the CEE countries.

During the second decade of transition, the quality of the loan-portfolio in all CEE countries improved substantially, reflecting a more prudent behaviour by the banks, stronger institutions, and a more favourable macroeconomic environment. Substantial progress was achieved also with regard to the reduction of the intermediation cost, with the interest rate spreads following a declining trend in most countries. However, the interest rate spreads remain higher in CEE countries than the average of the Euro Area, potentially suggesting that the financial intermediation process in the transition economies continues to be characterized by a lower degree of efficiency.

The favourable developments in the banking systems of CEE countries during the second decade of transition was seriously threatened in 2009, when the global crisis led to a deterioration of the operating environment. As a consequence, the non-performing loans increased considerably in all countries and the interest rate spreads responded positively to the increased risks.

The developments regarding competition, loan portfolio quality, and interest rate spreads will be investigated empirically in greater detail in chapters 4, 5, and 6 respectively. Special attention will be paid to the estimation of the banking sector competition in the CEE countries, and its impact on the loan portfolio quality and interest margins.

CHAPTER 3

The Measurement of Banking Sector Competition: Theoretical Background and Literature Review

3.1 Introduction

Although competition has been given enormous attention in the economic literature, there is no general agreement on the best approach to be used for measuring the degree of competition. The literature on the measures of competition is divided into two major streams, the structural and non-structural approaches.

In the structural approach, the level of competition is indicated by the degree of market concentration, measured by various concentration indices (e.g. Hirschman-Herfindahl Index and n-firm concentration ratio). The structural approach is mainly represented by the Structure-Conduct-Performance (SCP) paradigm which, in its original form, maintains that an exogenously given market structure influences the conduct of banks and their performance. According to the SCP paradigm, banks operating in more concentrated markets generate higher profits, because concentration enables them to exert market power and collude with each other. Hence, based on the SCP paradigm, competition is measured by the degree of market concentration, with higher values of market concentration indicating a lower degree of competition. However, the view that market concentration implies lower competition is widely criticised in the literature, what has led to the development of the non-structural approaches which do not take into account the structural features of the market when measuring competition.

The most commonly used non-structural approach is represented by the method of Panzar and Rosse (1987) which measures the competition by estimating a reduced-form revenue equation that measures the elasticity of bank revenues with respect to changes in input prices. The sum of elasticities of bank revenues with respect to the input prices produces the Panzar-Rosse H-statistic which indicates whether banks behaviour is consistent to the notion of monopoly, monopolistic competition, or perfect competition. The value of the Panzar-Rosse approach is that it directly quantifies the competitive behaviour of the banks.

The Panzar-Rosse approach has been applied extensively in the banking literature which includes studies that have estimated banking sector competition for different countries and regions. The empirical studies that have applied the Panzar-Rosse approach to the banking industry have followed a quite homogenous methodology and have mostly found that the investigated banking sectors have been operating under monopolistic competition. However, the view of Bikker et al. (2007, 2009) that a Panzar-Rosse model should not include the total assets variable to control for bank's size in the regression raises questions regarding the validity of the results generated by most of the empirical studies in this field. According to Bikker et al. (2007, 2009), controlling for total assets transforms the reduced-form revenue equation into a price equation, and thus produces a higher H-statistic which does not properly measure the degree of competition.

Therefore, the aim of this chapter is to provide a critical review of the approaches used to measure competition from both the theoretical and empirical point of view. The chapter is organized as follows. The next section presents the structural approach for the measurement of competition, focusing on the SCP paradigm and the theories that oppose the SCP paradigm. Section 3.3 presents the theoretical background of the Panzar-Rosse approach. Section 3.4 presents a critical review of studies that have applied the Panzar-Rosse approach to measure competition in the banking sector. Section 3.5 concludes.

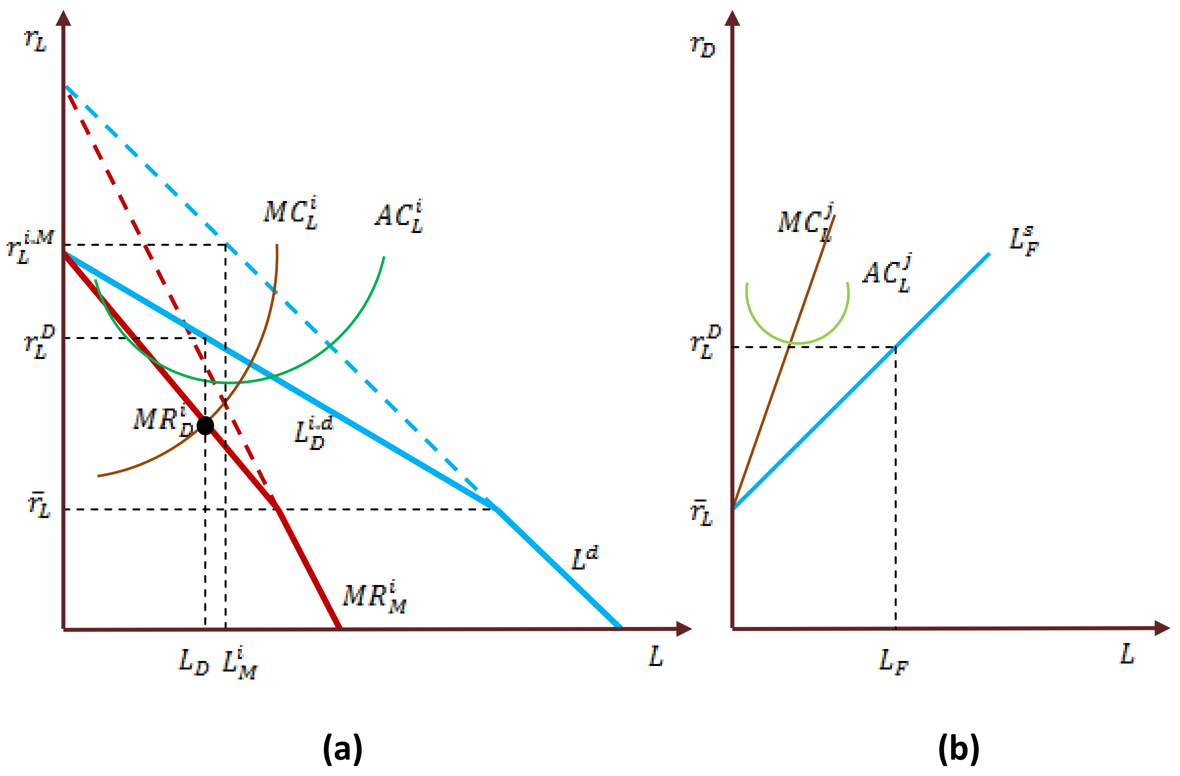
3.2 Structural approach

The structural approach for the measurement of competition mainly relies on the Structure-Conduct-Performance (SCP) paradigm which relates competition to the degree of market concentration. The SCP paradigm originates from the work of Bain (1951), where he analysed firms' performance in 42 industries in the US during the 1930s. The results of this study suggested that firms operating in more concentrated industries and markets with higher entry barriers generated higher rates of return compared to firms operating in less concentrated industries and those with lower entry barriers. These findings were interpreted as evidence for the SCP paradigm. In its original form, the SCP paradigm maintains that an exogenously given market structure influences the conduct of banks and their performance. More specifically, the SCP paradigm claims that a higher degree of concentration grants market power to incumbent firms and enables them to behave in particular ways, such as colluding with each other, which results in higher profits. However, in most of the studies dealing with the SCP paradigm, firms' conduct is not explicitly taken into account; therefore, it is rather the structure-performance relationship which is explored and a particular type of conduct or behaviour is only assumed.

In line with the SCP hypothesis, Philips (1962) and Scherer and Ross (1990) claim that collusion is more likely to appear when the market is operated by fewer firms. In highly concentrated markets, where the industry output is produced by few firms, the actions of one firm tend to affect the actions of other rival firms, thus causing interdependence among firms which induces collusion as a possible way of easing competitive pressures and charging higher prices. According to the authors, an increase in the number of firms reduces the market share of each individual firm, so firms are more likely to ignore the interdependence among them and less likely to engage in colluding arrangements. Hay and Kelley (1974) studied the price-fixing cases handled by the Department of Justice in US and found that 76 percent of collusion cases occurred in markets where the four-firm concentration ratio was over 50 percent, providing support to the view that collusion is more likely to appear in industries that have higher degrees of market concentration.

Van Hoose (2010) applies the SCP hypothesis to the bank loan market in a dominant-bank framework and claims that the dominant bank maintains a higher loan interest rate but which declines to a lower level when the number of banks increases. This market consists of a dominant incumbent bank i and a number of smaller banks indexed $j= 1,\dots,m$. Van Hoose assumes that the dominant incumbent bank possesses cost advantages deriving from economies of scale which serve as a barrier to entry to new banks. As a result, the market is operated by the dominant incumbent bank and few smaller banks. Figure 3.1 illustrates the profit maximising equilibrium of the dominant bank as well as the group of smaller banks.

Figure 3.1 The SCP hypothesis in banking: a loan market with an incumbent bank and few small banks



If the dominant incumbent bank *i* operates alone in the market, i.e. if it is a monopoly bank, it would face the loan market demand curve L^d which represents the total demand for loans. MC^i_L would be its marginal cost and MR^i_M would be its marginal revenue curve. Looking for profit maximization, bank *i* would provide the economy with loans equivalent to L^i_M, charging a monopoly loan rate $r^{i,M}_L$. The profit that bank *i* would be realizing at this points would be equivalent to the quantity of loans multiplied by the difference between the loan rate $r^{i,M}_L$ and the average cost corresponding with this amount of lending which is depicted by AC^i_L (panel a).

In panel (b), it is shown that smaller banks, depicted by *j*, have a higher marginal cost (MC^j_L) and average cost (AC^j_L) for every given level of lending compared to the dominant incumbent bank *i*, deriving from cost disadvantages that they have. Smaller banks have an upward sloping loan supply curve (L^s_F), meaning that they are willing to lend as long as loan interest rates are above the reservation loan rate $\bar{r}_L$. The amount of loans issued by each of these banks is small in relation to total lending, so all of them take the market loan interest rate, i.e. the interest rate of the dominant incumbent bank, as given. The total supply of loans by these banks is shown by the supply curve L^s_F.

Because of the competition from the smaller banks, the dominant incumbent bank does not face the entire market demand L^d (panel a), but instead the residual demand curve $L^{i,d}_D = L^d - L^s_F$. This means that the dominant incumbent bank faces a lower demand for loans which is equivalent to the difference between the total loan demand and the amount of loans supplied by small banks. The new marginal revenue curve which corresponds to the new demand curve ($L^{i,d}_D$) is depicted by MR^i_D. In these circumstances, the incumbent bank maximizes its profit by issuing a lower amount of loans (L_D), while the loan interest rate declines to r^D_L, with a negative impact on the incumbent bank's profit. Nevertheless, the dominant incumbent bank still earns positive profits since the price charged is higher than its average cost. Smaller banks take the dominant incumbent bank's loan rate as given and extend loans equivalent to L_F (panel b) which represents the difference between the total loans demanded in the market and the amount of loans supplied by the dominant incumbent bank. At this point, each small bank earns a zero profit since price is equal to their average cost, so there is no incentive for smaller banks either to enter or exit the market.

This example elaborates that the increase in the number of firms, i.e. greater competition, reduces the market price and leads to a reduction in the dominant incumbent bank's profits. The assumption that the dominant incumbent firm faces lower average costs, due to economies of scale, may provide support to the *efficiency hypothesis* (discussed later) which argues that the profits of dominant incumbent firms are higher because of their superior efficiency. Nonetheless, the illustration supports the SCP paradigm by showing that the dominant incumbent firm does not behave like a competitive firm but instead charges prices that exceed its average costs. Despite being more efficient, the dominant incumbent firm does not adjust the price to its costs which would also lower prices for the consumers but instead charges monopoly prices. Whereas in competitive markets, more efficient firms are characterized by lower prices which enable them to be more competitive and increase their market share.

A dominant bank may also engage in different types of strategic behaviour that disadvantage the smaller banks and enable the dominant bank to increase its market share and maintain a higher market price. According to Salop and Scheffman (1987), firms may engage in strategies that raise rivals' costs (i.e. input prices), thus pushing them to increase the price and reduce their level of output. Possible forms of cost-raising strategies may include the abuse of the regulatory process by lobbying for regulations that disadvantage the rivals and commencement of advertising wars. In a market dominated by a dominant firm and few smaller firms, as in the illustration elaborated above, it is more likely that the cost-raising strategies would be initiated by the dominant firm. Since the dominant firm possesses economies of scale, an increase of input prices would increase the average cost of the dominant firm by a lower amount compared to the smaller firms, thus pushing smaller firms to charge higher prices that reduce the demand for their products. In addition, the stronger financial position gives the dominant firm a greater lobbying power which may lead to regulations that disadvantage the smaller firms.

Despite its extensive use in the literature as a mainstream framework for assessing the competition, the SCP paradigm has been subject to criticisms that contest its ability to explain the competitive conditions in a market. The criticisms are mostly directed to the assumed one-way causality from market structure to conduct and then to performance. According to Vesala (1995), market structure and conduct are endogenously determined as it is unreasonable to exclude the feedback effects from potential strategic behaviour of firms, i.e. the conduct of firms, to the market structure. For example, entry decisions in an industry may well depend on the conduct of the existing participants in the market, i.e. the actual degree of competition, the price they charge and the non-price aspects of competition. The SCP paradigm is criticised also because of its incompatibility with some of the existing theories, since not all the theories (still within mainstream economics) predict a positive relationship between market power and concentration (Vesala, 1995). For instance, the Cournot equilibrium is consistent with the SCP paradigm by predicting a positive relationship between market concentration and performance, claiming that a smaller number of firms is associated with lower industry output and higher prices. On the other hand, under the Bertrand equilibrium price competition may be efficient even in a duopoly, suggesting that as long as there are at least two firms in the market, the equilibrium price will be the competitive price. According to this theory, each firm will tend to set prices below the prices charged by its rivals, aiming at gaining rivals' customers. The sequence of price undercutting will continue until price declines to the level of the marginal cost, where firms do not have any incentive to undertake further price reductions (Lipczynski et al., 2005).

One of the most widely reported critiques to the SCP approach is represented by the Efficiency Structure hypothesis (ES) which was developed by Demsetz (1973). Similar to the SCP, the ES hypothesis is a structural approach but often referred as the alternative of the SCP paradigm. The main objection of the ES to the SCP paradigm is related to the assumption that the higher profits in concentrated industries are attributed to the collusive behaviour or exertion of market power by the firms operating in those markets. According to the ES hypothesis, apart from market concentration, the market shares of individual firms must be included in the analysis to explain the industry profitability. This theory claims that higher profits realized by firms operating in concentrated markets are a result of the superior efficiency of larger firms which derives from economies of scale. According to this view, more efficient firms have the option of either keeping prices at the same level with other participants and earn higher profits, due to their cost advantages, or reducing prices and increase their market share which again leads to higher profits. In other words, this approach claims that higher profits in concentrated markets are not the result of the market power but rather the superior efficiency of dominant firms. While the SCP paradigm argues for a one-way causality from market structure to firms' conduct, the ES hypothesis suggests that it is firms' conduct that affects market structure but it also allows for feedback effects from structure to firms' conduct which are transmitted through the impact of market structure on firms' efficiency, i.e. from economies of scale.

The Relative Market Power (RMP) hypothesis, developed by Shepherd (1982), also acknowledges the inclusion of market shares of individual firms into the analysis to explain the performance of an industry. However, this view relates the higher profits of larger firms to the market power and product differentiation of individual firms rather than to the superior efficiency of dominant firms as argued by the ES hypothesis. This may be considered as an argument in support of the SCP paradigm but the difference between the two is that RMP does not consider the higher profits in concentrated markets as originating from the collusion between firms but rather from the market power of individual firms (Shepherd, 1986).

Another critique to the SCP paradigm is related to the fact that this approach regards higher profits as an indicator of the presence of market power. According to Vesala (1995), profits represent only a poor measure of market power as these two variables are not necessarily positively correlated. The author claims that firms may charge higher prices due to their market power, but may still realize low profits because of their cost inefficiencies. This view is in line with the *quiet life* hypothesis which claims that the managers of firms that have monopoly power are less induced to pursue policies aimed at the enhancement of efficiency since revenues can be increased by charging higher prices. But, because of the inefficiencies associated with the market power, the increase in revenues does not necessarily lead to higher profitability (Punt and van Rooij, 1999). However, despite the fact that firms with high monopoly power are considered to be less efficient than firms operating in competitive markets, still monopoly firms are generally expected to generate higher profits than the competitive firms. In this context, this might imply that higher profits might signal the presence of market power.

The SCP approach to competition is at odds with an important view on the concept of competition – the view associated with Schumpeter. According to Schumpeter, competition should be viewed less in terms of the effect on prices but more in terms of its impact on new technology, new sources of supply and new types of organizational development which provide enterprises with quality and cost advantages (Cook, 2002). Schumpeter argues that the quality and cost advantages originating from the innovation process may temporarily alter the market structure to a monopoly, rewarding the innovating firm with higher profits, but the monopoly power of this firm will be eroded by the innovations of other firms which are attracted by the high profits in the industry. The innovative activity, according to this view, mainly comes from outsiders (Bloch, 2000). In this respect, market concentration is not viewed as the opposite of the competition, but rather as an integral part of a dynamic competing process. Schumpeter's approach amounts to an endogenous relationship between the actions of the entrepreneur and the market structure, while the SCP hypothesis argues for a one-way impact from market structure to the entrepreneur's actions. In addition, the SCP approach does not take into account potential cost differences among firms which represent a key feature of Schumpeter's argument. Cost advantages might be better taken into account by the Efficiency Structure hypothesis because the use of market shares of individual firms to explain profitability may, to some extent, address the cost differences among firms. However, this approach assumes that cost differences arise from the differences in the market shares, i.e. from economies of scale, rather than from innovations as argued by Schumpeter.

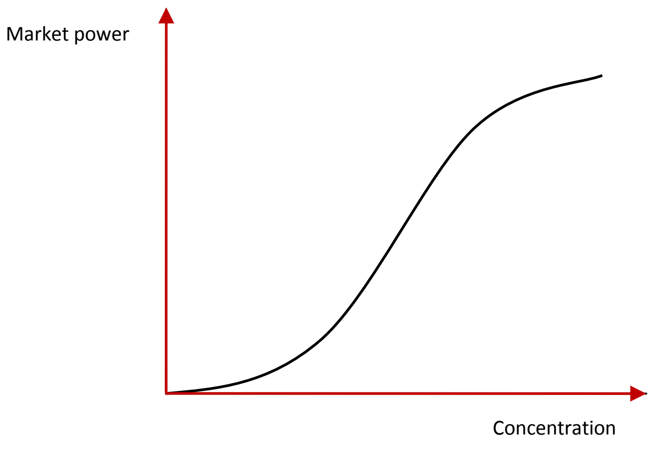
Another related approach that criticizes the SCP paradigm is the Contestability Theory, developed by Baumol (1982) and Baumol et al. (1982). According to this theory, firms behave competitively also in a concentrated industry or even in a monopoly if the market is contestable. Perfectly contestable markets are those that are characterized by free entry and costless exit. The contestability theory claims that firms operating in a contestable market behave competitively even if the market is highly concentrated, because charging prices that exceed the average cost would make the industry attractive to the new entrants which would then reduce the profits of existing firms. However, at least one of the key assumptions of the contestability theory, that the market is characterized by free entry, may not be much realistic in banking markets, bearing in mind the specifics of the sector that require potential entrants to meet specific criteria which, depending on how they are interpreted by the licensing authorities, might sometimes serve as barriers to entry.

The contestability theory shares a key feature with the SCP paradigm in acknowledging the positive impact of the higher number of firms on the level of competition. However, there is an important difference between these two theories: the SCP paradigm takes into account only the actual number of firms operating in the market whereas the contestability theory refers to the potential number of firms. The contestability theory is in line with Schumpeter's view regarding the role of new entrants for the enhancement of competition but it is not based on the innovative activity of the new entrants which represents the core of Schumpeter's argument.

Another critique to the SCP paradigm that applies particularly to the banking sector comes from the perspective of asymmetric information theories put forward by Shaffer (2002). According to his view, the SCP hypothesis assumes that an increase in the number of banks reduces the market power of banks who would then charge lower loan interest rates. On the other hand, screening theories generally suggest that as the number of banks increases, banks are less incentivised to screen the potential borrowers. With a higher number of banks operating in the market, the market share of each bank tends to shrink. So, in order to maintain or eventually increase their market share, banks may reduce their screening procedures and offer easier access to credit to their clients. As a consequence, the probability of granting credit to lower quality borrowers will increase, implying a higher credit risk for the banking sector. The higher credit risk, in turn, leads to upward adjustment of interest rates charged by banks. A more detailed discussion of asymmetric theories in the context of the relationship between banking sector competition and risk-taking will be provided in chapter 5.

Another view on the relationship between concentration and market power suggests that these two variables are positively related, but their relationship is not monotonic. In this context, it may be expected that the conduct of firms operating in markets with a low degree of concentration can be close to competitive, and an increase of concentration from this low level will generate an increase in the market power (Cetorelli, 1999). However, at high levels of concentration, conduct is considered to be already far from the competitive behaviour, so an additional increase of concentration is not expected to be associated with a further increase of market power (Figure 3.2).

Figure 3.2 Non-linear relationship between concentration and market power



Another view with regard to the use of market concentration to infer the competitive conditions is presented by Carlton and Perloff (2000). According to these authors, even if market concentration explains the competitive conditions, concentration indices may not properly indicate market competition in an industry whose products compete closely with the products of another industry. For example, the concentration index for the banking loans market may underestimate competition in the lending market if a substantial amount of loans are extended by microfinance institutions. In addition, nowadays banks are increasingly facing cross-border competition from banks operating in other countries which also cannot be captured by the concentration indices.

To summarise, the SCP paradigm claims that firms' performance is explained by the degree of market concentration, arguing that a higher degree of concentration provides the dominant firms with the possibility to exert market power and engage in collusive behaviour which enables them to charge higher prices and generate higher profits. In other words, it is argued that higher concentration indicates a lower level of competition. The main theoretical challenge to the SCP hypothesis is based on the assumed one-way relationship from concentration to firms' conduct and their performance. This challenge focuses on the core argument of this paradigm that higher profit rates in concentrated industries derive from the market power. Another important challenge is based on the contestability theory, according to which concentrated markets and even monopolies can behave competitively if the markets are contestable. Despite the shortcomings argued by different views, the SCP paradigm continues to be broadly used as a foundation for measuring competition by many empirical studies, including studies of banking industry.

3.3. Non-structural approaches

The non-structural approaches for the measurement of competition were developed as a response to the deficiencies of the structural approach. The non-structural approaches measure competition or the market power by directly quantifying the competitive behaviour of the bank, rather than inferring it from the analysis of the degree of market concentration.

The most-widely used non-structural approach for the measurement of banking sector competition is the Panzar and Rosse (1987) model which will be explained in more details in Section 3.3.1. Given its wide acceptance as an appropriate method for measuring the degree of competition, and its ability to directly quantify the competitive behaviour of the banks and indicate whether it is consistent with monopoly, monopolistic competition, or perfect competition, we treat this method as our main approach for measuring the degree of banking sector competition in this thesis.[7]

Another widely used approach that does not take into account the structural features of the market when measuring the degree of market power is the Lerner Index (Lerner, 1934). The Lerner Index measures the mark-up of price over the marginal costs for each bank. Higher values of the index indicate a higher degree of market power being exerted by the investigated banks. The Lerner Index will be used as an alternative measure to the Panzar-Rosse measure of competition in chapters 5 and 6 where we estimate the impact of banking sector competition on the degree of risk-taking and financial intermediation costs, respectively. The estimates of the Lerner Index are obtained from the study of Efthyvoulou and Yildirim (2013).

[7] Other non-structural approaches for the measurement of competition include the model of Iwata (1974), Bresnahan (1982) and Lau (1982), but the empirical applications of these models are rather scarce.

A recently developed non-structural method for the measurement of competition is the Boone Indicator, introduced by Boone (2000, 2004), Boone et al. (2004) and CPB (2000). The Boone Indicator estimates the degree of competition based on the idea that competition increases the market shares of more efficient firms and reduces the market shares of inefficient firms. In this context, the larger the impact of efficiency on the increase of firms' market shares, the higher is considered to be the degree of competition in that market and *vice versa*. The first study to apply the Boone Indicator to measure the competition in the banking sector is Leuvensteijn et al. (2007), which uses the Boone Indicator to estimate the degree of banking sector competition in a sample of EU countries. One advantage of the Boone Indicator compared to the Panzar-Rosse method is that it enables the estimation of the degree of competition not only for the entire market but also for separate product markets. On the other hand, the Boone Indicator may serve as a measure of the intensity of competition but it is not able to distinguish whether the competitive behaviour of banks is consistent with monopoly, monopolistic competition, or perfect competition. The Boone Indicator is not applied in this thesis.

3.3.1 Panzar-Rosse method

The Panzar and Rosse (1987) model, hereafter referred as the P-R model, is a non-structural approach, grounded in the microeconomic theory which measures competition by directly quantifying the conduct of firms and not taking into account the market structure. In assessing competition, the focus of the P-R model is on the competitive behaviour of firms rather than on market structure, implying some similarity between this approach and contestability theory. Some studies, such as, Bandt and Davis (2000), Nathan and Neave (2001) and Yildirim and Philippatos (2003) use the P-R approach to test the contestability theory by measuring the competitive behaviour of banks in markets characterized by a high degree of concentration. The non-monopoly behaviour of banks found in these markets supports the predictions of the contestability theory.

The P-R model produces the so-called H-statistic which measures the sum of elasticities of bank's revenues with respect to input prices (Panzar and Rosse, 1987). In other words, the H-statistic indicates how a bank's revenues respond to an increase of input prices. The value of the H-statistic indicates whether the conduct of banks is in accordance with the notion of monopoly, monopolistic competition, or perfect competition (Table 3.1).

Table 3.1 The range of values of H-statistic of the Panzar-Rosse model

H-statistic values	Competitive behaviour
$H \leq 0$	Monopoly
$0 < H < 1$	Monopolistic Competition
$H = 1$	Perfect competition

As shown in Table 3.1, a negative value of the H-statistic which implies that an increase of input prices leads to a decline of firm's revenues, is consistent with monopoly. Under a monopoly, an increase of input prices increases firm's marginal costs, reduces the equilibrium output and subsequently reduces the revenues, giving an H-statistic of less than zero. Figure 3.3 illustrates the adjustment from an increase of input prices under monopoly. For simplicity, it is assumed that long-run average costs (LRAC) and long-run marginal costs (LRMC) are horizontal (and hence equal). The monopoly firm operates in the price-elastic range of the demand function.

Figure 3.3 The adjustment of monopoly to the increase of input prices

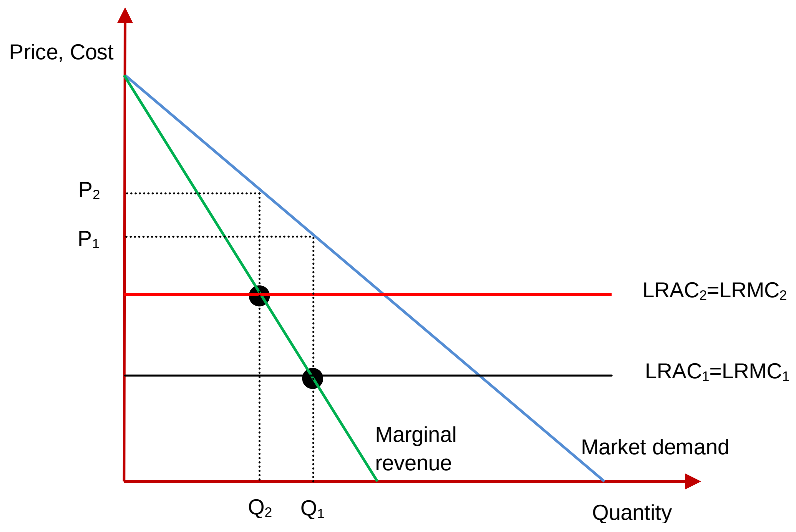


Figure 3.3 shows that, as input prices increase (from $LRAC_1$ to $LRAC_2$), the monopolist's profit-maximizing price and output adjust from (P_1, Q_1) to (P_2, Q_2). More specifically, as a consequence of the increase of input prices, monopolist maximizes the profit at a higher price which, due to the price-elastic demand, leads to a decrease of output and, hence, to a decrease of monopolist's revenues.

Under perfect competition, the H-statistic takes the value of unity (H=1) which implies that an increase in input prices leads to an equiproportionate increase in firms' revenues. Since in a perfectly competitive market price always equals marginal cost, and in the long run firms always operate at the minimum efficient scale, an increase of marginal costs will be followed by a proportionate increase of prices. The increase of prices will result in a reduction of market demand which will push some firms to exit the market. As a result, the surviving firms will face their original demand at the new level of prices which, as shown by Panzar and Rosse (1987), implies that, in the long run, their revenues will increase by as much as the increase of the input prices.

In monopolistic competition (long-run equilibrium), the H-statistic takes a value ranging between zero and one (0<H<1) which implies that the increase of input prices will be associated with a less than proportional increase of revenues. Similar to the case of perfect competition, the increase of prices resulting from the increase in marginal costs will reduce the market demand and push some of the firms to exit the market. However, unlike in the case of perfect competition, the surviving firms will not face their original demand because their products are not perfect substitutes to the products of the firms that have left the market. In addition, under monopolistic competition, the perceived number of competitor firms changes the elasticity of the perceived demand function. Hence, the surviving firms will not increase their prices by as much as the increase of marginal costs in order not to attract the entry of new firms in the market. As a result, bank revenues will respond positively to the increase in input prices, but the increase in revenues will be proportionately smaller than the increase in input prices. As Goodard and Wilson (2009) put it, under monopolistic competition, an increase in average costs leads to an adjustment of both output and the number of perceived competitors as to achieve the monopolistic equilibrium condition MR=MC and AR=AC.

For countries whose banking sectors have a limited exposure to the external markets, the H-statistic explains the competitive structure prevailing in the domestic market (Bikker and Groenveld, 1998). This is arguably the case with the South-Eastern Europe economies which are characterized by small banking sectors, whose activity is mainly focused on lending to the domestic economy, financed by domestically collected deposits. For countries whose banking sectors are engaged in sizable foreign activities, the H-statistic explains the average competitive conduct of the banks, exercised both in the domestic and external markets. Shaffer (2004a) considers as a great advantage the fact that no specific market definition appears in the Panzar-Rosse revenue equation which enables the measurement of competitive behaviour no matter the characteristics of the market in which banks operate. This feature of the P-R approach is important also for countries where banks face competitive pressures from other financial institutions (e.g. microfinance institutions) since the estimated H-statistic measures the competitive conduct of the banks in general, without distinguishing between market participants. In addition, the fact that the P-R approach measures the overall competitive behaviour of the banks is highly important for the countries where banks face cross-border competition from banks operating in other countries.

A standard regression, known as the Panzar-Rosse model, used for calculating the H-statistic is a reduced-form revenue equation that takes the following form:

$$\log\ (TR_{i,t}) = \alpha_0 + \sum_{i=1}^{n} \beta_i \log w_i + \sum_{i=1}^{n} \gamma_i \log z_i + \varepsilon \qquad (3.1)$$

where, *i* is the index for the bank, *TR* represents the bank's revenues, *w* represents a vector of bank's input prices, *z* represents a vector of control variables that affect bank's revenues and *ε* represents the error term.

The literature is not unanimous on the appropriate measures of inputs and outputs for financial intermediaries (Nathan and Neave, 1989). The studies applying the P-R approach to the banking sector have used the "intermediation approach" to notions of 'input' and 'output' (Sealey and Lindley, 1977), treating banks as firms that produce loans by using labour, capital, deposits and other loanable funds as inputs.[8] As for the control variables, studies

[8] The other stream of literature on the definition of financial intermediaries' inputs and outputs is called the "production approach" and considers both loans and deposits as bank outputs, while the only inputs of banks are considered to be labour and physical capital (Freixas and Rochet, 1997).

applying the P-R approach to the banking sector have included variables that explain bank-specific features, such as those reflecting the risk profile and the structure of assets.

The log-log form specification of the revenue equation (Equation 3.1) is considered to be appropriate since coefficients can be interpreted as constant elasticities. The H-statistic is the sum of revenue elasticities with respect to input prices, i.e.:

$$H = \sum_{i=1}^{n} \beta_i \tag{3.2}$$

The P-R model is based on several assumptions, including the assumption that banks are operating in long-run equilibrium, the performance of a bank is influenced by the actions of other participants in the market, the cost structure of banks is homogenous and the price elasticity of demand is greater than unity (Bikker and Haaf, 2002).

To test whether banks are operating in a long-run equilibrium, previous studies have usually estimated the H-statistic from a reduced-form profit equation which uses the same explanatory variables as the reduced-form revenue equation (Equation 3.1), but instead of bank's revenues these studies use profitability measures (e.g. return on assets) as the dependent variable. The models produce an H_{ROA} which represents the sum of elasticities of bank profitability with respect to input prices. The market is considered to be operating in long-run equilibrium when the H_{ROA} equals zero which implies that, in long-run equilibrium, bank profitability is not statistically correlated with factor input prices (de Rozas, 2007). The market is considered to be in disequilibrium when the H_{ROA} value is negative. However, Bikker et al. (2009) claim that H_{ROA} must not necessarily equal zero if the market is in structural equilibrium, but under imperfect competition. In this view, when the market demand is characterized by some degree of elasticity, the monopolist may not be able to pass the entire increase of costs to the clients which will result in a $H_{ROA}<0$.

Some of the assumptions of the P-R model put this approach at odds with the Schumpeterian notion of competition. The assumption that the banking sector operates in long-run equilibrium gives the P-R model a static nature which is contrary to Schumpeter's argument that views competition as a dynamic process. According to the Schumpeter's 1954 work, the static theory operates at a higher degree of abstraction compared to the dynamic theory since it ignores past and future values of variables, such as lags, sequences and rates of change (Goddard and Wilson, 2009). As Goddard and Wilson put it "… in practice adjustment towards equilibrium might be less than instantaneous, and markets might be out of equilibrium either occasionally, or frequently, or always" (p. 2282). However, the results from a Monte Caro simulations exercise conducted by Goddard and Wilson (2006) suggest that the view that markets are characterized by partial adjustment is valid for developed countries, whereas the group of developing and transition countries included in the exercise appeared to be characterized with instantaneous adjustment.

Despite representing two distinctive approaches, some studies suggest that P-R model and SCP paradigm may have a common ground in explaining competition in the banking sector (Bikker and Groeneveld, 1998; Bikker and Haaf, 2002b). In these studies, the relationship between the H-statistic and market concentration resulted negative, suggesting that higher concentration is associated with less competition. Bikker and Haaf (2002b) estimated the impact of market concentration, measured by the Herfindahl-Hirschman Index (HHI), on the H-statistic for a sample of European Union (EU) countries. The results suggested a negative and significant coefficient for the HHI which implies that a higher degree of concentration corresponds to a lower level of competition (i.e. lower H-statistic). These results might serve as evidence supporting the use of the HHI to explain competition. A similar study was conducted by Bikker and Groeneveld (1998) who investigated the relationship between the

H-statistic and the share of five largest banks' assets in total banking sector assets (CR_5) for a sample of EU countries. The results suggested a negative relationship between CR_5 and the H-statistic, but the relationship appeared to be weak.

However, some authors, such as Casu and Girardone (2006), have found the impact of market concentration on the H-statistic for a sample of EU-15 countries, to be statistically insignificant, suggesting that market concentration does not explain market competition. Claessens and Laeven (2004) had earlier investigated this relationship for a sample of banks in 50 countries. They did not find a negative relationship between these variables but instead a positive and statistically significant relationship. They attributed these findings to the inclusion of some large countries, such as US, France, Germany and Italy which had low values of H-statistic and also low degrees of market concentration due to the large number of banks operating in these markets. Excluding these countries from the sample resulted in an insignificant relationship between competition and market concentration.

3.4 Estimating the Panzar-Rosse H-statistic: a review of the literature

Table 3.2 summarises some of the most important studies that have applied the P-R approach to the banking industry. As this table shows, most of these studies have used panel data and have mostly found that competition in these markets can best be described as monopolistic competition. However, earlier studies such as Nathan and Neave (1989), Molyneux et al. (1994) and Vesala (1995) applied the P-R approach to cross-section data, but found that the competitive behaviour of the banking system (i.e. H-statistic) was quite volatile from year to year. For example, in the study of Molyneux et al., the behaviour of banks operating in the UK shifted from monopoly in one year to almost perfect competition in the following year. A considerable year-to-year volatility of the H-statistic is observed also in our estimation of the H-statistic for each country/year for the CEE countries which is presented in chapter 5. On this issue, Bikker and Groenveld (1998) suggested that it is unlikely that competitive conditions change so drastically from year to year. Bikker and Groenveld attribute these changes to the fact the gradual market dynamics were not accounted for in the model, suggesting that market structure shifts gradually over time. In their study of banking sector competition in the EU-15 countries for the period 1989-1996, these authors introduced a logistic time curve in the P-R model to explicitly account for possible time variations in the H-statistic. The findings suggested that banks were operating under monopolistic competition, while the constitutive terms of the H-statistic slightly decreased over time. However, the results indicated monopolistic competition also when the logistic time curve was excluded from the model.

Table 3.2 A summary of studies applying the P-R approach to the banking industry

Authors	Period	Countries examined	Dependent variable	Results
Ahi (2002)	1995-2001	Estonia	Interest revenues; Total revenues	Monopolistic competition
Bikker and Groenveld (1998)	1989-1996	EU 15	Interest income/total assets; Total revenues/total assets	Monopolistic competition
Bikker and Haaf (2002b)	1988-1998	23 European and non-European countries	Interest revenues/total assets	Monopolistic competition
Bikker et al. (2007)	1986-2005	101 countries world-wide	Interest income; Total revenues	Monopolistic competition
Casu and Girardone (2006)	1997-2003	EU-15	Total income/total assets	Overall: monopolistic competition Finland: perfect competition Greece: monopoly
Claessens and Laeven (2004)	1994-2001	50 countries	Interest revenues/total assets; Total revenues/total assets	Monopolistic competition
De Bandt and Davis (2000)	1992-1996	Germany, France, Italy, United States	Interest income; Total revenues	Overall: monopolistic competition Lower H-statistic for smaller banks.
Hahn, (2008)	1995-2002	Austria	Total income/total assets	Monopolistic competition

Hempell (2002)	1993-1998	Germany	Total income/total assets	Monopolistic competition
Mamatzakis et al. (2005)	1998-2002	SEE countries	Interest income/total assets; Total revenues/total assets	Monopolistic competition
Mkrtchyan (2005)	1998-2002	Armenia	Interest income/total assets	Monopolistic competition
Manthos (2008)	1999-2006	Central and Eastern Europe	Total revenues; Gross interest income; Total revenues/Total assets	Overall: Monopolistic competition Bosnia and Herzegovina, Kazakhstan: Monopoly
Molyneux et al. (1994)	1986-1989	UK, Germany, France, Italy, Spain	Interest revenues to total assets	UK, Germany, France, Spain: Monopolistic competition Italy: Monopoly
Nathan and Neave (1989)	1982-1984	Canada	Total revenue less provisions for loan losses	1982: perfect competition 1983,1984: monopolistic competition
Staikouras and Fillipaki (2006)	1998-2002	EU	Interest income/total assets	Monopolistic competition
Vesala (1995)	1985-1992	Finland	Total interest revenues; Total interest revenues from outstanding loans	Overall: Monopolistic competition 1989, 1990: perfect competition
Yildirim and Philippatos (2003)	1993-2000	Central and Eastern Europe countries	Interest income/total assets; Total revenues/total assets	Monopolistic competition

Dynamics were incorporated also by Bikker and Haaf (2002b), who multiplied the elasticities that constitute the H-statistic by a continuous time-curve model. The coefficient accounting for time was zero in 53% of all cases, indicating no significant changes in competitive conditions over time, whereas the positive values of this coefficient found in some of the cases suggest that competition increased over time. Similar to Vesala (1995), Bikker and Haaf interpreted the H-statistic as a continuous variable, meaning that for an H-statistic ranging between 0 and 1, a higher value indicates a more competitive behaviour.[9]

Claiming that the adjustment towards market equilibrium is partial rather than instantaneous, Goddard and Wilson (2009) suggest that static revenue equations estimated through the Fixed Effects (FE) or Random Effects (RE) method are misspecified. In cases when the dependent variable (i.e. bank's revenues) depends on its previous values, the static model will suffer from autocorrelation in the disturbance term. As a consequence the constitutive elasticities of the H-statistic will be biased towards zero. Hence, the authors suggest that the P-R revenue equation should be estimated using the General Method of Moments (GMM) in a dynamic formulation, including the lagged dependent variable among the explanatory variables. In a sample composed of developed countries, the GMM estimator yielded higher estimates than the FE estimator, providing evidence in favour of their view that FE estimates, based on static formulation, are biased towards zero. However, the introduction of dynamics to the P-R model is at odds with one of the key assumptions of the P-R approach which assumes that markets operate in long-run equilibrium continuously, i.e. in each period. However, according to Goddard and Wilson (2009), the estimation of the P-R revenue equation using dynamic panel data eliminates the need for the continuous market equilibrium assumption. Employing dynamic panel data enables the movement towards equilibrium to be achieved over time.

[9] According to Vesala (1995), the H-statistic is an increasing function of demand elasticity, implying that the less market power is exercised, the higher will be the value of the H-statistic. According to this view, the H-statistic serves not only to depict a type of market structure, but also to measure the magnitude of competition.

Within the studies that have applied the P-R approach to the banking industry, there are differences also with regard to the dependent variable used in the model. Some studies have used interest revenues as the dependent variable which is based on the fact that the core activity of most banks is financial intermediation (Molyneux et al., 1994; Bikker and Haaf, 2002b). However, since the non-interest income generating activities undertaken by banks are continuously increasing in modern banking, some authors have used total revenues as the dependent variable, in order to capture banks' conduct over their entire range of activities (Nathan and Neave, 1989; Hempell, 2002; Hahn, 2008). Other studies, including Vesala (1995) and Claessens and Laeven (2004), for comparison have used both measures of income as the dependent variable and the values of the H-statistic have been similar, suggesting that the choice between interest revenues and total revenues for the dependent variable does not affect the measurement of competition in the banking sector. However, Bikker and Haaf (2002b) did the same comparison and found that the choice of these two variables had an impact on the results. The study referred to the banking sector in the Netherlands for the period 1991-1998, where the share of non-interest revenues to total revenues was 16%. Because of the small share of non-interest revenues, they used interest revenues as the dependent variable which provided a higher explanatory power for the model. The fit of the P-R model, as measured by R^2, was 0.90 when interest revenues were used as the dependent variable, whereas it declined to 0.60 when the dependent variable consisted of total revenues. In addition, the value of the H-statistic obtained by using total revenues as the dependent variable was substantially lower than with interest revenues as the dependent variable. According to the authors, this is attributed to the fact that funding costs which in most studies represent the main component of the H-statistic, are not relevant for the non-interest revenue generating activities.

In order to put aside the effect of the bank's size, the dependent variable in most of the studies shown in Table 3.2 have used income (either total or interest income) scaled to total assets (e.g. Hempell, 2002; Claessens and Leaven, 2003; Yildirim and Philippatos, 2003; Casu and Girardone, 2006). However, Bikker et al. (2007) criticise using revenues to total assets, claiming that it transforms the reduced-form revenue equation into a price equation. The ratio between revenues and total assets produces the income generated by a unit of assets which, in a simplified example where banks' assets are entirely composed of loans and its revenues consist of interest income, would represent the loan interest rate, i.e. the price of a unit of assets. According to Bikker et al. (2007), employing the P-R approach to estimate the level of competition through a price equation instead of a reduced-form revenue equation impairs the estimation of the H-statistic by producing a higher value, thus leading to wrong conclusions on the degree of competition. The wrong conclusions can be inferred when market structure is characterized by monopoly, since the monopoly price is an increasing function of the marginal cost. More specifically, using a price variable instead of revenues as the dependent variable produces an H-statistic that measures the elasticity of prices (more specifically price of loans) with respect to input prices instead of the elasticity of revenues with respect to input prices. In this context, under monopoly conditions, an increase in input prices would have a positive impact on the price level, i.e. would produce a positive H-statistic ($H>0$), given that the monopolist always increases the price when marginal costs increase (no matter the consequences for the revenues). Conversely, using revenues as a dependent variable, the H-statistic for the monopoly firm would be negative ($H<0$), reflecting the negative impact of the increase of input prices on the revenues. This takes place due to the profit maximizing objective of the monopolist which implies that, faced with increasing marginal costs, the monopolist increases the price that, because of operating in the elastic range of the demand curve, leads to a more than proportionate decline in the demand for a monopolist's products. As a consequence, the monopolist ends up charging higher prices, but producing proportionately less output which implies a lower level of revenues. In a study covering 18,000 banks from 101 countries throughout the world, Bikker et al. (2007) found that using the income to total assets ratio as the dependent variable tends to overestimate competition by producing a higher H-statistic. Using the absolute value of income as the dependent variable, the authors found that monopoly cannot be rejected in 28% of the investigated cases against 0% under the previous model. They also found that perfect competition cannot be rejected in 38% of cases compared to 20-30% when the dependent variable has been scaled.

Another form of the same issue regarding the specification of the P-R revenue equation is related to the inclusion of total assets (TA) as a control variable in the regression. Many studies (e.g. Nathan and Neave, 1989 and Shaffer, 2004b) include TA as a bank-specific control variable and the main rational for doing so is that the size of a bank may affect its revenues, i.e. larger banks generate higher revenues, *ceteris paribus*, in ways unrelated to variations of input prices. On the other hand, Bikker et al. (2009) claim that the inclusion of TA as a control variable produces a positive H-statistic (H>0) even when the market is operating under a monopoly structure which is in contradiction with the basic principles upon which the P-R framework is built that predict a negative H-statistic (H<0) for monopoly markets. The inclusion of TA as a control variable implies that output is held constant, meaning that it does not allow for output adjustment by the monopolist as a response to the increase in input prices.[10] Consequently, since the profit-maximization objective always requires the monopolist to increase the price when its marginal costs increase, the response of

[10] Total assets consist of the firm's output and other asset categories (e.g. cash and fixed assets). In our case, it is important to note that controlling for total assets holds the bank's total assets constant, meaning that also the total output of the bank (e.g. loans) which is a subcategory of total assets will be held constant, i.e. will not be allowed to adjust to the change of input prices.

the monopolist to the increase in input prices would be only the increase of the price level, while the demand for products would remain constant and not adjust to the new level of price. Hence, the increase in the price level with the output held constant would imply that the change in monopolist's revenues as a consequence of the increase in input prices would be positive which, in a P-R model, would produce a positive H-statistic. The view that controlling for total assets produces a higher H-statistic is supported also by Goddard and Wilson (2009) which through a Monte Carlo simulation exercise found that the inclusion of total assets as a control variable causes an upward shift to the H-statistic.

As explained above, both using revenues to total assets as the dependent variable and/or including total assets as an explanatory variable in a P-R model transforms the reduced-form revenue equation into a price equation, meaning that the H-statistic would represent the sum of the price elasticities with respect to the input prices instead of the sum of revenue elasticities. As a consequence, the H-statistic estimated by using a price equation will always be positive even for monopoly markets. This is confirmed also by our estimation results in chapter 4 where we apply the Panzar-Rosse approach to estimate competition in the banking sectors of CEE countries altogether and separately estimate competition in the banking sector of Kosovo. In the case of CEE countries, using the absolute value of revenues as the dependent variable (i.e. using a reduced-form revenue equation) produces a negative H-statistic which suggests that the competitive behaviour of banks operating in the CEE region is consistent with monopoly. However, by using the revenue to total assets ratio as the dependent variable or including total assets as explanatory variable (i.e. using a price equation) produces a positive H-statistic which rejects the monopoly structure. In the case of Kosovo, the H-statistic produced by the reduced-form revenue equation is positive, but its value increases when the model is transformed into a price equation. Box 3.1 presents an arithmetic illustration which shows that using revenues to total assets as the dependent variable and including total assets as an explanatory variable are expected to produce similar results.

The studies that estimate the P-R model using a price equation suffer from another deficiency since they generally do not take into account the theoretical predictions on the potential endogeneity between the interest rates (i.e. revenues/total assets) and some of the control variables (e.g. loans to total assets ratio and equity to total assets ratio).

Box 3.1 Review of Panzar-Rosse model specifications

As explained in this section, Bikker et al. (2007, 2009) argue that scaling the dependent variable to total assets and/or including total assets as a control variable produce similar results. In this box, we provide an arithmetic illustration to explain why these two model specifications are expected to produce similar results.

According to Bikker et al. (2007), a P-R regression suffers from misspecification if the dependent variable (total or interest revenues) is scaled to total assets and/or if total assets are included as a control variable. According to these authors, the P-R model should take the following form:

$$\log TR = \alpha_0 + \sum_{i=1}^{n} \beta_i \log w_i + \sum_{i=1}^{n} \gamma_i \log z_i + \varepsilon \qquad (1)$$

where, the dependent variable (TR) is the absolute value of revenues, w_i represents a vector of input prices, z_i represents a vector of control variables (excluding total assets) and ε represents the error term.

However, the majority of studies applying the P-R approach to the banking sector have estimated the P-R model by either revenues to total assets as the dependent variable or by including total assets among the control variables, or both. Equation (2) shows a P-R specification form where the dependent variable consists of total revenues to total assets. This form of specification has been used in many studies, including Bikker and Groenveld (1998), Hempell (2002) and Mamatzakis et al. (2005).

$$\log(TR/TA) = \alpha_0 + \sum_{i=1}^{n} \beta_i \log w_i + \sum_{i=1}^{n} \gamma_i \log z_i + \varepsilon \qquad (2)$$

Another stream of studies applying the P-R method to assess competition in the banking sector estimate the regression by using the absolute value of revenues as the dependent variable, but including total assets among the control variables in order to control for bank's size. Equation (3) represents an equation of this form which has been applied in some studies, including Shaffer (2004) and Manthos (2008).

$$\log TR = \alpha_0 + \sum_{i=1}^{n} \beta_i \log w_i + \sum_{i=1}^{n} \gamma_i \log z_i + \lambda_i \log TA_i + \varepsilon \qquad (3)$$

However, despite representing two different models, equation (2) and equation (3) have the same properties, if it is assumed that the coefficient on total assets (λ) is equal to unity.

Assuming $\lambda = 1$, equation (3) may also be expressed as:

$$\log TR - \log TA = \alpha_0 + \sum_{i=1}^{n} \beta_i \log w_i + \sum_{i=1}^{n} \gamma_i \log z_i + \varepsilon \qquad (4)$$

where, $\log TR - \log TA \approx \log(TR/TA)$. Hence, equation (4) is a restricted version of equation (3).

Bikker et al. (2009) claim that the restriction of assumption that $\lambda = 1$ often holds in empirical studies, relating it to the law of one price which postulates that firms operating in the same market and selling homogeneous products apply the same output prices. As a result, the revenues of these firms are proportional to their size as measured by total assets.

Using a price rather than a revenue equation appears not to be an issue for markets operating under perfect competition, since under such conditions there is no price mark-up based on market power, but prices are fully determined by input prices, including a charge for invested equity (Bikker et al., 2007). Under perfect competition, firms' prices are equal to the minimum average costs, implying that any increase of costs must be associated with a proportionate increase of prices, otherwise firms would be operating with losses. The increase of prices reduces the aggregate demand, pushing some firms to exit the market. The exit of these firms compensates the declining demand for the surviving firms which enables them to produce their original level of output at the increased price level, thus increasing their revenues by as much as the increase of prices which is proportional to the increase of input prices. Therefore, the sum of the elasticities of input prices under a perfectly competitive equilibrium will be unity whether the dependent variable in the P-R model is a price variable or a revenue variable.

Similarly, the H-statistic is not expected to be affected by controlling or not for total assets when the market is operating under a long-run perfectly competitive equilibrium. In such conditions, firms' prices equal minimum average costs, which are U-shaped, and an increase of input prices will be associated with an increase of output prices, while the output scale at which average costs are minimized is not affected by changes in input prices. In other words, under perfect competition, an increase of input prices leads to an increase of output prices, while there is no adjustment in the volume of the output in the market.[11]

However, Bikker at al. (2009) raise another issue that contests the interpretation of the Panzar-Rosse H-statistic when the market is operating in competitive equilibrium even in cases when the equation is estimated using an unscaled dependent variable. Their critique is based on a review of literature, including Johnston (1960), who report evidence that many industries have constant average costs over a range of scales, which contradicts the

[11] Due to the price-elastic demand, the increase of prices reduces the aggregate demand, pushing some of the firms to exit the market. The remaining firms will take over the demand of the exiting firms and will be able to produce the same level of output as before the increase of input prices.

mainstream microeconomic theory that assumes firms to have U-shaped average costs in equilibrium. According to the issue raised by Bikker et al., in a perfectly competitive environment, considering that banks are price-takers and cannot unilaterally affect the market price, an increase of input prices should not necessarily lead to the increase of output price, which is contrary to what the original Panzar-Rosse method assumes. Therefore, an increase of input prices would make banks operate with a price that is lower than the marginal cost, which would cause losses to the banks operating in the market. However, under the assumptions that banks operate with constant average costs, they might reduce their level of output in order to mitigate their losses. The reduction of the level of output would lead to a decline of revenues, implying that the increase of input prices would lead to a decline of banks' revenues even if the market is perfectly competitive. In other words, the H-statistic would take a negative value also under perfect competition. This would cause problems for the original interpretation of the Panzar-Rosse model, since the negative values of the H-statistic would no longer be able to rule out that the banking sector is operating in a competitive environment. However, in the absence of more direct and especially more recent empirical evidence, this issue may be considered to be a theoretical possibility rather than as the norm. At present, there is not a sufficiently strong case for researchers to assume constant costs and so abandon the Panzar-Rosse approach. However, this represents an important issue for further research, which may produce important inferences on the appropriateness of the Panzar-Rosse method for measuring banking sector competition. On the basis of this judgement, we pursue our research using the Panzar-Rosse approach. Yet, partly reflecting this reservation, we use other measures/indicators of banking sector competition (i.e. the Lerner Index and the Herfindahl-Hirschman Index) to check our findings for robustness.

Another potential complication to the interpretation of the H-statistic may be related to the fact that a negative H-statistic may be consistent also to oligopoly instead of monopoly (Panzar and Rosse, 1977). According to Bikker et al. (2009), this may be the case both when average costs are U-shaped and when they are constant. However, this might not represent a serious concern regarding the interpretation of the H-statistic given that both monopoly and oligopoly are characterized by a high degree of market power.

3.5 Conclusions

Despite the great attention that the banking sector competition has attracted in the economic literature, still there is no general agreement on which is the most appropriate approach to measure the competition. This chapter has presented a critical review of the most widely used methods for the measurement of competition. The methods for the measurement of competition are classified in two main categories, consisting of the structural approach and the non-structural approach.

The structural approach for the measurement of competition is mostly based on the Structure-Conduct-Performance paradigm which uses the degree of market concentration as a measure of competition and claims that a higher degree of market concentration corresponds to a lower degree of competition. According to this approach, in more concentrated markets banks are able to exert market power and the collusion between banks is more likely to happen, thus leading to higher interest rates charged by the banks and, hence, higher profits generated. However, the Structure-Conduct-Performance paradigm has been largely criticised in the literature which has questioned its appropriateness as a reliable framework for inferring the degree of competition. The criticisms are mostly directed to the assumed one-way causality from structure to conduct, and the exclusion of the possibility that the conduct of the bank may also affect its market share and the market structure in general. In addition, the contestability theory claims that highly concentrated markets or even monopolies can be competitive if they are fully contestable.

The criticisms directed to the structural approach for the measurement of competition have led to the development of the non-structural approaches which quantify the competitive behaviour of the bank without taking into consideration the structural features of the market. The most widely used non-structural method for the measurement of competition is represented by the Panzar-Rosse method which measures competition by estimating the elasticity of bank revenues to the changes of input prices, i.e. by estimating the Panzar-Rosse H-statistic. Depending on the response of bank revenues to the changes of input prices, it can be inferred whether banks behaviour is in line with monopoly, monopolistic competition, or perfect competition. In addition, since the H-statistic is an increasing function of the demand elasticity, the value of the H-statistic can also be used to assess the magnitude of the competition.

The Panzar-Rosse method has been largely used in the empirical literature to measure competition in the banking sector in different countries and regions. The most common finding for the investigated banking sectors was monopolistic competition. However, the validity of these findings may be questioned considering that most of these studies either scale the dependent variable (interest or total income) to total assets or include the total assets as an explanatory variable in order to control for bank size. According to Bikker et al. (2007, 2009), controlling for total assets transforms the Panzar-Rosse reduced-form revenue equation into a price equation and causes an upwards shift to the H-statistic. As a consequence, the H-statistic will always be positive, implying that monopoly will always be rejected.

Another issue related to the specification of the Panzar-Rosse model includes the choice between the bank's total income and interest income for the dependent variable. Most of the empirical studies have used the interest income based on the fact that banks' activity mostly relies on the financial intermediation, while there are also arguments in favour of using the total income, given that non-interest generating activity is continuously gaining more ground within the banks. The Panzar-Rosse method has mainly been applied using static models, while there are arguments in favour of using dynamic models in order to allow for a gradual adjustment towards the long-run equilibrium.

Despite the fact that Panzar-Rosse approach has been widely used and accepted as an appropriate method for measuring the degree of competition, possible caveats on its interpretation were discussed in section 3.4. However, given the absence of direct recent evidence on the relevance of these caveats in practice, it was argued it was appropriate to continue investigating using the Panzar-Rosse statistic.

CHAPTER 4

The Estimation of Banking Sector Competition in the CEE Countries and Kosovo

4.1 Introduction

Before the transition process began, the banking systems in most CEE countries were characterized by monobank systems. In the former Yugoslavia, each republic had a dominating bank and few other banks that operated in different segments of the economy. Overall, banking system competition in the CEE countries may be considered to have been inexistent or highly limited. The transition from the monobank system into the two-tier banking system produced oligopolistic market structures in most countries. The asset portfolios of the monobanks were inherited by a single bank, or a few banks, which led to the banking markets being highly concentrated. The degree of financial intermediation was very low, while the interest rate spreads were high. These factors may suggest that banks operating in the CEE countries continued to exert market power in the initial stage of the transition process. However, the banking reforms that included the privatization of the state-owned banks and the elimination of entry barriers for foreign banks resulted in a large number of foreign banks entering the banking systems of the CEE countries. The entry of foreign banks is considered to have substantially induced banking system competition, especially given the commercial banking experience that was brought by them. In the meantime, the CEE countries recorded progress also with regard to the development of competition policy and institutions, but the progress was slow and most of the CEE countries lag behind the more advanced countries of the Euro Area. Hence, the aim of this chapter is to estimate the degree of banking system competition in the CEE countries, in order to be able to assess whether, after the changes that took place, their banking sectors were transformed into competitive markets. Given that Kosovo's banking system was newly developed, and the fact that no previous study has addressed banking sector competition in this country, we address this issue by conducting a separate estimation within this chapter.

Although the measurement of competition has been given enormous attention in the economic literature, there is no general agreement on which is the most appropriate method to measure banking sector competition. However, as elaborated in chapter 3, the approach of Panzar and Rosse (1987), which directly quantifies competitive behaviour, is largely being recognized as an appropriate approach to measure competition. Based on this approach, competition is measured by the elasticity of bank revenues to the change of input prices, which indicates whether the competitive behaviour of banks is consistent with monopoly, monopolistic competition, or perfect competition. This method has previously been applied in a number of studies that have investigated banking sector competition in the CEE countries, such as Yildirim and Philippatos (2003) for the period 1993-2000, Mamatzakis et al. (2005) for the period 1998-2002, and Manthos (2008) for the period 1999-2006. These previous have generally found monopolistic competition.

In this chapter, we contribute to the existing literature by applying the Panzar-Rosse method to estimate competition in the banking systems of 16 CEE countries for the period 1999-2009, and by separately estimating - for the first time - competition for the banking sector of Kosovo for the period 2001-2010. In addition, unlike the other studies that have estimated banking sector competition for the CEE countries, we follow Bikker et al. (2007, 2009), who suggest not to scale the dependent variable to total assets and not to include total assets as an explanatory variable in a Panzar-Rosse model. By doing so, we aim at eliminating the misspecification bias that is present in most of the studies that have applied the Panzar-Rosse approach to measure banking sector competition (see discussion in chapter 3, page 73-78). Moreover, we also test whether banking sector competition in the non-EU countries of the CEE region differs from the competition in the EU members of this region. The application of the Panzar-Rosse approach in both the sample of CEE countries and for Kosovo is conducted using dynamic panel data. The estimation for the CEE countries uses annual bank-level data and is conducted using the General Method of Moments (GMM) as estimator. The estimation for Kosovo is based on quarterly bank-level data and uses the Unobserved Components Method, which is more suitable than GMM given the small sample of data.

This chapter is organized as follows. In the next section, we present a brief recapitulation of the Panzar-Rosse approach for the measurement of competition. Section 4.3 presents the estimation of banking sector competition for the CEE countries which includes the model description, the explanation of the estimation methodology (General Method of Moments), and the estimation results. Section 4.4 presents the estimation of competition for the banking sector of Kosovo, including the model description, the estimation methodology (Unobserved Components Method), and the estimation results. Section 4.5 presents the main conclusions from this study.

4.2 The Panzar-Rosse method for the measurement of competition

The Panzar –Rosse method is a non-structural approach for the measurement of competition. This approach quantifies the competitive behaviour of the bank by estimating the elasticity of bank revenues to the changes of bank's input prices (Equation 4.1).

$$\ln(rev_i) = \alpha_0 + \beta_1 \ln(funding\ costs)_i + \beta_2 \ln(labour\ costs_i) + \beta_3 \ln(physicalcapital\ costs_i) + \sum_{i=1}^{n} \gamma_i z_i + error\ term$$

4.1.

where, *i* indexes the banks; *rev* represents the bank revenues; *funding costs*, *labour costs* and *physical capital costs* represent the input prices; and *z* is a vector of control variables.

The sum of the elasticity coefficients of the bank revenues with respect to the changes of input prices ($\beta_1 + \beta_2 + \beta_3$) produces the H-statistic that explains whether banks' competitive behaviour is in line with monopoly ($H \leq 0$) , monopolistic competition ($0<H<1$), or perfect competition ($H=1$).

A smaller or equal to zero H-statistic ($H \leq 0$) implies that the increase of input prices leads to a decline of bank revenues which, based on the principles upon which the Panzar-Rosse method is built, implies that the competitive behaviour of the banking system is in line with monopoly (see chapter 3 for a detailed discussion of the Panzar-Rosse method). An H-statistic of between zero and one ($0<H<1$) corresponds to monopolistic competition, implying that an increase of input prices leads to a less than proportional increase of the bank revenues. The banking system is considered to be operating in perfect competition when the H-statistic equals one (H=1), implying that an increase of input prices leads to a proportional increase of bank revenues.

One of the key assumptions upon which the Panzar-Rosse approach is built is the assumption that banks are operating in long-run equilibrium. To test whether the banking market is operating in long run equilibrium, previous studies using this approach have estimated a regression similar to equation 4.2, but using Return on Assets (ROA) as the dependent variable. The model produces an H_{ROA} that is the sum of $\beta_1 + \beta_2 + \beta_3$, which represents the sum of the elasticities of bank profitability with respect to the input prices. The market is considered to be operating in long-run equilibrium when $H_{ROA}=0$, thus implying that in the long-run equilibrium bank profitability is not statistically correlated with input prices (de Rozas, 2007). However, Bikker et al. (2009) claim that H_{ROA} must not necessarily equal zero if the market is in structural equilibrium but under imperfect competition. In this view, when the market demand is characterized by some degree of elasticity, the monopolist will not be able to pass the entire increase of costs to the customers; hence, H_{ROA} will be smaller than zero (i.e. negative).

4.3 Estimation of Banking Sector Competition in the CEE countries

In this section, we estimate the banking system competition in the CEE countries using the Panzar-Rosse approach. The estimation is done for a sample of 16 CEE countries for the period 1999-2009, including Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, and Slovenia.[12] The regression uses bank-level data obtained from the

[12] Kosovo is not included in this sample because the data on personnel expenses, which is a key variable in this model, are reported as a separate category only as of the year 2008. The estimation of banking sector

BankScope database, and macroeconomic and institutional variables obtained from different sources. The estimation is done on a pooled and unbalanced panel of data.

4.3.1 Model description

This section describes the model that is used to estimate the banking sector competition for our sample of countries. Our model is in line with most of the studies that have used the Panzar-Rosse approach to measure banking sector competition, with some modifications related to the control for bank's size. In addition, among the control variables we include also macroeconomic and institutional variables, in order to control for country-level factors that might have an impact on bank revenues. The model used for this estimation has the following form:

$$\ln(\text{int\_int\_}real_{it}) = \alpha_0 + \beta_1 \ln(\text{int\_}inc\_real_{it-1}) + \beta_2 \ln(p\_funds_{it}) + \beta_3 \ln(p\_labour_{it}) + \beta_4 \ln(p\_physcapital_{it}) + \beta_5 equity\_ta_{it} + \beta_6 loans\_ta_{it} + \beta_7 prov\_loans_{it} + \beta_8 rgdp\_growth_{it} + \beta_9 ebrd\_bankref_{it} + \beta_{10} dv\_foreign_{it} + \beta_{11} dv\_origin_{it} + \beta_{12} dv\_year_{it} + \beta_{13} dv\_country_{it} + \varepsilon_{it}$$

4.2

where, i = 1 … 294 indexes the banks; and t = 1999 … 2009 indexes the years.

competition for Kosovo is conducted separately, in Section 4.4 of this chapter, with a small modification to the original Panzar-Rosse model.

Table 4.1 Description of variables

Variable	Description
int_inc_real	interest income adjusted to inflation
p_funds	interest expenses / total funding
p_labour	personnel expenses / total assets
p_physcapital	other operating expenses / fixed assets
loans_ta	total loans / total assets
prov_loans	loan-loss provisions/total loans
equity_ta	equity / total assets
rgdpgrowth	real GDP growth rate
ebrd_bankref	EBRD index of banking reform
dv_foreign	dummy variable for foreign ownership
dv_origin	dummy variable for the country-of-origin of the bank (1 for EU-12 or US)
dv_year	dummy variables for years
dv_country	dummy variables for country

One of the issues that must be considered when specifying a model like this is the choice of the dependent variable to represent bank revenues. As discussed in chapter 3, most studies have used the interest income as the dependent variable given that the lending activity was the dominant activity in the banking sectors that were analysed. Some other studies have used the total income as the dependent variable considering that the non-interest income was continuously increasing its share in the total income, so having the total income as a dependent variable would capture the overall competitive behaviour. Given that the banking sectors of the CEE countries are mainly concentrated in the traditional banking activities, where interest income largely dominates the overall structure of bank revenues (on average 73% of total revenues), the dependent variable in our main model specification is the interest income (*int_inc_real*). The use of the interest income for the dependent variable is favoured also because of the fact that, among the three input categories considered in this exercise, the largest expenditure category is represented by the funding costs, which are more relevant for the determination of the interest income than the total income (total income includes also the non-interest income). Nevertheless, we run a separate regression also with the total income (*tot_inc_real*) as the dependent variable in order to check if the results are robust to the choice between the interest income and the total income for the dependent variable. In both cases, the dependent variable is an absolute value and it is adjusted for inflation meaning that the dependent variable is represented by the real interest income and the real total income, respectively.

The decision to use the absolute value of the interest income and total income as dependent variables, rather than scaling them to total assets which has been practiced by most of the studies that have applied the Panzar-Rosse method, is based on Bikker et al. (2007) who claim that the scaling the income variable to total assets misspecifies the Panzar-Rosse model. According to this view, by scaling the income variable (both interest and total income) to total assets transforms the revenue equation into a price equation, hence, producing an upwardly biased H-statistic. Using the interest income or the total income scaled to total assets for the dependent variable will always produce a positive H-statistic, which means that monopoly will always be rejected (see chapter 3 for a detailed elaboration on this issue). In a study covering 18,000 banks from 101 countries throughout the world, Bikker et al. (2007) found that using the absolute value of income as a dependent variable, monopoly cannot be rejected in 28% of the investigated cases against 0% under models using revenues scaled to total assets as the dependent variable. In order to test the hypothesis of Bikker et al. (2007), we run separate regressions to test whether, and how the H-statistics produced from the regressions with an unscaled dependent variable differ from the regressions that use a scaled dependent variable.

In selecting the variables for the input prices, we follow the "intermediation approach" (Sealey and Lindley, 1977) which treats banks as firms that produce loans by using as inputs deposits and other loanable funds, labour, and capital. Therefore, in line with most of the studies applying the Panzar-Rosse approach to measure banking competition, input prices in our model consist of three categories: a) price of funds (variable *p_funds*), which is measured by the interest expenses to total funds ratio; b) price of labour (variable *p_labour*), which is measured by the ratio between personnel expenses and total assets;[13] and c) price of physical capital (variable *p_physcapital*), which is measured by the other operating expenses to fixed assets ratio.[14] These three variables representing the input prices are the variables of main interest in our model, since the sum of their coefficients will produce the H-statistic, which is our measure of competition. In line with all the literature in this field the dependent variable (*int_inc_real*) and the variables on the input prices (*p_funds*, *p_labour*, and *p_physcapital*) are transformed into natural logarithms in order for the coefficients of the input prices to be interpreted as constant elasticities.

A number of variables are included to control for bank specific features that may affect bank revenues. The variable *loans_ta* is included in the regression to account for bank-specific differences with regard to the composition of total assets and is computed as the gross loans

[13] The most appropriate measure of labour costs is considered to be the ratio between the personnel expenditures and the number of bank employees. However, because there are a lot of missing data on the number of employees in the BankScope database, most studies have used the share of personnel expenses to total assets, which is used also in our estimation.

[14] Other operating expenses include depreciation, amortization, occupancy costs, operating lease rentals and other administrative expenses.

to total assets ratio. A higher loan to total assets ratio is expected to have a positive impact on the level of interest income, since loans represent the main source of banks' income.

The variable *equity_ta* represents the share of equity to total assets and is included in the regression to control for the degree of the bank's risk-aversion. This variable is expected to have a negative sign, since banks with higher capitalization ratio tend to be more conservative and, as such, tend to finance safer projects which bear lower interest rates (Molyneux et al., 1994). On the other hand, based on Maudos and Fernández de Guevara (2004), higher equity ratio may be expected to have a positive impact on banks' revenues since banks with higher equity ratios may set higher interest rate margins in order to compensate for the higher costs of equity financing compared to the cost of external financing.

In our regression, we control also for the quality of the loan portfolio by including the loan-loss provisions to total loans ratio (*prov_loans*). A higher loan-loss provisions ratio reflects a lower-quality loan portfolio. The impact of the loan-loss provisions ratio on the revenues, on the one hand, may be expected to be negative since a lower quality of the portfolio implies more defaulted loans and, hence, less interest received by the bank. On the other hand, the impact on the revenues may be expected to be positive, considering that banks may charge higher interest rates on loans in order to compensate the potential losses arising from the defaulted loans.

In line with Bikker et al. (2009), our regression model does not contain total assets as an explanatory variable to control for bank's size. According to Bikker et al. (2009), the inclusion of total assets among the explanatory variables entails the same bias as the scaling of the dependent variable to total assets, thus transforming the reduced-form revenue equation into a price equation (see chapter 3 for a detailed elaboration on this issue). In order to test the hypothesis of Bikker et al. (2009), we run a separate regression in which we include the total assets (*logta*) variable among the explanatory variables to check whether and how the H-statistic differs from the regressions run without controlling for total assets.

In our regression, we control also for the potential impact of the macroeconomic environment on banks' revenues. The real GDP growth (*rgdpgrowth*) is included to control for the impact of the overall macroeconomic activity on the level of bank revenues. Its impact is expected to be positive, since in good times for the economy the demand for loans is expected to increase thus leading to higher income for the banks. The regression controls also for the impact of banking reform, using the EBRD index of banking reform (see chapter 2 for a more detailed explanation of this index). Higher values of the index indicate a more advanced level of banking reform.

Given that foreign-owned banks have a large presence in the banking systems of the CEE countries, it is important to control for the potential impact of foreign ownership. Foreign-owned banks are considered to differ from domestically-owned banks mainly in terms of higher efficiency, given that foreign banks may be superior in terms of their technology and the screening of applicants (Lehner and Schnitzer, 2008). Efficiency may affect the bank's revenues, which represent the dependent variable in our regression, through its impact on the interest rates. Foreign banks may differ from the domestic banks also with regard to the composition of their loan portfolios, given that foreign banks are considered to be more conservative and to focus on the financing of safer projects (Claeys and Hainz, 2007). Investing in safer projects can have a negative impact on the bank's revenues, since the low-risk projects usually bear lower loan interest rates. On the other hand, the impact on revenues can be positive considering that lower-risk projects may lead to less loan defaults and, hence, higher revenues received by the bank. Therefore, we control for bank's foreign ownership by including a dummy variable (*dv_foreign*) which takes a value of 1 if the bank is 51% or more foreign owned and 0 if the bank is domestically owned. Given that the readily available BankScope database provides information only on the current ownership of the bank, we utilize the shareholders' history from this database, through which we identify the bank's ownership for the available years. However, it must be noted that this variable is characterized by a more pronounced absence of data which reduces our overall sample size.

Given that the foreign banks that operate in the CEE region originate from different countries, we consider that the origin of the foreign banks may play a role on the way that banks exercise their activity, especially given the fact that foreign banks operating in the CEE countries are mostly subsidiaries of their parent banks that operate in the country of origin. This implies that the strategy and the organizational culture of the foreign-owned banks is largely in line with their parent banks, which may imply significant differences among the foreign-owned banks depending on how advanced the country of the origin is. According to Hasselman (2006), the activity of the foreign banks is mostly determined by the strategic considerations of the parent banks. Therefore, we have constructed a dummy variable (*dv_origin*) which takes a value of 1 if the foreign bank comes from an EU-12 country or United States and 0 if the foreign bank's origin is some other country.

In order to take into account the potential impact from time-specific effects, the model includes a complete set of year dummies (*dv_year*). By including the year dummies we also minimize the possibility of cross-group residual correlation if there has been some year-specific development that has affected all the banks included in the sample (e.g. global financial crisis). If such a development is not controlled by year dummies, then it enters the error term and leads to cross-group residual correlation. Also, since the banks included in our sample are from different countries, a complete set of country dummies is included in the model in order to control for country-specific effects (*dv_country*).

Data description

The bank-specific data in this study are sourced from the Fitch-IBCA Bankscope database, which provides annual data on banks operating all around the globe. The data on the real GDP growth rates are obtained from the European Union Commission (AMECO database) and International Monetary Fund. The index on banking reform is obtained from the European Bank for Reconstruction and Development (EBRD) transition reports.

Table 4.2 Summary statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
int_inc_real	2916	105167	235138	115	3177846
p_funds	2906	0.039	0.036	0.000	0.816
p_labour	2495	0.018	0.015	0.001	0.220
p_physcapital	2884	2.454	5.332	0.029	94.029
loans_ta	2904	0.550	0.203	0.000	1.396
equity_ta	2926	0.154	0.133	-0.124	0.987
prov_loans	2628	0.019	0.049	-0.482	0.497
ta	2926	1732561	3849060	2981	38100000
rgdpgrowth	2909	3.976	4.172	-17.729	13.501
ebrd_bankreform	2914	3.343	0.572	1.000	4.000
dv_foreign	2155	0.638	0.481	0.000	1.000
dv_origin	2155	0.484	0.500	0.000	1.000

4.3.2 Estimation Methodology and Diagnostic Tests

Since we are dealing with panel data, we have started our estimation strategy by initially considering the pooled OLS, the fixed effects (FE) and the random effects (RE) methods to estimate our regression. However, these methods are likely to produce inconsistent and biased estimates due to the autocorrelation problem encountered in our model. The Wooldridge test for autocorrelation in panel data rejects the null hypothesis of no autocorrelation, thus suggesting the relationship that we are investigating has a dynamic nature and should not be estimated with a static model (Appendix 2.1.1).

The alternative to tackle the autocorrelation problem is to use a dynamic model for our estimation by including the lag of the dependent variable among the explanatory variables. Apart from the need to tackle the statistical problems related to a static model, the dynamic model also enables us to capture the persistence of the dependent variable when there is at least some degree of continuity in the banking environment and banking behaviour. The underlying reason why this is possible with a dynamic model is that the lagged dependent variable captures the entire time-path (or history) of the dependent variable. In other words, in a dynamic model history is accounted for, while in a static model history is excluded. In our regression, where the dependent variable consists of the interest revenues, we consider that the past values of the dependent variable to some extent are expected to be reflected in the current values given the fact that revenues are considered to change gradually unless extraordinary circumstances appear in the economy. The reason why revenues are expected to change gradually over time may be related to the fact that the factors that potentially affect the interest rates (e.g. monetary policy, banks' efficiency) and the factors that may affect the supply and demand for loans (e.g. banks' lending strategies, the real GDP growth) are expected to change gradually rather than being characterized by continuous structural breaks.

The FE and RE models are not considered to represent appropriate methods for the estimation of dynamic models because of the likely correlation between the lagged dependent variable and the error term, which causes an endogeneity problem in our model. Therefore, we proceed with the estimation of our model using the General Method of Moments (GMM) estimator which has been developed by Arellano and Bond (1991) and augmented by Arellano and Bover (1995) and Blundell and Bond (1998). The GMM estimator overcomes the problem of endogeneity between the lagged dependent variable and the error term by using instrumental variables from within the dataset to instrument the lagged dependent variable. Since the instrumentation is not limited to one instrument for parameter to be estimated, then it is possible to have more than one moment condition per parameter to be estimated.[15] This represents another important advantage of the GMM compared to other methods, since the greater is the number of moment conditions included in the model the greater is the number of potentially valid instruments that are available and the more efficient the dynamic estimation is likely to be (Bond, 2002). In addition, the GMM method is particularly suitable for datasets with a large number of individuals (N) and a short time-series, which is consistent with our data set that is composed of over 299 banks and a time-series of 10 years.

As mentioned above, the GMM estimator was principally developed in two stages, starting with Arellano and Bond (1991), which is known as "difference" GMM, and then augmented by Arellano and Bover (1995) and Blundell and Bond (1998), which is known as "system" GMM. Under the "difference" GMM, equations are estimated using the first differences of the variables, whereas the instrumental variables consist of the lagged levels of the suspected endogenous variables. The "system" GMM estimates the model by creating a system of two

[15] Moment conditions specify variables that are not correlated with the error term, including the lagged values and even future values of the time varying variables.

equations for each time period, where one is a first-order differenced model instrumented by lagged levels as in Arellano and Bond (1991), and the other is an equation where variables are held in their original levels and instrumented with lags of their own first differences. Hence, the system GMM produces a greater number of moment conditions, since endogenous variables are instrumented by both lags of their own levels and lags of their own first differences.

The larger number of moment conditions that can be used implies that more information is used in the estimation, which makes the "system" GMM a more efficient estimator compared to the "difference" GMM. Nevertheless, the greater number of moment conditions sometimes may generate too many instruments which, especially for small datasets, may be problematic. The problem of "too many instruments" weakens the diagnostic tests for the validity of instruments, by making them increasingly unable to reject the null hypothesis of instrument validity. In our case, the number of instruments is 50 which is not considered to be high taking into account that we have 299 groups in the model.

Another advantage of "system" GMM over the "difference" GMM is that the former allows for the effects of time invariant regressors in the model to be estimated, whereas the latter differences them out.

Therefore, we choose the "system" GMM as our preferred estimator to assess the level of banking system competition in the CEE countries. Before interpreting the estimation results, a number of diagnostic tests are performed to verify whether the model is well specified. Unlike other methods, the GMM does not require distributional assumptions such as normality, and also is robust to heteroscedasticity.

Diagnostic tests

The diagnostic tests in the GMM approach start with the tests on the validity of instruments. The instrument validity test can be performed in two ways: a) Arellano-Bond tests for first-order and second-order serial correlation in the residuals; and b) the Sargan test of over-identifying restrictions.

The Arellano and Bond (1991) GMM estimator requires that there is no second-order serial correlation in the error term of the first-order differenced model. In our case, this requirement is satisfied given that the null hypothesis of no second-order serial correlation cannot be rejected, thus suggesting that the instruments are valid. However, for this test to be reliable the model should have first-order autocorrelation in the differenced error terms, which implies that errors in levels do not follow a random walk. The null hypothesis that there is no first-order serial correlation in the error term can be rejected at the 1% level of significance, suggesting that the test for second-order serial correlation in our regression is reliable (Appendix 2.1.3).

The other tests on the validity of instruments are represented by the Sargan test and Hansen test, which test whether the overidentifying instruments are uncorrelated with the error term. The Sargan test is not robust to the presence of heteroscedasticity and autocorrelation, whereas the Hansen test is robust to both and, as such, is considered to be more reliable (Roodman, 2005). In our case, the Sargan test rejects the null hypothesis that the instruments are uncorrelated with the error term, but the hypothesis is not rejected by the Hansen test with a p-value of 0.402 (Appendix 2.1.3). While the Hansen test is preferred, it can be weakened (i.e. its ability to reject the null hypothesis of validity of overidentifying instruments) in the presence of “too many instruments” (Roodman, 2009). The presence of this problem is shown by a p-value close to 1. However, this does not appear to be a problem in our regressions.

The Hansen test statistics can be used also to test the validity of subsets of instruments through the Difference-in-Hansen tests of exogeneity of instrument subsets. In this regard, we test for the joint validity of the differenced instruments used for the level equation. The test results suggest that the null hypothesis that differenced instruments are valid may not be rejected (p-value = 0.389), hence providing support to the choice of the "system" GMM against the "differenced" GMM to estimate our equation.

Another concern related to the specification of panel data models has been raised by Sarafidis et al. (2009), who claim that panel data are likely to suffer from cross-sectional dependence, "which may arise due to spatial dependence, economic distance, common shocks". In order to tackle this problem, we have followed the conventional method of including year dummies in the model. However, Sarafidis et al. (2009) claim that the inclusion of time dummies may not be sufficient to tackle the problem of cross-sectional dependence. These authors suggest that the above tests of instrument validity may be indicative for the presence of a cross-sectional dependence problem. In this regard, our results that there is no evidence of second-order serial correlation in the residuals may imply that there is no heterogeneous error cross-section dependence.

The last specification test for our model is related to the size of the coefficient on the lagged dependent variable which, in our case, is in line with the suggestion of Roodman (2006), who claims that a good estimate of the true parameter should lie between the estimates obtained from the Ordinary Least Squares (OLS) and the Fixed Effects (FE) methods. The coefficient of the lagged dependent variable obtained through the GMM is 0.856, which is larger than the coefficient of 0.515 obtained through the FE method and smaller than the coefficient of 0.922 obtained through the OLS method (Appendix 2.1.3).

Given that one of the main assumptions of Panzar-Rosse approach for the measurement of competition is that markets are in long-run equilibrium, we have investigated the long-run equilibrium by estimating equation 4.2 with the return on assets (ROA) as the dependent variable.[16] The estimation provided an H_{ROA} coefficient (measuring constant elasticity) of -0.01, which can be considered as very close to zero and, hence, makes the Panzar-Rosse approach applicable for our sample of data (Appendix 2.1.2). The fact that the joint impact of the input prices on the ROA is statistically different from zero might raise concerns on whether the market is in long-run equilibrium. However, taking into account the suggestion of Bikker et al. (2009) that H_{ROA} must not necessarily equal zero if the market is in structural equilibrium but under imperfect competition, we consider that the Panzar-Rosse approach is applicable to our sample of data. In addition, the introduction of dynamics in our model enables a gradual adjustment towards the long-run equilibrium.

4.3.3 Estimation results

This section presents the estimation results from the application of the Panzar-Rosse approach to measure banking sector competition in the CEE countries during the period 1999-2009. Table 4.3 presents four model specifications, which differ from each other mainly with regard to the dependent variable. The main model specification is presented in the first column and uses the interest income as the dependent variable.

[16] The long-run equilibrium test is explained in more details in Chapter 3 and in section 4.2 of Chapter 4. In line with Claessens and Laeven (2004), the measure of ROA is expressed as ln(1+ROA) in order to adjust for potential negative values that might have occurred due to bank losses in any year.

The estimation results suggest that the competitive behaviour of banks operating in the CEE countries is consistent with monopoly given that the sum of the coefficients of input prices (*logp_funds, logp_labour, logp_physcapital*) has produced a negative H-statistic equal to -0.064 (Table 4.3, Specification 1). The linear combination test suggests that the joint impact of the input prices on the interest income (i.e. the dependent variable) is statistically insignificant, implying that the H-statistic is not significantly different from zero, which provides further evidence in support of the monopoly behaviour given that also an H=0 is considered to imply monopoly behaviour (Table 4.4). The negative value of the H-statistic suggests that the increase of input prices leads to a reduction of banks' interest revenues. Based on the microeconomic theory, under a monopoly structure, an increase of input prices will increase firms' marginal costs which will lead to an increase of output prices and to a reduction of the level of output. The reduction of the output level will subsequently lead to a decline of banks' revenues. We would like to acknowledge that a negative H-statistic might also be consistent with oligopoly (see section 3.4). In this context, the negative value of the H-statistic might still signal that the banking sectors of the CEE countries exert a high degree of market power, but the magnitude of the market power would be lower than in the case of monopoly. However, if the issue raised by Bikker et al. (2009) that banks might be operating with constant average costs in equilibrium were to hold, then our interpretation of the H-statistic should be taken with reservation, given their claim that a negative H-statistic might not rule out that the market is competitive (see the discussion in section 3.4 for a more detailed elaboration). However, unless this issue is investigated by relevant empirical evidence, we will treat their claim just as a theoretical possibility and continue interpreting the H-statistic values based on the original Panzar-Rosse framework.

The estimation of the Panzar-Rosse model using a dynamic model enables us to estimate also the long-run H-statistic, which in our case has a value of -2.63. This suggests that the competitive behaviour of banks operating in the CEE countries in the long run is consistent with monopoly and the degree of market power is higher than in the short run.

As discussed earlier in this chapter, the studies that have applied the Panzar-Rosse method have not reached a conclusion on whether the interest income or the total income is a more appropriate measure to be used as dependent variable. Therefore, for comparison we have run an additional regression using total income as the dependent variable. The results seem to be consistent, producing an H-statistic of -0.14, which in absolute size is larger than the H-statistic obtained in the first specification but still is negative and suggests that CEE banking sectors are characterized by monopoly behaviour (Table 4.3, Specification 2). Given that both specifications produce a negative H-statistic, it may be considered that the choice between the interest income and total income for the dependent variable is not highly relevant for assessing the competitive behaviour of the banks.

Taking into consideration the number of banks operating in the CEE countries, the finding that the banking systems of these countries have been characterized by monopoly behaviour might be considered as unexpected. However, the persisting low degree of financial intermediation, the higher interest rate spreads compared to the Euro Area and the slow progress in the development of competition policy may represent important illustrative facts that banks that have operated in the CEE during the period 1999-2009 have behaved like monopolies.

Table 4.3 Estimation results of the H-statistic for the CEE countries

VARIABLES	(1)	(2)	(3)	(4)	(5)
Laglogint_inc_real	0.856***		0.748***		0.171***
	(0.071)		(0.062)		(0.043)
logp_funds	**0.129*** **	**0.156*** **	**0.220*** **	**0.376*** **	**0.342*** **
	(0.042)	(0.050)	(0.050)	(0.031)	(0.034)
logp_labour	**-0.141*** **	**-0.185** **	**-0.173*** **	**0.155*** **	**0.154*** **
	(0.046)	(0.091)	(0.058)	(0.019)	(0.022)
logp_physcapital	**-0.051**	**-0.111**	**-0.134*** **	**0.025** **	**0.024** **
	(0.035)	(0.082)	(0.045)	(0.010)	(0.010)
loans_ta_c4	0.063	0.072	0.061	0.193**	0.379***
	(0.077)	(0.123)	(0.089)	(0.097)	(0.100)
equity_ta_c4	-0.853**	-1.559*	-1.287***	0.541***	0.582**
	(0.346)	(0.855)	(0.351)	(0.199)	(0.271)
prov_loans_c4	-0.168	0.916*	-0.215	-0.179	-0.645
	(0.297)	(0.539)	(0.323)	(0.394)	(0.516)
rgdpgrowth	0.022***	0.020***	0.019***	0.005***	0.008***
	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)
ebrd_bankref1	-0.161***	-0.186**	-0.102	0.027	-0.059
	(0.062)	(0.080)	(0.067)	(0.028)	(0.036)
dv_foreign	0.066	0.047	0.070	-0.030	-0.049*
	(0.042)	(0.077)	(0.051)	(0.023)	(0.025)
dv_origin	0.057	0.122	0.098*	0.017	-0.006
	(0.060)	(0.112)	(0.054)	(0.020)	(0.022)
logpfunds_dvnoneu			-0.150**		
			(0.067)		
logplabour_dvnoneu			-0.176**		
			(0.087)		
logpphyscapital_dvnoneu			0.112**		
			(0.055)		
dv_noneu			-1.700***		
			(0.497)		
Laglogtot_inc_real		0.709***			
		(0.173)			
Laglogintinc_ta				0.280***	
				(0.053)	
logta					0.850***
					(0.046)
dv_year	Yes	Yes	Yes	Yes	Yes
dv_country	Yes	Yes	Yes	Yes	Yes
Constant	1.747***	3.286**	3.222***	-0.143	-0.807***
	(0.654)	(1.477)	(0.704)	(0.173)	(0.254)
Observations	1,610	1,607	1,610	1,610	1,610
Number of bank	299	298	299	299	299

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note a): Appendix 2.1 presents the STATA outputs for all the model specifications.

Note b): Specification 1 uses the real interest income as dependent variable; Specification 2 uses the real total income as dependent variable; Specification 3 uses real interest income as dependent variable, but includes the interactions of input price variables with the dummy variable for non-EU countries; Specification 4 uses the interest income to total assets ratio as dependent variable; Specification 5 uses the real interest income as dependent variable, but includes the total assets variable among the explanatory variables;

Given that within the CEE countries there are differences between the non-EU and EU countries in many aspects of banking sector structure and operating environment, we have also tested whether the degree of banking sector competition in the non-EU members of the CEE region has differed from the EU members of this region. We have conducted this test by interacting each of the input prices variables (i.e. the components of the H-statistic) with the dummy variable *dv_noneu* which takes a value of 1 if the country is not an EU member (Table 4.3, specification 3).[17] According to Brambor et al. (2006), the coefficient of a constitutive component of the interaction term can be interpreted alone only assuming that the other constitutive component of the interaction term equals zero. In our case, the coeficients of the primary variables *p_funds*, *p_labour* and *p_physcapital* reflect the impact of input prices on banks' revenues when the other component of the interaction term *dv_noneu* equals zero. In other words, the sum of the coefficients of *p_funds*, *p_labour* and *p_physcapital* represents the H-statistic for the EU countries of our sample (*dv_noneu*=0), which is -0.09. The coefficients of the interaction terms in our regression (*logpfunds_dvnoneu*, *logplabour_dvnoneu* and *logpphyscapital_dvnoneu*) suggest that when *dv_noneu* equals 1, i.e. when the country is not an EU member, the input prices have a statistically significant additional impact on bank's revenues compared to the situation when the country is an EU member. Summing up the coefficient of each interaction term

[17] The inclusion of the interaction term is done in line with Brambor et al. (2006) who suggest that in the case of multiplicative interaction models, the regression should include all the constitutive terms of the interaction term and the interaction term itself. These authors suggest that the coefficients of the constitutive terms should not be interpreted as average effects. The coefficient of one component term can be interpreted only assuming that the other component of the interaction term equals zero.

(*logpfunds_dvnoneu*, *logplabour_dvnoneu* and *logpphyscapital_dvnoneu*) with the coefficient of its respective constitutive term (*p_funds*, *p_labour* and *p_physcapital*), we obtain the H-statistic for the non-EU members of our sample, which represents the impact of input prices on bank's revenues when the country is an EU member plus the additional impact when the country is not an EU member. The sum of these coefficients is presented in Table 4.4 (specification 3) and shows an H-statistic of -0.30 for the non-EU countries. The negative values of the H-statistics for the EU and non-EU countries suggest that banks operating in both the EU and non-EU countries of the CEE region are characterized with monopoly behaviour. However, the fact the the H-statistic of non-EU countries is lower (i.e. more negative) than the H-statistic of the EU countries suggests that the banking sectors of non-EU countries are characterized by an even lower degree of competition compared to the banking sectors of the EU countries. Recalling the evidence provided in chapter 2, the non-EU countries of the CEE region have been characterized by a lower degree of financial intermediation, higher interest rate spreads, and lower development of competition policy, compared to the EU members of the region, which might serve as indicators of a lower degree of banking sector competition in these countries. Banks operating in the non-EU countries of the CEE are also likely to face less competition from cross-border lending, given the smaller number of large foreign corporations operating in these countries. In addition, the persistently high profitability ratios recorded by the banking sectors of these countries might have well accommodated banks in the existing positions as to not induce a more aggressive competitive behaviour which could eventually undermine their profits.

Regarding the impact of individual variables on the interest income, the coefficient on the lagged dependent variable (*Laglogintinc_real*) is positive and highly significant, showing a high level of persistence of the bank interest revenues over the periods (Table 4.3). This implies that bank revenues in the current year are largely consistent with the bank revenues in the previous year. The statistically significant coefficient of the lagged dependent variable confirms the dynamic nature of our model and may serve as evidence in support to Goddard and Wilson (2009) who suggest that the Panzar-Rosse method should be estimated using dynamic models rather than static models as used by the majority of studies applying this method.

Funding costs (*logp_funds*) have a significantly positive impact on the interest income, implying that an increase of deposit and other funds interest rate results in a higher level of interest income (Table 4.3, Specification 1). This relationship between funding costs and interest income principally suggests that banks pass a portion of the increase of funding costs to their customers, presumably by charging them higher interest rates on loans and on other interest-generating assets. On the other hand, labour costs (*logp_labour*) have a significantly negative impact, while the physical capital costs (*logp_physcapital*) have a statistically insignificant impact.

Regarding other control variables, the degree of risk-aversion, measured by the equity to total assets ratio (*equity_ta*) has a negative and statistically significant coefficient, showing that more conservative banks tend to generate less interest income. The structure of the assets (*loans_ta*) and the quality of the loan portfolio (*prov_loans*) have statistically insignificant coefficients. Also, bank's ownership (*dv_foreign*) and country-of-origin (*dv_origin*) both statistically insignificant coefficients. Regarding country-level variables, the real GDP growth rate (*rgdpgrowth*) has a positive and statistically significant coefficient, suggesting that when the economy is growing banks' interest revenues tend to increase. This may primarily reflect the growing demand for loans during the "boom" periods. The *ebrd_bankref* variable is significantly negative, suggesting that the progress in banking reform had a negative impact on banks' revenues.

Table 4.4 Joint impact of the input prices on the dependent variable

	Coefficient	Std. error	z	P>|z|	[95% Conf. Interval]	
Specification 1	-0.064	0.066	-0.960	0.337	-0.194	0.066
Specification 2	-0.140	0.138	-1.020	0.309	-0.410	0.130
Specification 3	-0.300	0.115	-2.610	0.009	-0.526	-0.075
Specification 4	0.556	0.043	13.070	0.000	0.473	0.640
Specification 5	0.519	0.051	10.220	0.000	0.419	0.618

Note a): The joint impact of the input prices on the dependent variable is calculated using the linear combinations command (lincom) in STATA. The "coefficient" in this table represents the sum of the coefficients on logp_funds, logp_labour and logp_physcapital (for Specification 3: logpfunds_dvnoneu+ logp_funds, logplabour_dvnoneu+logp_labour, logpphyscapital_dvnoneu+logp_physcapital) which produces the H-statistic.

Note b): Specification 1 corresponds to the model with the interest income as dependent variable; Specification 2 corresponds to the model with the total income as dependent variable; Specification 3 uses real interest income as dependent variable, but includes the interactions of input price variables with the dummy variable for non-EU countries; Specification 4 corresponds to the model with the interest income to total assets ratio as dependent variable; Specification 5 corresponds to the model with the interest income as dependent variable, but which includes also total assets among the explanatory variables.

The overall finding of our analysis that the competitive behaviour of banks operating in the CEE countries complies with monopoly behaviour is not consistent with most other studies that have applied the Panzar-Rosse approach to investigate banking sector competition for the CEE countries as well as with studies that have applied this approach to other regions which have mostly found monopolistic competition (Yildirim and Philippatos, 2003; Mamatzakis et al., 2005; Claessens and Laeven, 2003). However, we attribute this difference to the model specification, claiming that we have made an improvement to the model specification by taking into account the suggestion of Bikker et al. (2007, 2009) not to control for total assets as well as not to scale the dependent variable (i.e. interest or total income) to total assets (see discussion in chapter 3, page 73-78). In order to test the hypothesis of Bikker et al. (2009) that the inclusion of total assets as an explanatory variable leads to a higher H-statistic, we estimate equation 4.2 with total assets (*logta*) among the explanatory variables (Table 4.3, Specification 5).[18] As expected, the H-statistic turns from negative in the previous specification to positive with a coefficient of 0.519 which would suggest that the behaviour of banks operating in the CEE countries is consistent with monopolistic competition (Table 4.4, Specification 5). This would make our findings consistent with most of the studies that have applied the Panzar-Rosse approach to measure banking sector competition for the CEE countries and other regions. Similarly, we estimate equation 4.2 with the interest income/total assets as the dependent variable (Table 4.2, Specification 4). The results are similar to Specification 5, with an H-statistic of 0.556 (Table 4.4, Specification 5). This confirms also our explanation in chapter 3 (Box 3.1) that the scaling of the dependent variable to total assets and the inclusion of the total assets as an explanatory variable entails the same misspecification bias, by turning the H-statistic from a negative value into a positive value when the market is operating under monopoly. These results may serve as evidence in support of the hypothesis of Bikker et al. (2007, 2009) on the scaling of the dependent variable to total assets and the inclusion of total assets as an explanatory variable in a Panzar-Rosse model.

[18] Given that the scaling of the dependent variable to total assets and the inclusion of total assets as an explanatory variable (Specifications 4 and 5) transform the reduced-form revenue equation into a price equation (i.e. the dependent variable becomes the *ex-post* interest rate), in these specifications the control variables *equity_ta*, *loans_ta*, *prov_loans*, and *logta* are treated as endogenous based on the predicted relationship between these variables and the interest rate. For a more detailed elaboration on these relationships see the description of variables in Chapter 6.

4.4 Estimation of the Banking Sector Competition in Kosovo

Kosovo's banking system started to operate after the end of the war in 1999, when Kosovo inherited a destroyed economy, while the banking system was inexistent. However, within a relatively short period of time, Kosovo built the basis of a contemporary banking system, fully privately owned and with a dominating presence of foreign capital. The continuous increase in the number of banks is considered to have increased the competition among banks, which was primarily expressed through a faster geographical expansion of banks, lower interest rate spread, larger range of products and better quality of services. However, the number of banks operating in Kosovo remains relatively low compared to other countries in the region, while the market structure continues to be characterized by a relatively high degree of market concentration. The interest rate spreads, in spite of the continuous decline, remain among the highest in the CEE region, while the degree of financial intermediation is the lowest. These facts make the investigation of banking sector competition in Kosovo an interesting exercise. Hence, in the following sections we apply the Panzar-Rosse approach to quarterly bank-level data on the banks operating in Kosovo which are sourced from the Central Bank of the Republic of Kosovo.

4.4.1. Model description

In this section, we apply the Panzar-Rosse approach to estimate the competition in the banking sector of Kosovo for the period 2001-2010. The regression used to estimate the Panzar-Rosse H-statistic for the banking system of Kosovo is in principle similar to equation 4.2, which is used to estimate banking competition in CEE countries, but is modified by few restrictions that are mainly related to data limitations.

$$\ln(totinc\_real_{it}) = \alpha_0 + \beta_1 \ln(pf_{it}) + \beta_2 \ln(plc_{it}) + \beta_3 equity\_ta_{it} + \beta_4 loans\_ta_{it} + \beta_5 prov\_loans_{it} + \beta_6 dv\_year_{it} + \varepsilon_{it} \quad (4.3)$$

where,

i is the index for bank, *t* is the index for year, and *α* is the constant.

Table 4.5 Description of variables

Variable	Description
totinc_real	total income adjusted for inflation
pf	interest expenditures / total funds
plc	general and administrative expenses / total assets
loans/ta	loans / total assets
equity/ta	equity / total assets
prov_loans	loan_loss provisions / total loans
dv_year	dummy variable for year
ε	error term

Since the activity of Kosovo's banking sector is mainly concentrated in the traditional banking activities, where interest income dominates the overall structure of bank revenues, the dependent variable in our regression could be the interest income. However, since the non-interest income is continuously becoming more important, we run the regression also with total income as the dependent variable and check whether the value of the H-statistic is robust. Similar to equation 4.2, we use the absolute value of income as the dependent variable, rather than scaling it to total assets. Both the total income and the interest income are adjusted for inflation.

Also, in selecting the variables for the input prices, we follow the ‘’intermediation approach’’ (Sealey and Lindley, 1977) which treats banks as firms that produce loans by using as inputs deposits and other loanable funds, labour, and capital. However, because separate data on labour costs for the Kosovo’s banking system are available only as of 2008, we follow Yildirim and Philippatos (2003) in using the general and administrative expenses to total assets ratio to account for both labour and physical capital expenditures in order not to reduce the number of observations in our model. In line with the other studies in this field, the dependent variable and the variables representing the input prices (*pf* and *plc*) are transformed into logarithms in order for the coefficients (β_1 and β_2) to be interpreted as constant elasticities.

The regression includes the same set of bank-level control variables as in equation 4.2. However, we have not been able to control for the country-level variables. The quarterly real GDP growth data are still not produced in Kosovo, and the European Bank for Reconstruction and Development (EBRD) has not produced the banking reform index for Kosovo since Kosovo was not an EBRD member.[19]

The data used in this analysis are bank-level balance sheet and income statement quarterly data for the period 2001-2010 for all commercial banks operating in Kosovo, collected from the Central Bank of the Republic of Kosovo.

[19] Kosovo became a member of the European Bank for Reconstruction and Development in 2012.

Table 4.6 Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
totinc_real	252	4.279	5.082	0.013	21.932
pf	252	0.006	0.012	0.000	0.185
plc	252	0.014	0.010	0.004	0.080
loans_ta	255	0.479	0.193	0.000	0.780
equity_ta	255	0.131	0.095	0.024	0.792
prov_loans	255	0.049	0.045	-0.033	0.283

4.4.2 Estimation Methodology

The Wooldridge test for autocorrelation in panel data suggests that there is autocorrelation in the data and that a static model would not be appropriate for our estimation (Appendix 2.2.1). One of the methods to overcome the problem of autocorrelation in a panel model consists of the inclusion of the lagged dependent variable as an explanatory variable in the model. However, this may cause correlation between the error term and the lagged dependent variable, leading to an endogeneity problem in the model. This endogeneity problem may be tackled by using the General Methods of Moments (GMM) approach which uses instruments from within the sample to substitute for the lagged dependent variable. However, because our analysis relies on a small sample of data in terms of the number of individual groups (N), the GMM method is not applicable since it is appropriate for samples with large N.

The autocorrelation problem in our model may indicate that our dependent variable might be affected also by other variables that are not included among our explanatory variables. In addition, if the omitted variables have an autoregressive statistical generating mechanism, then the model may be characterized also by an autocorrelated error term.

In order to tackle the autocorrelation problem in our model, the next attempt is to model the dynamics in the error term, using the Unobserved Components Model, estimated according to Cochrane-Orcutt (1949). This method estimates the slope coefficients of a static model conditional on AR(1) dynamics in the residuals; i.e. in equation 4.3 $\varepsilon_{it} = \rho\varepsilon_{it-1} + \nu_{it}$ (where v_{it} is white noise). However, the Unobserved Components model is valid only under the assumption that the common factor restrictions hold. Based on Spanos (1986) and McGuirk and Spanos (2004), common factor restrictions are explained in Box 4.1.

Box 4.1 Testing for Common Factor Restrictions

To explain the Common Factor Restrictions (CFR), for simplicity, we assume a model with only two explanatory variables and an autoregressive error term of first order – AR(1).

$$Y_{it} = \alpha + \alpha_2 X_{it} + \alpha_3 N_{it} + \varepsilon_{it} \quad (4.3)$$

where, $\varepsilon_{it} = \rho\varepsilon_{it-1} + \nu_{it}$ (4.4)

ε_{it-1} is the disturbance term, and

ν_{it} is the white noise component

Lagging once each of the equation (4.3) components, we get:

$$Y_{it-1} = \alpha + \alpha_2 X_{it-1} + \alpha_3 N_{it-1} + \varepsilon_{it-1} \quad (4.5)$$

Solving equation (4.5) for ε_{it-1}:

$$\varepsilon_{it-1} = Y_{it-1} - \alpha - \alpha_1 X_{it-1} - \alpha_2 N_{it-1} \quad (4.6)$$

Substituting equation (4.6) into equation (4.4):

$$\varepsilon_{it} = \rho(Y_{it-1} - \alpha - \alpha_2 X_{it-1} - \alpha_3 N_{it-1}) + \nu_{it} \quad (4.7)$$

$$\varepsilon_{it} = \rho Y_{it-1} - \rho\alpha - \rho\alpha_2 X_{it-1} - \rho\alpha_3 N_{it-1}) + \nu_{it} \quad (4.8)$$

Substituting equation (4.8) into equation (4.3):

$$Y_{it} = \alpha + \alpha_2 X_{it} + \alpha_3 N_{it} + \rho Y_{it-1} - \rho\alpha - \rho\alpha_2 X_{it-1} - \rho\alpha_3 N_{it-1} + \nu_{it} \quad (4.9)$$

Collecting the terms of equation (4.9):

$Y_{it} = (1-\rho)\alpha + \alpha_2X_{it} + \alpha_3N_{it} + \rho Y_{it-1} – \rho\alpha_2X_{it-1} – \rho\alpha_3N_{it-1} + \nu_{it}$ (4.10)

According to Sargan (1964), equation (4.10) is a restricted version of the following dynamic linear regression model:

$Y_{it} = \alpha + \alpha_1Y_{it-1} + \alpha_2X_{it} + \alpha_3N_{it} + \alpha_4X_{it-1} + \rho\alpha_5N_{it-1} + \nu_{it}$ (4.11)

The coefficient of X_{it-1} in equation (4.9) is $– \rho\alpha_2$, which is equivalent to the product of the coefficients of Y_{it-1} and X_{it} in equation 4.11. More precisely, the negative of the coefficient on the lagged explanatory variable equals the product of the coefficient on the lagged dependent variable and the coefficient on the current value of the explanatory variable. This defines the following non-linear restriction:

$– \rho\alpha_2X_{it-1} = \rho Y_{it-1} * \alpha_2X_{it}$ (4.12)

In terms of equation (4.11), this expression is:

$– \alpha_4X_{it-1} = \alpha_1Y_{it-1} * \alpha_2X_{it}$ (4.13)

Similarly, the coefficient of N_{it-1} in equation (4.10) is $– \rho\alpha_3$ which is equivalent to the product of the coefficients of Y_{it-1} and $N_{it.}$ Hence,

$– \rho\alpha_3N_{it-1} = \rho Y_{it-1} * \alpha_3N_{it}$ (4.14)

$– \alpha_4N_{it-1} = \alpha_1Y_{it-1} * \alpha_3N_{it}$ (4.15)

Expressions in equation (4.13) and (4.14) represent the common factor restrictions. The dynamic linear regression (equation 4.11) can be transformed into its restricted form (equation 4.10) only if these restrictions hold.

Therefore, in order to apply the unobserved components method to our analysis, we must initially test whether the CFRs hold in our model. To test for CFR, we first transform our model (equation 4.3) into a dynamic linear regression model of order one (equation 4.16). Equation 4.16 is estimated both by the fixed effects (FE) method and by pooled ordinary least squares (OLS) in order to check the CFR test for robustness.[20]

[20] Between the Fixed effects and the Random effect methods, the Hausman test suggests that our regression should be estimated with the Fixed Effects method. Appendix 4.2.2 provides the STATA outputs on the

$$\ln(totinc\_real_{it}) = \alpha_0 + \beta_1 \ln(pf_{it}) + \beta_2 \ln(plc_{it}) + \beta_3 equity\_ta_{it} + \beta_4 loans\_ta_{it} + \beta_5 prov\_loans_{it} + \beta_6 \ln(totinc\_real_{it-1}) + \beta_1 \ln(pf_{it-1}) + \beta_2 \ln(plc_{it-1}) + \beta_3 equity\_ta_{it-1} + \beta_4 loans\_ta_{it-1} + \beta_5 prov\_loans_{it-1} + \beta_6 dv\_year_{it} + \varepsilon_{it}$$

(4.16)

Having estimated equation (4.16), we test the null hypothesis that CFRs hold. The test for CFRs is performed based on the derivation explained in Box 1.

Box 4.2 Results of the test for Common Factor Restrictions

CFR test results from the estimation of equation (4.16):

```
testnl _b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]
```

FE	F(1, 203) =	11.20
	Prob > F =	0.0010
OLS	F(1, 212) =	41.32
	Prob > F =	0.0000

```
testnl _b[Laglogtotinc_real]*_b[logplc] = -_b[Laglogplc]
```

FE	F(1, 203) =	2.01
	Prob > F =	0.1581
OLS	F(1, 212) =	1.67
	Prob > F =	0.1972

```
testnl _b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta]
```

FE	F(1, 203) =	20.00
	Prob > F =	0.0000
OLS	F(1, 212) =	10.31
	Prob > F =	0.0015

```
testnl _b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta]
```

FE	F(1, 203) =	10.29
	Prob > F =	0.0016

estimation of the Hausman test, whereas Chapter 5 provides a detailed explanation of the Fixed Effects and Random Effects methods.

OLS	F(1, 212) =	0.10
	Prob > F =	0.7482

```
testnl _b[Laglogtotinc_real]*_b[prov_loans] = -_b[Lagprov_loans]
```

FE	F(1, 203) =	0.01
	Prob > F =	0.9288
OLS	F(1, 212) =	4.39
	Prob > F =	0.0374

Based on the above-presented results, it appears that the null hypothesis that CFRs hold cannot be rejected for three of the variables, hence we consider that we can apply the unobserved components method to estimate our model, even though when tested jointly for all the variables CFRs do not appear to hold.

```
testnl (_b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]) (_b[Laglogtotinc_real]*_b[logplc] = -
_b[Laglogplc]) (_b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta])
(_b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta])(_b[Laglogtotinc_real]*_b[prov_loans]
= -_b[Lagprov_loans])
```

FE	F(5, 203) =	11.61
	Prob > F =	0.0000
OLS	F(5, 212) =	9.72
	Prob > F =	0.0000

The test results suggest that CFR hold for three of the variables (Box 4.2). Hence, we apply the unobserved components method to a static fixed effects panel to estimate equation (4.3), i.e. to estimate the degree of competition in the Kosovo's banking system.

Since one of the main assumptions of the Panzar-Rosse approach is that the market is operating in long-run equilibrium, we initially perform the long-run equilibrium test by estimating equation (4.2) with Return on Assets (ROA) as a dependent variable. The H-statistic obtained from the test for long-run equilibrium is almost zero (H_{ROA} = -0.05) which may suggest that the market is operating in long-run equilibrium (Appendix 2.2.5). In addition, the modelling of the dynamics in the error term may enable a gradual convergence towards the equilibrium position even if the market in not entirely in long-run equilibrium. Hence, we consider that the Panzar-Rosse approach may be applied to estimate the banking sector competition in Kosovo.

4.4.3 Estimation Results

This section presents the results from the estimation of the Panzar-Rosse model for the banking sector of Kosovo for the period 2001-2010. Table 4.7 presents the estimation results, where the main model is presented in the first column while the other columns present alternative models. The estimation results produce an H-statistic that ranges between zero and one (0<H<1) which suggests monopolistic competition both when using total income or interest income as the dependent variable. However, given that the joint impact of input prices is more statistically significant when total income is used as the dependent variable, we refer to the regression run with total income as the dependent variable as the main model, whereas the regression with interest income as the dependent variable is treated as an alternative regression.

Based on the estimation results, the H-statistic for the banking system of Kosovo has a positive value of 0.33 which suggests that the behaviour of banks operating in Kosovo is consistent with monopolistic competition (Table 4.7, specification 1).[21] This result is confirmed also by the linear test for the joint impact of the input prices on the total income, presented in Table 4.8 which suggests that the joint impact of input prices is significantly different from zero (*p-value* =0.000). The H-statistic has a positive coefficient also when the regression is run using interest income as the dependent variable (H-statistic=0.167), but the

[21] The H-statistic is calculated by summing the coefficients of variables that represent the input prices (price of funds: PF, and price of labour and physical capital: PLC).

coefficient is smaller than with the total income as the dependent variable (Table 4.8). Given that both specifications produce a positive H-statistic (i.e. $0<H<1$), the results may be considered as suggesting that the competitive behaviour of banks operating in Kosovo has been in line with monopolistic competition.

Table 4.7 Estimation of the H-statistic for the banking system of Kosovo

VARIABLES	(1)	(2)	(3)	(4)
logpf	0.415***	0.491***	0.240***	0.230***
	(0.046)	(0.060)	(0.048)	(0.050)
logplc	-0.082	-0.324***	0.210***	0.357***
	(0.076)	(0.083)	(0.066)	(0.063)
loans_ta	0.949***	1.970***		
	(0.333)	(0.353)		
equity_ta	-1.968***	-2.945***		
	(0.749)	(0.738)		
prov_loans	0.410	1.039		
	(0.955)	(1.010)		
Lagloans_ta			0.785***	0.622**
			(0.236)	(0.247)
Lagequity_ta			-2.397***	-2.053***
			(0.526)	(0.548)
Lagprov_loans			-0.154	-0.341
			(0.685)	(0.722)
logta			0.593***	
			(0.084)	
dv_year	YES	YES	YES	YES
Constant	3.193***	1.215***	-0.113	-1.356***
	(0.141)	(0.266)	(0.224)	(0.193)
Observations	238	238	230	230
Number of bank	10	10	10	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note a): Appendix 2.2 presents the STATA outputs for all the model specifications.
Note b): Specification 1 uses the real total income as the dependent variable; Specification 2 uses real interest income as the dependent variable; Specification 3 uses total income as the dependent variable, but includes the total assets variable among the explanatory variables; Specification 4 uses the total income to total assets ratio as the dependent variable.
Note c): Given that the scaling of the dependent variable to total assets and the inclusion of total assets as an explanatory variable (Specifications 3 and 4) transform the reduced-form revenue equation into a price equation (i.e. the dependent variable becomes the interest rate), in these specifications the control variables *equity_ta, loans_ta*, and *prov_loans* are treated as endogenous (hence, included in lags) based on the predicted relationship

between these variables and the interest rate. For a more detailed elaboration on these relationships see the description of variables in chapter 6.

Compared to the results from the previous section, where competition was measured for banks operating in the CEE region, it appears that banking sector competition in Kosovo was higher than the average of the CEE region. This may primarily reflect the fact that Kosovo's banking system has been newly created and banks have competed more aggressively to seize the market opportunities. Banks in Kosovo during the period under investigation have been highly active in expanding their branch networks throughout the country which represents a very important form of product differentiation. In addition, even though the highest among the CEE region, the interest rate spreads in Kosovo have recorded a continuous decline during these years, potentially reflecting the evolving competition between banks. Similarly, the high degree of market concentration that characterized Kosovo's banking sector since the beginning of its operations has declined continuously.

Regarding the impact of individual variables on the total income (i.e. the dependent variable), Table 4.7 (Specification 1) shows that the price of funds variable (*PF*) has a significantly positive coefficient, suggesting that an increase in the price of funds will result in higher revenues which may imply that an increase of bank's financing costs may be passed to the clients, presumably by charging them higher interest rates. The other component of input prices in our model which is the price of labour and physical capital (*PLC*) and is measured by the ratio of general and administrative expenses to total assets, has a negative coefficient but is statistically insignificant. The coefficient on loans to total assets (*loans_ta*) is positive and highly significant, indicating that a higher loan-to-total assets ratio results in a higher level of bank revenues. The coefficient on the variable equity to total assets (*equity_ta*) is significantly negative, suggesting that more risk-averse banks tend to be characterized by a lower level of income. The loan-loss provisions to total loans ratio (*prov_loans*), which measures the quality of the loan portfolio, resulted statistically insignificant.

Table 4.8 The joint impact of the input prices on the dependent variable

	Coefficient	**Std. error**	**z**	**P>|z|**	**[95% Conf. Interval]**	
Specification 1	0.333	0.081	4.120	0.000	0.174	0.493
Specification 2	0.167	0.090	1.860	0.065	-0.010	0.344
Specification 3	0.450	0.067	6.730	0.000	0.318	0.582
Specification 4	0.587	0.065	9.080	0.000	0.460	0.715

Note a): The joint impact of the input prices on the dependent variable is calculated using the linear combinations command (lincom) in STATA. The "coefficient" in this table represents the sum of the coefficients on logpf and logplc which is the H-statistic.
Note b): Specification 1 corresponds to the model with the total income as dependent variable; Specification 2 corresponds to the model with the interest income as dependent variable. Specification 3 corresponds to the model with the total income as dependent variable, but includes the total assets variable among the explanatory variables; Specification 4 corresponds to the model with total income to total assets ratio as dependent variable.

Similar to section 4.3, where we estimated the banking sector competition for the CEE countries, in this section we run two alternative model specifications in order to test the hypotheses of Bikker et al. (2007, 2009) on the scaling of the dependent variable to total assets and the inclusion of total assets among the explanatory variables. Specification 3 presents the results from the estimation of our model using the total income/total assets as the dependent variable, whereas specification 4 presents the model with the total income as dependent variable but including the total assets among the explanatory variables (Table 4.7 and 4.8).[22] In both specifications, the H-statistic is higher compared to the model where the

[22] Given that the scaling of the dependent variable to total assets and the inclusion of total assets as an explanatory variable (Specifications 3 and 4) transform the reduced-form revenue equation into a price equation (i.e. the dependent variable becomes the *ex-post* interest rate), in these specifications the control variables *equity_ta*, *loans_ta* and *prov_loans* are treated as endogenous (hence, included in lags) based on the predicted relationship between these variables and the interest rate. For a more detailed elaboration on these relationships see the description of variables in Chapter 6.

absolute value of total income is used as the dependent variable (Table 4.8). These results may be considered as further evidence in favour of the hypotheses of Bikker et al. (2007, 2009).

4.5 Conclusions

In this chapter, the Panzar-Rosse model has been applied to estimate banking sector competition in the CEE countries. A separate estimation is conducted to estimate the banking sector competition in Kosovo in order to address the data limitations arising from the newly created banking system in this country. In both cases, the Panzar-Rosse method was applied on panel data accounting for dynamics in order to address the serial correlation problem as well as to satisfy the suggestions of the authors who claim that the adjustment towards long-run equilibrium is not an instant process, but takes place gradually over time. Unlike most of the studies that have applied the Panzar-Rosse method to estimate banking sector competition, we have not scaled our dependent variable to total assets and neither have we included the total assets among the control variables, which is in line with the recommendations of Bikker et al. (2007, 2009).

The estimation of banking sector competition for the CEE countries has been conducted using the General Method of Moments. The estimation results have produced a negative H-statistic, which implies that the behaviour of banks operating in the CEE countries is consistent with monopoly behaviour. Taking into consideration the number of banks operating in the CEE countries, this finding might be considered as unexpected. However, the persisting low degree of financial intermediation, the higher interest rate spreads compared to the Euro Area and the slow progress in the development of competition policy may represent important illustrative facts suggesting that the banks that have operated in the CEE during the period 1999-2009 have behaved like monopolies. Nevertheless, it should be acknowledged that a negative H-statistic might be consistent also with oligopoly, implying that our estimate of the H-statistic would still signal the presence of a high degree of market power, but which is more moderate compared to the monopoly. Another reservation regarding the interpretation of the H-statistic is related to the proposal of Bikker et al. (2009), who show that a negative H-statistic does not necessarily indicate monopoly behaviour if banks' average costs are constant in equilibrium (see section 3.4). In such a situation, the negative value of the H-statistic might not be able to rule out the imperfect competition, so our interpretation that the behaviour of banks operating in CEE countries is consistent with monopoly would need to be taken with reservation. Nevertheless, since the proposal of Bikker et al. (2009) is a theoretical possibility rather than a norm, we continue to interpret the H-statistic based on the original Panzar-Rosse framework and leave this issue to be investigated by future empirical research.

Within the CEE sample of countries, market power resulted to be higher among the banks operating in the non-EU countries of the CEE region compared to the EU countries of this region. These countries have been characterized by an even lower degree of financial intermediation, higher interest rate spreads, and lower development of competition policy, compared to the EU members of the CEE region. The banks operating in the non-EU countries of the CEE are also likely to face less competition from cross-border lending, given the smaller number of large foreign corporations operating in these countries. In addition, the persistently high profitability ratios recorded by the banking sectors of these countries might have well accommodated banks in their existing positions as to not induce a more aggressive competitive behaviour, which could eventually undermine their profits.

The estimation of banking sector competition in Kosovo has been conducted using the Unobserved Components Model, which incorporates the dynamics in the error term. GMM estimation of a dynamic panel model, which is considered as more appropriate for large – i.e.

large N - panel datasets, could not be applied in the case of Kosovo due to the small number of banks. The estimation results suggest that the conduct of banks operating in Kosovo has been consistent with monopolistic competition. Compared to the previous results, it appears that the degree of banking sector competition in Kosovo is higher than the average degree of competition for the overall CEE region. This may primarily reflect the fact that Kosovo's banking system has been newly created and banks have competed more aggressively to seize the market opportunities. Despite the fact that the interest rate spread in Kosovo is the highest among the CEE countries, it has followed a continuously declining trend, thus potentially reflecting increasing competition between banks.

In both the estimations, the dependent variable in the main regression has consisted of the interest income, given that financial intermediation dominates the banks' activity in these countries, but for comparison also total income has been used. The results have generally been consistent, suggesting that the choice between the interest income and the total income for the dependent variable is not decisive for the measurement of banking sector competition using the Panzar-Rosse approach.

In order to test for potential upward bias on the H-statistic arising from for the inclusion of total assets in the regression, we have estimated alternative model specifications both by scaling the dependent variable to total assets and by including the total assets variable among the explanatory variables. Both the estimation for the CEE countries and for Kosovo provide evidence in support of the view of Bikker et al. (2007, 2009), who claim that the inclusion of total assets inflates the H-statistic and, as a consequence, that monopoly is always rejected. In the case of CEE countries, the H-statistic becomes positive, thus rejecting the monopoly and suggesting monopolistic competition. In the case of Kosovo, the H-statistic remains positive, but the coefficient is higher.

CHAPTER 5

The Impact of Banking Sector Competition on Banks’ Risk-Taking in CEE Countries

5.1 Introduction

The main challenge during the transition process of the banking sector in the CEE countries was the management of non-performing loans, which became a serious threat to the stability and development of the banking sector. The reasons for the high non-performing loans were multiple, starting from the legacies inherited from the centrally-planned economies, the poor corporate management of the newly created banks, the weak institutions, and the poor macroeconomic performance of these countries. However, the long process of the governments' interventions to clean banks' balance sheets from the non-performing loans and reform the banking sector by privatizating the state-owned banks and strengthening the financial regulatory and supervisory institutions, led to substantial improvement of loan-portfolio quality in the CEE countries.

The issue of bank risks is considered as highly important both in the literature and among the regulators, primarily because banks' bankruptcies are expected to be associated with much larger negative consequences for the economy compared to the bankruptcy of other types of firms. According to Beck et al. (2010), banks differ from other types of firms because of three main reasons: a) potential bankruptcy of banks entails high social costs which are mainly related to potential losses for the uninformed depositors who are not able to properly assess the risks they face; b) the bankruptcy of a bank can negatively affect also other banks through the contagion effect[23], thus affecting negatively the overall financial stability, the payments system and, in turn, the functioning of the real economy; and c) banks are special firms because of the presence of banking regulation, which implies also the existence of a safety net for banks that, among others, includes deposits insurance, lender of last resort

[23] Contagion effect can occur in two forms: (i) the bankruptcy of a bank increases the uncertainty of other banks' clients regarding the immunity of their own banks and may induce them to withdraw their deposits; (ii) because banks hold claims on other banks, the bankruptcy of one of the banks may cause losses also to other connected banks.

support and a procedure for the resolution of banking crisis. The existence of such a safety net may impose a considerable financial burden for the regulator and the government, thus increasing the overall cost of a bank's bankruptcy.

Acknowledging the potential costs associated with bank risks, the economic literature has largely dealt with factors that lead banks to take higher risks. In this context, considerable attention has been paid to the relationship between competition and the risk-taking behaviour of banks, with a significant part of the literature arguing that competition leads to a higher level of risk-taking by banks. Based on this view, regulators, especially in the past, have often undertaken measures to restrict banking sector competition, aiming at safeguarding the banking system stability. However, the other strand of the literature promotes the view that banking competition reduces the level of risk taken by banks, suggesting that banks with more market power undertake higher levels of risk compared to banks operating in more competitive markets.

The investigation of the relationship between banking sector competition and risk-taking is particularly important for the CEE countries, given that banking sector competition in these countries is a more recent phenomenon that started to evolve more substantially in the second decade of the transition process, when foreign banks started to enter these markets. In addition, banking sector competition in these countries is expected to increase further as the non-EU countries of the CEE move towards EU membership. The integration prospects make these countries more attractive to large European financial corporations that are currently operating in more competitive markets, with relatively lower profit margins, to extend their activity towards transition economies, which are viewed as potentially more profitable.

Aiming at shedding light to the relationship between banking sector competition and risk-taking in the CEE countries, in this chapter, we investigate this relationship for a sample of 15 CEE countries during the period 1999-2009. The measure of competition in this study consists of the Panzar-Rose H-statistic, which we estimate for each country and for each year. To our knowledge, this is the first study to use the Panzar-Rosse H-statistic in estimating the impact of banking sector competition on risk-taking for the CEE countries; the previous studies have mostly used market concentration indices, which might not represent adequate measures of competition. For comparison, we use also the Lerner Index as a measure of market power and the Herfindahl-Hirschman Index as a measure of market concentration. The degree of the bank's risk (i.e. the dependent variable) in this study is proxied by the ratio between loan-loss provisions and total loans, which reflects the quality of the bank's loan portfolio. The regression includes also for the impact of other bank-specific variables as well as macroeconomic and institutional variables expected to be important for the determination of banks' risk-taking. Given the potential differences between the non-EU and the EU countries with respect to the banks' behaviour and the operating environment, we also test whether the relationship between banking sector competition and risk-taking in the non-EU countries of the CEE region is significantly different from that in the EU countries of the region. The estimation is conducted using the Fixed Effects Vector Decomposition method.

This chapter is structured as follows. Section 5.2 presents a critical review of the literature dealing with the relationship between banking sector competition and risk-taking. Section 5.3 reviews the empirical literature on this field. Section 5.4 presents the estimation of the impact of competition on risk-taking for our sample of data, including the model description, the estimation methodology, and the estimation results. Section 5.5 concludes.

5.2 Theoretical Background

This section provides a review of the theory on the relationship between banking sector competition and the risk-taking behaviour of banks. We start the section with a discussion on the "franchise value" hypothesis, which is one of the most important theories on the relationship between competition and bank risk-taking. We continue the section by explaining that the competition – risk-taking relationship is affected also by other factors such as the disclosure of risk information by banks, the deposit insurance scheme and the regulatory capital requirements. The relationship is further addressed from the perspective of asymmetric information theories; the "risk-shifting" effect and the "margin" effect; and finally from the viewpoint of relationship lending.

5.2.1 The ''Franchise Value'' hypothesis

The view that more intense competition leads to higher risk-taking by banks is mainly based on the "franchise value" or "charter value" hypothesis, derived from the work of Keeley (1990). Franchise value refers to the present value of future profits that would be earned by a bank if it continued to operate in the market. According to Demsetz et al. (1996), the franchise value originates from two main sources: the "market-related" and the ''bank-related'' sources. The market-related sources consist of the regulatory measures that restrict competition by giving the opportunity, i.e. the franchise, to only a limited number of banks to operate in the market and to have larger potential profits. The bank-related sources of the franchise value mainly include the bank's efficiency and the valuable lending relationships which enable the bank to earn higher profits if it continues to operate. Keeley (1990) based his work on the concept of "market-related" franchise value, considering that the supply of bank franchises (or charters) was limited, so only a certain number of banks had the possibility of operating in the market, thus possessing a degree of market power. As a result, these banks have the possibility to charge higher interest rates on loans and pay lower interest rates on deposits; hence, earn higher profits. Under these conditions, banks would be inclined to take less risk and hold higher capital ratios, since potential bankruptcy would imply giving up the opportunity to earn the profits that could be earned if the bank continued to operate. In other words, the opportunity cost of going bankrupt is very high for these banks. On the other hand, a higher level of competition might imply a larger number of banks operating in the market, which would seek to maintain/increase their market share by offering higher interest rates on deposits and lower interest rates on loans, thus reducing the interest rate margin and leading to a lower level of profit for each of the banks. As a consequence, the decline in the value of profits that a bank can earn upon continuing to operate in the market makes the franchise less valuable. The decrease of the franchise value, in turn, reduces the opportunity cost of the bankruptcy and, as a result, the bank takes higher levels of risk because the potential bankruptcy would pose a lower cost in terms of the foregone future profits. Therefore, according to Keeley (1990), the increase of competition reduces the franchise value and induces banks to undertake higher risks in order to maintain/increase their profits. The higher level of undertaken risk will then be reflected into a lower quality of the asset portfolio and a lower level of bank capitalization.

The franchise value hypothesis is supported also by a number of other authors such as Hellman et al. (2000) and Repullo (2003) who have claimed that increased competition leads to higher risk-taking by banks. The focus of these studies is the competition between banks in the market for deposits, where they find that higher competition induces banks to offer higher deposit interest rates in order to attract higher levels of deposits. The higher deposit rates, in turn, narrow the interest rate margin, leading to lower profits and, hence, lower franchise value. Under these conditions, banks are supposed to have two investment alternatives consisting of prudent assets, which are low-risk and low-return assets, and gambling assets, which are high-risk and high-return assets. Under the conditions of higher deposit rates, banks will tend to favour the investments in gambling assets, which provide a higher return in the present period, while the lower franchise value implies a lower opportunity cost in terms of foregone future profits if the bank goes bankrupt.

The impact of competition on bank' risk-taking, however, depends also on a number of other factors, such as the disclosure of risk information by banks, the presence of deposit insurance schemes, and the regulatory capital requirements which interact with competition in determining the risk-taking attitude of banks.

5.2.2 The disclosure of risk information by banks

The relationship between competition and the risk-taking behaviour of banks is argued to be affected also by the extent to which banks disclose information about their risk levels. According to Hellman et al. (2000), banks that prefer to invest in riskier assets tend to offer higher deposit interest rates, which enable them to attract higher volumes of deposits and increase their investments in "gambling" assets that provide higher rates of return. However, according to Matutes and Vives (2000), if banks would reveal the quality of their assets portfolio, which would make their level of risk observable to the public, rational depositors would punish the risky banks by depositing less. In other words, depositors would impose discipline on banks with respect to their risk-taking behaviour were the quality of banks' asset portfolio to be observable. Similarly, Cordello and Yeyati (1998) claim that when the banks' risk is observable, banks tend to improve their asset quality, which will also make depositors accept lower interest rates. As a result, a bank's margin will not be affected by the increase of competition and the quality of its asset portfolio will remain sound. A similar view is shared also by Shy and Stanbecka (1998) who refer to the quality of a bank's asset portfolio as an important strategic instrument in competing in the deposit market. The view that increased competition does not necessarily lead to higher deposit rates and, therefore higher risk-taking, is supported also by Niinimäki (2004) who claims that depositors avoid the banks offering excessively high deposit rates, considering that high deposit rates are usually offered by risky banks. As a result, a "credit rationing" equilibrium takes place in the deposit market, in which rational depositors do not supply deposits to banks that provide suspiciously high interest rates.[24]

However, even in cases when the bank information is observable to the public, banks may not necessarily be adequately monitored by depositors. As cited by Birchler (2000), Dewatripont and Tirole (1994, p. 31) claim that bank debt is mainly held by small depositors, who are unsophisticated and, as such, unable to adequately assess bank risks.[25] In addition, the authors claim that bank depositors are large in number and they have little individual incentive to monitor the bank activities. A similar view is shared also by Freixas and Rochet (1997, p. 264) who claim that bank debt is mostly held by uninformed and dispersed small depositors that are not able to perform proper monitoring of banks' activities. Taking into account these views, the depositor monitoring of banks may be less effective in preventing banks from engaging in excessive risk-taking.

[24] "Credit rationing" will be explained later in this chapter.

[25] It uses Dewatripont, M. and Tirole, J. (1993), La Réglementation Prudentielle des Banques, HEC University de Lausanne, Payot, Lausanne.

5.2.3 Deposit Insurance Scheme

An important determinant of banks' behaviour with respect to their risk-taking is the presence of a deposit insurance scheme (DIS) that aims at insuring depositors against potential losses occurring from a bank's bankruptcy. The presence of a DIS may worsen the risk-taking incentives of banks, since they have the backing of the deposit insurance fund to pay back the depositors in case of failure.

The presence of a DIS also reduces depositors' incentives to monitor banks' risk position, since their deposits will be guaranteed irrespective of the riskiness of banks' assets. Indeed, depositors may even favour a riskier bank-behaviour, which would enable the bank to realize higher returns and pay higher interest rates to the depositors, thus destroying the "credit rationing" equilibrium in the deposit market that takes place when deposits are not insured and the risk is observable to the depositors (Niinimäki, 2004). With deposit insurance in place, banks are not likely to compete through asset quality to attract larger volumes of deposits but, instead, competition will mainly rely on deposit interest rates. In other words, since depositors will be indifferent to the risk position of the bank, interest rates will represent the main factor that determines a depositor's decision to place his deposits in a bank. As a result, the interest rate elasticity of the supply of deposits will increase, implying that the volume of deposits available to the banks will be more sensitive to the level of interest rates (Cordello and Yeyati, 1998). In order to attract more deposits, banks must offer higher interest rates on deposits, which decrease their interest margins and, potentially, lead to lower profits. As a consequence, banks will tend to invest in riskier assets which, if successful, will provide higher returns and, if not successful, the depositors will be compensated by the deposit insurance scheme. To summarise, the presence of a deposit insurance scheme may lead to higher deposit interest rates and higher moral hazard by banks.

The impact of competition on bank risk-taking would depend also on the nature of the DIS with respect to the form of banks' contributions to the deposit insurance fund. If the banks' contributions to the fund consist of a flat premium not related to the risk position of the bank, then the increase of competition will increase banks' moral hazard, inducing higher levels of risk-taking by banks as discussed above. However, the potential adverse effects deriving from a deposit insurance scheme might be mitigated by adopting a risk-based deposit insurance scheme, under which banks would pay an insurance premium that reflects the risk position of the bank, implying that banks that have riskier asset portfolios would pay higher contributions to the deposit insurance fund (Shy and Stanbecka, 1998). Under a risk-based DIS, banks would be inclined to maintain a better-quality asset portfolio, since increased risk-taking would be associated with higher contributions to the deposit insurance fund. As a consequence, banks will favour investing in prudent assets, which provide lower returns compared to the riskier assets, but they will also be able to offer lower interest rates on deposits. Therefore, under a risk-based DIS, competition for deposits among banks through deposit interest rates will be less intense and the level of risk-taking will be lower, implying that risk-based deposit insurance may lower banks' moral hazard problem.

5.2.4 Regulatory Capital Requirements

Among the most widely used regulatory measures to deal with the banks' moral hazard are the regulatory capital requirements. As discussed above, when competition increases, banks tend to offer higher deposit rates, which will reduce the banks' profits by reducing the interest margins. In order to maintain/increase their profits, banks are then inclined to invest in riskier assets that provide higher returns, but at the same time increase the probability of bank failure if the investments are not successful.

If banks face higher capital requirements, then a potential default would cost shareholders their own equity. This view has been elaborated by Hellman et al. (2000) and Repullo (2003) who claim that with capital requirements in place, the banks' equity is put at risk, so banks do not have the incentives to engage in high levels of risk that could potentially push them to bankruptcy. According to this view, increased competition will not trigger high levels of risk if capital requirements are high enough to put a sufficient amount of the bank's equity at risk. However, according to Hellman et al. this view is ambiguous because, apart from the "equity-at-risk" effect, there may also take place a negative "franchise value" effect, which makes capital requirements induce higher levels of risk-taking by banks. According to this view, if injecting additional capital is costly for the bank, an increase in capital requirement will imply lower profits for the bank in each period which, in turn, decreases the bank's franchise value. As a result of the decrease of the franchise value, the bank would be induced to invest in riskier assets. In addition, the higher the level of equity that the bank holds, the lower will be the return to equity from bank lending, which will decrease the franchise value of the bank and also the equity at risk, since lower profits have a negative impact on bank's equity. On the other hand, Repullo rejects the claim that higher capital requirements may have a negative franchise value effect, stating that higher capital requirements have only the "equity-at-risk" effect, thus discouraging higher risk-taking and ensuring a prudent equilibrium. According to Repullo, when the cost of capital exceeds the return from prudent assets, in order to maintain the profit margins, banks will offer lower deposit interest rates, meaning that the franchise value will be preserved.

The discussion so far has emphasized the detrimental impact of increased competition in the deposit market on bank behaviour, while it has largely ignored the impact of competition in the loan market for the risk-taking behaviour of the banks. The focus of the aforementioned theoretical studies on the competition for deposits is to some extent justified by Niinimäki (2004) who claims that competition in the deposit market may lead to excessive risk-taking while, when competition takes place in the loan market, there is risk-taking, but excessive risk is avoided. According to this study, when competition takes place only in the loan market, even though investment in extremely risky assets promise higher returns, the probability that the project will turn out successful is so low, that it makes the expected profit from lower-risk investments to be higher, suggesting that banks will not favour excessive risk-taking. Excessive risk-taking in the asset side according to Niinimäki (2004) would occur if competition takes place in the deposit market, because competition for deposits would drive deposits rates upwards, thus reducing banks' interest margins and profits. In order to compensate for the declining profits, banks would be inclined to invest in riskier assets which, if successful, would provide higher rates of return. However, based on the previous argument of Niinimäki (2004) that banks tend to hesitate to invest in high-risk assets when their probability of default is high, then competition for deposits should not necessarily imply excessive risk-taking by banks on the asset side of the balance sheet.

5.2.5 Asymmetric information theories

Another strand of the banking literature investigates the impact of competition on bank risk-taking from the perspective of asymmetric information theories, which are addressed in this section. We begin the section by introducing the adverse selection theory in the context of financial intermediation and by providing a link between banking competition and the likelihood of adverse selection in the banking market. Since screening procedures represent an important tool for tackling the adverse section problem, the section continues with a discussion on the relationship between competition and the level of screening performed by banks. Further, we introduce the concept of moral hazard in the banking system and address the relationship between banking competition and the scale of monitoring as an instrument to avoid moral hazard. This subsection ends with a brief discussion of “credit rationing” theory linked to banking competition.

Adverse Selection

One of the problems faced by banks in the financial intermediation process is adverse selection, where banks have difficulties in distinguishing between low-risk and high-risk borrowers. The increase of competition among banks may further exacerbate the adverse selection problem, thus increasing the possibility of granting access to finance to high risk borrowers (Marquez, 2002). According to Marquez, as the number of banks increases, each bank has less information about the market participants because of the “information dispersion” among banks. When the market is operated by few banks, in equilibrium banks may not grant loans to some of their old customers who are known to be of poor credit quality. However, as the number of banks increases each bank has information on a smaller number of potential borrowers, implying that the bank will not be able to use the information on borrowers’ past performance when deciding whether to grant a loan. Consequently, banks can end up granting loans also to bad borrowers, which will lead to a higher level of risk in the banks’ asset portfolios. However, this theory does not take into account the information-sharing infrastructure such as credit bureaus that are nowadays present almost in every country. These information-sharing facilities enable banks to have access to the information on the credit worthiness of all the existing and previous borrowers in the financial system of a country. Therefore, the presence of these facilities may limit the “information dispersion” problem in the banking industry, thus contributing to the mitigation of the adverse selection problem.

Screening

The adverse selection problem is also tackled through screening procedures, whereby banks induce the potential borrower to reveal information that is relevant for the bank's decision as to whether or not to issue a loan to that particular customer. The ability and willingness of banks to screen the potential borrowers may be affected to a large extent by the level of competition in the banking market. The majority of studies examining the impact of competition on bank screening argue for a negative relationship, implying that higher competition leads to less screening by banks, thus increasing the probability that a larger share of poor quality borrowers will be granted credit (Chan et al., 1986; Manove et al., 2001). According to Chan et al., by reducing the interest rate spread and, therefore profits, the increase of competition will push banks to cut their screening expenditures and thus perform less screening on loan applicants. Other authors, such as Dell'Ariccia (2000) and Bolt and Tieman (2004) argue that a larger number of competing banks corresponds to stronger incentives to deviate from appropriate screening of potential borrowers because of the additional market share the deviating banks will be able to seize. In other words, facing stronger competition, banks will ease the acceptance criteria for loan applicants, thus enabling a larger number of them to obtain access to credit. This will enable banks to seize a larger market share while worsening the adverse selection problem and undertaking higher levels of risk in the asset portfolio. Lowering the acceptance criteria leads to the ‘'winner's curse'’ problem, developed by Shaffer (1998), which claims that as the number of banks increases there is higher probability that a number of bad borrowers that have not passed the screening test in some of the banks will find at least one other bank where they will pass this test. As a result, in aggregate terms, a higher proportion of bad borrowers will be able to obtain access to credit, thus deteriorating the quality of the loan portfolio in the banking system.

However, increased competition may not necessarily have a negative impact on banks' screening effort. Chen (2007) views screening as an additional component of competing strategy for the bank, arguing that a bank can compete with other banks by offering lower loan interest rates as well as by increasing its screening effort. According to this author, apart from preferring lower loan interest rates, good borrowers may also prefer to be better screened, so that they can be correctly recognized by the bank which, in turn, would reward them with easier and more favourable access to finance in the future.

Moral Hazard

Another asymmetric information problem often associated with the financial intermediation process in the banking industry is related to moral hazard, which can occur both on the bank's side and on the borrower's side. As discussed earlier in this chapter, banks can commit moral hazard by investing in riskier assets, which may put the depositors at risk. If the investment in risky assets turns out to be successful, the bank will earn higher returns than if it had invested in prudent assets. Conversely, if the investment does not turn successful, the losses will be borne either by depositors or by the deposit insurance fund if there is one in place. The moral hazard behaviour can also take place on the side of the borrower when the borrower decides to use the funds for different purposes than those initially agreed with the lender (Bebczuk, 2003). More specifically, the borrower can undertake a higher level of risk than was agreed with the lender, thus increasing the probability of loan default.

Monitoring

In order to mitigate the possibility of moral hazard by the borrower, banks can engage in monitoring the borrowers' activity, aiming at preventing them from conducting "hidden actions". The extent to which banks engage in monitoring activity depends, among others, on the degree of competition in the banking market; thus, establishing another channel through which the degree of competition is predicted to affect banks' risk.

The literature on agency problems in the banking industry mainly suggests that monitoring is more likely to take place when banks have market power, whereas, as the competition increases banks tend to reduce their monitoring activity (Covitz and Heitfield, 1999; Caminal and Matutes, 2002). According to Caminal and Matutes (2002), competitive banks monitor only when monitoring costs are low, whereas monopolistic banks monitor for low and intermediate monitoring costs, but not for very high costs. Caminal and Matutes claim that a monopoly bank has a stronger incentive to monitor, because of the higher proportion of the rents it can appropriate by monitoring. A monopoly bank has a higher margin which, on the one hand, implies that it can allocate more expenditures for monitoring and, on the other hand, has more incentives to monitor because returns from the successful loans are higher. However, does it imply that monopoly banks are associated with a lower level of risk in their asset portfolios? According to Caminal and Matutes (2002), monopoly banks grant borrowers easier access to finance, since, rather than screening the potential borrower before approving the loan, their attention is mainly concentrated on the monitoring of the loan after it has been issued. As a consequence, a number of poor quality borrowers may pass more easily the screening test of the monopoly bank and secure access to credit, thus increasing the overall riskiness of monopoly bank's loan portfolio.

"Credit Rationing"

The relationship between banking sector competition and risk-taking can be addressed also from the perspective of "credit rationing" theory, developed by Stiglitz and Weiss (1981), which claims that even though borrowers may be willing to pay higher interest rates, in equilibrium, banks may view the demand as excessive. More specifically, as entrepreneurs tend to undertake higher levels of risk when interest rates increase, the "credit rationing" theory argues that banks will quit lending at very high loan interest rates, supposing that only high-risk borrowers will be willing to pay very high interest rates. Within the banks' efforts to alleviate the moral hazard problem, "credit rationing" and monitoring are viewed as substitutes for each other (Caminal and Matutes, 2002). This means that a bank can either decide to perform "credit rationing", i.e. quit lending when it perceives that a pool of loan applicants is composed of risky entrepreneurs, or it can decide to engage in monitoring, i.e. grant applicants easier access to finance and then monitor their activities to reduce moral hazard. According to Caminal and Matutes (2002) and Koskela and Stanbecka (2000), monopoly banks do not apply "credit rationing", while competitive banks do. According to this theory, monopoly banks would be more prone to risk-taking since, by monitoring instead of "credit rationing", they will enable the high-risk applicants to gain access to finance (i.e. enter into the bank's loan portfolio), thus increasing the riskiness of their asset portfolio. Once the borrower receives the loan, the bank is then constrained in terms of controlling the project's riskiness.

Covitz and Heitfield (1999)

Covitz and Heitfield (1999) present a different view with respect to the relationship between banking sector competition, risk-taking, and monitoring. They claim that competitive markets are characterized with higher levels of bank risk-taking compared to monopoly markets, suggesting that in a competitive banking environment the level of risk in the banks' loan portfolios is determined by the attitudes of borrowers towards the risk rather than by banks' risk preferences. In a monopoly market, borrowers do not have alternative sources of bank financing, so they must obey to bank's conditions in order to secure access to finance. In this regard, if the bank considers that a project bears excessive risk, it may either refuse to finance it or it may affect the risk level by pushing the applicant to revise the project. Whereas, in a competitive market, since borrowers have more alternatives to secure banking finance, banks are more reluctant to refuse applications and are less able to affect the level of risk in the applicants' projects. According to this theory, borrowers in a competitive market also have the control over interest rates, whereas a monopoly bank controls both the level of risk and the interest rates. A monopoly bank chooses a more conservative equilibrium, which incorporates a lower interest rate and a lower level of asset-portfolio risk. By setting a lower loan interest rate, the monopoly bank induces the entrepreneurs to undertake safer projects, while it also monitors them in order to prevent potential moral hazard. Conversely, in a competitive market, as entrepreneurs are inclined to undertake higher levels of risk, they will compensate the bank with a higher loan interest rate and the bank, in turn, will not engage in monitoring. Based on this view, competitive banks will neither "credit ration" nor engage in monitoring, thus ending up with a higher level of risk in their portfolios. To summarize, the view of Covitz and Heitfield (1999) postulates that monopoly banks perform both more screening and monitoring, thus incurring lower levels of risk in their portfolios, while competitive banks engage in higher levels of risk-taking in order to maintain their market shares. However, the positive relationship between competition and risk-taking in the view of Covitz and Heitfield is largely attributed to the ability of borrowers to affect interest rates, claiming that in a competitive market borrowers are ready to pay higher interest rates and at the same time undertake higher risks. This leads to the conclusion that competitive banks may end up charging higher loan interest rates than monopoly banks, which is at odds with most of the competition – interest rates literature that suggests the opposite.

5.2.6 The "Risk-Shifting Effect" and the "Margin Effect"

The impact of competition on the level of bank risk-taking through its impact on loan interest rates has been addressed also by Boyd and de Nicoló (2005) who suggest that monopoly banks take higher risks, while increased competition leads to lower risk in banks' asset portfolios. This theory is viewed as an important challenge to the "franchise value" hypothesis, which claims that increased competition depletes the monopoly rents, thus inducing the bank to finance riskier projects that promise a higher rate of return. According to Boyd and de Nicoló, as monopoly banks tend to charge higher loan interest rates, entrepreneurs will be inclined to engage in riskier projects, which promise them higher rates of return, in order to compensate for the high interest payments. As a consequence, the asset portfolio of the monopoly bank will be characterized by a higher level of risk. Conversely, when competition increases, banks will tend to offer lower loan interest rates which, in turn, will induce borrowers to undertake safer projects. This implies that the increase of competition in the banking market leads to a lower risk in banks' asset portfolios.

The view of Boyd and de Nicoló (2005) was partially supported by Martinez-Miera and Repullo (2010), who refer to it as the *risk shifting effect*. According to them, the *risk-shifting* *effect* mostly occurs in highly concentrated markets, presumably because of the considerably high interest rates charged by banks. However, they criticise the view of Boyd and de Nicoló for not taking into account the fact that the decline of interest rates due to more intense bank competition also reduces interest revenues from non-defaulted loans, which may lead to higher fragility. The impact of the decline in interest rates on the interest revenues, by Martinez-Miera and Repullo is referred as the *margin effect*. They claim that as competition intensifies, the *risk-shifting effect* is dominated by the *margin effect*. This implies that when market concentration is very high, the existing level of interest is high enough to make banks capable of withstanding a potential decline of the interest rate without seriously threatening the bank performance and stability. Under these conditions, the decline in interest rate will lead to lower risk-taking by borrowers, while the decline of interest revenues will not threaten the overall bank performance. However, as competition continues to intensify and interest rates continue to decline, the negative impact for bank stability stemming from the decline of overall interest revenues will start to dominate the positive impact from lower risk-taking by borrowers, thus leading to a more fragile position for the bank. To summarise, Martinez-Miera and Repullo (2010) argue for a U-shaped form of the relationship between market power and the risk of bank failure, claiming that bank risk will decrease with the decline of market power, but only up to a certain level, and then will start to increase as market power declines further.

5.2.7 Relationship Lending

Relationship lending represents another channel through which the competitive conditions in the banking market may affect banks' risk-taking. Relationship lending is referred to a lasting lender-borrower relationship which can benefit both the bank and the borrowers. The benefits of the bank are mainly related to the role of relationship lending in attenuating the asymmetric information of the bank with respect to the borrowers. In a lasting lending relationship, the bank is able to accumulate borrower-specific information, which provides informational rent by facilitating the bank's lending decisions in the future. Regarding the borrowers, relationship lending may improve their access to finance both with regard to the amount of credit they can obtain and the cost of credit (Petersen and Rajan, 1994). The improved access to finance, especially for the high quality borrowers, occurs because during the previous periods the bank has been able to collect information on the quality of the borrowers, which enables it to distinguish between good and bad borrowers.

The degree to which banks engage in relationship lending may have implications also for the choice of asset portfolio (Besanko and Thakor, 2004). As postulated by Demsetz et al. (1996), relationship lending represents one of the "bank-related" sources of the franchise value, implying that the more a bank is engaged in relationship lending the higher will be its franchise value. This also implies that the more a bank is engaged in relationship lending the costlier would be its potential bankruptcy, as elaborated by the "franchise value" hypothesis, since the bank would give up the opportunity to further generate rents from the utilization of the borrower-specific information that has obtained during the period of the lending relationship. In this regard, a bank which is more deeply engaged in relationship lending, i.e. has a higher franchise value, is expected to undertake a lower level of asset risk so as not to put at risk the continuation of its activity and the expected rents.

The extent to which banks can engage in relationship lending and the relationship between this type of lending and the level of risk undertaken by the bank depends also on the level of banking sector competition. Relationship lending is argued to be more present in monopolistic markets, since borrowers are inclined to build stronger ties with their creditors in the absence of other alternatives in the market. According to Petersen and Rajan (1994), monopolistic banks are more prone to engage in relationship lending and especially with young firms. Based on their view, monopolistic banks can build strong ties with young firms considering that in the beginning of their business firms are more fragile and need financial support with better terms. Monopolistic banks tend to charge the young firms lower interest rates in the beginning of their business with the purpose of extracting extra rents when they become mature and have a stronger financial position. By engaging in relationship lending with the young firms, the monopolistic bank will benefit in terms of information rents, but will also induce the young firms to engage in lower-risk projects due to the lower interest rates charged initially, whereas the additional rents extracted in the future will not affect the firm's choice between different levels of project risks. However, providing fragile young firms with low interest rate financing may increase the overall riskiness of the monopolistic bank's loan portfolio due to the potential uncertainties linked with the future performance of the young firms.

Relationship lending is less likely to take place when banks operate in a competitive market. Under these conditions, potential borrowers face a larger number of alternatives, making it difficult for a bank to maintain strong ties with its clients. In this regard, contrary to monopolistic banks, the competitive banks may not expect to extract additional rents from future surpluses of their borrowers (Petersen and Rajan, 1994).

5.2.8 Summary

In this section we presented the theoretical background on the relationship between competition and risk-taking behaviour of banks. We started the analysis with the "franchise value" hypothesis which claims that competition leads to higher risk-taking by banks. We showed that this relationship depends also on the degree to which banks disclose their risk information to the public, claiming that the more information is available to the public the lower will be the impact of competition on risk-taking. In addition, we showed that the impact of competition on risk-taking may depend also on regulatory capital requirements and the presence of a deposit insurance scheme but the direction of impact is quite ambiguous. The relationship between competition and risk-taking was then addressed from the perspective of information asymmetry where it was emphasized that in general competition may increase the asymmetric information problems. But there are also views that claim the opposite. The section continued with a discussion of the "risk shifting" effect and the "margin effect", which treat the relationship between competition and risk-taking based on the impact of loan interest rates on the risk attitude of borrowers. The section ended with the discussion of relationship lending, which is argued to be discouraged by competition. Relationship lending is considered to reduce the level of banks' risk, but there are arguments that claim the opposite. In general, the theoretical literature is largely inconclusive with regard to the impact of banking competition on the risk-taking behaviour of banks.

5.3 Review of empirical studies

In this section we present a review of studies that have empirically investigated the relationship between competition and the risk-taking behaviour of banks. We also provide a critical assessment of methodologies used in these studies. Similar to the theoretical studies, the relationship between competition and banks' risk-taking remains ambiguous also in the empirical literature, with one strand claiming that higher competition impairs the stability of the banking system, while the other maintains that the stability of the banking system is enhanced when there is more intense competition between banks. One characteristic of the empirical studies investigating this relationship is that they use different indicators to proxy and measure competition. Also, different indicators are used to measure the level of risk taken by banks. Often, the differences in the empirical results are attributed to the differences in the indicators used to measure competition and the bank's risk.

The debate on the relationship between banking sector competition and risk-taking has primarily started from the work of Keeley (1990) who developed the "franchise value" hypothesis. Keeley provided empirical support for his hypothesis by investigating the liberalization of legal entry barriers for bank holding companies in the US during the period 1970-1986, which represents a rather indirect measure of banking competition. His findings suggest that banks possessing higher market power, as expressed by the market-to-book asset ratio, i.e. Tobin's Q, held higher capital-to-asset ratios and lower default risk as expressed by lower risk premiums on uninsured certificates of deposits.[26] Using Tobin's Q as a measure of market power, Salas and Saurina (2003) supported the "franchise value" hypothesis, finding that banks with higher market power tend to have higher capitalization ratios and lower shares of loan losses to total loans. This hypothesis was supported also by Dick (2006) who investigated the impact on the degree of risk taken by banks in different states in the US during the period 1993-1999 of the removal of regulatory restrictions on banks' ability to open branches. The results of this study suggested that the deregulation led to higher risk-taking by banks, as measured by charged-off losses over loans or by the loan-loss provisions. The author suggests that banks might have used their greater geographic diversification as a hedge against higher risk-return combinations. However, a similar study by Jayaratne and Strahan (1998) found that loan-losses decreased sharply after the liberalization of state-wide branching. According to Jayaratne and Strahan, the liberalization of geographic expansion has enabled the more efficient banks to expand at the expense of less efficient banks,

[26] Keeley (1990) used the Tobin's Q to proxy market power based on the suggestion of Lindenberg and Ross (1981) who found a high correlation between price-cost margins and Tobin's Q.

resulting in overall bank performance improvement. In addition, the enhancement of banks' efficiency implied cost savings which have been passed to bank borrowers through lower interest rates on loans. Based on Boyd and De Nicoló's (2005) "risk-shifting" hypothesis, lower loan interest rates may then result in a lower level of risk-taking by borrowers and, consequently, a sounder loan portfolio for banks. Similarly, using data for 70 countries for the period from 1980 to 1997, Beck et al. (2003) found that countries with fewer regulatory restrictions on bank competition and with national institutions that encourage competition in general are less likely to incur systemic banking crises.

Other studies in this field have used more direct measures of competition such as the Panzar-Rosse H-statistic or market concentration indices and, similarly, the results remain inconclusive with regard to the impact of competition on banks' risk-taking. Using BankScope data for EU-15 countries, Schaeck and Čihák (2007) used separately the H-statistic and the market share of the three largest banks as proxies for competition, while using the equity-to-total assets ratio as a measure of the bank risk. By finding a positive relationship between the H-statistic and the level of bank capitalization, their results suggest that increased competition reduces banks' risk. In addition, they also found that the degree of bank's capitalization is negatively affected by the degree of market concentration. The view that competition enhances banking stability has been supported also by Schaeck et al. (2006) who used a duration analysis model to measure the time needed for the transition from a sound banking system to a systemic banking crisis. Using the H-statistic as a measure of competition, they found that banking competition increases the duration of transition from a sound banking system to a systemic crisis. However, this study also found that concentration increases the time to crisis, seemingly a contradictory finding. The authors justify these results by supporting the previous findings of Claessens and Laeven (2003) who claimed that concentration and competition describe different features of a banking market, and therefore they have independent effects on the stability of the banking system. Similar "contradictory" results were found also by Beck et al. (2003) who found that, on the one hand, countries that encourage banking competition are less likely to incur banking crisis and, on the other hand, that crises are less likely in more concentrated banking systems.

A negative relationship between competition and banks' risk-taking was also found by Boyd et al. (2006), who provided empirical support for the theoretical findings of Boyd and De Nicoló (2005) that competition enhances banking stability. As a measure of competition they used the Herfindahl Hirschman index (HHI), whereas bank risk was measured by the "Z-score" (which is a proxy for the solvency risk, measuring the number of standard deviations below the mean by which profits would have to decline so as to deplete the equity capital).[27] The HHI has a significantly negative sign, suggesting that lower market concentration (i.e. higher competition) is associated with a higher "z-score'' (i.e. a lower probability of bank failure). The authors further disaggregate the relationship between the HHI and the "z-score", looking at the three components of the "z-score" separately and find that the risk of failure in more concentrated banking systems is higher mainly because of the higher volatility of banks' return on assets ratio in more concentrated markets. The impact of the higher volatility of return on assets ratio appears to outweigh the effect of the positive relationship between the HHI and the return on assets.

Motivated by the theoretical findings of Boyd and De Nicoló (2005), Jiménez et al. (2007) estimated the relationship between banking sector competition and risk-taking for the Spanish banking system. Finding a negative relationship between market power and non-performing

[27] "Z-score'' is defined as $Z = (ROA+EA) / \delta(ROA)$, where ROA is the return on assets, EA is the equity-to-total assets ratio, and $\delta(ROA)$ represents the standard deviation of ROA. A higher "Z-score" implies a lower level of solvency risk, since greater losses would be needed to occur in order to deplete the existing capital and push the bank to default.

loans, their results strongly support the “franchise value” hypothesis; thus, contesting the view of Boyd and De Nicoló (2005). Jiménez et al. (2007) also tested for a potential non-linear relationship between market power and non-performing loans, by including the squared value of the market power variable in the regression, and found a negative relationship, thus rejecting also the claims of Martinez-Miera and Repullo (2010) for a U-shaped relationship between market power and bank risk.

Investigating the impact of competition on credit risk for the EU countries, Chen (2007) found a negative but insignificant effect of the H-statistic on the level of non-performing loans and loan-loss provisions, suggesting that competition did not represent an important determinant of developments in the loan portfolio quality in EU countries. However, this study reports a positive relationship between the net interest margin and non-performing loans and loan-loss provisions, suggesting that the increase of loan interest rates was associated with lower quality loan portfolio. If interest rates are higher when banks possess more market power, then this finding might be considered as a support to the view of Boyd and De Nicoló (2005) who claim that market power impairs the loan portfolio quality, since higher interest rates charged by banks lead to higher risk levels undertaken by borrowers.

Similarly, Yeyatti and Micco (2003) investigated the impact of the penetration of foreign banks and banking competition on the banks’ risk-taking in the Latin American banking sectors. The measures of competition in this study consisted of the H-statistic and market concentration, while the level of bank risk was measured by the “Z-score” as a proxy for the probability that losses exceed the bank’s equity capital. The main findings of this study suggest that the penetration of foreign banks in Latin American banking sectors reduced the banking sector competition which, in turn, was associated with lower bank fragility. These results provide support to the "franchise value" hypothesis by suggesting that a decrease of competition, i.e. an increase of market power, enhances banking stability.

A more comprehensive study on the relationship between competition and banking stability has been conducted by Berger et al. (2009) who use three types of measures for banking stability, consisting of a measure of the overall bank risk (i.e. the "Z-score"), a measure of credit risk (i.e. the share of non-performing loans to total loans) and a measure of the bank's capitalization ratio (i.e. the share of equity to total assets). Different measures have been used also for market power, including the Lerner Index and market concentration indices.[28] The results lend support to the view that market power is associated with a higher credit risk, because of the positive relationship between market power measures and the share of non-performing loans to total loans. On the other hand, the authors also find that market power has a positive impact on the "Z-score" and the capitalization ratio, suggesting that banks with higher market power tend to have a lower probability of default and keep higher capitalization ratios. According to these authors, banks possessing higher market power tend to ask for higher loan interest rates and so may incur higher rates of non-performing loans, but at the same time protect their "franchise value" by holding higher capital ratios. To summarise, the results of this study suggest that despite increasing the loan risk, market power tends to enhance overall bank stability, thus lending support to the "franchise value" hypothesis.

Similarly, Agoraki et al. (2009) investigate the impact of market power, as measured by the Lerner index, on the bank risk as measured by the "Z-score" and the non-performing loans for a sample of 13 Central and Eastern Europe Countries for the period 1998-2005. The results of this study support the "franchise value" hypothesis by finding that market power is

[28] The Lerner index is a measure of market power, indicating by how much the price exceeds the marginal costs. The Lerner index is expressed as $L = (P - MC)/P$, where P stands for the price and MC for the marginal costs.

associated with both lower non-performing loans and a higher “Z-score”, i.e. lower solvency risk.

5.3.1 Review of methodologies

This subsection provides a discussion on the methodologies used in some of the above mentioned studies that have investigated the relationship between measures of competition and measures of banks’ risk-taking. All of these studies have used bank-level panel data methods to estimate these relationships, while there are differences with regard to the econometric approaches, with some of the studies applying static models and the others using dynamic models.

Salas and Saurina (2003) have used the simple Ordinary Least Square (OLS) method to estimate the relationship between competition and banks’ risk taking. A static model was used also by Yeyatti and Micco (2003) who also controlled for bank-specific fixed effects. In practice, panel-data static models often suffer from the autocorrelation problem, which implies that the model should be a dynamic model. Similar to most of the studies reviewed in the previous section, both Salas and Saurina (2003) and Yeyatti and Micco (2003) are limited in the sense that they do not provide information on their diagnostic tests to support that their models are well specified.

Chen (2007) employed a panel-data fixed effects model but, due to the strong temporal dependence of the dependent variable, included also the lagged dependent variable among the explanatory variables, thus specifying a dynamic model. Even though the author reports that the re-specified model revealed satisfactory diagnostics, the model may still be misspecified due to the endogeneity between the lagged dependent variable and the error term.

Another important issue is related to studies that estimate the relationship between competition and risk-taking by using the H-statistic as a measure of competition (Yeyatti and Micco, 2003; Chen, 2007; Schaeck and Čihák, 2007). Since the H-statistic is itself an estimated variable, it contains its own standard errors, which should be corrected in the second-stage regressions; otherwise, the standard errors in the second-stage model do not reflect the imprecision of the first-stage estimation. In this regard, Schaeck and Čihák (2007) report that they have applied the "bootstrapping procedure" to correct the standard errors of the H-statistic in the second-stage regression, whereas Yeyatti and Micco (2003) and Chen (2007) do not report any measures to correct the standard errors of the H-statistic, which implies that the validity of their inferences on the impact of competition may be questionable.

5.4 Estimation of the impact of banking sector competition on risk-taking in the CEE countries

This section deals with the estimation of the impact of banking sector competition on the level of risk-taking by banks in the transition economies of the Central and Eastern Europe countries during the period 1999 – 2009. The level of bank risk in this study is proxied by credit risk, given the fact that lending activity dominates banking system activity in the countries covered in this study. The degree of risk-taking in our regression is measured by the loan-loss provisions to total loans ratio, which is a measure of the quality of the loan portfolio and, hence, proxies the degree of bank's risk. Competition is measured by the Panzar-Rosse H-statistic which we estimate separately for each country/year. The choice of the H-statistic to measure competition is based on the features of the Panzar-Rosse approach, which uses bank-level data to directly quantify banks' competitive behaviour. Nevertheless, we test also for the impact of alternative measures of competition that are used in the literature, such as the Lerner Index and the Herfindahl-Hirschman Index.

This section continues with the estimation of the Panzar-Rosse H-statistic for each country/year. Then, in the next section we use the H-statistic to estimate the impact of competition on the degree of bank's risk-taking. The regression controls also for the impact of other factors, including bank-specific variables, macroeconomic variables, and institutional variables.

5.4.1 Estimation of the Panzar-Rosse H-statistic for each country/year

In this section, we estimate the banking sector competition, i.e. the Panzar-Rosse H-statistic, for each country and each year, which will then be included as an explanatory variable to estimate the impact of competition on banks' risk-taking.

The Panzar and Rosse (1987) model is a non-structural approach for the measurement of competition, grounded in the microeconomic approach that measures competition by directly quantifying the conduct of banks and not taking into account the market structure. The P-R model produces the so-called H-statistic, which measures the sum of elasticities of bank's revenues with respect to input prices. The H-statistic indicates how bank's revenues respond to an increase of input prices and takes values from below 0 to 1. An $H \leq 0$ implies that banks' competitive behaviour is consistent with monopoly; $0<H<1$ implies that banks' behaviour is consistent with monopolisitic competition; and $H=1$ implies perfect competition (for a more detailed explanation of the Panzar-Rosse method see chapter 3). However, if the proposal of Bikker et al. (2009) on the possibility of banks having constant average costs in equilibrium were to hold, then a negative H-statistic might not necessarily be considered to indicate imperfect competition (see section 3.4 for a more detailed elaboration). Nevertheless, since there is no compelling empirical evidence on this issue, we treat this just as a theoretical possibility and continue to interpret the H-stastistic based on the original Panzar-Rosse framework.

The measurement of the banking sector competition for each country/year is conducted by estimating the following equation which uses cross-section data from each country for the period 1999-2009.

$$\log \text{int}\, income_i = \alpha_0 + \beta_1 \log pfunds_i + \beta_2 \log plabour_i + \beta_3 \log pphyscapital_i + \beta_4 \log loans\_ta_i + \beta_5 \log equity\_ta_i + \varepsilon_i \quad (5.1)$$

where *i* denotes the bank.

The dependent variable in this regression is represented by the interest income (*intincome)*, but we run this regression also using total income (*totincome*) as the dependent variable. This enables us to produce two alternative H-statistics for each country/year and for comparison we use both of them separately in estimating the impact of competition on the degree of risk-taking.

The control variables consist of input prices, which are the variables of interest, and control variables. The input prices in our model are represented by the price of funds (*pfunds)* which is the ratio between interest expenses and total deposits; the price of labour (*plabour*) which is the ratio between personnel expenses and total assets; and the price of physical capital (*pphysicalcapital*) which is the ratio of other operating expenses to fixed assets.

Compared to chapter 4, where we estimated the level of competition for the overall CEE region, in this section we have restricted the number of control variables in order to retain the degrees of freedom given the small number of cross-section observations for some of the countries in the analysis. Hence, we control only for the loans to total assets ratio (*loans_ta*) and for the equity to total assets ratio (*equity_ta*), which appeared to be the most systematically statistically significant in all the different combinations. The loans to total assets ratio is included in the model to control for the structure of assets; and the equity to total assets ratio measures the degree of risk-aversion. The variables are log-transformed in order that coefficients can be interpreted as constant elasticities.

The H-statistic is calculated as the sum of the input prices coefficients, which in our case is $\beta_1 + \beta_{2+}\ \beta_3$. The equation is estimated by Ordinary Least Squares (OLS) which has known small-sample properties that make it suitable for our analysis given the small number of cross-section observations for some of the countries included in our sample. For all the cross-section estimations we have also performed the standard diagnostic tests for homoscedasticity, normality and linearity. In the vast majority of cases the null hypotheses for these tests cannot be rejected.

Before estimating the H-statistic, we have conducted also the test for long-run equilibrium, which is based on a model similar to equation 5.1 but where the dependent variable is the Return on Assets (ROA) instead of the interest income (see chapter 4 for a more detailed explanation of the long-run equilibrium test). The results show that the H_{ROA} (i.e. the sum of input prices coefficients) that is derived from this model is zero or very close to zero for each country-year included in the analysis (the linear combinations are mostly not significantly different from zero), suggesting that the Panzar-Rosse model is applicable to these countries individually (see Appendix 3.1).

However, it should be noted that the cross-section estimation of the H-statistic for the CEE countries suffers from data limitations both in terms of sample size for individual countries and data quality. For some of the countries in our analysis, there was only a small number of yearly observations available, which imposed that for some countries/years the estimation to be conducted on a fairly small number of cross-section observations. This may be a consequence of the small number of banks operating in some of the countries at certain years, but it can also be a consequence of the insufficient coverage of the transition countries by the BankScope database. The other issue is related to the data quality. Table 4.2 shows that for all the variables used in the cross-section estimation (i.e. *p_funds*, *p_labour*, *p_physcapital*, *loans_ta*, *equity_ta*), the minimum and maximum values have quite a high divergence from the mean. This may signal a substantial presence of outliers in the data. The presence of outliers is more concerning when estimation is conducted on very small samples of data, because the leverage of a particular observation can be large. We have considered the possibility of removing the outliers, but due to the large presence of outliers it was likely to cause a considerable reduction in the number of observations. Therefore, in order to avoid a further reduction of our already small sample sizes, we removed only the outliers that clearly appeared to be far away from the mean, which on average are no more than ten outliers for a variable.

Despite these caveats related to the sample size and the quality of data, we decided to proceed with the estimation of the H-statistic for each country/year, which will then be used as an explanatory variable in the estimation of the impact of competition on banks' risk-taking and net interest margins. The existing literature that has investigated these relationships for the transition economies has mostly proxied the competition by using market concentration indices, which are largely considered to be a poor measure of competition, while, to the best of our knowledge, none of them has used the Panzar-Rosse H-statistic that is considered to be a more adequate measure of competition. Therefore, despite the limitations, we intend to estimate the H-statistic for each country/year and be the first to use it in the estimation of the impact of competition on banks' risk-taking and net interest margins in the transition economies.

Beucase of these caveats related to the estimation process and other reservations on the interpretation of the H-statistic that have been discussed above, we use also the Lerner Index obtained from Efthyvoulou and Yildirim (2013) as an alternative measure of competition. This will enable us to verify the inferences derived from the models where H-statistic was used as a measure of competition.

5.4.1.1 The results of cross-section estimations of the Panzar-Rosse H-statistic

This section presents the estimated H-statistics for each of the CEE countries that are included in our analysis and for each of the years covered in our analysis.[29] The estimation results that are presented in Table 5.1 indicate several important points.

First, H-statistics could not be estimated for some years because of the small number of banks reported in the BankScope database for some of the countries in those years. Second, the H-statistics for most of the countries and for most of the years have a negative value which is consistent with the overall finding in chapter 4, in which the H-statistic was estimated from a pooled sample of CEE countries for the period 1999-2009. Third, from the individual country results, it is difficult to build an overall picture regarding the trend of the H-statistic over the years in the CEE countries because of the variations between countries, except for the period 2007-2009 that seems to have been characterized by declining H-statistics in most of the

[29] The H-statistics could not be estimated for Kosovo and Montenegro due to the small number of cross-section observations.

countries. This may be an indication of lower banking sector competition during the crisis years.

Table 5.1 Estimation results of the H-statistics for individual countries

Year	Albania	Bosnia and Herzegovina	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia
1999	-	-	-	-0.948	-1.468	-	-7.902	-
2000	-	-	-	0.643	-0.636	-	-3.173	-
2001	-	-	-	-0.441	-1.388	-	-1.450	-
2002	-0.095	-	-1.597	-1.336	0.577	-11.030	-1.948	-0.466
2003	0.041	-	-1.761	-2.836	0.693	-9.083	-1.819	-0.349
2004	2.213	0.084	-0.927	-1.185	0.894	-4.239	-1.584	-1.365
2005	2.932	-1.138	-1.879	-4.464	-1.306	-	-1.417	-1.746
2006	2.191	-1.003	-1.073	-4.693	-1.407	-11.728	-1.318	-0.999
2007	-1.132	-1.620	-1.357	-3.769	0.294	-6.001	-0.776	-0.363
2008	0.148	0.343	-0.570	-3.935	-1.444	0.399	0.908	-0.119
2009	-	-0.677	-0.798	-3.317	-2.730	-	-0.435	-0.955

Year	Lithuania	Macedonia	Poland	Romania	Serbia	Slovakia	Slovenia
1999	-	-	0.262	5.187	-		-0.192
2000	-	-	-4.222	0.555	-	2.618	-1.469
2001	-	-	1.062	0.336	-	-1.526	-
2002	-4.995	-2.711	0.410	0.423	-	-1.134	-5.998
2003	-2.272	-0.421	-0.091	-0.385	0.174	-2.368	-0.528
2004	-4.095	0.298	-0.836	0.035	-0.104	-3.782	0.507
2005	-4.412	0.489	-1.576	-1.114	0.101	-2.282	4.527
2006	-6.173	-0.783	0.835	0.830	-0.363	-3.954	-3.609
2007	-7.582	-2.247	1.351	-0.039	-0.931	-4.050	1.694
2008	-9.199	-1.431	-1.984	-0.025	-0.864	-4.005	2.626
2009	-7.042	0.400	-1.379	-0.473	-2.561	-2.573	2.200

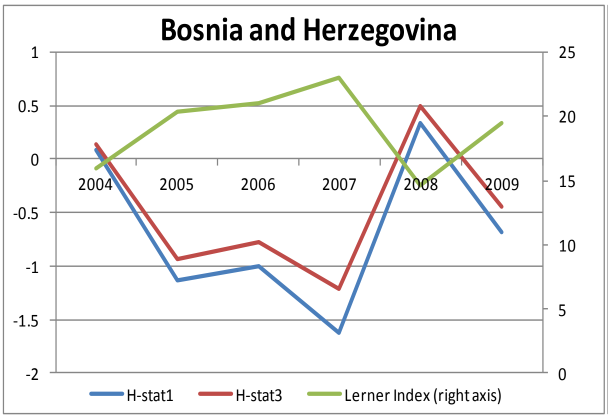
Fourth, the H-statistic estimated using the interest income as the dependent variable (h_stat1) and the H-statistic estimated using the total income as the dependent variable (h_stat3) appear to have similar values and trend which suggests that using either interest income or total income as the dependent variable produces similar results (see Appendix 3.3 for the *h_stat3* estimates). Fifth, both the h_stat1 and the h_stat3 for most of the countries show a clear inverse relationship with the Lerner Index which is a measure of market power (see Appendix 3.4 for the Lerner Index values).[30] In addition, as shown in the example presented in Figure 5.1, our estimates of the H-statistics and the Lerner Index are similar also in terms of the variation from year to year (see Appendix 3.5 for the figures on all the sample countries). The inverse relationship and the similarity with regard to the variation with the Lerner Index may also serve as evidence that our H-statistic estimate is properly measuring the degree of competition.

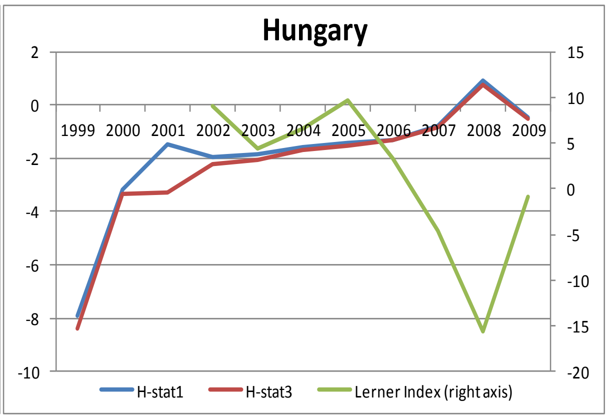
However, it must be noticed that both our estimates of the H-statistic and the estimates of the Lerner Index obtained from Efthyvoulou and Yildirim (2013) are characterized by a pronounced degree of volatility from one year to the other. Given that both the H-statistic and the Lerner Index are characterized by a similar degree of volatility, it may be considered that a potential reason for the high degree of volatility may be the small sample of observations available and the potentially poor quality of data for the transition economies in the BankScope database. In our estimation of the H-statistic, the small number of observations in some of the cases imposed estimations with minimal degrees of freedom (e.g. only 1 degree of freedom in extreme cases). On the other hand, recalling the review of the empirical literature applying the Panzar-Rosse model in the banking sector (section 3.4), we notice that also when applied to EU countries data the Panzar-Rosse method produced quite volatile yearly H-statistics (Nathan and Neave ,1989; Molyneux et al., 1994; Vesala, 1995). For example, in the study of Molyneux et al. (1994), the behaviour of banks operating in the UK shifted from monopoly in one year to almost perfect competition in the following year. On this issue, Bikker and Groenveld (1998) suggested that it is unlikely that competitive

[30] The Lerner Index for each country/year is obtained from Efthyvoulou and Yildirim (2013), who have estimated the Lerner Index for individual CEE countries for the years 2002-2010.

conditions change so drastically from year to year. Bikker and Groenveld attribute these changes to the fact the gradual market dynamics were not accounted for in the model. Hence, the high volatility of the cross-section H-statistic estimates appears to be quite usual also in the rest of the literature, which may raise the question as to whether it is appropriate to measure competition on a cross-section basis given that it is a dynamic process and gradual changes must be taken into account in the model. In order for the cross-section estimates of the H-statistic to be a more credible measure of competition, it is recommended to have also comparisons with other measures of competition such as the Lerner Index (implemented above) and the Boone Indicator (not implemented in this thesis).

Figure 5.1 Examples of the variation of the H-statistics and the Lerner Index in selected CEE countries





Sixth, there are a few cases where the H-statistic is higher than 1, something which is not foreseen by the theory on which the Panzar-Rosse approach was established. However, the F-test suggests that for all these cases the sum of the input prices (that compose the H-statistic) is not significantly different from 1. A potential reason for having H-statistics higher than 1 may be the fact that the number of observations for some countries/years is quite small and the quality of data reported for the transition countries in the BankScope database might not be of good quality, which might have repercussions for the estimation results. However, given that this phenomenon has appeared also in other studies such as Bikker and Haaf (2002) and Coccorese (2009), which have applied the Panzar-Rosse method to estimate yearly H-statistics for EU countries, then the problem may be more general and potentially related to the issue as to whether it is appropriate to estimate competition on cross-section data given the potential need to incorporate the gradual dynamics in the model.

5.4.2 Estimation of the impact of banking sector competition on banks' risk-taking

This section presents the empirical estimation of the relationship between banking sector competition and bank's risk-taking. For the measure of competition, we use the cross-section estimates of the H-statistic from the previous section. In addition, we use also other measures of market power such as the Lerner Index and Herfindahl-Hirschman Index in order to be able to compare the results. The regression includes also other bank-specific, macroeconomic and institutional indicators that are considered to be important for the determination of the level of risk taken by the banks.

5.4.2.1 Model description

The estimation of the relationship between banking sector competition and risk-taking in the banking sectors of the CEE countries during the period 1999-2009 is conducted using the following regression:

$$\begin{aligned} prov\_loans_{it} &= \alpha_0 + \beta_1 H\_stat1_{it} + \beta_2 nonintinc\_ta_{it-1} + \beta_3 equity\_ta_{it-1} + \beta_4 loans\_ta_{it-1} + \\ &\beta_5 nim_{it-1} + \beta_6 \log ta_{it} + \beta_7 growth\_loans_{it-1} + \beta_8 rgdpgrowth_{it} + \beta_9 gdp\_percap_{it} + \beta_{10} cpi_{it} + \\ &\beta_{11} \log exch\_rate_{it} + \beta_{12} ebrd\_bankref_{it} + \beta_{13} propertyrights_{it} + \beta_{14} dv\_foreign_{it} + \\ &\beta_{15} dv\_origin_{it} + \beta_{16} dv\_year_{it} + \beta_{17} dv\_country_{it} + \varepsilon_{it} \end{aligned}$$

(5.2)

Where *i* denotes the bank and *t* denotes the year.

Table 5.1 Description of variables

Variables	**Description**
prov_loans	loan-loss provisions / total loans
h-stat	Panzar Rosse H-statistic
nonintinc_ta	total non-interest operating income / total assets
equity_ta	equity/total assets
logta	natural logarithm of total assets
loans_ta	total loans/total assets
nim	net Interest Margin = (interest income - interest expenses)/average earning assets
growth_loans	annual growth rate of loans
rgdpgrowth	real GDP growth rate
gdp_percap	gdp per capita
cpi_ebrd	inflation
exch_rate	exchange rate (national currency/Euro)
ebrd_bankref	EBRD banking reform index
propertyrights	Property Rights Index (Heritage Foundation)
dv_foreign	dummy variable for foreign ownership (1 for foreign ownership)
dv_origin	dummy variable for the country-of-origin of the bank (1 for EU-12 or US)
dv_year	dummy variable for year
dv_country	dummy variable for country

The dependent variable in equation 5.2 is the loan-loss provisions to total loans ratio (*prov-loans*) which is a measure of banks' loan portfolio risk. When a loan becomes non-performing, the bank is required to allocate provisions to cover potential losses from non-performing loans.[31] Hence, an increase in the loan-loss provisions tends to reflect a deterioration of the loan portfolio quality and subsequently higher bank risk.

Banking sector competition in our model is represented by the Panzar-Rosse H-statistic (*H_stat1)* which is estimated for each country/year. By using the Pazar-Rosse H-statistic in estimating the relationship between banking sector competition and risk-taking we have followed a number of authors who have used this variable such as Yeyatti and Micco (2003), Schaeck et al. (2006), Schaeck and Čihák (2007) and Chen (2007). For comparison, we run a separate regression in which we replace the *h_stat1* variable with the *h_stat3*. As explained in the previous section, these two measures differ from each other with respect to the dependent variable that has been used when they were estimated.[32]

The use of the H-statistic as a continuous variable has been suggested by Vesala (1995) who claimed that the H-statistic is an increasing function of the demand elasticity, implying that a higher H-statistic implies a higher intensity of competition. The interpretation of the H-statistic as a continuous variable and the use of its magnitude to measure the degree of competition are supported also by Claessens and Leaven (2004), under the assumption that the bank faces a demand function with constant elasticity and a Cobb-Douglas production

[31] Non-performing loans are the loans that belong to one of the lower credit quality grades (Angklomkliew *et al.*, 2009). In some countries, a loan is considered to be non-performing if it is in arrears for more than 60 days, whereas in some countries non-performing loans include loans that are in arrears for more than 90 days.

[32] The dependent variable in a Panzar-Rosse model may be the bank's interest income or the total income. Since there is no conclusive argument on which is more appropriate, in order to test for robustness, we have run separate cross-section estimations using the interest income as the dependent variable and the total income. The *h_stat1* variable was estimated using interest income as the dependent variable and the *h_stat3* was estimated using total income as the dependent variable.

technology. The predicted sign for the competition variable can be either positive or negative given that the theory so far did not come to a conclusion on the relationship between banking sector competition and risk-taking (Section 5.2).

Despite the fact that the H-statistic has been widely used as a continuous measure of competition, there are also arguments that may oppose its use as a continuous measure. If the proposal of Bikker et al. (2009) on the possibility that banks' average costs in equilibrium may be constant were to hold, then the negative values of H-statistic might not be interpreted as indicating monopoly behaviour (see section 3.4 for a more detailed elaboration). In other words, the negative values of the H-statistic would not necessarily indicate a high level of market power (i.e. lack of competition). Nevertheless, since there is no compelling direct empirical evidence to support this proposal, we treat this issue as a theoretical possibility and leave it to be investigated by future research; therefore, we continue to interpret the H-statistic based on the original Panzar-Rosse framework.

For another comparison with our results and given the potential caveats of the H-statistic, we run a separate model using the Lerner Index (*lerner_index* variable) instead of the H-statistic. The Lerner Index is obtained from the study of Efthyvoulou and Yildirim (2013) who have estimated this index for individual CEE countries for each year in the period 2002-2010.[33] The Lerner Index is inversely related to the H-statistic, with higher values of the Lerner Index implying higher market power, i.e. lower competition.

Some of the studies that have investigated the relationship between banking sector competition and risk-taking have used the degree of market concentration as a measure of competition, considering that higher market concentration implies lower competition.

[33] The Lerner Index estimates are not available for Estonia and Lithuania.

However, by recalling the discussion on the efficient structure hypothesis and the contestability theory from chapter 3, it may be argued that market concentration is not an adequate measure of banking sector competition. In addition, the market concentration index takes into account only the banks operating within a country, thus excluding the potential competitive pressures coming from outside a country's borders, which is especially important for the EU member states that have more integrated financial sectors. Nevertheless, in order to make our results comparable with the results of other studies, we run a separate regression in which we replace the H-statistic variable with the market concentration index. In addition, even if the degree of market concentration does not represent an adequate measure of competition, still it may represent an influential factor for the risk-taking behaviour of the banks.

Apart from the variable of main interest, which is the variable on the banking sector competition, our model includes also other control variables considered to be important for the determination of banks' risk-taking. The other control variables included in the model can be classified in three categories: a) bank-specific variables; b) macroeconomic variables; c) institutional variables; and d) dummy variables for countries and years.

a) Bank-specific variables

Non-interest income (Lag*nonintinc_ta*)

The non-interest income to total assets ratio (Lag*nonintinc_ta*) is included in the regression to control for the potential impact of the diversification of banks' revenues on the quality of loan portfolio. The larger the share of the non-interest income, the lower is likely to be the dependence of the bank on the income from the lending activity, which implies that a potential deterioration in the quality of the loan portfolio, and hence a reduction of the interest income, is expected to have a lower impact on the overall performance of the bank. Therefore, banks with higher non-interest income may be less concerned for the quality of loans and, hence, may be likely to engage in higher levels of lending risk. Banks that are able to secure strong earnings from the non-interest generating assets may be able to afford higher potential losses from the interest-generating assets, which may make them more likely to invest in high-risk and high-return assets. The non-interest income variable is likely to be endogenous to the quality of the loan portfolio (i.e. the dependent variable), since the causality may run also from the quality of the loan portfolio towards the structure of assets. When the quality of loans deteriorates, i.e. when the loan-loss provisions increase, banks may be less willing to expand their lending activity, so they may tend to extend their focus towards safer assets, such as the non-interest generating assets. Therefore, in order to reduce the possibility of the potential endogeneity, the non-interest income variable is is included in its first lag.

The degree of risk-aversion (Lag*equity_ta*)

The risk attitude of a bank considerably depends on the amount of equity held by the bank, which in our regression is represented by the equity to total assets ratio (Lag*equity_ta*). According to Saunders and Allen (2002), banks hold equity as a cushion against losses that may occur from the materialization of the credit, market or operational risk. When holding equity as a cushion against potential losses, a potential bankruptcy of the bank will cost the shareholders their own equity. Therefore, banks that hold higher capital ratios are likely to be more conservative in terms of risk-taking in order to be able to preserve the shareholders equity (Hellman *et al.*, 2000; Repullo, 2003). As a result, the expected sign of the equity ratio is negative. This variable is included in the regression in its first lag in order to reduce the possibility of the potential endogeneity with the loan-loss provisions. The endogeneity between the equity ratio and the loan-loss provisions may arise given that provisions are recorded as an expense in the bank's income statement and, hence, affect the net profit which, in turn, may have an impact on the bank's equity.

Net Interest Margin (Lag*nim*)

The extent of loan repayment and, subsequently, the amount of loan-loss provisions, are considered to be affected also by the level of interest rates, which in our regression are represented by the net interest margin (Lag*nim*). Saunders and Allen (2002) argue that the relationship between high loan interest rates and expected loan repayments is negative, implying that an increase of loan interest rates leads to higher loan-loss provisions. According to these authors, this happens because of the adverse selection and the *risk-shifting* effect. The adverse selection is considered to take place because, when loan rates increase, the "good" borrowers may leave the loan market and decide to self-finance their investment projects, thus leaving the "bad" borrowers to dominate the pool of loan applicants. The remaining "bad" borrowers, who may have limited liability and equity at stake, may cause the *risk-shifting* effect by engaging in high risk – high return projects in order to compensate for the high interest rate payments. If the project is successful they will be able to repay the loan, whereas if they default their own losses will be limited. Nevertheless, the relationship between the interest rates and the credit risk may be seen also from another perspective. Higher interest rates may discourage the weak borrowers from applying for loans, hence leading to a market dominated by financially stronger borrowers who are capable of withstanding higher interest rates. Hence, the increase of the net interest margin may have a negative impact on the level of risk taken by the banks. In order to avoid the potential endogeneity with the loan-loss provisions, also the net interest margin is used in its first lag. The endogeneity may arise from the fact that changes in the credit risk (i.e. loan-portfolio quality) may affect the interest rates charged by the bank (i.e. higher credit risk implies higher risk-premiums in the interest rates).

Bank's size (*logta*)

The variable *logta* represents the natural logarithm of total assets and is included to control for bank size. The risk-taking behaviour of a bank may well be related also to its size. Larger banks may be considered as safer considering that they might have been operating for a longer period in the market, during which they may have established lending relationships with their clients which, in turn, gives them an advantage in terms of the information they possess. Larger banks are also likely to have stronger financial positions and longer experience in the banking industry, which makes them capable of building more advanced risk management capacities. According to EBRD (2006), smaller banks in the transition economies tend to focus on lending to small and medium enterprises, which are likely to be more risky. On the other hand, larger banks may at the same time be viewed as more risky due to the "too big to fail" effect. Since larger banks are systemically important and their potential bankruptcy might cause problems to the overall financial sector and the economy in general, the governments and other state authorities are often keen to bail out the large banks that are in difficulties. Under these conditions, moral hazard behaviour is more likely to take place at the larger banks, since these banks might undertake excessive levels of risk, being aware that state authorities will intervene to bail them out in case difficulties occur.

Credit growth (*Laggrowth_loans*)

The second decade of banking transition in the CEE countries was characterized by a rapid credit growth, which raised concerns about a potential deterioration of the loan-portfolio quality. Rapid expansion of lending activity may signal that banks are pursuing "aggressive" strategies in the lending market, which may be associated with lax lending criteria that enable them to increase their market shares. Such strategies may enable poor-quality borrowers to gain access to credit, thus worsening the quality of banks' loan-portfolios. Hence, among the explanatory variables in our regression we control also for the impact of the annual growth rate of loans (*Laggrowth_loans*) which is expected to have a positive impact on the loan-loss provisions ratio. This variable is included in its first lag in order to avoid potential endogeneity to the dependent variable. The endogeneity may arise from the fact that a potential increase of credit risk may induce banks to restrain their credit growth.

Foreign ownership (*dv_foreign*)

The degree to which banks engage in risk-taking may be well related to whether the bank is domestically owned or foreign owned. The theoretical literature on the foreign banks emphasizes the differences between the foreign owned banks and the domestically owned banks in terms of the asymmetric information they face. According to Dell'Ariccia and Marquez (2004), foreign banks are advantaged in terms of the possession of screening technologies to identify the good borrowers by analysing "hard" information, i.e. the information which can be observed by concrete evidence. Conversely, domestic banks have the advantage of possessing additional "soft" information on the borrowers, which they obtain from being part of the community where they operate. In this context, Sengupta (2007) claims that foreign banks may end up lending to less risky and larger borrowers, which is also known as "cream-skimming". Larger borrowers may be viewed as less risky, assuming that they can provide externally audited financial reports, and may have more advanced business planning capacities, which reduce the risk of non-repayment. On the other hand, the lending activity of domestic banks is mainly focused on smaller and more opaque borrowers, which are also expected to be more risky. A similar view is shared also by Claeys and Hainz (2007) who claim that foreign banks are more conservative in the sense that they concentrate more on financing safer projects.

Therefore, in order to control for the potential differences between the domestically owned and foreign owned banks, in our model we include a dummy variable (*dv_foreign*) which takes a value of 1 when the bank is more than 51% foreign owned and 0 when the bank is domestically owned. Given that the readily available BankScope database provides information only on the current ownership of the bank, we utilize the shareholders' history from this database through which we identify the bank's ownership for the available years. However, it must be noted that this variable is characterized by a pronounced rate of missing data which reduces our overall sample size.

Country-of-origin of the banks (*dv_origin*)

Given that the foreign banks operating in the CEE region originate from different countries, we consider that the country-of-origin of the banks may also play a role in the way that banks exercise their activity, especially given the fact that foreign banks operating in the CEE countries are mostly subsidiaries of their parent banks. This implies that their strategy and organizational culture may largely be in line with the standards in their home countries. In this context, Hasselman (2006) has found that the activity of foreign banks in the transition economies is mostly determined by the strategic considerations of the parent banks. Therefore, we construct a dummy variable (*dv_origin*) which takes a value of 1 if the foreign bank is an EU-12 or US country and 0 if the bank's origin is some other country.

b) Macroeconomic variables

Real GDP growth (*rgdpgrowth*)

The general economic activity or the business cycle is considered to have an important influence on the loan repayment capacity of borrowers. The general economic activity in our regression is controlled by the real GDP growth rate (*rgdpgrowth*). In good times for the economy, i.e. when the GDP is growing, income tends increase and so does the capacity of the borrowers to repay their loans. Under such conditions, loan repayments are more orderly and the quality of the loan portfolio improves, thus reducing the need for allocating loan-loss provisions. In addition, during good times for the economy, banks are more optimistic for the future, so they may allocate less loan-loss provisions, given that loan losses are less likely to happen. However, the increased confidence of the banks when the economy is growing may have its own risks, since by being more optimistic on the future performance of the economy banks may apply more relaxed lending criteria and grant access to credit also to "bad" borrowers, which may lead to a deterioration of the loan portfolio quality.

GDP per capita (*gdp_percap*)

The GDP per capita (*gdp_percap*) is included in the regression to control for the general economic development of each country in the analysis, and is expressed in thousands of US dollars. A higher level of economic development implies a higher level of wealth for its citizens and, thus a higher capacity of loan repayment. In addition, GDP per capita is often used as a proxy for the general quality of the institutions, since more developed countries are expected to have more functional institutions. Therefore, banks operating in countries with higher GDP per capita are expected to have better loan-portfolio quality, i.e. lower loan-loss provisions.

Inflation (*cpi_ebrd*)

Inflation in our regression is represented by the annual growth rate of the Consumer Price Index (*cpi_ebrd*). Higher inflation reduces real wages when the wages are not adjusted for inflation, thus weakening the loan repayment capacity of the borrowers and leading to higher loan-loss provisions. On the other hand, if loan interest rates are fixed and not adjustable to inflation, then the real interest rate may decline and make it easier for the borrowers to repay their loans when inflation increases.

Exchange rate (*logexch_rate*)

Another macroeconomic variable in our regression is the exchange rate (*logexch_rate*), which is expressed as national currency/euro. An increase of the exchange rate implies a depreciation of the national currency. The impact of the national currency depreciation on the loan repayment capacity of the borrowers depends on the currency in which loans are denominated. In the CEE countries the structure of bank loans is dominated by loans denominated in the national currency, while foreign currency deposits represent considerable shares of total deposits in some of the countries, especially in those relying more on remittances and tourism (e.g. Albania, Croatia). Under these conditions, a depreciation of the national currency would increase the loan repayment capacity of the borrowers, thus leading to lower loan-losses. Therefore, the depreciation of the exchange rate is expected to have a negative sign on the loan-loss provisions.

c) Institutional indicators

EBRD banking reform index (*ebrd_bankref*)

The banking sector reform process in the transition economies led the transformation from centrally-planned to market-based banking sectors. This process included the liberalization of the commercial banks operations, the entry of private banks in the markets, the development of a legal framework, and the development of regulatory and supervisory institutions. These reforms might have influenced also the risk-taking behaviour of the banks. Hence, among the control variables, we include also the EBRD banking reform index (*ebrd_bankref*), which takes values from 1 to 4+, with higher values indicating more advanced reform progress (a more detailed explanation of the index was provided in chapter 2).

Property rights index (*propertyrights_hrt*)

The lack of adequate protection of property rights is often considered to be among the main sources of uncertainty for the banks. The evidence presented in chapter 2 shows that the protection of property rights in the CEE countries has recorded a slow progress during the period under investigation. The protection of property rights is mainly related to the existence of the laws for the protection of the private property rights and the degree to which these laws are implemented by the judicial authorities. To control for the degree of property rights protection, we use the Property Rights Index (*propertyrights_hrt*) of the Heritage Foundation. This index is focused on the likelihood that private property will be expropriated and on issues related to the independence of the judicial system, the existence of corruption within the judicial system, and the ability of individuals and businesses to enforce contracts. The index takes values from 0 to 100, with higher values showing a better protection of property rights. In a country with a higher property rights index, which basically reflects a more efficient judicial system, banks face lower risks with regard to the implementation of contracts with their clients. If a client does not repay the loan, the bank can easily proceed with the execution of the collateral. Also, this will contribute to a higher self-discipline on the side of clients to honour the contracts between them and the banks. Conversely, when the judicial system is not efficient, moral hazard by borrowers is more likely to happen because, being aware that their collateral will not be executed or at least will take time until its execution, the "bad" borrowers may be induced not to repay the loan. Therefore, a better protection of the property rights is expected to lead to a lower non-performing loans ratio and, hence, lower loan-loss provisions.

d) Dummy variables for countries and years

Dummy variables for countries (*dv_country*)

Since the banks included in our sample are from different countries, a complete set of country dummies (*dv_country*) is included in the model in order to control for unobserved country-specific effects. Our data set includes banks from 15 different countries, where specific country characteristics may have an important role in determining the level of risk taken by banks. Some authors suggest that country dummies should be included in the regression to account for the "underlying historical fabric (…) that is not captured by any of the time and country varying regressors" (Plümper and Troeger, 2004).

Dummy variables for years (*dv_year*)

To take into account the potential impact from the time-specific effects, the model includes a complete set of year dummy variables (*dv_year*). By including the year dummies we also minimize the possibility of cross-group residual correlation if there has been some year-specific development that has affected all the banks included in the sample (e.g. global financial crisis). If such a development is not controlled by year dummies, then it enters the error term and leads to cross-group residual correlation.

Data

The bank-level data that are used in our estimation are sourced from the BankScope database. The data on the real GDP growth rate have been obtained from the EU Commission (AMECO database) and the IMF, whereas the GDP per capita and inflation data are obtained from the European Bank for Reconstruction and Development (EBRD). The exchange rate data are sourced from the Vienna Institute for International Economic Studies (wiiw). The banking reform index is obtained from the EBRD, whereas the Property Rights Index is obtained from the Heritage Foundation.

Table 5.2 Summary statistics

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
prov_loans	2628	1.934	4.945	-48.156	49.689
h_stat1	2650	-1.212	2.122	-11.728	5.187
Lagnonintinc_ta	2468	2.953	4.757	-5.357	73.832
Lagequity_ta	2480	15.359	13.067	-12.440	98.660
Lagnim	2470	5.111	3.864	-12.080	38.820
logta	2926	12.953	1.731	8.000	17.456
Laggrowth_loans	2230	40.675	59.849	-94.700	476.000
rgdpgrowth	2909	3.976	4.172	-17.729	13.501
gdp_percap	2925	7709.1	5039.1	933.4	27128.5
cpi_ebrd	2926	6.561	9.603	-2.700	97.128
logexch_rate	2869	2.054	1.782	-0.581	5.636
ebrd_bankref1	2914	3.343	0.572	1.000	4.000
propertyrights_hrt	2691	45.730	18.508	10.000	90.000
dv_foreign	2155	0.638	0.481	0.000	1.000
dv_origin	2155	0.484	0.500	0.000	1.000

5.4.2.2 Estimation methodology

The data set used in our analysis consists of cross-section individuals that are observed for several time periods. Hence, our model may be estimated by the conventional panel data techniques, such as: a) pooled OLS, which assumes no correlation between the explanatory variables and the error term; b) the fixed effects (FE) method, which allows the unobserved individual heterogeneity to be correlated with the explanatory variables, thus enabling the model to control for the unobserved time invariant characteristics related to the individuals in the sample; and c) the random effects (RE) method, which assumes that the unobserved heterogeneity is not correlated with the explanatory variables but is distributed independently from the explanatory variables (Wooldridge, 2002).

The choice between these methods is guided by the relevant diagnostic tests. These estimators vary from each other mainly with respect to how they treat the unobserved effects. Initially, we look at the F-test which enables us to choose between the OLS and the fixed effects method, by testing the null hypothesis that individual unobserved effects are equal to zero. If the null hypothesis is accepted we choose the OLS method; alternatively, we choose the FE as our preferred estimator. The F-test shows a p-value of 0.000 which strongly rejects the null hypothesis, thus suggesting that the individual unobserved effects are statistically significant. Hence, between FE and the OLS, we choose FE as our preferred estimator (see Appendix 3.6).

The next step is to choose between the FE and the RE. The most appropriate way to choose between these methods is through the Hausman test (Wooldridge, 2002). The main issue that is taken into consideration when choosing between the FE and the RE is whether the unobserved effects are correlated with the explanatory variables. The Hausman test takes into consideration the estimates from both FE and RE and checks if there is a systematic difference between them. Since FE is consistent when the explanatory variables are correlated with the unobserved effects, whereas RE is not, a statistically significant difference between the estimates of the two estimators goes against the use of the RE method. With a *p-value* of 0.000, the Hausman test rejects the null hypothesis that the difference in coefficients is not systematic, hence suggesting that the RE method is not appropriate to estimate our model (Appendix 3.6). According to Cameron and Trivedi (2005), FE is consistent and can be used even in cases when the Hausman test suggests that the RE method may be applied, whereas RE is inconsistent under a model in which the FE is suggested to be the appropriate estimator. Hence, taking into account the Hausman test results and the additional advantages of the FE method, we choose FE as our preferred estimator. Examples of the advantages of using the FE method can include: the FE method captures the unobserved time-invariant effects related to each of the individuals included in the sample; the RE assumes that the individuals included in the sample have been taken randomly from a large population. In our case, the banks included in the analysis represent the majority of the banks operating in the respective countries and their selection was not random but rather depended on the availability of the data, thus violating the RE method assumption.

However, a limitation of FE estimation is that this method does not allow the estimation of the effects of time-invariant explanatory variables and is not efficient in the estimation of slowly-moving variables. In our case, taking into account the variables that compose our model, the main limitation of the FE method is the insufficiently efficient estimation of the slowly-moving variables such as the property right index and the exchange rate, which represent potentially important factors for the determination of the level of risk in the banking sector. Variables are considered to be slowly-moving when there is little within-group variation which makes the estimation through the FE method difficult.

In order to estimate the effects of the slowly-moving variables more efficiently and maintain the original features of the FE method, we use the Fixed Effects Vector Decomposition (FEVD) method, which represents an augmented version of the FE method and takes into account both cross-group and within-group variation.

5.4.3.1 The Fixed Effects Vector Decomposition method

The FEVD approach has been developed by Plümper and Troeger (2004) as a method that enables the estimation of time-invariant variables in the presence of individual fixed effects. In other words, the FEVD enables the estimation of a fixed effects model that may include also time-invariant explanatory variables. In addition, Plümper and Troeger (2007) claim that the FEVD is more efficient compared to the FE also in terms of the estimation of explanatory variables that have a low within-group variation. This has been confirmed also by Greene et al. (2010), who found that the use of the FE to estimate models that contain slowly changing variables produces implausible estimates, while the FEVD estimates are much more meaningful.

In our case, the FEVD estimator enables us to retain the properties of the fixed effects model and at the same time enables us to include the time-invariant variables in our model (i.e. the country dummies) as well as to estimate more efficiently the variables with low within-group variation, which can be referred to also as "rarely changing variables". In order to identify the variables with low within variation, we follow the 'rule of thumb' proposed by Plümper and Troeger (2007) who suggest that a variable should be treated as "rarely changing" if the ratio of the *between* standard deviation and the *within* standard deviation (b/w) of that variable is at least 2.8.

Table 5.3 Identification of slowly-moving variables

Variable	Between stdev	Within stdev	Between/Within
h_stat1	1.607	1.478	1.088
Lagnonintinc_ta	4.339	3.500	1.240
Lagequity_ta	14.173	6.060	2.339
Lagnim	3.464	1.938	1.787
logta	1.606	0.646	2.486
Laggrowth_loans	40.141	50.241	0.799
rgdpgrowth	1.354	4.017	0.337
gdp_percap	4186.6	2957.6	1.416
cpi_ebrd	6.689	7.306	0.915
logexch_rate	1.805	0.139	12.991
ebrd_bankref1	0.535	0.243	2.206
propertyrights_hrt	18.080	4.784	3.779
dv_foreign	0.452	0.180	2.520
dv_origin	0.475	0.165	2.878

Table 5.2 shows that there are three variables, namely *propertyrights_hrt*, *dv_origin*, and *logexch_rate* which have a between/within ratio of above 2.8 and, therefore, are treated as “rarely changing” variables in our estimation.

The FEVD method is executed through the following steps:

i) In the first stage, Equation 5.2 is estimated using the normal fixed effects model. After the estimation of the regression, we predict the *fixed effects* vector, which is going to be used in the second stage of the regression.

ii) In the second stage, the *fixed effects* vector is regressed on the time-invariant and the “rarely changing” explanatory variables, which in our case are the country dummies and the variables *propertyrights_hrt*, *dv_origin*, and *exch_rate*. The regression is estimated using Ordinary Least Squares (OLS). After running the regression, we predict the *residuals*, which are included among the explanatory variables in the third stage of the FEVD model.

iii) In the third stage, which is the final step of the FEVD model, the regression is estimated by pooled OLS and includes all the time-variant and time-invariant variables, and also the *residuals* from the second stage among the explanatory variables (the complete procedure and STATA outputs of the FEVD estimation is presented in Appendix 3.8).

However, the above-presented procedure is not recommended for the final estimation unless the degrees of freedom in the third stage are adjusted by u_i-*1* when calculating the variance-covariance matrix of the time-variant and time-invariant variables. In addition, the term on the unobserved components (i.e. *residuals*), which is one of the explanatory variables in the third stage, is an estimated variable from the second stage. Because this variable is an estimated variable and not a fixed realization, the error involved in that estimation should be taken into account in the third stage. For doing so, Plümper and Troeger (2007) provide the STATA program (ado-file) *xtfevd* 4.0 which executes all the three stages of the FEVD and adjusts the standard errors both in terms of the correction of the degrees of freedom and in terms of accounting for the fact that the variable *residuals* in the third stage is an estimated variable and not a fixed realization. Therefore, our final estimation is conducted by using the *xtfevd* as estimator.

However, this approach is limited in terms of not being able to produce the diagnostic tests that are relevant for the original FE method. One way to conduct the diagnostic tests is to execute all the three stages of the FEVD approach manually and then conduct the diagnostic tests. However, given that the third stage estimates are produced with unadjusted standard errors, the validity of the diagnostic tests may be questionable. Given that our data sample consists of a large number of observations, in which the correction of the standard errors may be expected not to have a large impact, in Appendix 3.8 we present also the seperate execution of the three stages and the respective diagnostic tests (Appendix 3.8). The estimates obtained through this approach are highly similar to the estimates using *xtfevd 4.0*, which are presented in the next sub-section.

5.4.2.3 Estimation Results

This section presents the estimation results of the determinants of the loan-loss provisions in the CEE countries during the period 1999-2009. The main variable of interest in this analysis is the *h_stat1*, which measures the impact of banking sector competition on banks' loan-loss provisions (i.e. loan-portfolio quality). The estimation results are presented in Table 5.4 which contains the results of five different model specifications. The first column presents the results of the main model specification and the other columns present alternative model specifications.

Our main variable of interest, the *h_stat1*, has a negative coefficient that is statistically significant at the 10% level. The coefficient of -0.096 suggests that an increase of the H-statistic by one standard deviation reduces the loan-loss provisions to total loans ratio by 0.2 percentage points.[34] This suggests that banking sector competition has had a negative impact on the loan-loss provisions ratio, i.e. has contributed to the improvement of the loan-portfolio quality in the banks operating in the CEE countries. This finding contributes to the literature on the relationship between banking sector competition and risk-taking and is in line with a

[34] The standard deviation of the H-statistic is 2.12.

number of empirical studies in this field such as Schaeck and Čihák (2007), Schaeck et al. (2006), Beck et al. (2003), Jayaratne and Strahan (1998).

Table 5.4 Estimation results (dependent variable: loan-loss provisions/total loans)

VARIABLES	(1) prov_loans	(2) prov_loans	(3) prov_loans	(4) prov_loans	(5) prov_loans
h_stat1	-0.096*	-0.183***			
	(0.050)	(0.057)			
hstat1_dvnoneu		0.501***			
		(0.145)			
h_stat3			-0.089*		
			(0.051)		
lerner_index				0.028**	
				(0.013)	
hhi_dep					-0.002***
					(0.001)
Lagnonintinc_ta	0.016	0.016	0.016	0.009	0.033
	(0.026)	(0.026)	(0.026)	(0.027)	(0.026)
Lagequity_ta	-0.011	-0.012	-0.011	-0.010	-0.005
	(0.024)	(0.024)	(0.024)	(0.028)	(0.024)
Lagnim	-0.076	-0.078	-0.076	-0.072	-0.124*
	(0.069)	(0.069)	(0.069)	(0.076)	(0.067)
logta	-0.720***	-0.772***	-0.725***	-0.823***	-0.713***
	(0.247)	(0.247)	(0.248)	(0.289)	(0.265)
Laggrowth_loans	0.004**	0.003**	0.004**	0.003**	0.003**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
rgdpgrowth	-0.232***	-0.235***	-0.231***	-0.219***	-0.237***
	(0.027)	(0.027)	(0.027)	(0.031)	(0.027)
gdp_percap	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
cpi_ebrd	-0.006	-0.005	-0.006	-0.021	0.040
	(0.043)	(0.044)	(0.044)	(0.050)	(0.043)
ebrd_bankref1	-0.500	-0.802	-0.513	-0.678	-0.786
	(0.695)	(0.701)	(0.696)	(0.914)	(0.694)
dv_foreign	0.187	0.257	0.184	0.446	0.150
	(0.705)	(0.711)	(0.706)	(0.761)	(0.753)
propertyrights_hrt	-0.059***	-0.051**	-0.059***	-0.062**	-0.050**
	(0.021)	(0.021)	(0.021)	(0.025)	(0.021)
dv_origin	0.268	0.286	0.275	0.178	0.256
	(0.608)	(0.613)	(0.609)	(0.672)	(0.644)
logexch_rate	-3.864**	-3.222**	-3.839**	-3.245**	-4.878***
	(1.530)	(1.567)	(1.535)	(1.642)	(1.524)
dv_noneu		-7.195***			
		(2.056)			
eta	1.000	1.000	1.000	1.000	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	32.707***	36.824***	32.602***	31.856***	43.286***
	(8.782)	(10.464)	(8.800)	(9.449)	(8.719)

Observations	1,497	1,497	1,497	1,385	1,527
R-squared	0.476	0.484	0.475	0.468	0.462

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note a): Specification (1) includes the H_stat1 as a measure of competition; Specification (2) includes the interaction term between the H_stat1 and the dummy variable for the non-EU countries (*hstat1_dvnoneu*); Specification (3) includes the H_stat3 as a measure of competition; Specification (4) includes the Lerner Index (*lerner_index*) as a measure of market power; Specification (5) replaces the measures of competition with the degree of market concentration (*HHI_dep*).

Note b): the Stata outputs for all the specifications are presented in Appendix 3.10.

Since the H-statistic (h_stat1) is an estimated variable, it is necessary to correct its standard errors given the additional variance it carries from the first-stage estimation. However, because we run the regression using the *xtfevd 4.0* estimator, which adjusts the standard errors also to account for the fact that the model includes previously estimated variables, we do not conduct further adjustment of the standard errors with means such as bootstrapping that we apply in Chapter 6.

The negative relationship between competition and bank's risk-taking may primarily be attributed to the fact that with more competition depositors have more alternatives where to place their deposits and, as a result, they are more likely to "penalize" the excessive risk-taking banks by moving their deposits to safer banks. Based on the discussion from the theoretical background section, this can be the case when assuming that depositors are well informed on the risk behaviour of the bank. However, as earlier explained, it may not always be the case that depositors are well informed on the risk profile of the bank. Nevertheless, depositors may receive signals that may help them better understand the risk behaviour of the bank. Such a signal may be the deposit interest rates offered by a bank. Rapidly increasing deposit interest rates may imply that the bank behaviour is being too aggressive. Under these conditions, continuously increasing deposit rates up to a certain limit may be attractive for the depositors, but excessively high deposit rates may induce banks to engage in high risk – high return projects, which can induce depositors to shift their deposits to safer banks. In other words, "credit rationing" may take place in the deposits market.

Another argument as to why the increase of competition may lead to lower risk-taking by banks is related to the negative impact of competition on banks' profits. Bank profits are expected to decline when competition increases, primarily due to the expected decline of interest rate margins. A higher degree of risk-taking by banks, as a response to increased competitive measures, would imply larger potential loan-losses and, as a consequence, higher loan-loss provisions that would further reduce bank profits. Therefore, in order to preserve themselves from a further decline of profits, banks may respond to increased competition by taking measures that improve the risk-management. Examples of these measures may include review of the bank's investment strategy as well as the advancement of risk-assessment capacities such as enhancement of screening technologies and investments in personnel training.

Apart from estimating the average impact of competition on loan-loss provisions for the overall sample, we run an additional estimation to check whether competition in the non-EU countries of our sample affects bank's risk-taking differently compared to the EU countries of our sample. To do this, we interact our measure of competition (*h_stat1*) with the dummy variable *dv_noneu* that takes the value 1 if the country is not an EU member. The interaction term between the *h_stat1* and the *dv_noneu* is denoted as *hstat1_dvnoneu*.[35] Specification 2 in Table 5.4 (specification 2) presents the results from the regression that includes the interaction term. According to Brambor et al. (2006), who suggest that the coefficient of one

[35] The inclusion of the interaction term is done by following Brambor et al. (2006), who suggest that in the case of multiplicative interaction models the regression should include all the constitutive terms of the interaction term and the interaction term itself. These authors suggest that the coefficients of the constitutive terms should not be interpreted as average effects. The coefficient of a constitutive term can be interpreted only assuming that the other component of the interaction term equals zero.

of the constitutive components of the interaction term can be interpreted alone only assuming that the other constitutive term equals zero, the coeffiecient of the *h_stat1* represents the impact of banking sector competition on banks' risk-taking only in the EU members (i.e. *dv_noneu*=0). The statistically significant negative coefficient of *h_stat1* suggests that competition reduces the degree of risk-taking in the EU members of the CEE region. However, the statistically significant coefficient of the interaction term *hstat1_dvnoneu* shows that in the non-EU countries of the region competition has an additional impact on risk-taking compared to the EU countries of the region. Hence, in order to estimate the impact of banking sector competition on bank's risk-taking in the non-EU countries, we sum up the coefficient of *h_stat1* and the coefficient of the interaction term *hstat1_dvnoneu*, which together represent the impact of competition on risk-taking in EU countries plus the additional impact for the non-EU countries. The sum of these two coefficients gives a statistically significant coefficient of 0.318 which suggests that, in the non-EU countries of the CEE region, competition has a positive impact on the degree of banks' risk-taking, i.e. higher competition leads to higher banking sector risk (Table 5.5).

Table 5.5. The joint impact of *h_stat1* and *hstat1_dvnoneu*

prov_loans	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
(1)	0.318	0.128	2.48	0.013	0.067	0.570

The relationship between banking sector competition and risk-taking in the non-EU countries appears to be the opposite of the EU countries where competition appeared to reduce the degree of banks' risk-taking. This may reflect deficiencies in other but unobserved factors, given data limitations, which might have affected the relationship between competition and risk-taking in the non-EU members. Such deficiencies may include the quality of the licensing process, which can be affected by the professional capacity of the regulator, but also by potential influences of other factors affecting the licensing process (e.g. political influences). Another important element related to the licensing process is related to the quality of bank applications interested to enter the banking markets. The political instability and weak rule of law that have characterized most of the non-EU countries of the CEE during the period under investigation might have discouraged a number of good-quality foreign banks from entering these markets, creating room for competition to be increased through the licensing of weaker banks. Another potential deficiency in the non-EU countries may be related to the quality of personnel available to the banks. The quality of the personnel largely reflects the quality of education that is provided in these countries, which is generally considered to have lagged behind the EU standards.

As mentioned at the beginning of this section, apart from Specification 1 in which we estimate the relationship between competition and risk-taking using the *h_stat1* (Panzar-Rosse H-statistic) as a measure of competition, we run also a set of additional regressions as robustness checks to the inferences derived from the Specification1. Specification 3 shows that the estimation results appear highly similar also when using the *h_stat3* instead of the *h_stat1* as a measure of competition. This shows that whether the Panzar-Rosse H-statistic is estimated with the interest income or with the total income as the dependent variable does not make any substantial difference with regard to the estimation of the impact of banking sector competition on bank risk-taking.

In specification 4, we replace the H-statistic with the Lerner Index which is a widely used measure of market power. The estimated coefficient of the Lerner Index is positive and statistically significant at the 5% confidence level, suggesting that higher market power leads to higher risk-taking by banks. This result confirms our inference on the impact of competition measured by the Panzar-Rosse H-statistic, where we found that higher competition (i.e. lower market power) leads to lower risk-taking by the banks.

In Specification 5, we replace the H-statistic variable with the Herfindahl-Hirschman Index (*hhi_dep)* which measures the degree of market concentration. The estimated coefficient of the *hhi_dep* is negative and highly significant, suggesting that higher market concentration is associated with a lower level of risk in the banks' loan portfolios. If the Structure-Conduct-Performance paradigm, which claims that a higher degree of market concentration implies a higher degree of market power were to hold, then in our case the sign of the market concentration index should have been the same as the sign of the Lerner Index, which measures market power, and opposite to the sign of the H-statistic that measures competition. In our case, the market concentration index has the same sign as the variable measuring competition (*H_stat1*), which suggests that market concentration may not be capturing the impact of competition, but rather some other features of the market. For example, relationship lending is more likely to take place in more concentrated markets and may have an important impact on the risk taken by the banks. In addition, more concentrated banking markets tend to have fewer banks, which makes the bank-supervision process a more straight-forward task (World Bank, 2013, page 92). Claiming that market concentration does not appear to capture the impact of banking sector competition may serve as evidence in support to Claessens and Laeven (2003) who claimed that concentration and competition describe different features of a banking market.

The remaining part of this section is devoted to the interpretation of the estimated coefficients of the control variables, which are potentially important for the determination of bank's risk level. These variables control for a number of bank-specific, macroeconomic, and institutional factors that may influence the level of risk taken by banks. As presented in Table 5.4, the estimation results for the control variables are quite robust across the different model specifications, so we will focus only in the results from our main model specification (Specification 1).

The coefficient of the *logta* variable, which measures the size of the bank, has a negative and statistically significant coefficient at the 1% level. This shows that larger banks tend to have a lower level of risk in their loan-portfolio, which does not support the “too big to fail” hypothesis. Instead, it suggests that larger banks tend to be safer, which may reflect their advantages in terms of the possession of borrower-specific information, assuming that they have been operating for a longer period in the market, as well as their superior risk-management capacities stemming from their supposedly stronger financial position.

Another bank-specific variable that has resulted statistically significant is the annual growth rate of loans (*Laggrowth_loans*). Higher credit growth rates appear to have led to higher risk-taking, i.e. higher loan-loss provisions. A rapid expansion of loans is likely to be based on lax lending criteria. In order to increase their market shares, banks may choose to deviate from appropriate screening, thus enabling low-quality borrowers to gain access to credit. The other bank-specific variables, consisting of the non-interest income to total assets ratio (*Lagnonintinc_ta*), the equity to total assets ratio (*equity_ta*) and the net interest margin (*nim*) have the expected signs, but do not have a statistically significant impact on the quality of the loan portfolio.

Regarding the country-level indicators, our results show that real GDP growth rate (*rgdpgrowth*) has a negative coefficient, which is statistically significant at the 1% confidence level. This implies that higher GDP growth rates tend to significantly reduce the level of risk in the banks' portfolios, presumably by enhancing the repayment capacity of the borrowers. However, since the allocation of the loan-loss provisions is based also on banks' subjective behaviour, the negative impact of the real GDP growth rate on the loan-loss provisions ratio may also reflect the fact that during good times for the economy banks are more optimistic for the future, so they may tend to allocate less loan-loss provisions to cover potential loan losses, since the repayment capacity of the borrowers is expected to improve.

The exchange rate (*logexch_rate*), which is expressed as national currency/euro ratio, has a statistically significant negative coefficient. This suggests that the depreciation of the national currency improved the loan-repayment capacity of the borrowers, which may reflect the fact that the loan structure in most of the CEE countries is composed of loans denominated in national currency, while foreign currency savings represent substantial part of deposits in some of the countries. Under such conditions, the depreciation of the national currency eases the loan repayment for the foreign currency deposit-holders. The other macroeconomic variables included in our regression, which are the GDP per capita (*gdp_per cap*) and the inflation rate (*cpi_ebrd*), have a statistically insignificant impact on the determination of bank risk-taking in the CEE countries.

The coefficient on the property rights index (*propertyrights*) is negative and statistically significant. A better protection of property rights, which is primarily related to a more efficient judicial system, appears to significantly reduce the level of risk in the bank loan portfolios. In countries with a better protection of property rights, the repayment of loans is better enforced. Non-repaying borrowers may be much more easily induced to restart repaying their loans, otherwise their collateral will be executed and banks' losses will be mitigated. In addition, by being aware of the efficiency of the judicial system, the borrowers will *ex-ante* be more disciplined in terms of the timely repayment of their loans. The other institutional variable included in our regression, which is the EBRD banking reform index (*ebrd_bankref*), has a statistically insignificant coefficient. Even though the banking reform process is considered to have been one of the key factors that improved the stability of the banking system in the transition economies, the insignificant coefficient in our regression may reflect the fact that the main effects from the banking reform were achieved at the beginning of the transition process. Whereas, during the period 1999-2009, which is covered in our analysis, the banking reform index is shown to have been quite static or slowly-moving from year to year. The dummy variables on foreign ownership (*dv_foreign*) and country-of-origin (*dv_origin*) likewise appear to have insignificant coefficients.

Lastly, the coefficient of the variable *eta* that represents the individual fixed effects (i.e. the error term of the second stage FEVD regression) equals 1, which is consistent with the guideline of Plümper and Troeger (2004).

5.5 Conclusions

The theoretical literature on the relationship between banking sector competition and risk-taking remains largely inconclusive with regard to the nature of this relationship. The mainstream theory claims that competition leads to higher risk-taking by banks, but this view has faced criticism from other authors who claim that competition does not necessarily lead to higher risk-taking. The theoretical literature suggests that the relationship between banking sector competition and risk-taking depends also on other factors, such as the disclosure of risk information by banks, the presence of a deposit insurance scheme and information-sharing facilities, and the regulatory capital requirements. The debate on the relationship between banking sector competition and risk-taking remains open also in the empirical literature, where some studies have found a positive relationship and some have found a negative relationship.

The main part of this chapter consists of the empirical estimation of the impact of banking sector competition and banks' risk taking in the CEE countries during the period 1999-2009. In order to use a direct measure of banking sector competition, we estimated the Panzar-Rosse H-statistic for each country and for each year, while the measure of bank risk consists of the ratio of loan-loss provisions to total loans ratio. To our knowledge, this is the first study to use the Panzar-Rosse H-statistic to measure the impact of banking sector competition on risk-taking for a panel of CEE countries. Estimation is conducted using the Fixed Effects Vector Decomposition method.

Despite the fact that the H-statistic has been widely used as a continuous measure of competition, it was acknowledged there are also theoretical arguments that may oppose its use as a continuous measure. However, in the absence of direct supporting empirical evidence, this issue is left to be investigated by future research and we interpret the H-statistic based on the original Panzar-Rosse framework. Another reservation is that the cross-section estimation of the H-statistic has been conducted on small sample sizes and in the presence of outliers. However, in order for our inferences on the impact of competition to be more reliable, we have used also the Lerner Index as an alternative measure of competition.

The estimation results suggest that banking sector competition has had a negative impact on the loan-loss provisions ratio implying that, on average, competition contributed to the improvement of the loan-portfolio quality in the CEE countries during the period 1999-2009. However, the results differ significantly when distinguishing between the EU and non-EU countries of the CEE region. While for the EU countries the relationship between banking sector competition and risk-taking remains negative, this relationship is positive for the non-EU countries of the region, suggesting that an increase of competition in the non-EU countries may be detrimental for the stability of the banking sector in these countries. This result may be reflecting potential unobserved deficiencies in the non-EU countries, such as the quality of the financial institutions licensing process and the quality of personnel available to banks, which might have influenced the relationship between competition and risk-taking in the banking sectors of these countries.

For comparison, we have estimated the Panzar-Rosse H-statistic also using the total income as the dependent variable (in addition to the H-statistic that was estimated with interest income as dependent variable), and the results with respect to the impact of competition on risk-taking remain similar. In addition, the results remain similar also when replacing the H-statistic with the Lerner Index, which is an alternative measure of market power. The coefficient on the Lerner Index resulted significantly positive, suggesting that market power increases the degree of risk-taking, thus confirming our results on the negative relationship between competition and risk-taking. Another alternative measure used in our regression consists of the market concentration index, which resulted in a significantly negative coefficient, suggesting that banks operating in more concentrated markets tend to undertake lower risks. This result implies that market concentration has a similar impact to competition, which is in contradiction to the SCP paradigm that views concentration as an inverse measure of competition. This finding might serve as evidence in favour of the view that competition and concentration measure different features of the market.

Regarding the impact of the other control variables that are included in the regression, the results suggest that bank size is negatively related to the bank's risk-taking, while the higher growth rate of loans tends to lead to higher risk-taking. The overall performance of the economy seems to be highly important for the quality of the loan portfolio. Higher real GDP growth rates appear to improve the quality of loans. The loan-portfolio quality appeared to have been significantly enhanced also from the national currency depreciation. Another factor that appears to have had a highly significant impact on the enhancement of loan-portfolio quality is the protection of property rights. In general, the results suggest that the quality of the banks' loan portfolios is mostly determined by factors related to the operating environment, which may be exogenous to banks' actions.

CHAPTER 6

The Impact of Banking Sector Competition on Net Interest Margins in CEE Countries

6.1 Introduction

One of the key objectives of the transition process in the CEE economies was the establishment of sound and efficient banking sectors. After a decade of deep reforms which, among others, included the privatization of state-owned banks and the "opening-up" to foreign bank entry, the banking sectors of the CEE countries were able to achieve stability and improve the financial intermediation efficiency. The entry of the foreign banks was associated with the adoption of modern commercial banking techniques, which led to a more prudent and efficient banking sector in all the countries. During the second decade of the transition process, financial intermediation costs pursued a declining trend, but still remained at a higher level compared to the average of the Euro Area (see chapter 2).

High interest margins, despite the potential positive effects for the profitability and sustainability of the banks, are viewed as signals of financial intermediation inefficiency and, as such, are considered to have a negative impact on economic activity (Chortareas et al., 2012). When interest margins are high, potential savers are discouraged by the low deposit rates, and credit expansion is impeded by the high loan interest rates, thus negatively affecting investment. This is particularly important for the CEE and other countries that lack well-functioning equity markets. In the absence of developed equity and bond markets, financing options for the enterprises are much more limited, so the economy is more dependent on the financing from the banking sector and more sensitive to banks' net interest margins.

The theoretical and empirical literature emphasizes a number of factors that are considered to have an important role in determining the level of interest margins. One of the factors most frequently "blamed" for the high level of interest margins is lack of competition. The economic reasoning for the relationship between banking sector competition and interest margins, in general, is as follows: the lack of competition provides banks with market power which enable them to charge high interest margins and earn monopoly rents, while discouraging attempts to enhance their efficiency. The empirical studies investigating the determinants of the interest margins have mostly found a negative relationship, suggesting that higher competition leads to lower interest margins. A few studies have investigated this relationship for the CEE region and have similarly found that competition reduces the interest margins.

However, the majority of empirical studies that have investigated the determinants of interest margins have used the market concentration index as a measure of competition. Even though largely used in the literature, according to some of the theories elaborated in chapter 3, concentration may not represent an adequate measure of competition. In this context, the findings on the relationship between market concentration and interest margins might not be reflecting the relationship between competition and interest margins. Hence, in order to estimate the relationship between banking sector competition and interest margins in the CEE countries, we use a direct measure of competition consisting of the Panzar-Rosse H-statistic for each country/year that we have estimated in chapter 5. To the best of our knowledge, this is the first study to use the Panzar-Rosse H-statistic in estimating the relationship between banking sector competition and interest margins for the CEE countries. In addition, we employ also the Lerner Index, which is an alternative non-structural measure of market power. In order to make our results comparable to other studies, we run an additional regression using the market concentration index instead of the competition measure. The regression controls also for the impact of other variables, including bank-specific variables, macroeconomic variables, and institutional variables. For the dependent variable, we follow the majority of the studies in this field that use the net interest margin, which is a measure of financial intermediation cost. The estimation is dynamic, conducted on panel data, and uses the General Method of Moments.

This chapter is organized as follows. Section 6.2 presents a review of theory and empirical literature on the determinants of the interest margins. Section 6.3 deals with the estimation of the impact of banking sector competition on net interest margins in the CEE countries, and includes the model description, the estimation methodology, and the estimation results. Section 6.4 concludes.

6.2 Determinants of Interest Rate Margins: Review of Theories and Empirical Studies

This section presents a review of the theoretical and empirical studies on the determinants of the interest rate margins. The theoretical review starts with a discussion of the Ho and Saunders (1981) "dealership model", which has provided the basis for the analysis of the determinants of interest rate margins. Since the main focus of this study is related to the effects of competition on interest rate margins, the section addresses this relationship also from the perspective of efficiency and banks' risk-taking theories. The section continues with a review of the empirical studies, focusing on the impact of competition on interest rate margins.

6.2.1 Theoretical Background on the determinants of interest rate margins

The examination of the determinants of the banks' interest margins has primarily started from the pioneer work of Ho and Saunders (1981) who developed a model on the determinants of interest margins, where banks are viewed as risk-averse 'dealers' demanding one type of deposits and supplying one type of loans. For this reason, the Ho and Saunders model in the literature is known also as the "dealership model".

The model considers that in the process of financial intermediation, i.e. the collection of deposits and the supplying of loans, banks face uncertainty. This uncertainty primarily is sourced from the fact that the supply of deposits to the bank and the demand for bank loans is considered to have a stochastic nature, meaning that the inflow of the deposits in the bank and the demand for bank loans is not considered to take place in the same time, which makes it likely that banks will be holding unmatched portfolios of loans and deposits, thus potentially needing to invest in, or get financing from money markets. As a result, banks face the risk to either hold a “long” or a “short” position in the short-term money market, which exposes them to the interest rate risk.

The bank might be holding a “long” position in the short-term money market when the amount of deposits exceeds the amount of loans. To simplify the argument, Ho and Saunders suppose that the bank receives a long-term deposit for which it agrees to pay an interest rate until its maturity, while no demand for loan has yet taken place. Since there is no demand for loans, the bank will have to invest the funds in the money market at a risk-free short-term rate. By doing so the bank faces a reinvestment risk if the money market short-term rate falls at the end of the period, because the bank would have to continue paying the same deposit interest rate while having to reinvest its deposits in the money market at a lower interest rate. Similarly, the bank faces an interest rate risk if its position in the money market is “short”, which implies that the amount of issued loans exceeds the amount of deposits received. The bank can have a “short” position in the money market if, for example, the bank receives a demand for a long-term loan while no deposits inflow has taken place. In order to fund the loan, the bank will have to borrow in the short-term money market for which it will have to pay an interest rate. This exposes the bank to the refinancing risk if the short-term money market rate were to increase in the end of the period, because the bank would have to continue receiving the agreed loan interest rate while having to pay a higher short-term interest rate on the borrowings from the money market.

Being risk-averse as assumed by the model, the bank will have to set interest rates on deposits and loans to minimise the potential risks emanating from the fluctuations of the interest rates in the money market. Hence, in order to minimize these risks, the bank will set a deposit rate lower than the money market rate, while the loan interest rate will be set at a higher level than the money market rate, i.e. the bank will apply a risk-premium on the money market rate. The difference between the loan interest rate set by the bank and the deposit interest rate is known as the interest rate spread or as the interest rate margin. Ho and Saunders refer to the interest rate spread that is set to protect against such transactions uncertainties that arise from the risk of money market rate fluctuations as the *pure spread*.

However, the decision-making problem that banks face is to determine the optimal interest rate spread, i.e. the interest rate spread that maximizes their expected utility. According to the Ho and Saunders model, the optimal interest rate spread will depend on four factors which represent the main determinants of the interest rate spread: a) the market structure in which the bank operates; b) the degree of risk aversion of the bank's management; c) the average size of bank transactions; and d) the variance of interest rates.

The model predicts that banks will set higher interest rate spreads if they face relatively inelastic demand and supply functions in the markets where they operate, which enables them to exert monopoly power and set higher interest rate spreads. Conversely, under higher banking sector competition the demand for loans and the supply of deposits are characterized by higher price-elasticity. Competition increases the price-elasticity, because both borrowers and depositors have more alternatives to borrow from, and to deposit their money in. In a competitive market, a bank that increases the loan interest rate would face a lower demand for loans, because the potential borrowers would flee to other banks and *vice versa* if the bank reduces the interest rate. Similarly, banks that offer higher deposit interest rates would be able to attract more deposits; and *vice versa* for the banks that offer lower deposit rates. Hence, competition is considered to reduce the interest rate margin, since banks would tend to set lower loan interest rates in order to be able to lend more and higher deposit interest rates in order to attract more deposits. However, as far as the bank's management is risk-averse, the interest rate spread will be positive even if the market is highly competitive, because banks will always apply a risk-premium on the interest rate to protect themselves from potential losses.

The variance of interest rates is considered to have a positive impact on the interest margin, since banks will set higher premiums to compensate for the potential losses arising from the fluctuations in the money market interest rates. As explained above, since banks are viewed as entities that keep unmatched portfolio of loans and deposits, they may often need to reinvest in, or to get refinancing from the money market at different interest rates. This represents a source of uncertainty for the banks.

The interest rate spread is considered to be positively related also to the degree of the risk-aversion of the bank's management and the size of bank transactions. The original study of Ho and Saunders (1981) does not provide a more detailed elaboration on the relationship of these two influences and the interest margin. Hence, we will expand the discussion on these relationships in section 6.3.1 which describes the variables that are included in our empirical model for the investigation of the determinants of the net interest margins in the CEE countries.

In spite of the fact that the main source of the risk in the Ho and Saunders model is the interest rate risk deriving from the unmatched portfolio of loans and deposits, the size of the gap between the volume of loans and deposits is not among the factors considered to determine the size of the interest rate spread. According to the authors, in cases when deposits are greater than loans the bank will reduce the deposit interest rate to discourage the additional deposits and also reduce the loan interest rate to induce the demand for loans, such that the interest rate spread remains the same. The bank will act similarly also when the demand for loans is greater than the inflow of deposits by increasing the loan interest rate to discourage the demand for loans and increasing the deposit rate to attract additional deposits, such that the interest rate spread does not change.

The Ho and Saunders (1981) model, which assumes that banks' loan portfolio is homogenous, was extended by Allen (1988) who accounts for heterogeneity in the loan portfolio, by considering two types of loans. According to the author, product diversification can enable the bank to set optimal interest rate spreads for individual products, which can result in a lower overall interest rate spread. The Allen (1988) model was further expanded by Valverde and Fernández (2007), who assume that the bank portfolio is composed of loans and non-traditional assets (which include fee generating assets and other earning assets that are different from loans) and deposits.

Further extensions to the Ho and Saunders (1981) model include Angbazo (1997) who expands the model to take into account also the credit risk, i.e. the probability of loan default, claiming that a higher probability of loan default has a positive impact on the interest margin. Another extension to the model was done by Maudos and Fernández de Guevara (2004) who take into account the productive nature of the bank by including within the factors determining the interest rate spread production costs arising in the process of collecting deposits and issuing loans. The authors predict that production costs have a positive impact on the interest rate margin.

To summarise, the examination of the determinants of the bank interest margins has begun with the "dealership model" of Ho and Saunders (1981) which was later extended by other authors in order to account for additional factors potentially determining the interest rate spread. In all these models, the degree of market competition is one of the main determinants of the interest rate spread and its impact is predicted to be negative, implying that higher competition will lead to lower interest rate spreads.

6.2.2 Competition and interest rate margins: the perspective of efficiency theories

Bank interest margins are often viewed as a reflection of the degree of financial intermediation efficiency (Claeys and Vennet, 2008; Demirgüç-Kunt and Huizinga, 1999; Sologoub, 2006). A higher interest margin is considered to reflect a lower level of bank's efficiency. Inefficient banks are predicted to set higher interest margins in order to compensate for the additional costs that arise from their cost inefficiencies. However, banks may be able to set higher interest margins to compensate for their inefficiencies only if banking markets operate under imperfect competition, otherwise the inefficient banks would not be able to survive in competitive markets.[36] When competition increases, banks are likely to compete through their interest rates, with the banks applying lower interest margins being more likely to increase their market shares and survive in the market. However, banks may not necessarily be able to reduce their interest margins without enhancing their efficiency. Therefore, the increase of competition may induce banks to enhance their efficiency in order to be able to set more competitive interest margins. However, even though most of the theories predict that competition enhances efficiency, there are also views that argue for a negative impact of competition on the degree of efficiency. Hence, in this section we discuss the theories linking banking sector competition to the efficiency in order to better understand the potential impact of banking sector competition on interest rate margins, which is the focus of our analysis.

[36] The hypothesis that banking systems operate in uncompetitive markets has been confirmed by many empirical studies, including our results from Chapter 4 for the CEE countries as well as by other empirical studies such as De Bandt and Davis (2000) and Bikker et al. (2007).

The debate on the relationship between competition and efficiency was initiated by Hicks (1935) who came up with the "quiet life" hypothesis, which suggests that monopoly firms are less efficient compared to firms operating in more competitive markets. According to this hypothesis, monopoly banks' managers live a "quiet life", given that market power enables them to charge higher prices and, consequently, realize satisfactory profits without taking effort to cut their expenditures. However, this hypothesis is challenged by the fact that it does not explain why the owners of monopoly firms would exercise less control on the effort of the managers compared to the owners of the competitive firms. According to Jensen and Meckling (1976), the owner of a monopoly firm has the same incentives to monitor his managers as the owner of a firm under a competitive market. However, considering that the monopoly firms are likely to face lower price elasticity of demand, one reason for less monitoring under monopoly can be that the managers can more easily use price increase to satisfy the profit expectations of the owners, thus reducing the incentives of the owners to control the managers' effort in ensuring cost-efficiency.

The view that competition increases efficiency is shared also by Leibenstein (1966), who suggests that this happens for two reasons. First, when competition increases, the firm's profits are likely to decline, so the firm is exposed to the risk of bankruptcy. Hence, in order to avoid the personal costs from the potential bankruptcy of the firm, the managers are motivated to exert more effort to increase efficiency and so preserve the firm's profits. Second, when the number of firms increases, this enables the owners to compare the performance of their own firm relative to the other firms, thus providing a better tool for assessing the effort of the managers. In terms of the impact of competition on bank interest margins, the additional effort of the managers to increase efficiency by reducing costs will enable them to compete with other banks by setting lower interest margins.

Other views on the relationship between competition and efficiency are presented by Berger and Hannan (1998), who base this relationship on four pillars. First, market power enables the firm to charge higher prices, which provide higher profits to the owners, while managers will benefit in the form of a "quiet life", i.e. managers will not be concerned to increase cost-efficiency. Second, in the absence of competition, managers can pursue objectives other than profit-maximization by spending more on staff or other utility-enhancing inputs. This can be related to the argument of Leibenstein (1966), according to which, when the market is operated by fewer firms, the owners are limited in terms of their ability to assess the managers' effort given that their performance cannot be compared to other firms' performance. Third, the managers of monopoly firms may incur additional costs by allocating resources to activities that help them to retain market power. For example, bank managers can allocate resources to lobbying to limit the issuance of new banking licences or to restrict the geographic expansion of bank branches. These activities may deter efficiency due to the additional costs, even though they may translate into higher profits due to the retention of market power. Fourth, the ability to charge higher prices due to market power and to ensure economic profits for the owners may let incompetent managers persist over time. Whereas, in more competitive markets, competitive pressures will force the managers to be more efficient and keep the costs low in order to remain price competitive. The inability to do so may serve as a signal that changes in the management structure are needed.

Considering that, compared to other firms, banks are more exposed to asymmetric information problems, Pruteano-Podpiera et al. (2008) propose a different view regarding the relationship between competition and efficiency, which is more specifically related to the banking industry. The view of Pruteano-Podpiera et al. (2008) on the link between banking sector competition and efficiency is called the 'banking specificities' hypothesis. This hypothesis is largely based on the concept of relationship-lending that refers to a long-lasting relationship between the bank and the client, during which the bank benefits by accumulating borrower-specific information. This information on the borrowers is expected to help the bank avoid the adverse selection problems in its future decisions and avoid potential moral hazard from borrowers. However, as elaborated in chapter 5, relationship-lending tends to decrease when the number of banks increases, since the potential borrowers face a larger number of alternatives, making it difficult for a bank to maintain strong ties with its clients. In this context, the 'banking specificities' hypothesis claims that, by reducing relationship-lending, the increase of competition necessitates the increase of screening and monitoring by banks, which entails additional expenses and reduces the efficiency of the bank.

To summarise, most of the theories on the relationship between competition and efficiency predict that higher competition enhances efficiency, which in the case of the banking sector is expected to translate into lower interest margins. However, the 'banking specificities' hypothesis predicts that competition may have a negative impact on banks' efficiency, thus leading to higher interest rate margins.

6.2.3 Competition and interest rate margins: the perspective of bank risk-taking theories

The impact of banking sector competition on interest rate margins has been treated also in the literature addressing the link between competition and banks' risk-taking. Most of the studies in this field focus on the competition for deposits, arguing that as banks face more competition they tend to attract additional deposits by offering higher deposit interest rates in order then to be able to seize larger shares in the loans market (Keeley, 1990; Hellman et al., 2000; Repullo, 2003). Under competitive conditions, banks will not be able to compensate higher deposit rates by increasing loan rates. Instead, banks are more likely to reduce the loan interest rates when competition increases in order to maintain/increase their shares in the loans market. As a result, the increase of competition is expected to result in lower interest rate margins.

However, some authors argue that the increase of competition does not necessarily lead to higher deposit rates. According to Cordello and Yeyati (1998) and Shy and Stanbecka (1998), when the bank risk is observable, depositors are ready to accept even lower interest rates on their deposits from the banks that are viewed as safer in terms of asset quality. Hence, instead of competing through interest rates, banks may decide to use the quality of their assets as a strategic instrument to compete in the market for deposits.

Similarly, Chen (2007) argues that banking sector competition does not necessarily affect the interest margins. According to this author, banks can compete by offering lower loan interest rates as well as by increasing the screening of the loan applicants. In this view, apart from preferring lower loan interest rates, "good" borrowers may also prefer better screening by the bank in order to more easily distinguish themselves from the potentially "bad" borrowers. This will benefit the good borrowers by granting them easier and more favourable access to bank finance in the future.

Covitz and Heitfield (1999) present a different view regarding the impact of banking sector competition on interest rates, arguing that banks operating in more competitive markets charge higher loan interest rates. According to this view, in a monopoly market, borrowers are more restricted to obey the terms and conditions set by the bank, since they do not have alternative sources to secure bank financing. In this context, if the bank considers that the loan applicant's project bears excessive risk, it can either refuse to finance the project or may request the applicant to revise the project. Since in more competitive markets borrowers have more financing alternatives, banks are more reluctant to refuse the loan applications and are more limited in terms of affecting the level of risk in the loan applicant's project. According to the view of Covitz and Heitfield (1999), the riskier borrowers in more competitive markets tend to compensate the bank for the higher risk by being ready to pay higher loan interest rates.

6.2.4 Review of empirical studies

This section presents a review of the empirical literature that examines the determinants of net interest margins. The main focus of the section is the impact of banking sector competition on the net interest margin, which is also the main focus of this chapter. The empirical literature dealing with this issue has mostly followed the dealership model of Ho and Saunders (1981) who examined the determinants of the interest rate margins both theoretically and empirically. In both cases, competition is viewed as an important determinant of the interest rate margins. The studies that have followed the dealership model can be separated into the group that examines the determinants of the interest margin based on a two-stage model, which is in line with the original empirical estimation of Ho and Saunders (1981), and the group of studies that adapt the Ho and Saunders model into a single-stage model.

The main motivation to use a two-stage model is to initially estimate the *pure spread* which, as defined in the section 6.2.1, represents the interest rate spread that banks set to preserve themselves from money-market transaction uncertainties. The two-stage approach was first used by Ho and Saunders (1981) for a sample of over 100 major US banks, using quarterly data for the period 1976–1979. The first step of the model consists of cross-section estimations of the actual net interest margins on a set of bank-specific variables that were not taken into account in the theoretical model. These variables consist of: a) implicit interest payments[37], b) the opportunity cost of non-interest bearing reserve requirements; and c) the risk of loan default. The intercept term of these cross-section regressions represents the *pure spread* which implies that, at any time, the observable net interest margins will comprise of a *pure spread*, due to the underlying transactions uncertainty, plus the mark-ups for the implicit interest payments, the opportunity cost of non-interest bearing reserve requirements, and for the risk of loan default. Hence, the first step of the model will generate an estimate of the *pure spread* for the banks in the sample for each period, which is then used as a dependent variable in the second stage of the model. In the second stage, the dependent variable *pure spread* is regressed on the "theoretically motivated" variables that were accounted for in the Ho and Saunders (1981) theoretical model, which are: the market structure; the degree of bank's management risk aversion; the average size of bank's transactions; and the variance of interest rates.

The two-stage approach of Ho and Saunders (1981) was followed also by other authors such as Saunders and Schumacher (2000), Brock and Suarez (2000), and Männasoo (2012). Saunders and Schumacher (2000) investigate the determinants of interest rate margins in six selected EU countries and US for the period 1988-1995. Their findings suggest that banks operating in banking systems that are more restricted in terms of geographic restrictions on branching and universality of banking services appear to have higher interest rate spreads due to the higher monopoly power they may possess. A similar approach was followed also by Brock and Suarez (2000) for a sample of Latin American countries and Männasoo (2012) for Estonia, but they did not control explicitly for the impact of competition on the net interest margin.

[37] Implicit interest payments represent the payments through service charge remissions or other types of subsidies to the depositors due to the regulatory restrictions on the explicit deposit interest rate payments.

The other group of studies applying the dealership model have followed a single-stage model, where the net interest margin is estimated on a set of explanatory variables, which include the variables that were considered both in the theoretical and the empirical model of Ho and Saunders (1981). A number of authors have extended the model to account for additional explanatory variables, such as those capturing macroeconomic developments and institutional factors. One of the first studies to apply a single-stage dealership model is Demirgüç-Kunt and Huizinga (1999) who investigated the determinants of bank interest margins for a sample of 80 countries for the period 1988-1995. The authors estimate the determinants of the net interest margins by using a comprehensive set of explanatory variables, including variables explaining bank characteristics, macroeconomic indicators, financial structure variables, taxation and regulatory variables, and legal and institutional indexes. The impact of banks' market power on the interest margins is intended to be captured by the market concentration index, which was found to have a positive but statistically insignificant impact on the net interest margins. An insignificant impact of concentration on the net interest margin was found also by Velverde and Fernández (2007) for a sample of seven EU countries, and by Chortareas et al. (2012) for a sample of Latin American countries.

Other studies using the market concentration as a proxy for the market power have mostly found a positive and statistically significant impact on the net interest margin, suggesting that a higher degree of market concentration provides banks with a higher degree of market power which, in turn, enables them to set higher interest margins (Corvoisier and Gropp, 2001; Demirgüç-Kunt et al., 2003; Peria and Mody, 2004; Gelos, 2006; Hassan Khan and Khan, 2010; Schwaiger and Liebeg, 2007; Claeys and Vander Vennet, 2008). Nevertheless, there are studies such as Tarus et al. (2012), who have found a negative relationship between market concentration and net interest margins for the banking system of Kenya in the period

2000-2009. They justify their findings based on the fact that the banking system of Kenya is dominated by foreign banks, which tend to apply lower interest rate margins.

The literature on the determinants of the interest rate margins has paid attention also to the region of the Central and Eastern Europe, which is also the main focus of our study. These studies include Claeys and Vander Vennet (2008) for a sample of 31 Western and Eastern Europe countries for the period 1994-2001; Schwaiger and Liebeg (2007) for a sample of ten CEE countries that are EU member states and Croatia for the period 2000-2005; Kasman et al. (2010) for the new EU members and the candidate countries for the period 1996-2005; and Poghosyan (2010) for a sample of 11 CEE countries for the period 1995-2006. These studies have found a positive relationship between the market power and the net interest margin, except Poghosyan (2010) who has found a statistically insignificant impact of market power on the net interest margin.

Most empirical studies that have investigated the determinants of the banks' interest margins have used the degree of the market concentration as a proxy for market power. The use of the degree of market concentration as proxy for market power is based on the SCP paradigm, which is considerably criticized for claiming that a higher degree of market concentration implies a lower degree of competition (see chapter 3 for a detailed discussion on these issues). Therefore, it is questionable whether the results of these empirical studies on the impact of concentration on the net interest margins can be taken as valid inferences for the impact of market power/competition on net interest margins.

A few studies have used more direct measures of the market power/competition, which are known as non-structural measures of competition. In this regard, Chortareas et al. (2012), in a study covering nine Latin American countries for the period 1999-2006 use the Panzar-Rosse

H-statistic as a measure of competition and find a significantly negative relationship between the H-statistic and the net interest margin, suggesting that higher banking sector competition leads to lower interest margins. The H-statistic was used also by Gelos (2006), but its relationship with the interest margin appeared statistically insignificant. However, none of these studies consider the fact that the H-statistic itself is an estimated variable, which contains its own standard errors that should be corrected when applied in a second-stage regression; otherwise, the standard errors in the second-stage regression do not reflect the imprecision of the first-stage estimation. Some other studies have used the Lerner Index to control for the impact of market power on the banks' interest margins. Maudos and Fernández de Guevara (2004) used the Lerner Index in a study covering five EU countries for the period 1993-2000, where they found a positive relationship between the Lerner Index and the net interest margin, suggesting that higher market power leads to higher interest margins. Similarly, Kasman et al. (2010) used the Lerner Index in a sample of the new EU members and the EU candidate countries for the period 1996-2005 and found a positive relationship.

The literature that has used the dealership model to estimate the determinants of the net interest margins is mostly based on static models for panel data, with only few studies using dynamic models. Valverde and Fernández (2007) use the General Method of Moments (GMM) to account for the dynamics in the model, considering that the past values of the interest margins will affect the current values. The GMM approach was applied also by Chortareas et al. (2012). In both cases, the lagged dependent variable, i.e. the lagged interest margin, is statistically significant suggesting that the current values of the interest margins are affected by the past values.

6.3 Estimation of the impact of banking sector competition on net interest margins in the CEE countries

This section presents the estimation of the determinants of the net interest margins in 15 CEE countries for the period 1999-2009, where the main focus is the investigation of the impact of banking sector competition. The estimation uses data on 285 banks with a total of around 1,500 yearly observations. This section describes the model used to estimate this relationship and continues with the discussion of the estimation methodogy, which is followed by the interpretation of the estimation results.

6.3.1 Model description

For the estimation of the determinants of interest margins we follow the literature applying single-stage dealership models, given that the main objective of our exercise is to estimate the impact of competition on the interest margin that is derived from actual data, rather than the impact on the *pure spread* which is an estimated variable and may not be a sufficiently precise estimate. Moreover, the constant term of a regression picks up the influence on the dependent variable of all omitted systematic influences. So, in the two-stage approach the assumption has to be imposed that the pure spread is the only omitted systematic influence. If this is not the case, then what is being estimated is not the pure spread alone (as claimed by the methodology).

The explanatory variables included in our regression consist of bank specific variables that are mainly in line with Maudos and Fernández de Guevara (2004) but, in order to capture the potential impact of the overall macroeconomic environment and the institutional factors on the interest margins we expand the set of explanatory variables to include also macroeconomic and institutional variables in line with Demirgüç-Kunt and Huizinga (1999). Hence, the model takes the following form:

$$nim_{it} = \alpha_0 + \beta_1 Lagnim_{it-1} + \beta_2 Hstat_{it} + \beta_3 equity\_ta_{it} + \beta_4 nonint\,inc\_ta_{it} + \beta_5 \log grossloans_{it} +$$
$$\beta_6 prov\_loans_{it} + \beta_7 lqdassets\_custstfunding_{it} + \beta_8 nonint\exp\_ta_{it} + \beta_9 earningassets\_ta_{it} +$$
$$\beta_{10} bankdep\_custdep_{it} + \beta_{11} ebrd\_bankref_{it} + \beta_{12} economic\_freedom_{it} + \beta_{13} rgdpgrowth_{it} +$$
$$\beta_{14} gdp\_percap_{it} + \beta_{15} cpi\_ebrd_{it} + \beta_{16} dv\_foreign_{it} + \beta_{17} dv\_norigin_{it} + \beta_{18} dv\_year_{it} +$$
$$\beta_{19} dv\_country_{it} + \varepsilon_{it}$$

(6.1.)

Where, *i* (1,...*n*) indexes the banks and *t* (1,..,*T*) the years.

Table 6.1 Description of variables

Variables	**Description**
nim	Net interest margin: (interest income - interest expenses)/average earning assets
Lagnim	lagged dependent variable
h-stat	Panzar Rosse H-statistic
equity_ta	equity / total assets
nonintinc_ta	total non-interest operating income / total assets
loggross_loans	Logarithm of gross loans
prov_loans	loan-loss provisions / total loans
lqdassets_custstfunding	liquid assets / customer deposits and short-term funding
nonintexp_ta	total non-interest expenses / total assets
earningassets_ta	total earning assets / total assets
bankdep_custdep	bank deposits / customer deposits
ebrd_bankref	EBRD index of banking reform
economic_freedom	Economic Freedom Index (Heritage Foundation)
rgdpgrowth	real GDP growth rate

gdp_percap	gdp per capita
cpi_ebrd	inflation
dv_foreign	dummy variable for foreign ownership (1 for foreign ownership)
dv_origin	dummy variable for the country-of-origin of the bank (1 for EU-12 or US)
dv_year	dummy variable for year
dv_country	dummy variable for country

For the dependent variable we follow the majority of studies that investigate the determinants of the interest margins by using the Net Interest Margin (NIM), which is calculated as total interest income minus total interest expenditures divided by total earning assets. By choosing the NIM for the dependent variable, we decide to use an *ex-post* measure of interest margins rather than an *ex-ante* measure. The *ex-post* measure is calculated by using actual interest income and interest expenditure data, whereas the *ex-ante* measure of the interest margin is calculated from the contractual interest rates on loans and deposits. The *ex-post* interest margin is considered to be a better measure compared to the *ex-ante*, since the *ex-post* measure includes only the interest that is received by the bank, thus controlling for the unpaid interest from the defaulted loans. Nevertheless, the default risk premium is still incorporated in the *ex-post* measure, since the risk-averse banks will set higher interest margins in order to be compensated for the perceived credit default risk (Gelos, 2006). In addition, *ex-ante* interest margins are difficult to use in a study like this given that the available databases usually report the *ex-ante* interest rates at the country level and not for the individual banks. Moreover, the *ex-ante* interest rates are usually collected from different sources, thus making inter-country comparisons more difficult.

As mentioned in section 6.2.4, most of the studies investigating the determinants of the net interest margins use the market concentration indices to control for banking sector competition. However, by recalling the discussion on the efficient structure hypothesis and the contestability theory from chapter 3, it may be considered that market concentration may not be an adequate measure of banking sector competition. In addition, the market concentration index takes into account only the banks operating within a country, thus excluding the potential competitive pressures coming from outside a country's borders, which is especially important for the EU member states that have more integrated financial sectors. Taking into account these criticisms, we consider that inferences on the relationship between competition and the net interest margins derived from studies that use the degree of market concentration as a proxy for competition might be questionable.

Therefore, to control for the impact of banking sector competition on the net interest margins, we use the H-statistic (*h_stat1*) that is produced by using the Panzar-Rosse approach, which directly quantifies the competitive behaviour of the bank (chapter 3 provides a detailed explanation of the Panzar-Rosse approach). To our knowledge, this is the first study to use the H-statistic as a measure of competition within the literature investigating the determinants of bank interest margins in the CEE countries, and one of the few within the overall literature in this field. The use of the H-statistic marks an important difference also to the study of Maudos and Fernández de Guevara (2004) which, otherwise, we largely follow with respect to the choice of explanatory variables. The procedure and the results of the estimation of the H-statistic for each country/year are presented in chapter 5 (Section 5.4.1). Unlike Gelos (2006) and Chortareas et al. (2012), who do not acknowledge the fact that the H-statistic is an estimated variable, we acknowledge this fact and apply the bootstraping technique to correct the standard errors of the H-statistic. As higher values of the H-statistic reflect higher degree of competition, the expected sign of the H-statistic with regard to its impact on the NIM is negative, meaning that competition is expected to reduce the net interest margins. Under more competition, banks are expected to use the reduction of the interest margins as a competing strategy for increasing/maintaining their market share. By reducing the interest margins, banks will be offering higher deposit interest rates in order to become more attractive to the depositors and lower loan interest rates in order to induce the demand for loans. For comparison, we run a separate regression in which we replace the *h_stat1* variable with the *h_stat3*. As explained in the previous section, these two measures differ from each other with respect to the dependent variable that has been used when they were estimated.[38] The investigation in this chapter assumes the interpretation of the H-statistic as a continuous variable, as in chapter 5, and the supporting literature for, and possible caveats to this, are discussed in section 5.4.2.1.

In order to verify our inferences on the impact of competition on the net interest margin, we run a separate model using the Lerner Index (*lerner_index*) as a measure of market power. The Lerner Index is obtained from the study of Efthyvoulou and Yildirim (2013) who have estimated this index for individual CEE countries for each year in the period 2002-2010.[39] The Lerner Index is considered to be inversely related to the H-statistic, with higher values of the Lerner Index implying higher market power. Hence, the expected sign of the Lerner Index is positive, with higher market power being expected to lead to higher interest margins. For comparison with other studies, we also run a regression that controls for the impact of the Herfindahl-Hirschman Index (*hhi_dep*) which is a measure of market concentration.

[38] The dependent variable in a Panzar-Rosse model may be the bank's interest income or the total income. Since there is no conclusive argument on which is more appropriate, in order to test for robustness, we have run separate cross-section estimations using both the interest income as the dependent variable and the total income. The *h_stat1* variable was estimated using interest income as the dependent variable; and the *h_stat3* was estimated using total income as the dependent variable.

[39] The Lerner Index estimates are not available for Estonia and Lithuania.

The model controls also for other variables which can be classified in three categories: a) bank-specific variables; b) institutional variables; and c) macroeconomic variables.

a) Bank-specific variables

The degree of risk aversion (*equity_ta*)

In line with the original dealership model, one of the variables in our model controls for the degree of risk aversion, which is proxied by the equity to total assets ratio (*equity_ta*).[40] Banks holding higher equity ratios are considered to be more risk-averse, because the costs associated with a potential bankruptcy would imply the loss of their equity. And more risk-averse banks are expected to have higher net interest margins, according to Ho and Saunders (1981). In addition, since equity financing is considered to be more expensive than external financing, banks holding higher equity ratios are expected to set higher interest margins in order to compensate for the higher costs of holding equity. According to Claeys and Vennet (2008), the relationship between banks capitalization and the interest margin is expected to be positive for two reasons. First, a high capitalization ratio enables the bank to increase the portfolio of riskier assets which have higher rates of return, thus leading to a higher interest rate margin. Second, a higher capitalization ratio serves as a good signal of bank's creditworthiness, thus making the bank more attractive to depositors willing to deposit their money in safer banks at lower deposit interest rates. On the other hand, according to Molyneux et al. (1994), the equity ratio may have a negative impact on a bank's interest income since better capitalized banks tend to be more conservative and, hence, invest in less risky assets which also have lower interest rates. Following Demirgüç-Kunt and Huizinga

[40] According to Maudos and Fernández de Guevara (2004), the degree of risk-aversion would be better reflected by the amount of capital held in excess of the regulatory capital requirements. However, the data on the capital adequacy ratio in the BankScope database is available only for a small number of the banks. Hence, the equity to total assets ratio is the most widely used measure of the degree of risk-aversion in the empirical literature.

(1999), the capitalization ratio in our model is treated as a potentially endogenous variable with the NIM. Banks that have higher interest margins may be considered to have also higher profits which, in turn, may enable them to raise additional capital.

Credit default risk (*prov_loans*)

Since our measure of the interest margin is calculated based on *ex-post* interest revenues and expenses, we consider that the impact of the credit risk on the net interest margin may be treated from two perspectives: first, a higher credit risk may have a positive impact on the NIM, since banks are expected to set higher risk premiums on the loan interest rates in order to compensate for the potential losses associated with credit default; second, the impact on the NIM can be negative since defaulted loans will not generate interest income. For the measure of credit risk, we follow Poghosyan (2010) and Tarus et al. (2012) who use the loan-loss provisions to total loans ratio (*prov_loans*) to explain the impact of credit risk on interest rate margins. A more direct measure of credit risk could be the non-performing loans ratio, but this variable is characterized by a considerable missing of data in the BankScope database.

The credit risk variable is treated as endogenous due to the potential impact of the NIM on credit risk. Saunders and Allen (2002) argue that high loan interest rates lead to higher credit defaults which require more loan-loss provisions to be allocated. However, higher interest rates may also reduce the credit risk by discouraging the potentially weak borrowers from applying for loans (see chapter 5 for a more detailed discussion on the relationship between net interest margins and credit risk).

Average size of the bank transactions (*loggross_loans*)

One of the most important determinants of the interest margins in the theoretical model of Ho and Saunders (1981) is the average size of the bank transactions, which is expected to have a positive impact on the net interest margin. The larger the size of the transaction, i.e. credit transaction, the larger is expected to be the potential loss associated with that transaction, so a higher risk premium will be applied. However, since the data available in the BankScope database do not provide sufficient information for the calculation of the average size of bank transactions, we follow Maudos and Fernández de Guevara (2004) by using the amount of gross loans (*loggross_loans*). Despite using it as a control variable, we do not consider it as a very good measure of the average size of the bank transactions, because the number of loans in a portfolio, irrespective of the volume of the portfolio, may vary according to the mix of household and firm customers. Nevertheless, the evidence provided in EBRD (2006) that smaller banks mainly lend to smaller companies may serve as a supportive evidence for the use of gross loans to proxy the average transactions size. The *loggross_loans* variable is treated as potentially endogenous given that the change of loan interest rates may affect the demand and, therefore, the volume of loans.

Opportunity cost of bank reserves (*lqdassets_custstfunding*)

Central banks usually request the banks to hold a certain fraction of their deposits as reserves, which usually are held as cash in bank treasuries and as deposits with the central bank. The required reserves are remunerated at an interest rate that is lower than the market rate, thus incurring an opportunity cost to the bank. Therefore, a higher volume of reserves held by banks is expected to have a positive impact on the net interest margin, since banks will tend to compensate for the opportunity cost of holding reserves. Since the BankScope database does not provide sufficient information related to the volume of reserves held by banks, we follow Poghosyan (2010) and Männasoo (2012) by using the bank’s liquid assets as a proxy for its reserves, based on the fact that reserves comprise an important part of the liquid assets. Therefore, as a proxy for the opportunity cost of bank reserves we use the ratio between the liquid assets and total customer deposits and short-term funding (*lqdassets_custstfunding*). In principle, this ratio is expected to have a positive impact on the net interest margin, since banks would tend to compensate the opportunity cost of holding reserves by setting higher interest margins. On the other hand, since the liquid assets are composed of reserves and other short-term assets that have a lower return compared to other assets, a higher share of liquid assets may imply less interest income for the bank and, consequently, a lower net interest margin.

Non-interest operating income (*nonintinc_ta*)

The bank income is usually classified in two categories: the income generated by core banking activities, which is the interest income; and the income from other bank activities (e.g. income from fees and commissions, brokerage activities, foreign exchange transactions) which is called non-interest income (Stiroh, 2006). Even though there may be no direct link between the interest income and the non-interest income, indirectly they can affect each other. For example, a bank realizing strong earnings from non-interest generating activities may be more competitive in the interest generating activities by being able to afford to set lower interest rate margins. Hence, among the variables included in the regression to explain the net interest margins we include also the non-interest income to total assets ratio (*nonintinc_ta*) which is expected to have a negative sign. This variable is treated as potentially endogenous given that the causality between the non-interest income and the net interest margin can also take the opposite direction. For example, banks can reduce their interest rates to induce demand for loans and compensate part of the reduced interest income by increasing the revenues from non-interest generating assets.

Operating Expenditures (*nonintexp_ta*)

Operating expenditures are considered to be an important determinant of the net interest margins. Banks that operate with higher expenditures are expected to set higher interest margins in order to be able to compensate for the higher costs. In our regression we control for the impact of operating expenditures by including among our explanatory variables the total non-interest expenses to total assets ratio (*nonintexp_ta*). However, if banks can increase their profits by setting higher net interest margins, then they can be less motivated to improve their operating efficiency, which implies that the causality can also go from the net interest margin to the operating costs (Dietrich and Wanzenried, 2011). In order to control for this potential two-way causality, we treat the *nonintexp_ta* variable as potentially endogenous.

Implicit interest payments (*implicit_rate*)

Apart from paying an explicit interest rate on deposits, banks often provide "free" services to their clients which imply additional expenses for the banks and are known as implicit interest payments. To measure the implicit interest payments, we follow Ho and Saunders (1981), Saunders and Schumacher (2000) and Maudos and Fernández de Guevara (2004) by using the operating expenses minus non-interest income expressed as a percentage of total assets (*implicit_rate*). The *implicit_rate* is expected to have a positive impact on the net interest margin, since banks are expected to compensate the additional expenses of interest implicit payments by setting higher interest margins. However, since the *implicit_rate* in itself contains the operating expenses (*nonintexp_ta*) and non-interest income (*nonintinc_ta*), both of which are used as individual explanatory variables, its use in the main model causes a multicolineaerity problem. Hence, we include the *implicit_rate* only in a separate model specification, in which we exclude the *nonintexp_ta* and *the nonintinc_ta* variables. The *implicit_rate* variable is treated as potentially endogenous given that both of its components are individually considered to be potentially endogenous.

Quality of management (*earningassets_ta*)

The behaviour of the net interest margins is considered to be related also to the bank's management quality, supposing that a good management leads to a profitable-composition of a bank's portfolio. Maudos and Fernández de Guevara (2004) use the operating costs to gross income ratio as a proxy for the quality of management which, in our view, is quite similar to the operating expenditures to total assets ratio that is one of the explanatory variables in our regression. Therefore, we follow Agoraki (2010) who uses the earning assets to total assets ratio (*earningassets_ta*) as a proxy of the quality of management, claiming that better management is reflected into a higher earning assets to total assets ratio. According to Agoraki (2010), the quality of management (*earningassets_ta*) should have a positive impact on the net interest margin as it reflects profitable management decisions. However, it may also be expected that the quality of management may have a negative impact on the net interest margin, since a higher-quality management is expected to make the bank more competitive by enhancing the efficiency and reducing the interest margins. Controlling for the quality of management in our regression, except its importance from the economic point of view, is important also from the statistical point of view. Usually the quality of management is one of the variables that is not measured empirically and is left to enter the error term. By including this variable among the explanatory variables we take it out of the error term which reduces the potential endogeneity in the model.

Composition of deposits (*bankdep_custdep*)

According to Claeys and Vender Vennet (2008), the composition of deposits may be an important determinant of the net interest margin. To control for the composition of deposits, we use the share of deposits from banks to total customer deposits (*bankdep_custdep*). Given that deposits from banks are considered to be more expensive compared to deposits from customers, a higher share of deposits from banks would result in higher interest expenditures, thus reducing the net interest margin. On the other hand, a higher reliance on deposits from banks may push banks to charge higher loan interest rates in order to compensate for the higher interest expenditures, which may increase the net interest margin. Therefore, the expected sign of the *bankdep_custdep* variable may be considered as rather ambiguous.

Foreign Ownership (*dv_foreign*)

Even though the original dealership model does not consider a bank's ownership to be among the determinants of interest margins, some authors argue that foreign ownership may have an important role in the determination of the interest margins. Lehner and Schnitzer (2008) argue that one of the channels through which foreign ownership may have a negative impact on the interest margins is the efficiency channel. Foreign banks are considered to be superior in terms of screening utilities and technology utilization, which may lead to lower average costs. In addition, a higher entry of foreign banks may increase competition, thus potentially leading to lower interest margins. According to Claeys and Hainz (2007), foreign ownership may affect the interest margins through the portfolio channel. Based on this view, foreign banks are more conservative and tend to engage mainly in the financing of safer projects, which bear lower interest rates.

However, according to Poghosyan (2010), the control for foreign ownership may not be necessary in a dealership model, given that the channels of efficiency and competition are already controlled for in such models. Most of the dealership models include a variable on the cost efficiency of the bank as well as a variable on the market structure or banking sector competition, implying that the efficiency and competition channels, through which foreign ownership is considered to affect the interest margins, are already controlled for. Also, the portfolio channel in most cases is controlled for by a credit risk variable such as the non-performing loans ratio or the loan-loss provisions ratio.

In our model, assuming that foreign ownership may affect the net interest margin also through other channels, different from the above mentioned (e.g. corporate governance), we include the foreign ownership variable in order to control for whether the net interest margins of the foreign owned banks differ significantly from the net interest margins of the domestic banks. For comparison, we also run a separate regression that does not control for bank's ownership. Given that the readily available BankScope database provides information only on the current ownership of the bank, we utilize the shareholders' history from this database through which we identify the bank's ownership for the available years. Based on this information, we construct a dummy variable (*dv_foreign*) which takes a value of 1 when the bank is more than 51% foreign-owned and 0 when the bank is domestically owned. It must be noted that this variable is characterized by a more pronounced rate of missing data than are the other variables, which reduces our number of observations.

Country-of-origin of the banks (*dv_origin*)

Given that the foreign banks that operate in the CEE region originate from different countries, we consider that the country-of-origin of the banks may also play a role in the way that banks exercise their activity, especially given the fact that foreign banks operating in the CEE countries are mostly subsidiaries of their parent banks. This implies that their strategy and organizational culture may largely be in line with the standards in their home countries. According to Hasselman (2006), the activity of foreign banks in the transition economies is mostly determined by the strategic considerations of the parent banks. Therefore, we construct a dummy variable (*dv_origin*) which takes a value of 1 if the bank is an EU-12 or US country and 0 if the bank's origin is some other country.

b) Institutional variables

EBRD banking reform index (*ebrd_bankref*)

The banking sector reform process in the transition economies led the transformation from centrally-planned to market-based banking sectors. This process included the liberalization of the commercial banks' operations (including also interest rate liberalization), the entry of private domestic and foreign banks in the markets, the development of the legal framework, and the development of regulatory and supervisory institutions. These reforms transformed the banking sectors of the CEE countries into modern banking sectors, thus potentially affecting also the financial intermediation efficiency. Hence, among the control variables we include also the EBRD banking reform index (*ebrd_bankref*) which takes values from 1 to 4+, with higher values indicating more advanced reform progress (a more detailed explanation of the index was provided in chapter 2).

Economic Freedom Index (*economic_freedom_hrt*)

The Economic Freedom Index (*economic_freedom_hrt*) of the Heritage Foundation indicates the freedom of individuals to exercise their economic activity. The economic freedom index looks at ten areas which include: the protection of property rights; freedom from corruption; fiscal freedom; government spending; business freedom; labour freedom; monetary freedom; trade freedom; investment freedom; and financial freedom. The index takes values from 0 to 100, with higher values indicating a higher level of economic freedom. This index can be considered as a general indicator of the overall operating environment given the wide scope of the activities that it covers. The perceptions on the operating environment are considered to be an important element for the banks in the process of setting risk-premiums on loan interest rates. Therefore, the economic freedom index is expected to have a negative impact on the net interest margin, since a higher index reflects a more secure business environment. This index has been used also by other studies on this field, including Demirgüç-Kunt et al. (2003) and Schwaiger and Liebeg (2007).

c) Macroeconomic variables

Real GDP growth rate (*rgdpgrowth*)

The real GDP growth rate (*rgdpgrowth*) is included in the regression to control for the change of economic conditions. A higher growth rate of the real GDP suggests that the business activity in the economy is increasing, implying better performance for businesses and a higher level of income. The increase of the business performance and income in the economy is expected to reduce the default rates of the borrowers and, consequently, reduces the credit risk for the banks. As a response to the decrease of the credit risk, banks are expected to reduce their risk premiums on their loan rates, thus reducing their net interest margins. However, when the economy is growing, aggregate demand increases, thus encouraging firms to further expand their business activity. The expansion of business activity implies higher investments which, in turn, increase the demand for loans. The increase of the demand for loans may cause an upward pressure to the loan interest rates, which implies that the growth rate of the real GDP may have a positive impact on the net interest margin. Nevertheless, it must be considered that despite the potential increase of loan interest rates due to the higher demand, the net interest margin may not be much affected if banks have to offer higher deposit rates in order to be able to finance the credit growth. When the economy is growing, savers have more favourable opportunities to invest their savings; hence, higher interest rates must be offered in order to attract the depositors to save their money in the banks.

The empirical literature has mostly found a negative relationship between real GDP growth and the net interest margin (Demirgüç-Kunt and Huizinga, 1999; Gelos, 2006, Kasman et al. 2010; Valverde and Fernández, 2007). However, there are also studies that have found a positive impact (Claessens et al. 2001; Schwaiger and Liebeg, 2007).

GDP per capita (*gdp_percap*)

GDP per capita (*gdp_percap*) is included to control for the differences in the economic development of the countries and, as such, also reflects differences in banking technology, and other aspects of banking regulations omitted from the regression (Demirgüç-Kunt and Huizinga, 1999). GDP per capita is often regarded also as a proxy for the quality of institutions, since more developed countries are also expected to have better institutions. The impact of the GDP per capita on the net interest margins is expected to be negative, since a higher level of economic development is expected to imply lower risks for the banks.

Inflation (*cpi_ebrd*)

Inflation is generally considered to have a positive impact on the net interest margin. Higher inflation rates may be expected to increase the default risk of the borrowers, thus leading banks to charge higher loan interest rates (Chortareas et al., 2012). However, recalling our results from chapter 5, where we have found an insignificant impact of inflation on the loan-loss provisions ratio in the CEE countries, it is likely that banks have not increased their risk-premiums on loan interest rates as a way to protect against the potential impact of inflation on credit risk.

According to Perry (1992), the relationship between inflation and the net interest margin depends on whether inflation is anticipated or unanticipated. If the inflation is anticipated, banks will make an upward adjustment to the loan interest rates, thus increasing their interest margins. On the other hand, if the inflation rate is unanticipated, banks may be slow in adjusting the interest rates.

The empirical literature on the determinants of the net interest margins has mainly found a positive impact of inflation on the interest margin (Demirgüç-Kunt and Huizinga, 1999; Claeys and Vennet, 2008; Kasman et al., 2010; Chortareas et al., 2012). On the other hand, a few studies have found a negative impact (Abreu and Mendes, 2003; Peria and Mody, 2004).

Volatility of interbank interest rates (*stdev_interbank*)

Based on the theoretical background of the dealership model, the volatility of market interest rates is an important risk to the banks. Fluctuations in money market interest rates may affect a bank's financial position by affecting its yields when reinvesting in the money market and its costs when refinancing from the money market. Hence, banks apply risk-premiums to both loan and deposit rates in order to protect in relation to the money market interest rate risk. To proxy the volatility of the money market interest rates, we follow Maudos and Fernández de Guevara (2004) by using the annual standard deviation of the daily three-month interest rates in the inter-bank market (*stdev_interbank*).[41] However, the use of this variable in our case incurs problems due to missing data for some of the countries in the sample, which considerably reduces our sample size. The interbank interest rate data are fully missing for Bosnia and Herzegovina, and partially missing for some other countries such as Albania, Macedonia, Romania, and Serbia. Hence, we exclude this variable from the main model, but run a separate regression in which we control for the volatility of the interbank interest rates. Taking into account that banks operating in the CEE countries heavily rely on customer deposits and that the inter-bank market is not well-developed, we do not expect the money market interest rates to have an important impact on the banks' net interest margins.

Dummy variables for countries (*dv_country*)

Since the banks included in our sample are from different countries, a complete set of country dummies (*dv_country*) is included in the model in order to control for unobserved country-specific effects.

Dummy variables for years (*dv_year*)

To take into account the potential impact from the time-specific effects, the model includes a complete set of year dummy variables (*dv_year*). By including the year dummies we also minimize the possibility of cross-group residual correlation if there has been some year-specific development that has affected all the banks included in the sample (e.g. global financial crisis). If such a development is not controlled by year dummies, then it goes to the error term and leads to cross-group residual correlation, hence to biased and inconsistent estimates.

[41] The data for the daily three-month interbank market interest rates are sourced from the Bloomberg database.

Data

The bank-level data that are used in our estimation are sourced from the BankScope database. The data on the real GDP growth rate have been obtained from the EU Commission (AMECO database) and the IMF; whereas the GDP per capita and inflation data are obtained from the European Bank for Reconstruction and Development (EBRD). The banking reform index is obtained from the EBRD, whereas the Economic Freedom Index is obtained from the Heritage Foundation.

Table 6.2 Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
nim	2915	5.029	3.835	-16.940	38.820
Lagnim	2470	5.111	3.864	-12.080	38.820
h_stat1	2650	-1.212	2.122	-11.728	5.187
equity_ta	2926	15.373	13.280	-12.440	98.660
nonintinc_ta	2912	2.905	4.944	-5.357	85.668
loggross_loans	2908	12.255	1.899	4.812	17.195
prov_loans	2628	1.934	4.945	-48.156	49.689
lqdassets_custstfunding	2894	46.814	39.329	0.030	586.210
nonintexp_ta	2908	4.636	4.516	-0.969	75.827
earningassets_ta	2919	85.041	12.273	0.498	99.860
bankdep_custdep	2626	2.381	19.419	0.000	477.994
ebrd_bankref1	2914	3.343	0.572	1.000	4.000
economic_freedom_hrt	2676	59.792	7.487	29.400	78.000
rgdpgrowth	2909	3.976	4.172	-17.729	13.501
gdp_percap	2925	7709.1	5039.1	933.4	27128.5
cpi_ebrd	2926	6.561	9.603	-2.700	97.128
dv_foreign	2155	0.638	0.481	0	1
dv_origin	2155	0.484	0.500	0	1

6.3.2 Methodology and Diagnostic tests

The estimation of the determinants of net interest margins for our sample of data is conducted using the system General Method of Moments (GMM) dynamic panel estimator, which was initially developed by Arellano and Bond (1991) and extended by Arellano and Bover (1995) and Blundell and Bond (1998).[42] The reasons to use the system GMM approach include:

- The Wooldridge test for autocorrelation in static, fixed effects estimation of our panel data rejects the hypothesis of no autocorrelation, hence suggesting that our model should be estimated with a dynamic approach (see Appendix 4.1 for the autocorrelation test). To account for the dynamics in our model, we introduce the lagged dependent variable among the explanatory variables. However, this will not be the appropriate solution if our estimator consists of the usual static panel data techniques such as fixed effects or random effects estimation, due to the potential endogeneity between the error term and the lagged dependent variable. The system GMM approach overcomes the problem of endogeneity between the lagged dependent variable and the error term as well as the endogeneity between the explanatory variables by using instrumental variables from within the dataset.

- Enables the consideration of both the time and cross-sectional variation in the model.

- The error term in the GMM model allows for for bank-specific unobserved heterogeneity.

[42] See Chapter 4 for a more detailed explanation of the General Method of Moments.

- Is suitable for data sets with large number of individuals (N) and short time-series (T) which is the case with our sample.

- Apart from the statistical reasons, there is also an economic rational for using a dynamic model to estimate the determinants of the net interest margins. The dynamic model enables us to capture the persistence of the dependent variable when there is at least some degree of continuity in the banking environment and banking behaviour. The underlying reason why this is possible with a dynamic model is that the lagged dependent variable captures the entire time-path (or history) of the dependent variable. In other words, in a dynamic model history is accounted for, while in a static model history is excluded. In our regression, where the dependent variable is the net interest margin, we consider that the past values of the dependent variable to some extent are expected to be reflected in the current values, given that interest rates are partially affected by some factors that are expected to change gradually over time. For example, the efficiency of banks and the monetary policy stance are considered to represent important factors for the determination of the net interest margins, but these are considered to change gradually rather than having a high degree of instability from year to year.

Diagnostic tests

The diagnostic tests in the GMM approach start with the tests of the validity of instruments. The instrument validity can be tested in two ways: a) Arellano-Bond tests for first-order and second-order serial correlation in the residuals; and b) the Sargan test and the Hansen test of over-identifying restrictions.

The Arellano and Bond (1991) GMM estimator requires that there is no second-order serial correlation in the error term of the first-order differenced model. In our case, this requirement is satisfied, suggesting that the instruments are valid. However, for this test to be reliable the model should have first-order autocorrelation in the differenced error terms, which implies that errors in levels do not follow a random walk. The null hypothesis that there is no first-order serial correlation in the error term can be rejected at the 1% confidence level, suggesting that the test for second-order serial correlation is reliable (Appendix 4.3, Specification 1).

The other tests on the validity of instruments are represented by the Sargan test and Hansen test, which control whether the over-identifying instruments are uncorrelated with the error term. The Sargan test is not robust to the presence of heteroscedasticity and autocorrelation, whereas the Hansen test is robust to both and, as such, is considered to be more reliable (Roodman, 2005b). In our case, the Sargan test rejects the null hypothesis that the instruments are uncorrelated with the error term, but the hypothesis is not rejected by the Hansen test with a p-value of 0.555 (Appendix 4.3, Specification 1).

The Hansen test statistics can be used also to test the validity of subsets of instruments through the Difference-in-Hansen tests of exogeneity of instrument subsets. In this regard, we initially test for the joint validity of the differenced instruments used for the “level” equation.

The test results suggest that the null hypothesis that the differenced instruments are valid may not be rejected, hence providing support to the choice of the "system" GMM over the "differenced" GMM to estimate our equation.[43] Similarly, the Hansen test statistics do not reject the null hypothesis for the validity of other subsets of instruments, including the instruments for the lagged dependent variable and the subset of instruments for other explanatory variables that are considered to be potentially endogenous. Similarly, the Hansen test does not reject the exogeneity hypothesis for the variables that are considered as exogenous (see Appendix 4.3, Specification 1).

Another concern related to the specification of panel data models has been raised by Sarafidis et al. (2006), who claim that panel data models are likely to suffer from cross-sectional dependence, "which may arise due to spatial dependence, economic distance, common shocks". In order to tackle this problem, we have followed the conventional method of including year dummies in the model. However, Sarafidis et al. (2006) claim that the inclusion of time dummies is not sufficient to tackle the problem of cross-sectional dependence, suggesting that the above-mentioned tests of instrument validity may be indicative for the presence of a cross-sectional dependence problem. In this regard, our results that there is no evidence of second-order serial correlation in the residuals may imply that there is no heterogeneous error cross-section dependence. Also, our results on the validity of the lagged dependent variable instruments may be considered as indication that there is no obvious problem with heterogeneous error cross-section dependence.

Finally, we perform a specification check for our model related to the size of the coefficient on the lagged dependent variable which, in our case, is in line with the suggestion of Roodman (2006), who claims that a good estimate of the true parameter obtained through the

[43] See Chapter 5 for a detailed explanation of the differences between "system" GMM and "differenced" GMM.

GMM should lie between the estimates obtained from the Ordinary Least Squares (OLS) and the Fixed Effects (FE) methods. The coefficient on the lagged dependent variable obtained through the GMM is 0.63, which is larger than the coefficient of 0.36 obtained through the FE method and smaller than the coefficient of 0.75 obtained through OLS (see Appendix 4.2 for the FE and OLS estimation results).

6.3.3 Estimation results

This section presents the estimation results for the investigation of the determinants of net interest margins in the CEE countries for the period 1999-2009. Table 6.3 presents a number of different model specifications, where the first column (specification 1) presents the main specification and the rest are alternative specifications, which are mainly included to test for robustness.

The lagged dependent variable (*Lagnim*) is highly significant in all the model specifications, thus confirming the dynamic nature of our model and showing that net interest margins are persistent over time and follow a gradual adjustment towards new conditions. The coefficient of 0.628 (specification 1) shows a moderate persistence of the lagged net interest margin, suggesting that the margins in the current year to some extent reflect the margins of the previous year.

As expected, our results show a significant negative impact of the H-statistic on the net interest margin, suggesting that competition has contributed to the decline of net interest margins in the CEE countries. The coefficient of the H-statistic (*h_stat1*) is statistically significant at the 10% confidence level. Since we use a dynamic model to estimate the impact of competition on net interest margins, we are able also to estimate the long-run impact of competition. In the long run, the H-statistic has a coefficient of -0.66, which suggests that in the long run the impact of competition on net interest margins remains negative and the impact is larger than in the short run.

Table 6.3 Estimation results (dependent variable: net interest margin)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	nim	nim	nim	nim	nim	nim	nim
Lagnim	0.628***	0.638***	0.639***	0.612***	0.647***	0.666***	0.592***
	(0.086)	(0.082)	(0.088)	(0.106)	(0.083)	(0.070)	(0.081)
h_stat1	-0.029*	-0.016				-0.033*	0.178**
	(0.016)	(0.017)				(0.018)	(0.086)
hstat1_dvnoneu		-0.069					
		(0.055)					
h_stat3			-0.030*				
			(0.016)				
lerner_index				0.012***			
				(0.004)			
hhi_dep					0.0003**		
					(0.0001)		
equity_ta	0.036**	0.041**	0.031*	0.038*	0.041**	0.034*	-0.007
	(0.018)	(0.020)	(0.018)	(0.021)	(0.020)	(0.018)	(0.021)
nonintinc_ta	-0.108	-0.142	-0.078	-0.100	-0.112	-0.171*	-0.239**
	(0.099)	(0.106)	(0.084)	(0.104)	(0.106)	(0.089)	(0.113)
loggross_loans	0.190*	0.190*	0.149	0.170*	0.214**	0.237**	0.035
	(0.098)	(0.101)	(0.100)	(0.102)	(0.084)	(0.101)	(0.063)
prov_loans	0.076	0.093	0.072	0.086	0.097**	0.075	0.022
	(0.050)	(0.072)	(0.066)	(0.060)	(0.049)	(0.072)	(0.050)
lqdassets_custstfun	-0.003	-0.003	-0.003	-0.004	-0.002	-0.002	-0.001
	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
nonintexp_ta	0.132	0.120	0.098	0.136	0.171*	0.179**	0.271***
	(0.101)	(0.119)	(0.101)	(0.113)	(0.097)	(0.083)	(0.091)
earningsassets_ta	-0.035***	-0.035***	-0.030***	-0.036***	-0.031***	-0.029***	-0.025***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
bankdep_custdep	0.004	0.003	0.002	0.004	0.004	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
ebrd_bankref1	-0.005	0.093	-0.035	0.239	0.211	-0.156	0.186
	(0.230)	(0.269)	(0.242)	(0.264)	(0.238)	(0.205)	(0.240)
economic_freedom_	-0.028**	-0.023	-0.027**	-0.022	-0.021	-0.019	-0.032*
	(0.014)	(0.015)	(0.014)	(0.014)	(0.013)	(0.016)	(0.017)
rgdpgrowth	0.048***	0.054***	0.045***	0.050***	0.058***	0.051***	0.055***
	(0.015)	(0.020)	(0.015)	(0.016)	(0.014)	(0.017)	(0.012)
gdp_percap	0.00005**	0.00005**	0.00004**	0.00003	0.00004*	0.00002	0.00006**
	(0.00002)	(0.0002)	(0.00002)	(0.0002)	(0.0002)	(0.00002)	(0.00002)
cpi_ebrd	0.010	0.014	0.013	0.007	0.001	0.011	0.015
	(0.014)	(0.015)	(0.014)	(0.015)	(0.015)	(0.024)	(0.015)
dv_foreign	-0.133	-0.158	-0.090	-0.122	-0.165*		
	(0.089)	(0.104)	(0.094)	(0.100)	(0.097)		
dv_origin	-0.013	0.010	-0.005	0.015	0.005		
	(0.099)	(0.106)	(0.099)	(0.108)	(0.117)		

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
dv_noneu		1.856***					
		(0.493)					
hstat1_nonintexpta							-0.067*
							(0.034)
dv_year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
dv_country	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	3.320	0.954	3.463	2.458	0.598	1.860	4.161**
	(2.127)	(2.481)	(2.287)	(2.184)	(1.988)	(2.239)	(1.972)
Observations	1,498	1,498	1,498	1,380	1,530	1,822	1,498
Number of bank	285	285	285	265	285	347	285

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note a): Specification (1) includes the h_stat1 as a measure of competition; Specification (2) includes the interaction term between the h_stat1 and the dummy variable for the non-EU countries (hstat1_dvnoneu); Specification (3) includes the h_stat3 as a measure of competition; Specification (4) includes the Lerner Index (lerner_index) as a measure of market power; Specification (5) replaces the measure of competition with the degree of market concentration (i.e. Herfindahl-Hirschman Index: HHI_dep); Specification (6) excludes the foreign ownership variables; Specification (7) includes the interaction term between operating expenses (nonintexp_ta) and the degree of competition (h_stat1).

Note b): The respective STATA outputs for all the model specifications are presented in Appendix 4.3. These outputs show the pattern of instrumentation according to the identification of potentially endogenous variables in the discussion of variables above.

Since the H-statistic is an estimated variable from a first-stage regression (see chapter 5, section 5.4.1) and when used in the second-stage regression may carry over imprecision from the first-stage, we apply the bootstrapping technique in order to correct its standard errors (Table 6.4).[44] This is a conservative approach to inference, with bootstrapping typically yielding standard errors on our estimate of the H-statistic (*h_stat1*) that are somewhat larger than the default cluster-robust standard errors.

[44] The *h_stat1* variable is obtained by estimating the Panzar_Rosse model for each country and for each year (see Chapter 5). The *h_stat1* is estimated using bank's interest income as a dependent variable.

Table 6.4 Bootstrapped standard errors of *h_stat1*

	Observed Coef.	Bootstrap Std. Err.	z	P>z	Normal-based [95% Conf. Interval]	
_bs_1	-0.029	0.017	-1.73	0.084	-0.061	0.004

The bootstrapped standard errors confirm our results that banking sector competition has a significantly negative impact on the net interest margin. When competition increases, banks are expected to offer higher interest rates on deposits in order to attract more deposits and lower interest rates on loans in order to be more competitive in the credit market, thus ending up with lower interest rate margins. The H-statistic's coefficient of -0.029 suggests that an increase of the H-statistic (*h_stat1*) by one standard deviation, holding other variables constant, would lead to a decline of the net interest margin by 0.06 percentage points.[45] From the economic point of view, the impact of the banking sector competition on the net interest margin does not seem to be very large. However, it must be noticed that the size of the H-statistic coefficient shows the impact of banking sector competition on the net interest margin holding other variables in the model constant. This means that the actual size of the H-statistic's coefficient does not include the impact that competition is expected to have on the NIM through other channels already controlled for in the model. For example, the H-statistic's coefficient does not account for the impact that competition may have on the NIM by inducing the enhancement of banks' cost-efficiency, which is already controlled for by the operating expenses to total assets ratio (*nonintexp_ta*). Given the significantly negative impact of the H-statistic, policies that promote the banking sector competition may be considered to be desirable. This is especially important given our findings from chapter 5, which suggest that, overall, banking sector competition has a negative impact on the level of

[45] The standard deviation of the H-statistic is 2.12.

risk taken by the banks operating in the CEE region. However, the encouragement of banking sector competition requires special attention when speaking for the non-EU countries of the region given our findings from chapter 5 that suggest a positive relationship between banking sector competition and risk-taking in the non-EU countries. Hence, in order to utilize the efficiency benefits of increased competition in the non-EU countries, further strengthening of regulatory and supervisory capacities is needed to prevent the potentially detrimental effects of increased competition for the stability of the banking sector.

Apart from estimating the average impact of competition on the net interest margin for the overall sample, we run an additional estimation where we check whether competition in the non-EU countries of our sample affects banks' net interest margins differently compared to the EU countries of our sample. We interact our variable of competition *h_stat1* with the dummy variable for the non-EU countries (*dv_noneu*) that takes the value 1 when the country is not a member of the EU. The interaction term between the *h_stat1* and the *dv_noneu* is denoted as *hstat1_dvnoneu*.[46] The estimation results of the regression that includes the interaction term are presented in Table 6.3 (specification 2). The coefficient of *h_stat1*, which in this case reflects the impact of banking sector competition on the net interest margin for the EU countries of our region (i.e. *dv_noneu*=0), is negative but statistically insignificant suggesting that competition does not represent a statistically significant determinant of banks' net interest margins in the EU countries. Also, the coefficient of the interaction term *hstat1_dvnoneu* which is included in the regression to check if there is an additional impact of competition on net interest margins if the country is not an EU member is statistically

[46] The inclusion of the interaction term is done in line with Brambor et al. (2006) who suggest that in the case of multiplicative interaction models, the regression should include all the constitutive terms of the interaction term and the interaction term itself. These authors suggest that the coefficients of the constitutive terms should not be interpreted as average effects. The coefficient of one component term can be interpreted only assuming that the other component of the interaction term equals zero.

insignificant. However, summing up the coefficient of the primary variable *h_stat1* and the coefficient of the interaction term *hstat1_dvnoneu*, which together represent the impact of competition on net interest margins in the non-EU countries of the CEE region, we obtain a coefficient of -0.085 that is statistically significant at the 10 percent confidence level (Table 6.5). This result suggests that, unlike in the EU countries of the region where competition does not appear to significantly affect the net interest margins of the banks, in the non-EU countries competition has a significantly negative impact on the net interest margins. Apart from the statistical significance, the results suggest a difference also in terms of the size of the impact where the coefficient for the non-EU countries is higher than for the EU countries.

Table 6.5. The joint impact of *h_stat1* and *hstat1_dvnoneu*

nim	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
(1)	-0.085	0.051	-1.66	0.097	-0.185	0.015

Considering that, compared to the EU countries, the non-EU countries are generally characterized by weaker institutions, including also the bank regulatory and supervisory institutions, it might be expected that banks operating in the non-EU countries may respond more aggressively to the increase of competitive pressures. This argument may be related also to the results presented in chapter 5, where banking sector competition in the non-EU countries appeared to have a positive impact on the degree of banks' risk-taking, which is opposite to the EU countries where competition seemed to have a negative impact on banks' risk-taking.

As explained earlier in this chapter, apart from the *h_stat1* we include also a number of alternative measures of competition/market power in order to reinforce our inferences on the relationship between banking sector competition and net interest margins.

In Specification 3, as a measure of competition we use an alternative H-statistic variable (*h_stat3*) which differs from *h_stat1* based on the model specification that was used when this variable was estimated.[47] The estimation results appear robust, with *h_stat3* having a negative and statistically significant coefficient at the 10% confidence level, which is similar in magnitude to the *h_stat1*. This also shows that whether the Panzar-Rosse H-statistic is estimated with interest income or total income as the dependent variable, the inferences on the relationship between banking sector competition and net interest margins remain similar.

An another model specification replaces the H-statistic with the Lerner Index (*lerner_index*) which is a measure of market power (Specification 4). We have obtained the *lerner_index* variable from Efthyvoulou and Yildirim (2013) who estimated this index for individual CEE countries for each year.[48] The coefficient on the *lerner_index* is positive and highly significant, suggesting that higher market power leads to higher net interest margins. This finding is consistent with our results which suggest that higher competition (i.e. lower market power) leads to lower interest margins. The robustness of our results is shown also by the other control variables that retain the same sign and mostly the same level of statistical significance in both cases, using the H-statistic for the measure of competition and using the Lerner Index.

[47] The *h_stat3* variable was obtained by estimating the Panzar-Rosse model for each country/year using total income as the dependent variable.

[48] The Lerner Index is not available for Estonia and Lithuania.

In specification 5, we replace the H-statistic with the market concentration index (*HHI_dep*) which, despite the many critiques, in the literature is broadly considered as a measure of market power. The estimation results suggest that market concentration has a positive and statistically significant impact on the net interest margin, which is in line with most of the previous empirical studies that have found that banks operating in more concentrated markets tend to set higher net interest margins.

The remaining part of this section presents the interpretation of the estimated coefficients for the other control variables, which are considered as potential determinants of the net interest margins. These variables include bank-specific, macroeconomic, and institutional indicators that may influence banks' net interest margins. As shown in Table 6.3, the estimation results for the control variables are quite robust across the different model specifications, so we will focus in the interpretation of results from our main model specification (Specification 1).

The risk-aversion variable, proxied by the equity to total assets ratio (*equity_ta*), has a positive coefficient which is statistically significant at the 5% confidence level, suggesting that bank's equity ratio plays an important role in the determination of the net interest margin. According to this result, banks that maintain higher equity ratio tend to have higher net interest margins. Since equity financing is considered to be more expensive than other forms of financing and bears a higher opportunity cost, banks tend to compensate this cost by charging higher loan interest rates. In addition, since more capitalized banks are considered to be safer, a higher equity ratio may enable the bank to attract deposits at a lower interest rate, which will lead to a higher net interest margin.

The diversification of bank's activity, measured by the non-interest income to total assets ratio (*nonintinc_ta*) has the expected negative coefficient, but which is statistically insignificant. This suggests that the diversification of banks' activity toward the non-interest generating assets did not have a significant impact on the net interest margins in the CEE countries. This may be related to the fact that the share of non-interest generating assets in the banking sectors of the CEE countries is still low and, as such, banks may not significantly rely on this source of income to compensate potential reductions in the income from the interest-generating assets.

The *loggrossloans* variable, which is included in the model to proxy for the average size of the bank's transactions, has a positive and statistically significant coefficient at the 10% confidence level, suggesting that larger loans tend to be associated with higher interest rates. Banks may apply higher risk-premiums on larger loans given that potential default on larger loans is expected to incur larger losses for the banks.

The variable controlling for the quality of the loan portfolio, i.e. the credit risk (*prov_loans*), has the expected positive sign but its coefficient is statistically insignificant. Nevertheless, since its *p-value* is 0.133, this variable might be considered as border-line at the 10% confidence level. A positive coefficient of this variable suggests that banks with lower-quality loan portfolios tend to charge higher loan interest rates in order to compensate for the potential losses occurring from the defaulted loans. In addition, since potential loan repayment problems usually start to take place in a later stage after the loan has been disbursed, banks facing higher credit risk tend to charge higher loan interest rates in order to collect a higher amount of the interest during the period that the loan is performing which, to some extent, would compensate the losses from a potential default in the future.

The variable consisting of liquid assets expressed as a percentage of customer deposits and short-term funding (*lqdassets_custstfunding*), which is included in the regression to control for the opportunity cost of holding reserves, has a statistically insignificant impact. This suggests that the opportunity cost of holding reserves was not significantly incorporated in the banks' interest rates. However, as discussed in the section on variables description, even though the reserves may compose a considerable part of the liquid assets, still the total amount of liquid assets may not be an appropriate proxy for the reserves. Hence, this variable might not properly account for the true impact of banks' reserves on the net interest margins.

The coefficient on the non-interest operating expenditures to total assets ratio (*ninintexp_ta*), which may serve as a proxy for the cost-inefficiency of the banks, has the expected positive sign but statistically insignificant. Banks with higher non-interest expenses (i.e. overhead costs) would be expected to set higher interest margins in order to compensate for the higher level of their operating expenses. However, the statistically insignificant impact of this variable might be attributed to the fact that our regression controls for bank's foreign ownership, the impact of which on the net interest margin is expected to be channelled mainly through the bank's cost efficiency (Poghosyan, 2010). In order to test for this, we have run a separate regression (Specification 6), in which we exclude the foreign ownership variables. The estimation results from this regression show a positive and statistically significant coefficient for the *nonintexp_ta* variable, suggesting that more inefficient banks tend to set higher net interest margins in order to compensate for the higher operating expenses. Supposing that the degree to which banks can compensate their cost inefficiencies by setting higher interest margins may depend on how competitive the market is, we run an alternative model specification in which we include the interaction term between the operating expenses (*nonintexp_ta*) and the H-statistic (Specification 7).[49] The interaction term

[49] This model specification does not control for foreign ownership, given that the non-interest expenditures to total assets ratio (*nonintexp_ta*) resulted statistically insignificant when we included the foreign ownership variables in the regression.

is denoted as *hstat1_nonintexpta*. The higher the degree of competition, the lower is expected to be the ability of banks to transfer their cost-inefficiencies into higher interest margins. The estimation results from this model specification show that the interaction term *hstat1_nonintexpta* has a negative and statistically significant coefficient, which suggests that the increasing impact of the operating expenditures on the net interest margin is reduced when competition increases. In other words, this finding suggests that inefficient banks are less able to charge higher interest rates when the market is competitive.

The model controls also for the impact of the quality of management on the net interest margin. The quality of management is proxied by the earning assets to total assets ratio (*earningsassets_ta*), with a higher ratio implying a better quality of management. The coefficient on the *earningsassets_ta* is positive and highly significant, suggesting that banks with better management quality tend to operate with lower net interest margins. The share of the deposits from banks to total customer deposits (*bankdep_custdep*), which is included in the regression to control for the composition of deposits, is statistically insignificant showing that the composition of deposits does not appear to be relevant for the determination of the net interest margins.

The Economic Freedom Index (*economic_freedom_hrt*), which is included in the regression to control for the overall institutional environment in each country, is statistically significant at the 5% confidence level with a negative coefficient. This suggests that countries with a higher economic freedom index which, among others, implies better protection of property rights and lower corruption, are characterized by lower interest rate margins. A higher economic freedom index indicates a less uncertain operating environment for the banks, which might be reflected in lower risk-premiums on the loan interest rates. The EBRD banking reform index (*ebrd_bankref*) has a statistically insignificant coefficient.

Regarding the macroeconomic variables, the results suggest that the real GDP growth rate (*rgdpgrowth*) has a positive and highly significant impact on the net interest margin (statistically significant at the 1% confidence level). This may be reflecting the positive impact of the GDP growth on the demand for loans which makes upward pressure on the loan interest rates. A positive coefficient is found also for the GDP per capita (*gdp_percap*) which is included in the regression to control for the overall level of economic development in each country. Its impact on the net interest margin in principle is expected to be negative, assuming that banks operating in more developed countries face lower levels of risk and, as such, apply lower risk premiums on their loan interest rates. On the other hand, the positive impact of the GDP per capita might also reflect the fact that more developed countries are considered to have better institutions, which have a positive impact on the banks' interest revenues by ensuring a more timely repayment of loans.

The variable on the inflation rate (*cpi_ebrd*) resulted statistically insignificant, suggesting that banks' net interest margins in the CEE countries have not been significantly responsive to change of inflation rates. Statistically insignificant appear also the dummy variables on foreign ownership (dv*_foreign*) and on the country-of-origin of the banks (*dv_origin*), suggesting that the net interest margins of the foreign owned banks are not significantly different from the net interest margins of the domestically owned banks.

Apart from the model specifications presented in Table 6.3 we have run also another two model speficifactions whose results are presented in Appendix 4.3. In Specification 8, we control for the impact of implicit interest payments (*implicit_rate1*) on the net interest margin. This variable represents bank expenses arising from the provision of "free" services to the clients. The results suggest that implicit interest payments have a positive and statistically significant impact on the net interest margin, suggesting that banks providing more "free" services to the clients tend to compensate them through higher interest margins. This model specification does not include the non-interest income to total assets variable (*nonintinc_ta*) and the non-interest expenses to total assets variable (*nonintexp_ta*) because these two variables jointly compose the *implicit_rate1* variable. The H-statistic, which is our variable of main interest, is robust in this model specification.

According to the theoretical background of the dealership model, an important determinant of the net interest margin is considered to be the volatility of the interbank-market interest rate. Hence, in the next model specification controls for the impact of the volatility of money market interest rates using the annual standard deviation of the daily 3-month interbank rates (*stdev_interbank*). The coefficient on the *stdev_interbank* has a positive sign but is statistically insignificant, suggesting that net interest margins do not respond significantly to fluctuations in the money market interest rates. The statistically insignificant impact of the *stdev_interbank* variable can be attributed to the fact that banks operating in the transition economies more heavily rely on financing through customer deposits, while the interbank markets in most of these countries are characterized by a low rate of activity. It must also be noted that because of the missing data, the model specification with the *stdev_interbank* variable excludes from the sample Bosnia and Herzegovina due to the lack of an interbank market while it has a pronounced rate of missing data also for some of the other countries in the sample. The *h_stat1* variable remains statistically significant and with a negative sign also in this regression (the STATA output for this model specification is presented in Appendix 4.3, Specification 9).

6.4 Conclusions

In contrast to the relationship between banking sector competition and risk-taking, where both the theoretical and empirical literature were quite inconclusive with regard to the impact of competition on risk-taking, in the case of the relationship between banking sector competition and the net interest margins both the theoretical and empirical literature generally agree that competition leads to lower interest margins. However, the vast majority of empirical studies that have investigated this relationship have used the market concentration index as a measure of competition, which may make the inferences derived by these studies on the relationship between competition and net interest margins questionable.

Therefore, in order to provide a more reliable picture regarding this relationship, we have used the Panzar-Rosse H-statistic to estimate the impact of banking sector competition on net interest margins in the CEE countries during the period 1999-2009. To our knowledge, this is the first study to use the H-statistic as a measure of banking sector competition when investigating the determinants of the net interest margins in the CEE countries. The estimation is performed on panel data with a dynamic model, using the General Method of Moments approach. It was noted that since the investigation in this chapter required the H-statistic to be interpreted as a continuous variable, thus the discussion of this issue in Chapter 5 is also applicable here. Similarly, the Lerner Index is employed as an alternative measure of competition.

Our estimation results suggest that banking sector competition has had a significantly negative impact on net interest margins in the CEE countries. This implies that the decline of the interest rate spreads that took place in the CEE countries during the period 1999-2009 was significantly driven by the increase of banking sector competition. However, by distinguishing between the EU and non-EU countries we found that the impact of banking sector competition on banks' net interest margins in the EU countries was statistically insignificant, as opposed to the non-EU countries were we found a statistically significant negative impact. Recalling the estimation results of chapter 5, where we found that in the non-EU countries competition had a positive impact on the degree of banks' risk-taking, we might infer that banks operating in the non-EU countries of the CEE region have responded more aggressively to the increase of competition by reducing the interest margins, but at the same time undertaking higher levels of risk compared to the banks operating in the EU countries of the CEE region. This implies that more effective financial regulatory and supervisory authorities are needed in the non-EU countries in order to preserve the stability of the banking sectors from the potentially detrimental effects of increased competition.

In order to make our inferences on the relationship between banking sector competition and net interest margin even more credible, we have used also alternative measures of banking sector competition. First, we estimated an alternative Panzar-Rosse H-statistic, by using the total income instead of the interest income in the first-stage regression. The new H-statistic retains the negative sign, while its statistical significance slightly declines. Second, we used the Lerner Index as a measure of market power and the results show a significantly positive impact, thus confirming our finding that market power leads to higher net interest margins. Third, we included the market concentration index, which has a significantly positive coefficient, suggesting that banks operating in more concentrated markets have higher net interest margins.

Regarding the impact of the control variables, the estimation results suggest that banks holding higher capitalization ratios tend to have higher net interest margins. Similarly, the average size of the loan transactions appears to be associated with higher interest rates, possibly reflecting higher potential risks that are associated with larger transactions.

Operating costs appear to have a positive impact on the net interest margins, but the ability of banks to translate higher operating costs into higher net interest margins appears to decline as competition increases. Better management quality appears to be associated with lower interest margins. The degree of economic freedom has a significantly negative effect, which may be reflecting the fact that more reformed countries are viewed as less uncertain by the banks and, hence, lower risk premiums are applied. Regarding the macroeconomic indicators, both the real GDP growth rate and the GDP per capita appear to have a significantly positive impact on net interest margins.

CHAPTER 7

Conclusions

7.1 Introduction

The aim of this thesis was to assess the degree of competition in the banking sectors of CEE countries and to help policy makers better understand the economic effects associated with increased banking sector competition. Banking sector competition has attracted much attention in the economic literature primarily because of its impact on a broad range of dimensions of banking sector activity. The two most important banking sector dimensions that are considered to be closely related to competition are the banks' risk-taking behaviour and their intermediation efficiency. The predicted impact of banking sector competition on these two important dimensions of banking sector activity has created the ground for an ongoing debate in the literature on whether banking sector competition is beneficial or detrimental for the economy. The existing studies in this field have generally been quite limited as they address the impact of competition only on single dimensions of banking sector activity while failing to provide a more comprehensive picture of the overall impact of competition. Therefore, in order to provide a more complete picture of the effects associated with increased banking sector competition, and contribute to the existing debate, this thesis has investigated the impact of competition both on the degree of banks' risk taking and on the net interest margins. The thesis is focused on three main issues: a) estimating the degree of banking sector competition in CEE countries; b) estimating the impact of banking sector competition on banks' risk-taking; and c) estimating the impact of banking sector competition on net interest margins.

In this chapter we present the main findings of this thesis, followed by some policy recommendations that will help the authorities design policies to support the development of a more stable and efficient banking sector. In addition, we outline the main contributions of this thesis to the existing literature as well as discuss the limitations encountered in this research project and opportunities for further research related to this field.

7.2 Main Findings

The development of modern banking systems in CEE countries started with the transition from the mono-bank system to the two-tier banking system in the beginning of the 1990s, but it needed a decade of costly reforms to make these banking systems adequately operational in the sense of enabling them to provide efficient financial intermediation and to be capable of sustaining potential shocks, endogenous or exogenous to banks' actions. A decade after the beginning of the transition process, substantial progress was recorded in building more stable and efficient banking sectors, which no longer represented a burden on public finances but rather began to be an important promoter of economic development in these countries. The liberalization of the banking markets and the consequent entry of foreign banks created the conditions for the development of banking sector competition. However, as depicted in the second chapter of this thesis (chapter 2), the banking sectors in CEE countries still have higher interest rate spreads and lower financial intermediation ratios compared to the Euro Area countries, potentially indicating that banks may be exerting some monopoly power.

As the main aim of this thesis was to assess the degree of banking sector competition in these countries and the effects associated with higher competition, in the third chapter of this thesis (chapter 3) we presented a critical review of the theoretical and empirical studies on the measurement of competition. This is highly important given that no consensus has been reached on the most appropriate method of measuring competition. The structural approach for the measurement of competition, which is largely considered as the traditional approach, is based on the Structure-Conduct-Performance (SCP) paradigm that views the degree of market concentration as a measure of competition and maintains that a higher degree of market concentration implies lower competition. However, the SCP paradigm has been largely criticised in the literature which has questioned its appropriateness as a reliable framework for the measurement of competition.

The criticisms are mostly directed at the assumed one-way causality from structure to conduct and performance, and the exclusion of the possibility that the conduct of the bank may also affect its market share and the market structure in general (i.e. the Efficient Structure hypothesis). In addition, the contestability theory claims that even highly concentrated markets can be competitive if they are fully contestable. The criticisms directed at the structural approach have led to the development of the non-structural approach which quantifies the competitive behaviour of the bank without taking into consideration the structural features of the market. The most widely used non-structural method for the measurement of competition is represented by the Panzar-Rosse method which measures the degree of competition by estimating the elasticity of bank revenues with respect to changes in input prices, i.e. the so-called ‘Panzar-Rosse H-statistic’. Depending on the response of bank revenues to changes in input prices, it can be inferred whether a banks’s behaviour is in line with monopoly, monopolistic competition, or perfect competition. Although the Panzar-Rosse approach has been widely used and accepted as an appropriate method for measuring the degree of competition, Bikker et al. (2009) present a theoretical argument which may challenge the original interpretation of the Panzar-Rosse H-statistic when the market is competitive. Based on their view that, in equilibrium, if firms’ costs are constant over a range of scales, a negative H-statistic would not rule out that the market is competitive. This would represent a caveat also for the use of the H-statistic as a continuous measure in chapters 5 and 6, since negative values of the H-statistic would not necessarily be considered to indicate a high level of market power. However, in the absence of more recent direct empirical evidence on the nature of banks' costs in equilibrium, we have treated this proposal as a theoretical possibility and left this issue to be investigated by future empirical research. Another complication to the interpretation of the H-statistic may be related to the fact that a negative H-statistic may also be consistent with oligopoly. However, this might not represent a serious limitation given that both monopoly and oligopoly are characterized by a high degree of market power. Another widely used non-structural measure of market power is the Lerner Index which measures the degree of mark-up on the price over the marginal cost. A higher mark-up corresponds to a higher degree of market power being exerted by the bank.

Even though no general agreement has been reached on which is the most appropriate method of measuring competition, the Panzar-Rosse approach is being increasingly accepted as the preferred method. Hence, taking into account its increasing acceptance in the literature, and its advantages as a measure of competition, we have chosen the Panzar-Rosse approach to measure banking sector competition in our sample of countries. For comparison purposes and given the potential caveats of the H-statistic, in chapters 5 and 6 we have used the Lerner Index as an alternative measure of competition, which has enabled us to verify the inferences on the impact of competition on the degree of risk-taking and net interest margins, respectively.

Chapter 4 of the thesis presents the empirical assessment of the degree of banking sector competition in CEE countries and the assessment of competition for the banking sector of Kosovo separately using the Panzar-Rosse approach. The estimation results suggest a lack of competition in the banking sectors of CEE countries. In other words, the behaviour of banks operating in these countries appears to be consistent with monopoly (or oligopoly), thus potentially reflecting the low degree of financial intermediation, the higher interest rate spreads compared to banks in the Euro Area and the slow progress in the development of competition policy in these countries. Within the CEE sample countries, market power seems to be higher amongst the banks operating in the non-EU countries of the region. These countries have been characterized by an even lower degree of financial intermediation, higher interest rate spreads, and lower development of competition policy compared to the EU members. Banks operating in the non-EU countries of the CEE are also likely to face less competition from cross-border lending, given the smaller number of large foreign corporations operating in these countries. In addition, the persistently high profitability ratios recorded by the banking sectors of these countries might well have secured banks in their existing positions, thereby reducing the incentive for a more aggressive competitive behaviour which could eventually undermine their profits. Regarding the banking sector of Kosovo, the competitive behaviour appears to be consistent with monopolistic competition. Based on this result, competition in the banking sector of Kosovo is higher compared to the average of the CEE region. This may primarily reflect the fact that Kosovo's banking system has been newly created and banks have competed more aggressively to seize the opportunities in a largely unexplored market.

The next objective of our thesis has been to estimate the impact of competition on the level risk taken by banks operating in CEE countries. The theoretical and empirical literature is broadly inconclusive on whether competition induces banks' risk-taking which may result in some degree of instability or, conversely, enhances the soundness and stability of the banking sector. In order to test this relationship, we investigated the relationship between the estimated values of the Panzar-Rosse H-statistic for each country/year (from chapter 5), and the ratio of loan-loss provisions to total loans as a measure of banks' risk-taking. The estimation results in chapter 5 suggest that competition has had a negative impact on the degree of risk-taking by banks, thus providing evidence in favour of the hypothesis that competition enhances banking stability. The negative relationship between competition and banks' risk-taking may primarily be attributed to the fact that with greater competition depositors have more alternatives for placing their deposits and, as a result, they may "penalize" the banks that are considered to take excessive risks by moving their deposits to safer banks. In addition, since bank profits are expected to decline when competition increases, primarily due to lower interest margins, banks might be expected to concentrate on safer projects in order to prevent potential losses from riskier loans which would further erode their profits.

However, by distinguishing between the EU and the non-EU countries of the region, we found that in the non-EU countries banking sector competition had a positive impact on the degree of banks' risk-taking, which is opposite to the relationship found for the EU members of the region. This might reflect deficiencies in other but unobserved factors, given available data, that might have affected the impact of competition on risk-taking in the non-EU countries. Examples may include the quality of the licensing process and the quality of the personnel involved.

Regarding the impact of the other control variables, the results suggest that the bank's size is negatively related to the bank's risk-taking which may reflect the better risk-diversification opportunities of the larger banks, and also the lower degree of asymmetric information faced by these banks, assuming that they have been operating for a longer period in the market. On the other hand, a higher growth rate of loans appears to have induced higher risk-taking, thus reflecting the lower lending-criteria that may be applied when banks pursue a more aggressive lending strategy. The macroeconomic performance of the country seems to be highly important for the quality of the loan portfolio. Higher real GDP growth rates and national currency depreciation appear to have an enhancing impact on the quality of loans. Also, the protection of property rights has a highly significant negative coefficient, suggesting that a better protection of property rights represents a key factor for the improvement of the loan portfolio quality. In general, the results suggest that the quality of the banks' loan portfolio is most significantly determined by factors related to the operating environment which are mostly exogenous to the bank's actions.

In order to present a more complete picture of the effects associated with competition, the next objective of this thesis was to investigate the impact of banking sector competition on the net interest margins. The theoretical and empirical literature generally agree that competition has a negative impact on net interest margins. The empirical results from the sixth chapter of this thesis (chapter 6) are consistent with the majority of the literature in this field, suggesting that banking sector competition has had a negative impact on net interest margins in CEE countries. By distinguishing the impact of banking sector competition in the non-EU countries from that in the EU countries of the CEE region, we found that competition has had a stronger impact in reducing the banks' net interest margins in the non-EU countries. Recalling the estimation results of chapter 5, where we found that competition had a positive impact on banks' risk-taking in the non-EU countries of the region, it may be inferred that banks operating in the non-EU countries have responded more aggressively to the increase of competition by narrowing the interest margins and undertaking higher risk, while the regulatory and supervisory authorities were less effective in the oversight of the banks.

Regarding the impact of other control variables, the estimation results suggest that banks holding higher capitalization ratios tend to have higher net interest margins, thus reflecting the more conservative behaviour of better capitalized banks, but also the fact that better capitalized banks tend to compensate the opportunity cost of holding more capital by charging higher interest rates. Similarly, the average size of loan transactions appears to be associated with higher interest rate margins, thus reflecting higher potential risks that are associated with larger transactions. Operating costs result to have a positive impact on the net interest margins, but the ability of banks to translate higher operating costs into higher net interest margins appears to decline as competition increases. Better management quality appears to be associated with lower interest margins. The index of 'economic freedom', used as a proxy for the overall progress of reforms in transition economies has a significantly negative coefficient which might be reflecting the fact that the faster reforming countries are viewed as less uncertain by banks and, hence, are subject to lower risk premiums. Regarding the macroeconomic indicators, the real GDP growth rate is shown to have a significantly positive impact on the net interest margins, reflecting the upward pressure on the level of interest rates of the higher demand for loans. A positive impact is found also for the GDP per capita which, apart from measuring the degree of economic development, is also considered to proxy the quality of the institutions.

To summarise, the main findings of this thesis suggest that the level of competition in the banking sectors of CEE countries is, on average, low and that the behaviour of these banks are characterized by monopoly behaviour. On the other hand, the thesis also provides evidence that more competition would bring desirable effects for CEE countries by increasing both the soundness of the banking sector and by increasing the efficiency of financial intermediation. However, our inferences on the degree of banking sector competition and the effects associated with higher competition should be taken with reservation if banks have constant average costs. Future empirical work on the nature of banks' average costs in equilibrium is recommended in order to derive inferences on the appropriateness of the current interpretation of the Panzar-Rosse H-statistic as an approach for measuring the degree of competition.

In addition, our inferences on the effects associated with higher banking sector competition in chapters 5 and 6 need to be treated with reservation also because of the limitations that have characterized our cross-section estimation of the H-statistics. Possibly because of the small samples of data for some countries/years and the suspected poor quality of data, in some cases we have obtained H-statistic values higher than 1, which are not theoretically possible in the original Panzar-Rosse approach, and with substantial year-to-year variation in the statistic. Nevertheless, given that our inferences on the effects associated with higher competition, derived by using the H-statistic as a measure of competition, are consistent with the inferences derived by using the Lerner Index, we consider that potential limitations related to the estimation of H-statistics did not have a serious impact on our final results.

7.3 Policy Implications

This thesis provides a platform for drawing several policy recommendations, which can help policy makers design policies that contribute to the building of more stable and efficient banking sectors in CEE countries. It should be noted that the following policy recommendations are based on a straightforward consideration of the results of the thesis, without consideration of the potential caveats that have been acknowledged throughout the thesis.

First, the evidence provided in chapter 4 suggests that the competitive behaviour of the banks operating in CEE countries is consistent with monopoly. Taking into consideration the overall evidence presented in chapters 5 and 6, we consider that the respective authorities should encourage greater competition in the banking sectors of these countries in order to contribute to the enhancement of the loan portfolio quality and the reduction of the interest rate margins. For the non-EU countries of the region, competition should be encouraged to utilize the financial intermediation efficiency benefits, but this should be condiditional to the further strengthening of the institutional capacities that secure an adequate oversight of banks' behaviour with regard to the risk-taking. Even though the identification of the measures that lead to more competition has not been amongst the main objectives of this research project, a few policy options that may encourage banking sector competition in CEE countries are highlighted here:

- The increase of the number of banks based on prudent licensing criteria.

- The reduction of barriers to entry and exit for banks in order to make the markets more contestable. Higher contestability will put pressure on the existing banks to behave more competitively in response to the threat of potential new entrants.

- Given the fact that the overall results presented in chapter 5 do not provide evidence in favour of a trade-off between competition and stability, competition policy might not need to be subordinated to stability policies. In this regard, the European Union transition countries have substantially strengthened the competition policy for the banking sectors during the last two decades (EBRD, 2009). However, this recommendation does not stand for the non-EU countries, where stability-oriented policies should prevail until adequate institutional capacities are developed to safeguard the banking stability from the potentially detrimental effects of increased competition.

- The authorities (central banks or supervisory agencies) should encourage banks to make the 'terms and conditions' of individual bank products easily understandable for the clients so that they can make comparisons between the products offered by different banks.

- The authorities should ensure that ‘switching costs’ do not serve as a source of market power for the banks. Because switching an account from one bank to another may be costly, clients are often “locked” into a certain bank which can therefore exert market power on the prices charged to its clients. Bank customers should have free and low-cost mobility to shift from one bank to another.

- The authorities should improve the coverage of information by the credit bureaus so that the additional information possessed by the existing banks does not serve as a barrier to entry to potential new entrants.

Second, we consider that the negative relationship between banking sector competition and risk-taking that was found in the fifth chapter of this thesis is largely attributed to the threat that depositors will “penalize” the banks that undertake excessive risks by shifting their deposits to alternative safer banks. In order for this competition effect to be stronger, the authorities should force the banks to disclose information related to the quality of their loan portfolio. In the short term, the disclosure of risk information may trigger panic among the depositors of low-quality banks; but, in the long-term, disclosure would encourage banks to use the quality of their loan portfolio as a competing instrument. In order for this policy to be effective, the authorities should also invest in the financial education of the public, given that depositors might lack adequate knowledge to understand the risk profile of the bank. This is especially important for the non-EU countries of the CEE, where financial illiteracy is considered to be higher.

Third, based on the evidence presented in chapter 5 that higher credit growth is associated with a lower quality of loan portfolios, the authorities should undertake substantial and timely measures to address the potential problems associated with the rapid credit growth. According to Herzberg and Watson (2007), these measures should be directed mainly at encouraging banks to maintain prudential screening procedures. In addition, the authorities and the banks should closely monitor whether there are risks being built up in the sectors that receive credit more heavily. If the expansion of credit is oriented towards potentially risky sectors, then counter-cyclical loan provisioning could be introduced in order to discourage the rapid growth of credit, or ceilings to credit growth rate may be imposed.

Fourth, the chapter 5 results provide evidence that the protection of property rights represents a highly important factor for the enhancement of loan quality in CEE countries. Therefore, further progress in the protection of property rights should be treated as a high priority by all these countries. The progress in this field, apart from a well defined legal framework, requires efficient judicial systems to effectively implement the laws related to the protection of creditor rights. This includes the need for specialized commercial courts and trained judges to increase the efficiency of the resolution of claims process.

Fifth, based on the empirical results from chapter 6, the index (or degree) of economic freedom appears to be an important factor for the reduction of net interest margins. The degree of economic freedom takes into account factors grouped into four categories: rule of law, limited government, regulatory efficiency, and the degree of market openness. The progress in these fields enhances the operating environment for banks and reduces their risk perceptions, thus leading to lower risk premiums applied on bank loans.

7.4 Contributions to knowledge

This thesis has contributed to the existing literature by providing new empirical evidence on the degree of banking sector competition in CEE countries as well as on the impact of competition on the degree of banks' risk-taking and net interest margins. The thesis has contributed also to the debate on the measures of competition by reinforcing previous claims on the improvement of the model specification for the estimation of the Panzar-Rosse model, and by providing comparisons between the impact of different measures of competition on the degree of banks' risk-taking and net interest margins. These contributions can be summarized as follows:

First, this is the first study to find that the competitive behaviour of the banks operating in CEE countries was characterized by monopoly behaviour during the period 1999-2009 period. In addition, we have distinguished between the banks operating in the non-EU countries of the CEE region and those operating in the EU countries of the region. The estimation results suggest that banks operating in the non-EU countries exert higher monopoly power that those operating in the EU countries of the region. Bearing in mind that none of the existing studies in this field have found monopoly behaviour in the banking sectors of the region, the value of our findings lies on the fact that they can serve as evidence to raise the alert on the deficiency of banking sector competition in these countries.

Second, this is the first study to have estimated the degree of competition in the banking sector of Kosovo. Due to the specific conditions related to the availability of data, a separate estimation had to be conducted for the case of Kosovo. Given the characteristics of Kosovo's banking sector, which is characterized by a high degree of market concentration, high interest rate spreads, and a low degree of financial intermediation, the findings of this study may be valuable for the assessment of competitive conditions by the authorities. In addition, in spite of the above mentioned features, Kosovo's banking sector appears to be characterised by a lower degree of market power compared to the average of the CEE region. This may be of interest to the researchers in the field of banking sector competition since it indicates that a higher degree of market concentration is not necessarily associated with higher degree of market power.

Third, on a more technical point, the sensitivity tests presented in chapter 4 reinforce the claims of Bikker et al. (2007, 2009) that the scaling of the dependent variable to total assets and/or the inclusion of total assets in the regression to control for the bank's size effect makes the Panzar-Rosse model misspecified. According to these authors, as a consequence of the misspecification, the Panzar-Rosse H-statistic will always be positive and the monopoly hypothesis will always be rejected. These claims are confirmed by our sensitivity tests through which we have found that by scaling the dependent variable to total assets, and/or including the total assets as an explanatory variable, the H-statistic for CEE countries shifts from a negative value to a positive value; i.e. the competitive behaviour shifts from monopoly to monopolistic competition. This evidence is confirmed also in the case of Kosovo where the H-statistic remains positive but with a higher coefficient. The evidence provided by this study contributes to the existing literature by also confirming that the scaling of the dependent variable to total assets and the inclusion of the total assets as an explanatory variable cause the same misspecification bias. The findings also contribute to the debate on the choice between 'interest income' and 'total income' for the dependent variable when estimating the Panzar-Rosse model by showing that the results remain broadly similar.

Fourth, to our knowledge, chapter 5 of this thesis represents the first study to use the Panzar-Rosse H-statistic as a measure of banking sector competition in investigating the relationship between competition and risk-taking in CEE countries. In addition, this is the first study to find that banking sector competition has had a negative impact on the degree of banks' risk-taking in these countries. The value of these findings is that, apart from contributing to the existing debate in the literature on the relationship between competition and risk-taking in the banking sector, they may help to encourage policy makers in the EU countries of the CEE region to give higher priority to those measures that enhance competition in the banking sector; whereas, for the non-EU countries our findings highlight the need that the increase of competition should be associated with further strengthening of financial regulatory and supervisory authorities. In this context, this is the first study to distinguish between the impact of banking sector competition on the degree of risk-taking in the EU and non-EU countries of the region.

Fifth, to our knowledge, chapter 6 is the first study to have used the Panzar-Rosse H-statistic in the estimation of the relationship between banking sector competition and banks' net interest margins. Furthermore, the findings from this chapter are consistent with the inferences derived by other studies in this field. Also, this is the first study to have distinguished between the relationship between competition and net interest margins in the EU and non-EU countries of the region.

Sixth, in both chapter 5 and 6 we used alternative measures of competition in order to verify our inferences regarding the impact of banking sector competition. (a) We used two alternative H-statistics, estimated using respectively interest income and total income as the dependent variable in the first-stage regression. The results, both with regard to the impact of competition on risk-taking and on net interest margins, appeared robust. (b) Using the Lerner Index, which is a measure of market power, in both chapters showed that it has the opposite impact compared to the H-statistic, thus confirming our inferences on the impact of competition on banks' risk-taking behaviour and net interest margins. The use of the Lerner

Index as an alternative measure of competition is particularly important given the potential caveats related to our cross-section estimation of the H-statistic. As elaborated also in section 7.2, because of potential data-related limitations, for some countries/years our cross-section estimations produced H-statistic values of greater than 1, which are not considered as theoretically possible in the original Panzar-Rosse approach.

Seventh, the evidence presented in chapter 6 provides support for Poghosyan (2010) who claims that control for foreign ownership may not be necessary in a dealership model given that efficiency and competition, which represent the main channels through which foreign ownership is expected to affect the interest rates, are already controlled for in such models. In our estimation results, the non-interest expenditures to total assets ratio, which is included in the regression to control for cost-inefficiencies, is statistically insignificant when the model controls for foreign ownership and statistically significant when not controlling for foreign ownership.

Eighth, the three empirical chapters of this thesis control also for the country-of-origin of the banks which, to our knowledge, has not been done by any of the existing studies in the fields covered by this thesis. Controlling for country-of-origin is particularly important given the fact that most of the foreign banks operating in CEE countries are subsidiaries which largely align their strategies with those of their parent banks. Depending on the origin of the parent banks, the subsidiaries operating in the CEE region may reflect part of the "banking culture" in their country of origin.

7.5 Limitations and suggestions for future research

This section presents some of the limitations encountered by this research project and provides some suggestions that would further enrich the literature on banking sector competition in CEE countries. The limitations of this study are mainly related to the data availability for some of the investigated topics. These can be summarized as follows:

First, the cross-section estimation of the Panzar-Rosse H-statistic could not be conducted for Kosovo and Montenegro due to the small number of banks in these countries. Therefore, they have been excluded from the analysis in chapters 5 and 6 in which the impact of banking sector competition on banks' risk-taking and net interest margins were estimated. Hence, the estimation of the effects associated with banking sector competition in these countries remains to be addressed by future research. The small number of cross-sectional units poses a limitation also for other countries in the sample, for some of which the H-statistic could not be estimated for the early years of the period under investigation.

Second, an investigation of the nature of banks' long-run average costs might help clarify the issue raised by Bikker et al. (2009) regarding the interpretation of the H-statistic when the market is competitive. According to Bikker et al., the H-statistic can take a negative value also when the market is competitive if banks operate with constant average costs. If this hypothesis holds, it would cause problems for the original interpretation of the Panzar-Rosse model because the negative values of the H-statistic would no longer be able to rule out that the banking sector is operating in a competitive environment, and compromise the use of the H-statistic as a continuous variable since the negative values could no longer be considered to indicate a high degree of market power.

Third, our cross-section estimates of the H-statistic in Chapter 5 are characterized by a pronounced rate of volatility from one year to the other, which is consistent with the volatility in the estimates of the Lerner Index for the CEE countries obtained from the study of Efthyvoulou and Yildirim (2013). The high degree of volatility of these estimates, among others, might be attributed to the serious limitations in terms of sample size for some contry/years as well as to the potentially poor quality of data on the transition economies in the BankScope database. Nevertheless, taking into account the fact that the cross-section estimates of the H-statistic appeared quite volatile also in studies that have investigated competition in EU banking markets, then the high degree of volatility in our H-statistic cross-section estimates may be linked to a more general problem related to the measurement of competition on a cross-section basis. One reason for this might be that competition is a dynamic process, so that gradual changes should be accounted for in the model. The use of other methods for the measurement of competition (including the Boone Indicator, which was not used in this thesis) on a yearly basis for the CEE countries is recommended to further investigate the volatility in the estimated degree of competition. The high degree of volatility in the yearly measures of competition may raise a very important question as to whether it is appropriate to measure the degree of competition on cross-section samples, especially for the transition economies where serious limitations on sample size and data quality exist.

Fourth, the alternative model specifications both in chapters 5 and 6 show that the Lerner Index yields more statistically significant estimates than our estimates of the H-statistic. The lower statistical significance of the estimated effects of the H-statistic may be a result of different reasons, potentially including the following.

1. if the alternative assumption introduced by Bikker et al. (2009) on the structure of banking costs were to hold for a substantial proportion of banks in our sample, then

the H-statistic would not uniformly indicate the competitive behaviour of banks, in which case the precision of the estimated H-statistic effect would be reduced. Nevertheless, given that the view of Bikker et al. is not based on overwhelming empirical evidence, in this thesis we treat it only as a theoretical possibility and leave it to be investigated by future research. The imprecision of our estimated effects of the H-statistic may be consistent with the proposition of Bikker et al. on constant costs, but it is not a direct proof of this proposition.

2. Given that both of these are estimated variables, the differences in the degree of statistical significance between the H-statistic and the Lerner Index estimates may be related to the respective modelling procedures whereby these measures are obtained. For example, the estimation of the Lerner Index might have been conducted after a large-scale cleaning of the data, which has not been the case in our estimation of the H-statistic.

Fifth, the estimation of the relationship between banking sector competition and banks' risk-taking in chapter 5 relies on a measure of loan portfolio quality that proxies the level of risk taken by banks. In order for the inferences related to the impact of competition on banks' risk-taking to be more reliable, it is desirable to estimate the impact of competition also on other measures of risk, such as the capitalization ratios and the probability of bank to default.

Sixth, the use of the net interest margins as a measure of financial intermediation cost in chapter 6 is consistent with the vast majority of studies in this field which consider that net interest margin is the most appropriate indicator to measure the financial intermediation cost. However, the value of the net interest margin may be limited in the sense that it does not allow researchers to distinguish whether it is changing because of the performance in collecting the interest income or it is changing because the risk premiums in the *ex ante* interest rates have changed. Even though the variable on the loan-portfolio quality is included in the regression, this does not fully control for the risk-premiums given the fact that banks' risk-perceptions are not based only the current quality of their loan portfolios, but also on expected future developments. Therefore, for comparison, it would be desirable to estimate also the determinants of *ex-ante* interest rate spreads.

Seventh, our finding that competition leads to lower net interest margins provides evidence in favour of a positive relationship between banking sector competition and overall economic activity. However, in order to have a more complete picture regarding the effects associated with higher competition it would be desirable to investigate also the impact of competition on other indicators such as the access of firms to bank financing and the general financial inclusion rate. These topics are particularly important for CEE countries, especially for the non-EU countries of the region given the lower rate of access to finance and financial inclusion in these countries.

Eighth, in this thesis we have measured the average competitive behaviour of the banks in the totality of their operations. However, given that banks organize their operations based on different business lines, it would be an interesting exercise to measure the competitive behaviour of banks across those different business lines. For example, lending to enterprises may be characterized by a different degree of competition compared to lending to households. A method for measuring competition for different business lines is the Boone Indicator, which is a recently developed method that became current in the literature during the course of writing this thesis.

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Appendixes

CHAPTER 2

CHAPTER 4

CHAPTER 5

CHAPTER 6

Chapter 2

Appendix 1.1 Selected macroeconomic indicators

a) Real GDP growth rates (in percent)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	13.5	6.6	7.9	4.2	5.7	5.7	5.8	5.4	5.9	7.5	3.3
Bosnia and H.	10.8	4.3	2.4	5.1	3.9	6.3	3.9	6.0	6.2	5.7	-2.9
Bulgaria	4.4	5.7	4.2	4.7	5.5	6.7	6.4	6.5	6.4	6.2	-5.5
Croatia	-1.0	3.8	3.7	4.9	5.4	4.1	4.3	4.9	5.1	2.2	-6.0
Czech Rep.	1.7	4.2	3.1	2.1	3.8	4.7	6.8	7.0	5.7	3.1	-4.7
Estonia	-0.3	10.0	7.5	9.2	7.8	6.3	8.9	10.1	7.5	-3.7	-14.3
Hungary	3.2	4.2	3.7	4.5	3.9	4.8	4.0	3.9	0.1	0.9	-6.8
Kosovo	-	-	-	-	5.4	2.6	3.8	3.4	6.3	6.9	2.9
Latvia	3.3	6.1	7.3	7.2	7.6	8.9	10.1	11.2	9.6	-3.3	-17.7
Lithuania	-1.1	3.3	6.7	6.8	10.3	7.4	7.8	7.8	9.8	2.9	-14.8
Macedonia	4.3	4.5	-4.5	0.9	2.8	4.6	4.4	5.0	6.1	5.0	-0.9
Montenegro			1.1	1.9	2.5	4.4	4.2	8.6	10.7	6.9	-5.7
Poland	4.5	4.3	1.2	1.4	3.9	5.3	3.6	6.2	6.8	5.1	1.6
Romania	-0.4	2.4	5.7	5.1	5.2	8.5	4.2	7.9	6.3	7.3	-6.6
Serbia	-	-	5.3	4.3	2.5	9.3	5.4	3.6	5.4	3.8	-3.5
Slovakia	0.0	1.4	3.5	4.6	4.8	5.1	6.7	8.3	10.5	5.9	-4.9
Slovenia	5.3	4.3	2.9	3.8	2.9	4.4	4.0	5.8	6.9	3.6	-8.0

Source: EU Commission, IMF World Economic Outlook (various issues).

b) GDP per capita (in thousands of US dollars)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	1,120	1,189	1,326	1,440	1,845	2,342	2,649	2,855	3,380	4,097	3,796
Bosnia and H.	1,310	1,390	1,462	1,626	2,203	2,638	3,121	3,606	4,547	5,535	5,122
Bulgaria	1,582	1,546	1,723	1,988	2,562	3,176	3,744	4,313	5,542	6,814	6,400
Croatia	5,065	4,823	5,152	5,958	7,625	9,167	10,004	11,046	13,214	15,637	14,241
Czech Rep.	5,876	5,545	6,077	7,401	8,975	10,742	12,200	13,887	16,880	20,761	20,412
Estonia	4,141	4,137	4,564	5,381	7,258	8,904	10,496	12,491	16,135	16,476	13,462
Hungary	4,788	4,635	5,238	6,567	8,281	10,152	10,902	11,193	13,699	15,459	12,819
Kosovo	-	1,124	1,590	1,611	1,667	1,813	1,834	1,875	2,046	2,291	2,293
Latvia	3,039	3,295	3,518	3,972	4,798	5,935	6,952	8,688	12,610	14,859	11,437
Lithuania	3,098	3,264	3,489	4,086	5,391	6,565	7,731	8,861	11,587	14,071	11,023
Macedonia	1,835	1,785	1,703	1,863	2,286	2,645	2,854	3,119	3,868	4,632	4,543
Montenegro	1,432	1,756	1,942	2,583	3,143	3,478	4,084	5,827	6,842	6,269	-
Poland	4,341	4,454	4,981	5,184	5,675	6,625	7,967	8,956	11,152	13,867	11,313
Romania	1,594	1,672	1,872	2,125	2,752	3,513	4,602	5,702	7,954	9,565	7,504
Serbia	2,472	933	1,520	2,021	2,630	3,145	3,349	3,953	5,393	6,514	5,889
Slovakia	3,794	5,328	5,619	6,420	8,483	10,371	11,525	12,777	15,541	18,181	16,245
Slovenia	9,008	8,557	9,271	10,920	14,201	16,834	18,151	19,400	23,505	27,128	24,366

Source: EBRD Transition Report (various issues).

c) Annual inflation rates (in percent)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	0.4	0.1	3.1	5.2	2.3	2.9	2.4	2.4	2.9	1.1	3.4
Bosnia and H.	-0.9	1.9	1.9	-0.2	0.1	-0.3	3.0	6.0	1.9	7.7	-2.7
Bulgaria	0.7	9.9	7.4	5.9	2.3	6.1	5.0	7.3	8.4	12.3	2.8
Croatia	4.0	4.6	3.8	1.7	1.8	2.1	3.3	3.2	2.9	6.1	2.4
Czech Rep.	2.1	4.0	4.7	1.8	0.2	2.8	1.9	2.6	3.0	6.3	7.3
Estonia	3.3	4.0	5.8	3.6	1.3	3.0	4.1	4.4	6.6	10.4	-0.1
Hungary	10.0	9.8	9.2	5.3	4.7	6.8	3.6	3.9	8.0	6.1	4.2
Kosovo	-	-	-	-	1.3	-1.1	-1.3	0.6	4.4	9.4	-2.4
Latvia	4.7	2.6	2.5	1.9	2.9	6.2	6.7	6.5	10.1	15.4	3.5
Lithuania	0.8	1.0	1.5	0.3	-1.1	1.2	2.7	3.8	5.7	11.0	4.2
Macedonia	-0.7	5.8	5.5	1.8	1.2	-0.4	0.5	3.2	2.3	8.3	-0.8
Montenegro	67.6	97.1	22.6	16.0	6.7	2.4	2.3	3.0	4.2	8.3	3.4
Poland	7.3	10.1	5.5	1.9	0.8	3.5	2.2	1.2	2.4	4.3	3.8
Romania	45.8	45.7	34.5	22.5	15.3	11.9	9.1	6.6	4.9	7.9	5.6

Serbia	41.1	70.0	91.8	19.5	11.7	10.1	16.5	12.7	6.5	12.4	8.1
Slovakia	10.6	12.0	7.3	3.0	8.5	7.5	2.5	4.5	2.8	4.6	1.6
Slovenia	6.2	8.9	8.4	7.5	5.6	3.6	2.5	2.5	3.6	5.7	0.9

Source:EBRD Transition Report (various issues).

Appendix 1.2 Banking system ownership and reform indicators

a) State-ownership of the banking system (in percent)

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Albania	81.1	64.8	59.2	54.1	51.9	6.7	7.7	0.0	0.0	0.0	0.0
Bosnia and H.	75.9	55.4	17.3	6.3	5.2	4.0	3.6	3.2	1.9	0.9	0.8
Bulgaria	50.5	19.8	19.9	14.1	0.4	2.3	1.7	1.8	2.1	2.0	2.4
Croatia	39.8	5.7	5.0	4.0	3.4	3.1	3.4	4.2	4.7	4.4	4.1
Czech Rep.	41.2	27.8	3.8	4.6	3	2.9	2.5	2.2	-	-	-
Estonia	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hungary	7.8	7.7	9.1	10.7	7.4	6.6	7.0	7.4	3.7	3.5	3.9
Kosovo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	2.6	2.9	3.2	4	4.1	4.0	4.3	4.4	4.2	19.5	17.1
Lithuania	41.9	38.9	12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Macedonia	2.5	1.1	1.3	2	1.8	1.9	1.6	1.6	1.4	1.2	1.4
Montenegro	-	-	-	-	-	16.4	5.1	0.0	0.0	0.0	0.0
Poland	24.9	23.9	24.4	26.6	25.7	21.7	21.5	21.1	19.5	18.3	22.1
Romania	50.3	50	45.4	43.6	40.6	7.5	6.5	5.9	5.7	5.6	7.9
Serbia	89.0	90.9	68.0	35.6	34.0	23.4	23.9	14.9	15.7	16.0	-
Slovakia	50.7	49.1	4.9	2.9	1.5	1.3	1.1	1.1	1.0	0.8	0.9
Slovenia	42.2	42.5	48.9	13.3	12.8	12.6	12.0	12.5	14.4	15.4	16.7

Source: EBRD Transition Report (various issues).

b) Foreign-ownership of the banking system (in percent)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	-	-	40.8	45.9	47.1	93.3	92.3	90.5	94.2	93.6	92.4
Bosnia and H.	-	-	65.3	76.7	79.7	80.9	90.9	94.0	93.8	95.0	94.5
Bulgaria	28.4	71.5	72.7	75.2	82.7	81.6	74.5	80.1	82.3	83.9	84.0
Croatia	39.9	84.1	89.3	90.2	91.0	91.3	91.3	90.8	90.4	90.8	91.0
Czech Rep.	27.1	75.4	89.1	85.8	86.3	84.9	84.4	84.7	-	-	-
Estonia	-	-	97.6	97.5	97.5	98.0	99.4	99.1	98.8	98.2	98.3
Hungary	-	-	66.5	85.0	83.5	63.0	82.6	82.9	64.2	84.0	81.3
Kosovo	-	100.0	75.4	77.4	74.3	73.9	78.8	83.3	85.8	89.9	90.0
Latvia	-	-	65.2	42.8	53.0	48.6	57.9	63.3	63.8	65.7	69.3
Lithuania	-	-	78.2	96.1	95.6	90.8	91.7	91.8	91.7	92.1	91.5
Macedonia	-	-	51.1	44.0	47.0	47.3	51.3	53.2	85.9	93.1	93.3
Montenegro	-	-	-	16.9	23.5	31.0	87.7	91.9	78.7	84.6	87.1
Poland	49.3	72.5	72.0	70.7	71.5	71.3	74.3	74.2	75.5	76.5	72.3
Romania	47.8	50.9	51.4	52.9	54.8	58.5	59.2	87.9	87.3	87.7	84.3
Serbia	-	-	13.2	27.0	38.4	37.7	66.0	78.7	75.5	75.3	-
Slovakia	37.8	40.6	78.3	84.1	96.3	96.7	97.3	97.0	99.0	99.2	91.6
Slovenia	-	-	15.2	16.9	18.9	20.1	22.6	29.3	28.8	31.1	29.5

Source: EBRD Transition Report (various issues).

c) EBRD banking reform index

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Albania	2	2.3	2.3	2.3	2.3	2.7	2.7	2.7	2.7	3.0	3.0
Bosnia and H.	2.3	2.3	2.3	2.3	2.3	2.7	2.7	2.7	2.7	3.0	3.0
Bulgaria	2.7	3.0	3.0	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7
Croatia	3	3.3	3.3	3.7	3.7	4.0	4.0	4.0	4.0	4.0	4.0
Czech Rep.	3.3	3.3	3.7	3.7	3.7	3.7	4.0	4.0	4.0	4.0	4.0
Estonia	3.7	3.7	3.7	3.7	3.7	4.0	4.0	4.0	4.0	4.0	4.0
Hungary	4	4	4	4	4	4.0	4.0	4.0	4.0	4.0	4.0
Kosovo	-	-	-	-	-	-	-	-	-	-	-
Latvia	3	3	3.3	3.7	3.7	3.7	3.7	3.7	4.0	4.0	3.7
Lithuania	3	3	3	3	3	3.3	3.7	3.7	3.7	3.7	3.7
Macedonia	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	3.0	3.0
Montenegro						2.3	2.3	2.7	2.7	3.0	3.0
Poland	3.3	3.3	3.3	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7

Romania	2.7	2.7	2.7	2.7	2.7	3.0	3.0	3.0	3.3	3.3	3.3
Serbia	1	1	1	2.3	2.3	2.3	2.7	2.7	2.7	3.0	3.0
Slovakia	2.7	3.0	3.3	3.3	3.3	3.7	3.7	3.7	3.7	3.7	3.7
Slovenia	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3

Source: EBRD Transition Report (various issues).
Note: Since the EBRD did quit the compilation of transition indicators for the Czech Republic after year 2007, for the years 2008 and 2009 we have assumed that the index has maintained the same value with the previous three years.

Appendix 1.3 Domestic credit to private sector (% of GDP)

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Albania	3.9	4.7	5.9	6.4	7.7	9.4	14.9	21.8	30.0	35.2	36.7
Bosnia and H.	48.0	37.4	26.2	30.3	34.7	36.9	43.1	49.5	61.8	67.4	54.4
Bulgaria	11.8	12.3	14.7	19.3	26.5	35.4	41.0	44.9	62.8	71.7	75.5
Croatia	32.3	32.0	36.3	43.6	45.8	48.5	52.6	59.2	62.3	64.7	67.2
Czech Rep.	54.0	47.2	39.1	29.6	30.5	31.3	35.4	39.4	46.3	50.6	52.0
Estonia	31.9	36.1	39.0	44.7	50.6	60.8	69.7	82.8	91.3	96.4	108.0
Hungary	25.9	32.5	33.3	35.0	42.7	45.9	51.2	55.6	62.6	69.8	69.5
Kosovo	-	0.2	0.9	3.0	7.8	14.1	18.8	22.3	28.3	33.1	35.7
Latvia	15.7	19.2	26.3	32.5	40.2	50.8	68.2	87.5	88.7	90.5	104.6
Lithuania	14.3	13.2	13.5	16.1	22.8	28.8	40.9	50.1	60.0	62.7	70.1
Macedonia	20.9	17.8	17.6	17.7	18.3	21.5	24.4	29.3	35.7	42.4	43.9
Montenegro	-	-	-	8.1	11.3	14.6	18.0	36.3	80.3	87.0	76.5
Poland	25.5	26.6	27.3	27.4	28.1	28.1	28.9	33.3	39.4	49.6	50.4
Romania	8.1	7.2	8.7	10.1	13.7	15.7	20.0	25.9	35.1	45.0	46.1
Serbia	28.8	49.1	33.8	17.3	19.3	23.0	29.0	29.2	35.2	40.2	45.2
Slovakia	54.4	51.1	37.2	39.3	31.8	30.4	35.1	38.7	42.4	45.0	51.1
Slovenia	33.3	35.8	37.9	38.7	41.3	47.9	56.3	65.9	78.8	85.3	92.9

Source: World Bank Development Indicators.

Chapter 4

Appendix 2.1 Estimation of the Banking Sector Competition in the CEE countries

Appendix 2.1.1 Wooldridge test for autocorrelation in panel data

```
xtserial logint_inc_real logp_funds  logp_labour  logp_physcapital  loans_ta_c4   equity_ta_c4
prov_loans_c4  rgdpgrowth  ebrd_bankref1  dv_foreign  dv_origin  dv_2000  dv_2001  dv_2002  dv_2003
dv_2004  dv_2005  dv_2006  dv_2007  dv_2008  dv_2009  dv_bos  dv_bul  dv_cro  dv_cze  dv_est  dv_hun
dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo
```

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation

F(  1,     250) =    253.562

     Prob > F =      0.0000
```

Appendix 2.1.2 Stata output for the long-run equilibrium test

```
xtabond2 logroaa Laglogroaa logp_funds logp_labour logp_physcapital loans_ta_c4 equity_ta_c4
prov_loans_c4  rgdpgrowth ebrd_bankref1 dv_foreign dv_origin dv_2000 dv_2001 dv_2002 dv_2003
dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Laglogroaa, laglimits (1
1)) gmm(equity_ta_c4, laglimits (2 2))  iv(logp_funds logp_labour logp_physcapital loans_ta_c4
prov_loans_c4  rgdpgrowth  dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol
dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin ebrd_bankref1) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed,
>  perm.
dv_2009 dropped due to collinearity
dv_mng dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estim
> ation.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1611
Time variable : year                            Number of groups   =       299
Number of instruments = 69                      Obs per group: min =         1
Wald chi2(34) =    479.56                                      avg =      5.39
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
     logroaa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  Laglogroaa |   .2247084   .0820117     2.74   0.006     .0639684    .3854483
  logp_funds |  -.0015453   .0029399    -0.53   0.599    -.0073074    .0042168
 logp_labour |  -.0109404   .0029401    -3.72   0.000    -.0167029   -.0051779
logp_physc~l |  -.0007426   .0011516    -0.64   0.519    -.0029996    .0015144
 loans_ta_c4 |   .0078644    .005774     1.36   0.173    -.0034525    .0191814
equity_ta_c4 |   .1076016   .0336082     3.20   0.001     .0417307    .1734724
prov_loans~4 |  -.3386661   .0615636    -5.50   0.000    -.4593285   -.2180037
  rgdpgrowth |   .0006972   .0002182     3.19   0.001     .0002695    .0011249
ebrd_bankr~1 |  -.0007438   .0039261    -0.19   0.850    -.0084389    .0069513
  dv_foreign |  -.0039706    .002259    -1.76   0.079    -.0083982     .000457
   dv_origin |  -.0001632   .0021775    -0.07   0.940     -.004431    .0041046
     dv_2000 |   .0015656   .0052417     0.30   0.765    -.0087079     .011839
     dv_2001 |   .0008196   .0059471     0.14   0.890    -.0108364    .0124757
     dv_2002 |   .0039822   .0039835     1.00   0.317    -.0038252    .0117897
     dv_2003 |   .0024416   .0033022     0.74   0.460    -.0040306    .0089139
     dv_2004 |   .0026396   .0030139     0.88   0.381    -.0032675    .0085467
     dv_2005 |   .0018429    .003201     0.58   0.565     -.004431    .0081168
     dv_2006 |  -.0004538   .0033713    -0.13   0.893    -.0070615    .0061539
     dv_2007 |  -.0008569   .0028305    -0.30   0.762    -.0064047    .0046908
     dv_2008 |  -.0032461   .0024104    -1.35   0.178    -.0079705    .0014782
      dv_bos |   .0021012   .0050831     0.41   0.679    -.0078615    .0120639
      dv_bul |   .0031075   .0055694     0.56   0.577    -.0078082    .0140232
      dv_cro |  -.0008089   .0064633    -0.13   0.900    -.0134767    .0118589
      dv_cze |  -.0032459   .0062267    -0.52   0.602      -.01545    .0089581
      dv_est |   .0102429   .0083921     1.22   0.222    -.0062053    .0266912
      dv_hun |   .0131646   .0068432     1.92   0.054    -.0002479     .026577
      dv_lat |   .0017874   .0062253     0.29   0.774     -.010414    .0139888
      dv_lit |  -.0025717   .0048434    -0.53   0.595    -.0120646    .0069213
      dv_mac |  -.0037315    .008605    -0.43   0.665     -.020597     .013134
      dv_pol |    .004599   .0055617     0.83   0.408    -.0063017    .0154998
      dv_rom |   .0077004    .004449     1.73   0.083    -.0010194    .0164202
      dv_ser |   .0042616   .0079402     0.54   0.591    -.0113009    .0198242
      dv_svk |  -.0002928   .0054148    -0.05   0.957    -.0109056    .0103201
      dv_slo |   .0001799   .0041331     0.04   0.965    -.0079208    .0082805
       _cons |  -.0592405   .0235033    -2.52   0.012    -.1053061   -.0131749
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(logp_funds logp_labour logp_physcapital loans_ta_c4 prov_loans_c4
    rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
    dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit
    dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
    ebrd_bankref1)
```

```
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.Laglogroaa
    L2.equity_ta_c4
Instruments for levels equation
  Standard
    _cons
    logp_funds logp_labour logp_physcapital loans_ta_c4 prov_loans_c4
    rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
    dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit
    dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
    ebrd_bankref1
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.Laglogroaa
    DL.equity_ta_c4
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -2.42  Pr > z =  0.015
Arellano-Bond test for AR(2) in first differences: z =   0.64  Pr > z =  0.522
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(34)   = 310.03  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(34)   =  39.67  Prob > chi2 =  0.232
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(16)   =  21.67  Prob > chi2 =  0.154
    Difference (null H = exogenous): chi2(18)   =  18.00  Prob > chi2 =  0.455
  gmm(Laglogroaa, lag(1 1))
    Hansen test excluding group:     chi2(16)   =  23.32  Prob > chi2 =  0.105
    Difference (null H = exogenous): chi2(18)   =  16.35  Prob > chi2 =  0.568
  gmm(equity_ta_c4, lag(2 2))
    Hansen test excluding group:     chi2(16)   =  16.40  Prob > chi2 =  0.425
    Difference (null H = exogenous): chi2(18)   =  23.27  Prob > chi2 =  0.180
  iv(logp_funds logp_labour logp_physcapital loans_ta_c4 prov_loans_c4 rgdpgrowth dv_2
> 000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos d
> v_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser d
> v_svk dv_slo dv_foreign dv_origin ebrd_bankref1)
    Hansen test excluding group:     chi2(2)    =   4.89  Prob > chi2 =  0.087
    Difference (null H = exogenous): chi2(32)   =  34.78  Prob > chi2 =  0.337


. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0132283   .0049459    -2.67   0.007    -.0229222   -.0035345
------------------------------------------------------------------------------
```

Appendix 2.1.3 Estimation of equation 4.2 with the Ordinary Least Squares and the Fixed Effects methods

Note: These two estimations are conducted in order to compared the coefficient of the lagged dependent variable obtained through the OLS and FE methods, with the coefficient of the lagged dependent variable obtained through the GMM approach.

```
regres logint_inc_real Laglogint_inc_real logp_funds logp_labour logp_physcapital
loans_ta_c4 equity_ta_c4 prov_loans_c4  rgdpgrowth ebrd_bankref1 dv_foreign dv_origin dv_2000
dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro
dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo
note: dv_2000 omitted because of collinearity
note: dv_mng omitted because of collinearity

      Source |       SS       df       MS              Number of obs =    1610
-------------+------------------------------           F( 34,  1575) = 1589.02
       Model |  4027.85115    34  118.46621           Prob > F      =  0.0000
    Residual |  117.420753  1575  .074552859           R-squared     =  0.9717
-------------+------------------------------           Adj R-squared =  0.9711
       Total |   4145.2719  1609  2.57630323           Root MSE      =  .27304

------------------------------------------------------------------------------
logint_inc~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Laglogint_~l |   .9227807    .005858   157.53   0.000     .9112904     .934271
  logp_funds |   .0356194   .0172958     2.06   0.040     .0016942    .0695447
 logp_labour |  -.0905957   .0154974    -5.85   0.000    -.1209934    -.060198
logp_physc~l |  -.0285111   .0089852    -3.17   0.002    -.0461352    -.010887
 loans_ta_c4 |   .1095453   .0426678     2.57   0.010     .0258538    .1932369
equity_ta_c4 |  -.6824234   .0952439    -7.17   0.000    -.8692417   -.4956051
prov_loans~4 |  -.0642393   .2251884    -0.29   0.775    -.5059398    .3774613
  rgdpgrowth |   .0201009   .0027336     7.35   0.000      .014739    .0254628
ebrd_bankr~1 |  -.1035429   .0622522    -1.66   0.096    -.2256489     .018563
  dv_foreign |   .0420595   .0219518     1.92   0.056    -.0009985    .0851174
   dv_origin |   .0108453   .0208433     0.52   0.603    -.0300383    .0517289
     dv_2000 |  (omitted)
     dv_2001 |    .198845    .098981     2.01   0.045     .0046967    .3929934
     dv_2002 |   .0787677   .0812594     0.97   0.333    -.0806202    .2381557
     dv_2003 |   .0374891   .0782825     0.48   0.632    -.1160597     .191038
     dv_2004 |   .2575318   .0797934     3.23   0.001     .1010193    .4140443
     dv_2005 |   .2664075   .0816885     3.26   0.001     .1061779    .4266371
     dv_2006 |    .270609   .0813283     3.33   0.001     .1110858    .4301322
     dv_2007 |    .361783    .082018     4.41   0.000     .2009071    .5226588
     dv_2008 |   .3510328    .083665     4.20   0.000     .1869263    .5151393
     dv_2009 |   .2688263   .0900941     2.98   0.003     .0921093    .4455434
      dv_bos |   .0269802   .0562264     0.48   0.631    -.0833063    .1372666
      dv_bul |   .1735805   .0776179     2.24   0.025     .0213352    .3258259
      dv_cro |   .1361894   .0922614     1.48   0.140    -.0447787    .3171576
      dv_cze |   .1461526   .0929216     1.57   0.116    -.0361104    .3284156
      dv_est |   .0984147   .1018496     0.97   0.334    -.1013604    .2981899
      dv_hun |   .2575393   .1006914     2.56   0.011     .0600361    .4550425
      dv_lat |   .0933631   .0859816     1.09   0.278    -.0752873    .2620134
      dv_lit |   .1430231    .076882     1.86   0.063    -.0077787     .293825
      dv_mac |  -.0066482   .0569702    -0.12   0.907    -.1183935    .1050972
      dv_mng |  (omitted)
      dv_pol |   .1661237   .0751054     2.21   0.027     .0188067    .3134408
      dv_rom |   .1894986   .0551218     3.44   0.001     .0813788    .2976185
      dv_ser |   .1776007   .0537472     3.30   0.001     .0721772    .2830243
      dv_svk |  -.0330145   .0785104    -0.42   0.674    -.1870104    .1209814
      dv_slo |   .0858968   .0658147     1.31   0.192    -.0431969    .2149905
       _cons |   .5730933   .1996854     2.87   0.004     .1814161    .9647705
------------------------------------------------------------------------------
```

```
xtreg logint_inc_real Laglogint_inc_real  logp_funds  logp_labour  logp_physcapital
loans_ta_c4   equity_ta_c4 prov_loans_c4   rgdpgrowth ebrd_bankref1   dv_foreign dv_origin
dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009, fe
note: dv_2001 omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      1610
Group variable: bank                            Number of groups   =       299

R-sq:  within  = 0.8536                         Obs per group: min =         1
       between = 0.9182                                        avg =       5.4
       overall = 0.9086                                        max =        10

                                                F(20,1291)         =    376.34
corr(u_i, Xb)  = 0.7430                         Prob > F           =    0.0000

------------------------------------------------------------------------------
logint_inc~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Laglogint_~l |   .5150843   .0151177    34.07   0.000     .4854263    .5447423
  logp_funds |   .3186855   .0187352    17.01   0.000     .2819306    .3554403
 logp_labour |  -.3099779   .0268249   -11.56   0.000    -.3626031   -.2573528
logp_physc~l |    .021843   .0139445     1.57   0.117    -.0055135    .0491994
 loans_ta_c4 |   .1127867   .0644962     1.75   0.081    -.0137422    .2393157
equity_ta_c4 |  -.6863698   .1352978    -5.07   0.000    -.9517975    -.420942
prov_loans~4 |  -.3595785   .1894383    -1.90   0.058    -.7312191    .0120621
  rgdpgrowth |   .0144826   .0021074     6.87   0.000     .0103483     .018617
ebrd_bankr~1 |   .1004838   .0486003     2.07   0.039     .0051396     .195828
  dv_foreign |  -.0382003   .0438395    -0.87   0.384    -.1242048    .0478042
   dv_origin |   .0478103   .0449995     1.06   0.288    -.0404698    .1360904
     dv_2000 |  -.1400757   .0773485    -1.81   0.070    -.2918181    .0116667
     dv_2001 |  (omitted)
     dv_2002 |   .0613265   .0597654     1.03   0.305    -.0559214    .1785744
     dv_2003 |   .0604337   .0590475     1.02   0.306    -.0554058    .1762733
     dv_2004 |    .215002   .0598944     3.59   0.000      .097501    .3325031
     dv_2005 |   .2709691   .0613158     4.42   0.000     .1506796    .3912586
     dv_2006 |   .3276813   .0614122     5.34   0.000     .2072027      .44816
     dv_2007 |   .4217069    .062363     6.76   0.000      .299363    .5440507
     dv_2008 |   .4249778   .0637933     6.66   0.000     .2998279    .5501276
     dv_2009 |   .4033378   .0685702     5.88   0.000     .2688165    .5378591
       _cons |   4.325737   .2425696    17.83   0.000     3.849863     4.80161
-------------+----------------------------------------------------------------
     sigma_u |  .67486224
     sigma_e |  .19656702
         rho |  .92179651   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(298, 1291) =     6.40           Prob > F = 0.0000
```

Appendix 2.1.4 Stata output for Specification 1

(Dependent variable: real interest income)

```
xtabond2   logint_inc_real   Laglogint_inc_real   logp_funds   logp_labour   logp_physcapital
loans_ta_c4   equity_ta_c4  prov_loans_c4  rgdpgrowth ebrd_bankref1   dv_foreign dv_origin
dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul
dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo,
gmm(Laglogint_inc_real,   laglimits   (2   2))   iv(logp_funds   logp_labour   logp_physcapital
loans_ta_c4  equity_ta_c4  prov_loans_c4  rgdpgrowth  dv_2000  dv_2001  dv_2002  dv_2003  dv_2004
dv_2005  dv_2006  dv_2007  dv_2008  dv_2009  dv_bos  dv_bul  dv_cro  dv_cze  dv_est  dv_hun  dv_lat
dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin ebrd_bankref1)
robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed,
>  perm.
dv_2009 dropped due to collinearity
dv_mng dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estim
> ation.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1610
Time variable : year                            Number of groups   =       299
Number of instruments = 50                      Obs per group: min =         1
Wald chi2(34) =  11571.78                                      avg =      5.38
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
logint_inc~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Laglogint_~l |    .856097   .0712376    12.02   0.000      .716474    .9957201
  logp_funds |   .1288184   .0415859     3.10   0.002     .0473114    .2103253
 logp_labour |   -.141265   .0461301    -3.06   0.002    -.2316784   -.0508516
logp_physc~l |  -.0512213   .0349461    -1.47   0.143    -.1197144    .0172718
 loans_ta_c4 |    .063464   .0770991     0.82   0.410    -.0876475    .2145755
equity_ta_c4 |  -.8533579   .3461235    -2.47   0.014    -1.531748   -.1749682
prov_loans~4 |  -.1680146   .2972108    -0.57   0.572     -.750537    .4145078
  rgdpgrowth |   .0217393   .0026259     8.28   0.000     .0165926     .026886
ebrd_bankr~1 |  -.1610378   .0619515    -2.60   0.009    -.2824606    -.039615
  dv_foreign |   .0664987   .0415761     1.60   0.110    -.0149889    .1479863
   dv_origin |   .0573738   .0603842     0.95   0.342    -.0609771    .1757246
     dv_2000 |   -.399803   .0848699    -4.71   0.000    -.5661449   -.2334611
     dv_2001 |   -.176902   .0915276    -1.93   0.053    -.3562928    .0024889
     dv_2002 |  -.2458918     .06618    -3.72   0.000    -.3756022   -.1161813
     dv_2003 |  -.2905139   .0568102    -5.11   0.000    -.4018598    -.179168
     dv_2004 |  -.0879458    .058064    -1.51   0.130     -.201749    .0258575
     dv_2005 |  -.0517026   .0498771    -1.04   0.300      -.14946    .0460547
     dv_2006 |   -.021098   .0466469    -0.45   0.651    -.1125243    .0703282
     dv_2007 |   .0610714   .0428894     1.42   0.154    -.0229903     .145133
     dv_2008 |   .0416834   .0286796     1.45   0.146    -.0145276    .0978943
      dv_bos |   .0837723   .0589751     1.42   0.155    -.0318169    .1993614
      dv_bul |   .3237083   .0964839     3.36   0.001     .1346034    .5128132
      dv_cro |   .2935497   .1018735     2.88   0.004     .0938812    .4932181
      dv_cze |   .3997085    .163861     2.44   0.015     .0785469    .7208701
      dv_est |   .2171297   .1406828     1.54   0.123    -.0586035    .4928628
      dv_hun |   .4907567   .1769405     2.77   0.006     .1439596    .8375538
      dv_lat |   .2716002   .0965639     2.81   0.005     .0823384    .4608619
      dv_lit |   .3244769   .0987172     3.29   0.001     .1309947     .517959
      dv_mac |     .02283   .0685788     0.33   0.739     -.111582    .1572421
      dv_pol |   .3784802   .1659952     2.28   0.023     .0531356    .7038249
      dv_rom |   .3319831   .1270359     2.61   0.009     .0829972    .5809689
      dv_ser |   .2517166    .084261     2.99   0.003     .0865681    .4168651
      dv_svk |   .1440336   .1282449     1.12   0.261    -.1073219     .395389
      dv_slo |   .2253004   .1161147     1.94   0.052    -.0022804    .4528811
       _cons |   1.747397   .6537905     2.67   0.008     .4659909    3.028803
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(logp_funds logp_labour logp_physcapital loans_ta_c4 equity_ta_c4
    prov_loans_c4 rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
```

```
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
    dv_origin ebrd_bankref1)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L2.Laglogint_inc_real
Instruments for levels equation
  Standard
    _cons
    logp_funds logp_labour logp_physcapital loans_ta_c4 equity_ta_c4
    prov_loans_c4 rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
    dv_origin ebrd_bankref1
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.Laglogint_inc_real
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.37  Pr > z =  0.001
Arellano-Bond test for AR(2) in first differences: z =  -0.49  Pr > z =  0.621
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(15)   =  52.53  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(15)   =  15.71  Prob > chi2 =  0.402
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(7)    =   7.24  Prob > chi2 =  0.405
    Difference (null H = exogenous): chi2(8)    =   8.47  Prob > chi2 =  0.389



. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
logint_inc~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0636679   .0663535    -0.96   0.337    -.1937185    .0663827
------------------------------------------------------------------------------
```

Appendix 2.1.5 Stata output for Specification 2

(Dependent variable: real total income)

```
xtabond2 logtot_inc_real Laglogtot_inc_real logp_funds logp_labour logp_physcapital
loans_ta_c4 equity_ta_c4 prov_loans_c4 rgdpgrowth ebrd_bankref1 dv_foreign_domestic_51
dv_foreignorigin dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008
dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom
dv_ser dv_svk dv_slo, gmm(Laglogtot_inc_real, laglimits (1 3)) iv(logp_funds logp_labour
logp_physcapital loans_ta_c4 equity_ta_c4 prov_loans_c4  rgdpgrowth dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign_domestic_51
dv_foreignorigin ebrd_bankref1) robust twostep


Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per
> m.
dv_2009 dropped due to collinearity
dv_mng dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimatio
> n.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1607
Time variable : year                            Number of groups   =       298
Number of instruments = 67                      Obs per group: min =         1
Wald chi2(34) =   3928.13                                      avg =      5.39
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
logtot_inc~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Laglogtot_~l |   .7090216   .1731275     4.10   0.000      .369698    1.048345
  logp_funds |   .1560965   .0504079     3.10   0.002     .0572988    .2548941
 logp_labour |  -.1846465   .0905896    -2.04   0.042    -.3621989   -.0070941
logp_physc~l |  -.1114678    .082419    -1.35   0.176     -.273006    .0500704
 loans_ta_c4 |   .0722313   .1232287     0.59   0.558    -.1692926    .3137552
equity_ta_c4 |  -1.558553   .8551738    -1.82   0.068    -3.234663    .1175564
prov_loans~4 |   .9159622   .5391583     1.70   0.089    -.1407688    1.972693
  rgdpgrowth |   .0198814   .0040549     4.90   0.000     .0119338    .0278289
ebrd_bankr~1 |     -.1856   .0800329    -2.32   0.020    -.3424615   -.0287385
dv_foreig~51 |   .0470771   .0772964     0.61   0.542     -.104421    .1985753
dv_foreign~n |   .1215213   .1123898     1.08   0.280    -.0987587    .3418013
     dv_2000 |  -.5176071   .1104911    -4.68   0.000    -.7341658   -.3010485
     dv_2001 |  -.3384193   .1322415    -2.56   0.010    -.5976079   -.0792306
     dv_2002 |  -.3525119   .0933592    -3.78   0.000    -.5354926   -.1695311
     dv_2003 |  -.3681191   .0923804    -3.98   0.000    -.5491814   -.1870569
     dv_2004 |  -.1963545   .0986143    -1.99   0.046     -.389635   -.0030739
     dv_2005 |  -.1298706      .0791    -1.64   0.101    -.2849038    .0251626
     dv_2006 |  -.1133892   .0598802    -1.89   0.058    -.2307523    .0039739
     dv_2007 |  -.0246692    .052291    -0.47   0.637    -.1271578    .0778193
     dv_2008 |  -.0422396   .0324208    -1.30   0.193    -.1057831     .021304
      dv_bos |   .1201434   .1276271     0.94   0.347    -.1300011    .3702879
      dv_bul |   .4622687   .1896408     2.44   0.015     .0905796    .8339579
      dv_cro |   .3959858   .1866421     2.12   0.034      .030174    .7617975
      dv_cze |   .6724644   .3388879     1.98   0.047     .0082563    1.336673
      dv_est |   .4571104    .318704     1.43   0.151    -.1675379    1.081759
      dv_hun |    .949037   .4554885     2.08   0.037      .056296    1.841778
      dv_lat |   .4050479   .1656863     2.44   0.014     .0803088     .729787
      dv_lit |   .4206029   .2053688     2.05   0.041     .0180874    .8231184
      dv_mac |   .0106785   .1291628     0.08   0.934    -.2424759    .2638329
      dv_pol |   .8146886   .4498143     1.81   0.070    -.0669312    1.696308
      dv_rom |   .6186788   .3347146     1.85   0.065    -.0373497    1.274707
      dv_ser |   .2697852   .2698502     1.00   0.317    -.2591116    .7986819
      dv_svk |   .3881088   .2740726     1.42   0.157    -.1490637    .9252813
      dv_slo |   .4315863   .2926266     1.47   0.140    -.1419514    1.005124
       _cons |   3.285585   1.477421     2.22   0.026     .3898934    6.181277
------------------------------------------------------------------------------
Instruments for first differences equation
```

```
  Standard
    D.(logp_funds logp_labour logp_physcapital loans_ta_c4 equity_ta_c4
    prov_loans_c4 rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo
    dv_foreign_domestic_51 dv_foreignorigin ebrd_bankref1)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(1/3).Laglogtot_inc_real
Instruments for levels equation
  Standard
    _cons
    logp_funds logp_labour logp_physcapital loans_ta_c4 equity_ta_c4
    prov_loans_c4 rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo
    dv_foreign_domestic_51 dv_foreignorigin ebrd_bankref1
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.Laglogtot_inc_real
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.56  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =   0.54  Pr > z =  0.586
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(32)   = 129.42  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(32)   =  32.77  Prob > chi2 =  0.429
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(23)   =  24.42  Prob > chi2 =  0.381
    Difference (null H = exogenous): chi2(9)    =   8.35  Prob > chi2 =  0.499


lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
logtot_inc~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.1400178   .1377061    -1.02   0.309    -.4099168    .1298811
------------------------------------------------------------------------------
```

Appendix 2.1.6 Stata output for Specification 3

(Dependent variable: real interest income; includes the interactions of the input prices with the dummy variable for non-EU countries, *dv_noneu*=1)

```
xtabond2  logint_inc_real  Laglogint_inc_real  logp_funds  logp_labour  logp_physcapital
loans_ta_c4  equity_ta_c4  prov_loans_c4  rgdpgrowth  ebrd_bankref1  dv_foreign  dv_origin
logpfunds_dvnoneu logplabour_dvnoneu logpphyscapital_dvnoneu dv_noneu dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos  dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Laglogint_inc_real,
laglimits  (1  1))  iv(logp_funds  logp_labour  logp_physcapital  loans_ta_c4  equity_ta_c4
prov_loans_c4  rgdpgrowth  dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol
dv_rom  dv_ser  dv_svk  dv_slo  dv_foreign  dv_origin  ebrd_bankref1  logpfunds_dvnoneu
logplabour_dvnoneu logpphyscapital_dvnoneu dv_noneu) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed,
>  perm.
dv_2009 dropped due to collinearity
dv_mng dropped due to collinearity
dv_slo dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estim
> ation.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1610
Time variable : year                            Number of groups   =       299
Number of instruments = 55                      Obs per group: min =         1
Wald chi2(37) =   9144.76                                      avg =      5.38
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
logint_inc~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Laglogint_~l |   .7481205   .0615084    12.16   0.000     .6275661    .8686748
  logp_funds |   .2199377   .0497753     4.42   0.000     .1223799    .3174955
 logp_labour |  -.1726025    .057739    -2.99   0.003    -.2857689    -.059436
logp_physc~l |  -.1337613    .044862    -2.98   0.003    -.2216893   -.0458334
 loans_ta_c4 |   .0614127   .0891642     0.69   0.491    -.1133459    .2361714
equity_ta_c4 |  -1.286948   .3513805    -3.66   0.000    -1.975641   -.5982548
prov_loans~4 |  -.2152835   .3227253    -0.67   0.505    -.8478135    .4172466
  rgdpgrowth |   .0194693   .0028002     6.95   0.000      .013981    .0249576
ebrd_bankr~1 |  -.1024123   .0667293    -1.53   0.125    -.2331993    .0283747
  dv_foreign |   .0697683   .0508261     1.37   0.170    -.0298489    .1693856
   dv_origin |   .0984443   .0539122     1.83   0.068    -.0072217    .2041103
logpfunds_~u |  -.1497955   .0671953    -2.23   0.026     -.281496   -.0180951
logplabour~u |  -.1763088   .0868361    -2.03   0.042    -.3465044   -.0061133
logpphysca~u |    .112356   .0549386     2.05   0.041     .0046782    .2200337
    dv_noneu |  -1.699698   .4968002    -3.42   0.001    -2.673408   -.7259875
     dv_2000 |  -.3764038   .1089936    -3.45   0.001    -.5900273   -.1627803
     dv_2001 |  -.2691797   .0957507    -2.81   0.005    -.4568477   -.0815117
     dv_2002 |  -.2816289   .0680664    -4.14   0.000    -.4150366   -.1482213
     dv_2003 |  -.3199546   .0633472    -5.05   0.000    -.4441127   -.1957964
     dv_2004 |  -.1292193   .0646005    -2.00   0.045     -.255834   -.0026047
     dv_2005 |  -.0920807   .0530327    -1.74   0.083    -.1960228    .0118615
     dv_2006 |  -.0550208   .0492404    -1.12   0.264    -.1515302    .0414887
     dv_2007 |   .0168639   .0462488     0.36   0.715    -.0737821    .1075099
     dv_2008 |   .0361896   .0303028     1.19   0.232    -.0232028    .0955821
      dv_bos |   .2113067   .0833856     2.53   0.011     .0478739    .3747395
      dv_bul |  -.0000394   .1020856    -0.00   1.000    -.2001235    .2000447
      dv_cro |    .396587   .1222791     3.24   0.001     .1569243    .6362496
      dv_cze |     .13456    .135374     0.99   0.320    -.1307683    .3998882
      dv_est |  -.0062041   .2102615    -0.03   0.976     -.418309    .4059009
      dv_hun |   .3086469   .1441874     2.14   0.032     .0260448    .5912491
      dv_lat |  -.1037993   .1319009    -0.79   0.431    -.3623203    .1547216
      dv_lit |  -.0429775   .1349103    -0.32   0.750    -.3073967    .2214418
      dv_mac |   .1172637   .0871842     1.35   0.179    -.0536142    .2881416
      dv_pol |   .2568178   .1177593     2.18   0.029     .0260138    .4876219
      dv_rom |   .0787984    .094848     0.83   0.406    -.1071003     .264697
      dv_ser |   .4997492   .1133245     4.41   0.000     .2776373    .7218612
```

```
      dv_svk |  -.1385108   .1311398    -1.06   0.291    -.3955401    .1185185
       _cons |    3.22194    .703504     4.58   0.000     1.843098    4.600783
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(logp_funds logp_labour logp_physcapital loans_ta_c4 equity_ta_c4
    prov_loans_c4 rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
    dv_origin ebrd_bankref1 logpfunds_dvnoneu logplabour_dvnoneu
    logpphyscapital_dvnoneu dv_noneu)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.Laglogint_inc_real
Instruments for levels equation
  Standard
    _cons
    logp_funds logp_labour logp_physcapital loans_ta_c4 equity_ta_c4
    prov_loans_c4 rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
    dv_origin ebrd_bankref1 logpfunds_dvnoneu logplabour_dvnoneu
    logpphyscapital_dvnoneu dv_noneu
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.Laglogint_inc_real
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.66  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.28  Pr > z =  0.783
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(17)   =  68.01  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(17)   =  19.91  Prob > chi2 =  0.279
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(8)    =   3.69  Prob > chi2 =  0.884
    Difference (null H = exogenous): chi2(9)    =  16.22  Prob > chi2 =  0.062



. lincom (logpfunds_dvnoneu+logp_funds)+ (logplabour_dvnoneu+logp_labour)+
(logpphyscapital_dvnoneu+logp_physcapital)

 ( 1)  logp_funds + logp_labour + logp_physcapital + logpfunds_dvnoneu +
       logplabour_dvnoneu + logpphyscapital_dvnoneu = 0

------------------------------------------------------------------------------
logint_inc~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.3001746   .1151065    -2.61   0.009    -.5257791   -.0745701
------------------------------------------------------------------------------
```

Appendix 2.1.8 Stata output for Specification 4

(Dependent variable: real interest income / total assets)

Note: Since the scaling of the dependent variable (interest income) to total assets transforms the reduced-form revenue equation into a price equation (i.e. the dependent variable becomes the interest rate), in this specification the control variables *prov_loans_c4*, *loans_ta_c4*, and *equity_ta_c4* are treated as endogenous (hence, included in lags) based on the predicted relationship between these variables and the interest rate. For a more detailed elaboration on these relationships see the description of variables in chapter 6.

```
xtabond2 logintinc_ta Laglogintinc_ta logp_funds logp_labour logp_physcapital loans_ta_c4
equity_ta_c4 prov_loans_c4 rgdpgrowth ebrd_bankref1 dv_foreign dv_origin dv_2000 dv_2001
dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo,
gmm(Laglogintinc_ta, laglimits (1 2)) gmm(prov_loans_c4 loans_ta_c4 equity_ta_c4, laglimits(2
3)) iv(logp_funds logp_labour logp_physcapital rgdpgrowth dv_2000 dv_2001 dv_2002 dv_2003
dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
ebrd_bankref1) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed,
>  perm.
dv_2009 dropped due to collinearity
dv_mng dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estim
> ation.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1610
Time variable : year                            Number of groups   =       299
Number of instruments = 135                     Obs per group: min =         1
Wald chi2(34) =   3266.35                                      avg =      5.38
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
logintinc_ta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Lagloginti~a |   .2796986   .0525003     5.33   0.000     .1767999    .3825974
  logp_funds |   .3764157   .0305039    12.34   0.000     .3166291    .4362024
 logp_labour |   .1552258   .0191444     8.11   0.000     .1177035    .1927481
logp_physc~l |    .024541   .0096414     2.55   0.011     .0056441    .0434378
 loans_ta_c4 |   .1927259   .0972246     1.98   0.047     .0021691    .3832827
equity_ta_c4 |   .5405428   .1990778     2.72   0.007     .1503575    .9307281
prov_loans~4 |  -.1788044   .3944519    -0.45   0.650    -.9519159    .5943071
  rgdpgrowth |   .0053443    .001768     3.02   0.003     .0018792    .0088095
ebrd_bankr~1 |   .0269762   .0276653     0.98   0.330    -.0272469    .0811993
  dv_foreign |  -.0295522   .0233685    -1.26   0.206    -.0753536    .0162492
   dv_origin |   .0167908   .0195698     0.86   0.391    -.0215654    .0551469
     dv_2000 |  -.0531937   .0550172    -0.97   0.334    -.1610255    .0546381
     dv_2001 |  -.0202976   .0412198    -0.49   0.622     -.101087    .0604918
     dv_2002 |  -.0439547   .0414033    -1.06   0.288    -.1251038    .0371943
     dv_2003 |  -.0492373   .0264172    -1.86   0.062    -.1010141    .0025395
     dv_2004 |  -.0186932   .0212339    -0.88   0.379    -.0603108    .0229245
     dv_2005 |  -.0348371   .0198287    -1.76   0.079    -.0737006    .0040264
     dv_2006 |  -.0539936   .0194018    -2.78   0.005    -.0920205   -.0159667
     dv_2007 |   -.045808   .0185136    -2.47   0.013     -.082094   -.0095221
     dv_2008 |   .0039819   .0166761     0.24   0.811    -.0287027    .0366666
      dv_bos |  -.1421673   .0566919    -2.51   0.012    -.2532813   -.0310532
      dv_bul |   -.027412   .0692523    -0.40   0.692    -.1631441    .1083201
      dv_cro |  -.1888659   .0621879    -3.04   0.002    -.3107519   -.0669798
      dv_cze |   -.209667    .070246    -2.98   0.003    -.3473466   -.0719874
      dv_est |  -.2399384   .0844729    -2.84   0.005    -.4055022   -.0743745
      dv_hun |  -.1069789   .0696538    -1.54   0.125    -.2434978    .0295401
      dv_lat |  -.1998476   .0636114    -3.14   0.002    -.3245237   -.0751715
      dv_lit |  -.2454068    .057516    -4.27   0.000    -.3581361   -.1326774
```

```
      dv_mac |  -.1123052   .0614718    -1.83   0.068    -.2327878    .0081773
      dv_pol |   -.254986   .0592266    -4.31   0.000     -.371068   -.1389041
      dv_rom |  -.1560751    .052733    -2.96   0.003    -.2594299   -.0527203
      dv_ser |  -.1419945   .0630064    -2.25   0.024    -.2654848   -.0185042
      dv_svk |  -.1698682   .0579088    -2.93   0.003    -.2833674   -.0563691
      dv_slo |  -.2501276    .055978    -4.47   0.000    -.3598424   -.1404128
       _cons |  -.1427205   .1730125    -0.82   0.409    -.4818188    .1963777
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(logp_funds logp_labour logp_physcapital rgdpgrowth dv_2000 dv_2001
    dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos
    dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin ebrd_bankref1)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(1/2).Laglogintinc_ta
    L(2/3).(prov_loans_c4 loans_ta_c4 equity_ta_c4)
Instruments for levels equation
  Standard
    _cons
    logp_funds logp_labour logp_physcapital rgdpgrowth dv_2000 dv_2001 dv_2002
    dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul
    dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom
    dv_ser dv_svk dv_slo dv_foreign dv_origin ebrd_bankref1
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.Laglogintinc_ta
    DL.(prov_loans_c4 loans_ta_c4 equity_ta_c4)
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -3.00  Pr > z =  0.003
Arellano-Bond test for AR(2) in first differences: z =  -0.73  Pr > z =  0.463
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(100)  = 371.24  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(100)  = 105.05  Prob > chi2 =  0.345
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(63)   =  68.96  Prob > chi2 =  0.283
    Difference (null H = exogenous): chi2(37)   =  36.09  Prob > chi2 =  0.511
  gmm(Laglogintinc_ta, lag(1 2))
    Hansen test excluding group:     chi2(76)   =  77.99  Prob > chi2 =  0.415
    Difference (null H = exogenous): chi2(24)   =  27.06  Prob > chi2 =  0.302
  gmm(prov_loans_c4 loans_ta_c4 equity_ta_c4, lag(2 3))
    Hansen test excluding group:     chi2(20)   =  26.88  Prob > chi2 =  0.139
    Difference (null H = exogenous): chi2(80)   =  78.17  Prob > chi2 =  0.537
  iv(logp_funds logp_labour logp_physcapital rgdpgrowth dv_2000 dv_2001 dv_2002 dv_200
> 3 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
>  dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv
> _origin ebrd_bankref1)
    Hansen test excluding group:     chi2(70)   =  77.21  Prob > chi2 =  0.259
    Difference (null H = exogenous): chi2(30)   =  27.84  Prob > chi2 =  0.579



. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
logintinc_ta |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .5561825   .0425623    13.07   0.000     .4727619    .6396031
------------------------------------------------------------------------------
```

Appendix 2.1.7 Stata output for Specification 5

(Dependent variable: real interest income; includes the *total assets* among the explanatory variables)

Note: Since the inclusion of total assets as an explanatory variable transforms the reduced-form revenue equation into a price equation (i.e. the dependent variable becomes the interest rate), in this specification the control variables *prov_loans_c4*, *loans_ta_c4*, and *equity_ta_c4* are treated as endogenous (hence, included in lags) based on the predicted relationship between these variables and the interest rate. For a more detailed elaboration on these relationships see the description of variables in chapter 6.

```
xtabond2   logint_inc_real   Laglogint_inc_real   logp_funds   logp_labour   logp_physcapital
loans_ta_c4  equity_ta_c4  prov_loans_c4  rgdpgrowth  ebrd_bankref1  dv_foreign  dv_origin  logta
dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul
dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo,
gmm(Laglogint_inc_real,   laglimits   (1   2))   gmm(prov_loans_c4   loans_ta_c4   equity_ta_c4,
laglimits(2 3)) iv(logp_funds logp_labour logp_physcapital rgdpgrowth  dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo  dv_foreign dv_origin
logta ebrd_bankref1) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed,
>  perm.
dv_2009 dropped due to collinearity
dv_mng dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estim
> ation.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1610
Time variable : year                            Number of groups   =       299
Number of instruments = 136                     Obs per group: min =         1
Wald chi2(35) =  75254.98                                      avg =      5.38
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
logint_inc~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Laglogint_~l |   .1706276   .0425804     4.01   0.000     .0871716    .2540836
  logp_funds |   .3416356   .0341533    10.00   0.000     .2746964    .4085749
 logp_labour |   .1535432   .0218881     7.01   0.000     .1106433    .1964431
logp_physc~l |   .0235046   .0103098     2.28   0.023     .0032977    .0437115
 loans_ta_c4 |   .3791947   .1004432     3.78   0.000     .1823297    .5760597
equity_ta_c4 |   .5823961   .2709562     2.15   0.032     .0513318     1.11346
prov_loans~4 |  -.6448098   .5161948    -1.25   0.212    -1.656533    .3669134
  rgdpgrowth |   .0083582   .0019422     4.30   0.000     .0045515    .0121649
ebrd_bankr~1 |  -.0585261   .0363118    -1.61   0.107    -.1296959    .0126436
  dv_foreign |  -.0492605   .0254986    -1.93   0.053    -.0992369    .0007159
   dv_origin |   -.006476   .0218612    -0.30   0.767    -.0493232    .0363711
       logta |    .849701   .0455947    18.64   0.000     .7603371    .9390649
     dv_2000 |   .3301914   .0705031     4.68   0.000     .1920079    .4683749
     dv_2001 |   .2686466   .0537629     5.00   0.000     .1632732    .3740201
     dv_2002 |   .2599727   .0528473     4.92   0.000     .1563939    .3635515
     dv_2003 |   .1713896   .0379036     4.52   0.000        .0971    .2456792
     dv_2004 |   .1729323   .0301764     5.73   0.000     .1137876     .232077
     dv_2005 |   .1211239   .0260523     4.65   0.000     .0700623    .1721854
     dv_2006 |   .0541615   .0256289     2.11   0.035     .0039298    .1043931
     dv_2007 |   .0232586   .0233781     0.99   0.320    -.0225616    .0690788
     dv_2008 |  -.0085506   .0190295    -0.45   0.653    -.0458478    .0287466
      dv_bos |  -.1454204   .0545237    -2.67   0.008    -.2522849   -.0385559
      dv_bul |  -.0367587   .0706466    -0.52   0.603    -.1752235     .101706
      dv_cro |  -.1288558   .0700275    -1.84   0.066    -.2661072    .0083956
      dv_cze |  -.2114565   .0818432    -2.58   0.010    -.3718663   -.0510467
      dv_est |  -.2734359   .1366885    -2.00   0.045    -.5413403   -.0055314
      dv_hun |   -.053273   .0859089    -0.62   0.535    -.2216515    .1151054
```

```
      dv_lat |  -.2050339   .0757179    -2.71   0.007    -.3534383   -.0566295
      dv_lit |  -.2727341   .0648462    -4.21   0.000    -.3998304   -.1456378
      dv_mac |   -.115918   .0650009    -1.78   0.075    -.2433174    .0114814
      dv_pol |  -.2236011   .0728639    -3.07   0.002    -.3664117   -.0807906
      dv_rom |  -.0914943   .0599433    -1.53   0.127     -.208981    .0259924
      dv_ser |  -.1809224   .0797871    -2.27   0.023    -.3373024   -.0245425
      dv_svk |  -.1468121   .0657711    -2.23   0.026    -.2757211   -.0179031
      dv_slo |  -.2626862   .0619388    -4.24   0.000    -.3840841   -.1412884
       _cons |  -.8065431    .254153    -3.17   0.002    -1.304674   -.3084123
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(logp_funds logp_labour logp_physcapital rgdpgrowth dv_2000 dv_2001
    dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos
    dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin logta ebrd_bankref1)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(1/2).Laglogint_inc_real
    L(2/3).(prov_loans_c4 loans_ta_c4 equity_ta_c4)
Instruments for levels equation
  Standard
    _cons
    logp_funds logp_labour logp_physcapital rgdpgrowth dv_2000 dv_2001 dv_2002
    dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul
    dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom
    dv_ser dv_svk dv_slo dv_foreign dv_origin logta ebrd_bankref1
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.Laglogint_inc_real
    DL.(prov_loans_c4 loans_ta_c4 equity_ta_c4)
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -2.66  Pr > z =  0.008
Arellano-Bond test for AR(2) in first differences: z =  -1.04  Pr > z =  0.299
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(100)  = 521.13  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(100)  = 113.39  Prob > chi2 =  0.170
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(63)   =  73.74  Prob > chi2 =  0.167
    Difference (null H = exogenous): chi2(37)   =  39.65  Prob > chi2 =  0.353
  gmm(Laglogint_inc_real, lag(1 2))
    Hansen test excluding group:     chi2(76)   =  90.71  Prob > chi2 =  0.120
    Difference (null H = exogenous): chi2(24)   =  22.68  Prob > chi2 =  0.539
  gmm(prov_loans_c4 loans_ta_c4 equity_ta_c4, lag(2 3))
    Hansen test excluding group:     chi2(20)   =  40.32  Prob > chi2 =  0.005
    Difference (null H = exogenous): chi2(80)   =  73.07  Prob > chi2 =  0.696
  iv(logp_funds logp_labour logp_physcapital rgdpgrowth dv_2000 dv_2001 dv_2002 dv_200
> 3 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
>  dv_hun dv_lat dv_lit dv_mac dv_mng dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv
> _origin logta ebrd_bankref1)
    Hansen test excluding group:     chi2(69)   =  89.06  Prob > chi2 =  0.053
    Difference (null H = exogenous): chi2(31)   =  24.33  Prob > chi2 =  0.797



. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
logint_inc~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .5186834   .0507656    10.22   0.000     .4191848    .6181821
------------------------------------------------------------------------------
```

Appendix 2.2 Estimation of the Banking Sector Competition in Kosovo

Appendix 2.2.1 Wooldridge test for autocorrelation in panel data

xtserial logtotinc_real logpf logplc loans_ta equity_ta prov_loans d2002 d2003 d2004 d2005 d2006 d2007 d2008 d2009 d2010

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation


  F(  1,       9) =     27.334
           Prob > F =      0.0005
```

Appendix 2.2.2 Hausman test for choosing between Fixed Effects and Random Effects

```
xtregar logtotinc_real logpf logplc loans_ta equity_ta prov_loans d2002 d2003 d2004 d2005
d2006 d2007 d2008 d2009 d2010, fe


FE (within) regression with AR(1) disturbances  Number of obs      =       238
Group variable: bank                            Number of groups   =        10

R-sq:  within  = 0.3928                         Obs per group: min =        10
       between = 0.1233                                        avg =      23.8
       overall = 0.3209                                        max =        39

                                                F(14,214)          =      9.89
corr(u_i, Xb)  = 0.0620                         Prob > F           =    0.0000

------------------------------------------------------------------------------
logtotinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       logpf |   .4148038   .0463096     8.96   0.000     .3235224    .5060851
      logplc |  -.0815421   .0760726    -1.07   0.285    -.2314896    .0684054
    loans_ta |   .9486441   .3327446     2.85   0.005     .2927675    1.604521
   equity_ta |  -1.968462   .7489249    -2.63   0.009    -3.444676   -.4922476
  prov_loans |   .4104165   .9554703     0.43   0.668    -1.472922    2.293755
       d2002 |  -.7045141   .1854236    -3.80   0.000    -1.070005   -.3390235
       d2003 |  -.6712704   .2288307    -2.93   0.004    -1.122321   -.2202197
       d2004 |  -.6639408   .2535803    -2.62   0.009    -1.163776   -.1641058
       d2005 |  -.6781914   .2690039    -2.52   0.012    -1.208428   -.1479547
       d2006 |  -.5701345   .2778916    -2.05   0.041     -1.11789   -.0223792
       d2007 |  -.4300106   .2862698    -1.50   0.135    -.9942801    .1342589
       d2008 |  -.6699065   .2950102    -2.27   0.024    -1.251404   -.0884085
       d2009 |  -.5960965   .3002014    -1.99   0.048    -1.187827   -.0043661
       d2010 |  -.5713018   .3065441    -1.86   0.064    -1.175534    .0329308
       _cons |   3.192752   .1409392    22.65   0.000     2.914945    3.470559
-------------+----------------------------------------------------------------
      rho_ar |  .71762761
     sigma_u |  .94139636
     sigma_e |  .26964311
     rho_fov |  .92417896   (fraction of variance because of u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(9,214) =    25.01               Prob > F = 0.0000
```

```
estimates store FE
```

```
xtregar logtotinc_real logpf logplc loans_ta equity_ta prov_loans d2002 d2003 d2004 d2005
d2006 d2007 d2008 d2009 d2010, re

RE GLS regression with AR(1) disturbances       Number of obs      =       248
Group variable: bank                            Number of groups   =        10

R-sq:  within  = 0.7663                         Obs per group: min =        11
       between = 0.4902                                        avg =      24.8
       overall = 0.4316                                        max =        40

                                                Wald chi2(15)      =    220.21
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0000

------------------- theta --------------------
  min      5%       median        95%      max
0.6494   0.6499     0.7657     0.7758   0.7758

------------------------------------------------------------------------------
logtotinc_~l |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       logpf |   .4420397   .0506859     8.72   0.000     .3426972    .5413822
```

```
     logplc |    -.15534   .0904923    -1.72   0.086    -.3327017    .0220216
   loans_ta |   1.062966   .3435895     3.09   0.002     .3895432    1.736389
  equity_ta |  -3.365806   .5627121    -5.98   0.000    -4.468702   -2.262911
 prov_loans |   1.841382   1.115721     1.65   0.099    -.3453902    4.028154
      d2002 |  -.1671964   .1851821    -0.90   0.367    -.5301466    .1957538
      d2003 |   .1732807   .2185047     0.79   0.428    -.2549807    .6015421
      d2004 |   .3508666   .2361125     1.49   0.137    -.1119054    .8136385
      d2005 |   .4058705   .2508957     1.62   0.106     -.085876     .897617
      d2006 |   .5969205   .2562752     2.33   0.020     .0946304    1.099211
      d2007 |   .8565486   .2588082     3.31   0.001     .3492939    1.363803
      d2008 |   .4248501   .2736696     1.55   0.121    -.1115324    .9612326
      d2009 |    .480305   .2851676     1.68   0.092    -.0786133    1.039223
      d2010 |   .4424562   .2976322     1.49   0.137    -.1408923    1.025805
      _cons |   1.741409   .5873059     2.97   0.003     .5903102    2.892507
-------------+----------------------------------------------------------------
     rho_ar |  .71762761   (estimated autocorrelation coefficient)
    sigma_u |  .75238408
    sigma_e |  .32823095
    rho_fov |  .84011163   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
estimates store RE
```

```
hausman FE RE

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
       logpf |    .4148038     .4420397       -.0272359               .
      logplc |   -.0815421      -.15534         .073798               .
    loans_ta |    .9486441     1.062966       -.1143221               .
   equity_ta |   -1.968462    -3.365806        1.397344          .49421
  prov_loans |    .4104165     1.841382       -1.430965               .
       d2002 |   -.7045141    -.1671964       -.5373177        .0094618
       d2003 |   -.6712704     .1732807       -.8445511        .0679644
       d2004 |   -.6639408     .3508666       -1.014807        .0924872
       d2005 |   -.6781914     .4058705       -1.084062        .0970282
       d2006 |   -.5701345     .5969205       -1.167055         .107456
       d2007 |   -.4300106     .8565486       -1.286559        .1223466
       d2008 |   -.6699065     .4248501       -1.094757        .1101635
       d2009 |   -.5960965      .480305       -1.076401        .0938099
       d2010 |   -.5713018     .4424562       -1.013758        .0733781
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from xtregar
           B = inconsistent under Ha, efficient under Ho; obtained from xtregar

    Test:  Ho:  difference in coefficients not systematic

                 chi2(14) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       36.60
                Prob>chi2 =      0.0008
                (V_b-V_B is not positive definite)
```

Appendix 2.2.3 Test for Common Factor Restrictions with Fixed Effects

```
xtreg logtotinc_real Laglogtotinc_real logpf Laglogpf logplc Laglogplc loans_ta Lagloans_ta
equity_ta Lagequity_ta prov_loans Lagprov_loans d2002 d2003 d2004 d2005 d2006 d2007 d2008
d2009 d2010, fe

Fixed-effects (within) regression               Number of obs      =       233
Group variable: bank                            Number of groups   =        10

R-sq:  within  = 0.9124                         Obs per group: min =         8
       between = 0.9608                                        avg =      23.3
       overall = 0.8927                                        max =        39

                                                F(20,203)          =    105.76
corr(u_i, Xb)  = 0.5704                         Prob > F           =    0.0000

------------------------------------------------------------------------------
logtotinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Laglogtoti~l |   .5078711   .0430765    11.79   0.000     .4229363     .592806
       logpf |   .1918663   .0622534     3.08   0.002     .0691202    .3146124
    Laglogpf |  -.2788719   .0465101    -6.00   0.000    -.3705768    -.187167
      logplc |  -.0513958   .0699465    -0.73   0.463    -.1893106     .086519
   Laglogplc |   -.048259    .065035    -0.74   0.459    -.1764898    .0799718
    loans_ta |   .4732201   .3059234     1.55   0.123    -.1299748    1.076415
 Lagloans_ta |    .649722   .2908071     2.23   0.027     .0763322    1.223112
   equity_ta |  -.0038824   .7260424    -0.01   0.996    -1.435434    1.427669
Lagequity_ta |  -1.482525   .6765563    -2.19   0.030    -2.816504   -.1485462
  prov_loans |   .8667856   .8337093     1.04   0.300    -.7770548    2.510626
Lagprov_lo~s |  -.3880092   .8570882    -0.45   0.651    -2.077946    1.301928
       d2002 |  -.2913091   .1300853    -2.24   0.026    -.5478008   -.0348174
       d2003 |  -.1221437   .1351936    -0.90   0.367    -.3887075      .14442
       d2004 |  -.0400188    .146034    -0.27   0.784    -.3279567    .2479192
       d2005 |   .0309868   .1555165     0.20   0.842    -.2756481    .3376216
       d2006 |   .1107842   .1627767     0.68   0.497    -.2101656     .431734
       d2007 |   .2176392   .1716081     1.27   0.206    -.1207237    .5560021
       d2008 |   .2331301   .1807503     1.29   0.199    -.1232586    .5895189
       d2009 |   .2397879   .1851005     1.30   0.197    -.1251783    .6047541
       d2010 |   .1704335   .1834117     0.93   0.354    -.1912028    .5320697
       _cons |   -.883285   .6591907    -1.34   0.182    -2.183024    .4164538
-------------+----------------------------------------------------------------
     sigma_u |  .36533703
     sigma_e |  .22937668
         rho |  .71725976   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(9, 203) =    10.95             Prob > F = 0.0000


testnl _b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]

  (1)  _b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]

             F(1, 203) =       11.20
              Prob > F =        0.0010


testnl _b[Laglogtotinc_real]*_b[logplc] = -_b[Laglogplc]

  (1)  _b[Laglogtotinc_real]*_b[logplc] = -_b[Laglogplc]

             F(1, 203) =        2.01
              Prob > F =        0.1581


testnl _b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta]

  (1)  _b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta]
```

```
             F(1, 203) =       20.00
              Prob > F =        0.0000


testnl _b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta]

  (1)  _b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta]

             F(1, 203) =       10.29
              Prob > F =        0.0016


testnl _b[Laglogtotinc_real]*_b[prov_loans] = -_b[Lagprov_loans]

  (1)  _b[Laglogtotinc_real]*_b[prov_loans] = -_b[Lagprov_loans]

             F(1, 203) =        0.01
              Prob > F =       0.9288


testnl (_b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]) (_b[Laglogtotinc_real]*_b[logplc] = -
_b[Laglogplc]) (_b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta])
(_b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta])(_b[Laglogtotinc_real]*_b[prov_loans]
= -_b[Lagprov_loans])


  (1)  _b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]
  (2)  _b[Laglogtotinc_real]*_b[logplc] = -_b[Laglogplc]
  (3)  _b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta]
  (4)  _b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta]
  (5)  _b[Laglogtotinc_real]*_b[prov_loans] = -_b[Lagprov_loans]

             F(5, 203) =       11.61
              Prob > F =        0.0000
```

Appendix 2.2.4 Test for Common Factor Restrictions with Ordinary Least Squares

```
reg  logtotinc_real  Laglogtotinc_real  logpf  Laglogpf  logplc  Laglogplc  loans_ta  Lagloans_ta
equity_ta Lagequity_ta prov_loans Lagprov_loans  d2002 d2003 d2004 d2005 d2006 d2007 d2008
d2009 d2010


      Source |       SS       df       MS              Number of obs =     233
-------------+------------------------------           F( 20,   212) =  201.66
       Model |  301.796432    20  15.0898216           Prob > F      =  0.0000
    Residual |  15.8636944   212  .074828747           R-squared     =  0.9501
-------------+------------------------------           Adj R-squared =  0.9453
       Total |  317.660127   232  1.36922468           Root MSE      =  .27355

------------------------------------------------------------------------------
logtotinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Laglogtoti~l |   .8566372   .0244179    35.08   0.000     .8085042    .9047702
        logpf |   .0824079   .0683808     1.21   0.229    -.0523854    .2172013
    Laglogpf |  -.5112273   .0459007   -11.14   0.000    -.6017075    -.420747
      logplc |  -.0456656   .0798455    -0.57   0.568    -.2030584    .1117272
   Laglogplc |  -.0320475   .0746314    -0.43   0.668    -.1791622    .1150671
    loans_ta |   .2636345   .3356261     0.79   0.433    -.3979573    .9252263
  Lagloans_ta |   .2051884   .3285388     0.62   0.533    -.4424328    .8528097
   equity_ta |   -1.09116   .8293763    -1.32   0.190     -2.72604     .543721
Lagequity_ta |   .7966793   .7288327     1.09   0.276    -.6400081    2.233367
  prov_loans |   .4385401    .974599     0.45   0.653    -1.482606    2.359686
Lagprov_lo~s |  -1.342897   .9786922    -1.37   0.171    -3.272112    .5863175
       d2002 |  -.2253027   .1535252    -1.47   0.144    -.5279341    .0773288
       d2003 |  -.1077648   .1576829    -0.68   0.495    -.4185919    .2030624
       d2004 |  -.0387211    .166525    -0.23   0.816    -.3669781    .2895358
       d2005 |   .0691781   .1756756     0.39   0.694    -.2771166    .4154729
       d2006 |   .1628883   .1834051     0.89   0.375    -.1986429    .5244195
       d2007 |   .2372873   .1920275     1.24   0.218    -.1412405    .6158151
       d2008 |   .2381073   .1929646     1.23   0.219    -.1422677    .6184824
       d2009 |    .345374   .1981809     1.74   0.083    -.0452835    .7360316
       d2010 |   .2842747   .1936752     1.47   0.144    -.0975012    .6660505
       _cons |  -2.685643   .6433967    -4.17   0.000    -3.953917   -1.417368
------------------------------------------------------------------------------


testnl _b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]

  (1)  _b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]

             F(1, 212) =       41.32
              Prob > F =        0.0000


testnl _b[Laglogtotinc_real]*_b[logplc] = -_b[Laglogplc]

  (1)  _b[Laglogtotinc_real]*_b[logplc] = -_b[Laglogplc]

             F(1, 212) =        1.67
              Prob > F =        0.1972


testnl _b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta]

  (1)  _b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta]

             F(1, 212) =       10.31
              Prob > F =        0.0015


testnl _b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta]
```

```
  (1)  _b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta]

            F(1, 212) =        0.10
             Prob > F =        0.7482


testnl _b[Laglogtotinc_real]*_b[prov_loans] = -_b[Lagprov_loans]

  (1)  _b[Laglogtotinc_real]*_b[prov_loans] = -_b[Lagprov_loans]

            F(1, 212) =        4.39
             Prob > F =        0.0374



testnl (_b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]) (_b[Laglogtotinc_real]*_b[logplc] = -
_b[Laglogplc]) (_b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta]) (_b[Laglogt
> otinc_real]*_b[equity_ta] = -_b[Lagequity_ta]) (_b[Laglogtotinc_real]*_b[prov_loans] = -
> _b[Lagprov_loans])


  (1)  _b[Laglogtotinc_real]*_b[logpf] = -_b[Laglogpf]
  (2)  _b[Laglogtotinc_real]*_b[logplc] = -_b[Laglogplc]
  (3)  _b[Laglogtotinc_real]*_b[loans_ta] = -_b[Lagloans_ta]
  (4)  _b[Laglogtotinc_real]*_b[equity_ta] = -_b[Lagequity_ta]
  (5)  _b[Laglogtotinc_real]*_b[prov_loans] = -_b[Lagprov_loans]

            F(5, 212) =        9.72
             Prob > F =        0.0000
```

Appendix 2.2.5 Test for long-run equilibrium

```
xtregar logroa logpf logplc loans_ta Lagequity_ta prov_loans d2002 d2003 d2004 d2005 d2006
d2007 d2008 d2009 d2010, fe

FE (within) regression with AR(1) disturbances  Number of obs      =       230
Group variable: bank                            Number of groups   =        10

R-sq:  within  = 0.2906                         Obs per group: min =         9
       between = 0.4546                                        avg =      23.0
       overall = 0.1559                                        max =        38

                                                F(14,206)          =      6.03
corr(u_i, Xb)  = -0.4879                        Prob > F           =    0.0000

------------------------------------------------------------------------------
     Logroa  |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       logpf |  -.0229266   .0051288    -4.47   0.000    -.0330383    -.012815
      logplc |  -.0273721   .0051211    -5.35   0.000    -.0374685   -.0172757
    loans_ta |   .0106356   .0192548     0.55   0.581    -.0273261    .0485974
Lagequity_ta |  -.0150172   .0366939    -0.41   0.683    -.0873608    .0573265
  prov_loans |  -.1386986   .0499344    -2.78   0.006    -.2371465   -.0402506
       d2002 |   .0336025   .0123314     2.72   0.007     .0092905    .0579145
       d2003 |   .0513561   .0127881     4.02   0.000     .0261438    .0765684
       d2004 |   .0509081   .0136024     3.74   0.000     .0240904    .0777259
       d2005 |    .058894   .0144329     4.08   0.000     .0304388    .0873492
       d2006 |   .0608434   .0147555     4.12   0.000     .0317523    .0899345
       d2007 |    .069782   .0150265     4.64   0.000     .0401565    .0994074
       d2008 |   .0611591   .0159847     3.83   0.000     .0296446    .0926737
       d2009 |   .0678833   .0163452     4.15   0.000     .0356579    .1001087
       d2010 |   .0642033   .0163414     3.93   0.000     .0319855    .0964211
       _cons |   1.097293   .0371129    29.57   0.000     1.024123    1.170462
-------------+----------------------------------------------------------------
      rho_ar |  .14277961
     sigma_u |  .00626579
     sigma_e |  .02008921
     rho_fov |    .088656   (fraction of variance because of u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(9,206) =   -14.81               Prob > F = 1.0000


lincom logpf+logplc

 ( 1)  logpf + logplc = 0

------------------------------------------------------------------------------
     logroa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0502987   .0068301    -7.36   0.000    -.0637646   -.0368329
------------------------------------------------------------------------------
```

Appendix 2.2.6 Stata output for Specification 1

(Dependent variable: real total income)

```
xtregar  logtotinc_real  logpf  logplc  loans_ta  equity_ta  prov_loans  d2002  d2003  d2004  d2005
d2006 d2007 d2008 d2009 d2010, fe

FE (within) regression with AR(1) disturbances  Number of obs      =       238
Group variable: bank                            Number of groups   =        10

R-sq:  within  = 0.3928                         Obs per group: min =        10
       between = 0.1233                                        avg =      23.8
       overall = 0.3209                                        max =        39

                                                F(14,214)          =      9.89
corr(u_i, Xb)  = 0.0620                         Prob > F           =    0.0000

------------------------------------------------------------------------------
logtotinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       logpf |   .4148038   .0463096     8.96   0.000     .3235224    .5060851
      logplc |  -.0815421   .0760726    -1.07   0.285    -.2314896    .0684054
    loans_ta |   .9486441   .3327446     2.85   0.005     .2927675    1.604521
   equity_ta |  -1.968462   .7489249    -2.63   0.009    -3.444676   -.4922476
  prov_loans |   .4104165   .9554703     0.43   0.668    -1.472922    2.293755
       d2002 |  -.7045141   .1854236    -3.80   0.000    -1.070005   -.3390235
       d2003 |  -.6712704   .2288307    -2.93   0.004    -1.122321   -.2202197
       d2004 |  -.6639408   .2535803    -2.62   0.009    -1.163776   -.1641058
       d2005 |  -.6781914   .2690039    -2.52   0.012    -1.208428   -.1479547
       d2006 |  -.5701345   .2778916    -2.05   0.041     -1.11789   -.0223792
       d2007 |  -.4300106   .2862698    -1.50   0.135    -.9942801    .1342589
       d2008 |  -.6699065   .2950102    -2.27   0.024    -1.251404   -.0884085
       d2009 |  -.5960965   .3002014    -1.99   0.048    -1.187827   -.0043661
       d2010 |  -.5713018   .3065441    -1.86   0.064    -1.175534    .0329308
       _cons |   3.192752   .1409392    22.65   0.000     2.914945    3.470559
-------------+----------------------------------------------------------------
      rho_ar |  .71762761
     sigma_u |  .94139636
     sigma_e |  .26964311
     rho_fov |  .92417896   (fraction of variance because of u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(9,214) =    25.01               Prob > F = 0.0000


lincom logpf+logplc

 ( 1)  logpf + logplc = 0

------------------------------------------------------------------------------
logtotinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .3332617   .0808082     4.12   0.000     .1739798    .4925436
------------------------------------------------------------------------------
```

Appendix 2.2.7 Stata output for Specification 2

(Dependent variable: real interest income)

```
xtregar logintinc_real logpf logplc loans_ta equity_ta prov_loans d2002 d2003 d2004 d2005
d2006 d2007 d2008 d2009 d2010, fe

FE (within) regression with AR(1) disturbances  Number of obs      =       238
Group variable: bank                            Number of groups   =        10

R-sq:  within  = 0.5780                         Obs per group: min =        10
       between = 0.2088                                        avg =      23.8
       overall = 0.4187                                        max =        39

                                                F(14,214)          =     20.94
corr(u_i, Xb)  = 0.0817                         Prob > F           =    0.0000

------------------------------------------------------------------------------
logintinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       logpf |   .4906671   .0602136     8.15   0.000     .3719793    .6093549
      logplc |  -.3236938   .0825687    -3.92   0.000    -.4864459   -.1609416
    loans_ta |   1.969857   .3527621     5.58   0.000     1.274523     2.66519
   equity_ta |  -2.944898   .7376445    -3.99   0.000    -4.398877   -1.490918
  prov_loans |   1.038931   1.009692     1.03   0.305    -.9512839    3.029146
       d2002 |  -.5105718   .2138205    -2.39   0.018    -.9320358   -.0891077
       d2003 |   -.461552   .2449761    -1.88   0.061    -.9444271    .0213232
       d2004 |  -.2362958   .2632803    -0.90   0.370    -.7552505    .2826588
       d2005 |  -.2154642   .2728257    -0.79   0.431    -.7532341    .3223056
       d2006 |  -.1600031   .2790694    -0.57   0.567    -.7100798    .3900737
       d2007 |  -.0123155   .2870494    -0.04   0.966    -.5781217    .5534907
       d2008 |   -.166603   .3005749    -0.55   0.580    -.7590695    .4258635
       d2009 |   -.067295   .3020737    -0.22   0.824    -.6627158    .5281259
       d2010 |  -.0620359   .3053307    -0.20   0.839    -.6638767     .539805
       _cons |   1.214954   .2662297     4.56   0.000     .6901858    1.739723
-------------+----------------------------------------------------------------
      rho_ar |  .50816138
     sigma_u |  .93576268
     sigma_e |  .31508675
     rho_fov |  .89816755   (fraction of variance because of u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(9,214) =    47.16               Prob > F = 0.0000

. outreg2 using chapter4kosovo20022014.xls, bdec(3)
chapter4kosovo20022014.xls
dir : seeout

. lincom logpf+logplc

 ( 1)  logpf + logplc = 0

------------------------------------------------------------------------------
logintinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .1669733   .0900105     1.86   0.065    -.0104474    .3443941
------------------------------------------------------------------------------
```

Appendix 2.2.8 Stata output for Specification 3

(Dependent variable: real total income; includes the *total assets* among the explanatory variables)

Note: Since the inclusion of total assets among the explanatory variables transforms the reduced-form revenue equation into a price equation (i.e. the dependent variable becomes the interest rate), in this specification the control variables *equity_ta*, *loans_ta*, and *prov_loans* are treated as endogenous (hence, included in lags) based on the predicted relationship between these variables and the interest rate. For a more detailed elaboration on these relationships see the description of variables in chapter 6.

```
xtregar logtotinc_real logpf logplc Lagloans_ta Lagequity_ta Lagprov_loans logta d2002 d2003
d2004 d2005 d2006 d2007 d2008 d2009 d2010, fe

FE (within) regression with AR(1) disturbances  Number of obs      =       230
Group variable: bank                            Number of groups   =        10

R-sq:  within  = 0.5793                         Obs per group: min =         9
       between = 0.9724                                        avg =      23.0
       overall = 0.9111                                        max =        38

                                                F(15,205)          =     18.82
corr(u_i, Xb)  = 0.6518                         Prob > F           =    0.0000

------------------------------------------------------------------------------
logtotinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       logpf |   .2401983   .0477304     5.03   0.000     .1460929    .3343038
      logplc |   .2097146   .0655507     3.20   0.002     .0804746    .3389546
 Lagloans_ta |   .7848517   .2356233     3.33   0.001      .320296    1.249407
Lagequity_ta |  -2.396715   .5255864    -4.56   0.000    -3.432963   -1.360467
Lagprov_lo~s |  -.1541074   .6847477    -0.23   0.822    -1.504158    1.195944
       logta |     .59276   .0844408     7.02   0.000     .4262763    .7592437
       d2002 |   .2177703   .1640754     1.33   0.186    -.1057212    .5412619
       d2003 |   .3130982   .1731668     1.81   0.072    -.0283181    .6545144
       d2004 |   .3637423   .1791014     2.03   0.044     .0106254    .7168592
       d2005 |   .3885945   .1844503     2.11   0.036     .0249315    .7522574
       d2006 |   .4486804   .1882899     2.38   0.018     .0774475    .8199134
       d2007 |   .5310229   .1911735     2.78   0.006     .1541045    .9079412
       d2008 |   .5215878   .2019626     2.58   0.011     .1233975     .919778
       d2009 |   .3880904   .2035488     1.91   0.058    -.0132271    .7894079
       d2010 |    .332232   .2063775     1.61   0.109    -.0746626    .7391266
       _cons |  -.1129168   .2244176    -0.50   0.615    -.5553795    .3295458
-------------+----------------------------------------------------------------
      rho_ar |  .53720685
     sigma_u |  .40038099
     sigma_e |  .21167174
     rho_fov |  .78155646   (fraction of variance because of u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(9,205) =     2.00               Prob > F = 0.0408


logpf + logplc = 0

------------------------------------------------------------------------------
logtotinc_~l |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .4499129   .0668395     6.73   0.000      .318132    .5816938
------------------------------------------------------------------------------
```

Appendix 2.2.9 Stata output for Specification 4

(Dependent variable: total income / total assets)

Note: Since the scaling of the dependent variable (total income) to total assets transforms the reduced-form revenue equation into a price equation (i.e. the dependent variable becomes the interest rate), in this specification the control variables *equity_ta*, *loans_ta*, and *prov_loans* are treated as endogenous (hence, included in lags) based on the predicted relationship between these variables and the interest rate. For a more detailed elaboration on these relationships see the description of variables in chapter 6.

```
xtregar logtotinc_ta logpf logplc Lagloans_ta Lagequity_ta Lagprov_loans d2002 d2003 d2004
d2005 d2006 d2007 d2008 d2009 d2010, fe

FE (within) regression with AR(1) disturbances  Number of obs      =       230
Group variable: bank                            Number of groups   =        10

R-sq:  within  = 0.3827                         Obs per group: min =         9
       between = 0.5438                                        avg =      23.0
       overall = 0.4839                                        max =        38

                                                F(14,206)          =      9.12
corr(u_i, Xb)  = -0.0093                        Prob > F           =    0.0000

------------------------------------------------------------------------------
logtotinc_ta |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       logpf |   .2304827   .0498634     4.62   0.000     .1321746    .3287907
      logplc |   .3567522   .0629877     5.66   0.000      .232569    .4809354
 Lagloans_ta |   .6219266   .2468107     2.52   0.012     .1353278    1.108525
Lagequity_ta |  -2.052696   .5484459    -3.74   0.000    -3.133983   -.9714098
Lagprov_lo~s |  -.3412769   .7215495    -0.47   0.637    -1.763845    1.081292
       d2002 |   .4056461   .1686162     2.41   0.017     .0732113    .7380809
       d2003 |   .4882682   .1803866     2.71   0.007     .1326276    .8439088
       d2004 |   .4660076   .1888587     2.47   0.014     .0936638    .8383514
       d2005 |   .4164052   .1952302     2.13   0.034     .0314998    .8013107
       d2006 |    .433467   .1988466     2.18   0.030     .0414316    .8255024
       d2007 |   .5009258   .2008022     2.49   0.013     .1050349    .8968166
       d2008 |   .5245299   .2109067     2.49   0.014     .1087175    .9403423
       d2009 |   .3195571    .209707     1.52   0.129    -.0938901    .7330043
       d2010 |   .2291003   .2089016     1.10   0.274     -.182759    .6409597
       _cons |  -1.356223   .1930753    -7.02   0.000     -1.73688   -.9755664
-------------+----------------------------------------------------------------
      rho_ar |  .54957942
     sigma_u |  .14895929
     sigma_e |  .22167187
     rho_fov |  .31108528   (fraction of variance because of u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(9,206) =    -0.17             Prob > F = 1.0000


lincom logpf+logplc

 ( 1)  logpf + logplc = 0

------------------------------------------------------------------------------
logtotinc_ta |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .5872349   .0646671     9.08   0.000     .4597407    .7147291
------------------------------------------------------------------------------
```

Chapter 5

Appendix 3.1 Long-run equilibrium test estimates (H_{ROA}) for each country/year

[standard errors in parentheses]

Year	Albania	Bosnia and Herzegovina	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia
1999	-	-	-	-0.009	-0.009	-	-0.136	-
				[0.021]	0.005		[0.149]	
2000	-	-	-	-0.033	-0.018	-	0.001	-
				[0.012]	0.012		[0.019]	
2001	-	-	-	-0.009	0.003	-	0.047	-
				[0.025]	0.014		[0.046]	
2002	-0.017	-	-0.006	-0.027	-0.002	-0.010	-0.018	-0.009
	[0.010]		[0.009]	[0.006]	0.008	[0.172]	[0.018]	0.006
2003	-0.051	-	-0.007	-0.010	-0.032	-0.044	-0.004	-0.011
	[0.026]		[0.014]	[0.005]	0.013	[0.003]	[0.016]	0.004
2004	0.030	-0.014	-0.008	-0.011	-0.015	-0.021	-0.033	-0.010
	[0.027]	[0.034]	[0.010]	[0.003]	0.010	[0.077]	[0.020]	0.006
2005	0.040	-0.015	0.013	-0.003	-0.026	-0.079	-0.015	-0.031
	[0.044]	[0.030]	[0.013]	[0.010]	0.010	[0.174]	[0.015]	0.010
2006	0.082	-0.009	-0.031	-0.012	-0.023	0.017	-0.034	-0.023
	[0.171]	[0.022]	[0.017]	[0.005]	0.009	[0.358]	[0.015]	0.015
2007	-0.024	-0.014	0.015	-0.029	-0.012	0.082	-0.082	-0.041
	[0.042]	[0.012]	[0.020]	[0.010]	0.009	[0.025]	[0.061]	0.010
2008	-0.094	-0.006	-0.005	-0.137	-0.021	0.082	-0.055	-0.077
	[0.053]	[0.012]	[0.018]	[0.020]	0.016	[0.001]	[0.029]	0.016
2009	-	0.002	-0.001	-0.061	-0.026	-	-0.029	-0.019
		[0.009]	[0.011]	[0.013]	0.020		[0.010]	0.022

Year	Lithuania	Macedonia	Poland	Romania	Serbia	Slovakia	Slovenia
1999	-	-	-0.005	-0.115	-	-	-0.007
			[0.011]	[0.486]			[0.012]
2000	-	-	-0.015	0.034	-	-0.091	0.014
			[0.009]	[0.094]		[0.149]	[0.063]
2001	-	-	0.003	-0.049	-	-0.085	-
			[0.010]	[0.060]		[0.038]	
2002	-0.053	-0.248	-0.017	-0.037	-	-0.056	-0.016
	[0.064]	[0.068]	[0.012]	[0.033]		[0.014]	[0.047]
2003	0.009	0.073	0.031	-0.047	-0.058	0.001	0.004
	[0.014]	[0.067]	[0.021]	[0.029]	[0.038]	[0.026]	[0.027]
2004	-0.013	-0.033	0.020	-0.005	-0.107	-0.022	-0.005
	[0.013]	[0.022]	[0.013]	[0.018]	[0.056]	[0.006]	[0.019]

2005	-0.001	-0.012	-0.007	-0.032	0.014	-0.015	0.008
	[0.003]	[0.023]	[0.015]	[0.016]	[0.038]	[0.007]	[0.014]
2006	-0.011	-0.062	0.001	-0.005	-0.058	-0.010	-0.020
	[0.006]	[0.023]	[0.006]	[0.015]	[0.037]	[0.013]	[0.015]
2007	-0.044	-0.035	-0.008	0.115	-0.050	-0.021	0.005
	[0.022]	[0.024]	[0.014]	[0.025]	[0.029]	[0.009]	[0.009]
2008	-0.011	-0.062	0.002	0.000	0.094	-0.051	-0.005
	[0.045]	[0.024]	[0.026]	[0.052]	[0.058]	[0.015]	[0.007]
2009	0.074	-0.020	-0.079	-0.031	-0.055	-0.071	-0.001
	[0.038]	[0.037]	[0.027]	[0.036]	[0.020]	[0.036]	[0.009]

A sample of the STATA output from the estimation of the long-run equilibrium test (H_{ROA}) for each country/year: the case of Hungary

Year 1999:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_1999==1

      Source |       SS       df       MS              Number of obs =       7
-------------+------------------------------           F(  5,     1) =    0.59
       Model |  .002340734     5  .000468147           Prob > F      =  0.7489
    Residual |  .000788203     1  .000788203           R-squared     =  0.7481
-------------+------------------------------           Adj R-squared = -0.5114
       Total |  .003128937     6   .00052149           Root MSE      =  .02807

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |    -.05782   .1018047    -0.57   0.671    -1.351371    1.235731
 logp_labour |  -.0502631   .0592109    -0.85   0.552    -.8026095    .7020833
logp_physc~l |  -.0280184   .0372329    -0.75   0.589    -.5011075    .4450707
logloans_t~4 |   -.041237    .104749    -0.39   0.761    -1.372199    1.289725
logequity_~4 |   .0690202   .0799622     0.86   0.547    -.9469959    1.085036
       _cons |  -.2057127   .3867453    -0.53   0.689    -5.119778    4.708352
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.1361015   .1489519    -0.91   0.529    -2.028715    1.756512
------------------------------------------------------------------------------
```

Year 2000:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2000==1

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  5,     5) =    1.82
       Model |  .001128136     5  .000225627           Prob > F      =  0.2636
    Residual |   .00062012     5  .000124024           R-squared     =  0.6453
-------------+------------------------------           Adj R-squared =  0.2906
       Total |  .001748256    10  .000174826           Root MSE      =  .01114

------------------------------------------------------------------------------
```

```
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   .0013527   .0211307     0.06   0.951    -.0529657     .055671
 logp_labour |  -.0073281   .0092724    -0.79   0.465    -.0311636    .0165074
logp_physc~l |   .0072564   .0051159     1.42   0.215    -.0058945    .0204073
logloans_t~4 |   .0216569   .0217716     0.99   0.366    -.0343088    .0776227
logequity_~4 |  -.0244348   .0270365    -0.90   0.408    -.0939344    .0450648
       _cons |  -.0673158   .0515186    -1.31   0.248    -.1997485     .065117
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |    .001281    .018903     0.07   0.949    -.0473106    .0498726
------------------------------------------------------------------------------
```

Year 2001:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2001==1

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  5,     3) =    2.53
       Model |   .00145944     5  .000291888           Prob > F      =  0.2373
    Residual |  .000345814     3  .000115271           R-squared     =  0.8084
-------------+------------------------------           Adj R-squared =  0.4892
       Total |  .001805254     8  .000225657           Root MSE      =  .01074

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   .0420775   .0544798     0.77   0.496    -.1313017    .2154566
 logp_labour |  -.0001844   .0102845    -0.02   0.987    -.0329143    .0325456
logp_physc~l |   .0047344   .0064903     0.73   0.519    -.0159205    .0253893
logloans_t~4 |  -.0013638   .0332091    -0.04   0.970    -.1070501    .1043225
logequity_~4 |   .0037677   .0237346     0.16   0.884    -.0717665    .0793019
       _cons |   .1380325   .1761816     0.78   0.491     -.422656     .698721
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .0466275   .0461415     1.01   0.387    -.1002153    .1934703
------------------------------------------------------------------------------
```

Year 2002:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2002==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    1.84
       Model |   .00370144     5  .000740288           Prob > F      =  0.1933
    Residual |   .00403092    10  .000403092           R-squared     =  0.4787
-------------+------------------------------           Adj R-squared =  0.2180
       Total |   .00773236    15  .000515491           Root MSE      =  .02008

------------------------------------------------------------------------------
```

```
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.0203462   .0171331    -1.19   0.262    -.0585212    .0178288
 logp_labour |  -.0030573   .0121909    -0.25   0.807    -.0302203    .0241056
logp_physc~l |   .0057737   .0059317     0.97   0.353    -.0074429    .0189904
logloans_t~4 |   .0034321   .0128438     0.27   0.795    -.0251856    .0320499
logequity_~4 |  -.0258332   .0121105    -2.13   0.059    -.0528171    .0011507
       _cons |  -.1223066   .0644393    -1.90   0.087    -.2658863     .021273
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0176299    .018453    -0.96   0.362    -.0587457     .023486
------------------------------------------------------------------------------
```

Year 2003:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2003==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    0.85
       Model |  .001983545     5  .000396709           Prob > F      =  0.5467
    Residual |  .004682579    10  .000468258           R-squared     =  0.2976
-------------+------------------------------           Adj R-squared = -0.0537
       Total |  .006666123    15  .000444408           Root MSE      =  .02164

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.0014463   .0122288    -0.12   0.908    -.0286938    .0258013
 logp_labour |   -.013543   .0119517    -1.13   0.284     -.040173     .013087
logp_physc~l |   .0109908   .0074276     1.48   0.170    -.0055589    .0275405
logloans_t~4 |   .0072448   .0156588     0.46   0.654    -.0276451    .0421348
logequity_~4 |  -.0116965   .0114019    -1.03   0.329    -.0371014    .0137084
       _cons |  -.0735745    .065517    -1.12   0.288    -.2195556    .0724065
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0039985   .0160941    -0.25   0.809    -.0398583    .0318613
------------------------------------------------------------------------------
```

Year 2004:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2004==1

      Source |       SS       df       MS              Number of obs =      20
-------------+------------------------------           F(  5,    14) =    1.15
       Model |  .003460445     5  .000692089           Prob > F      =  0.3783
    Residual |  .008390628    14  .000599331           R-squared     =  0.2920
-------------+------------------------------           Adj R-squared =  0.0391
       Total |  .011851073    19  .000623741           Root MSE      =  .02448

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
  logp_funds |   -.008795   .0148347    -0.59   0.563    -.0406123    .0230223
 logp_labour |  -.0251387   .0140758    -1.79   0.096    -.0553284    .0050509
logp_physc~l |   .0006971   .0063353     0.11   0.914    -.0128907    .0142849
logloans_t~4 |   .0088033   .0139517     0.63   0.538    -.0211201    .0387266
logequity_~4 |   .0018409    .015801     0.12   0.909    -.0320489    .0357307
       _cons |   -.108137   .0619822    -1.74   0.103    -.2410755    .0248015
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0332367   .0196282    -1.69   0.113    -.0753349    .0088616
------------------------------------------------------------------------------
```

Year 2005:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2005==1

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  5,    15) =    1.51
       Model |  .002835006     5  .000567001           Prob > F      =  0.2461
    Residual |  .005643857    15  .000376257           R-squared     =  0.3344
-------------+------------------------------           Adj R-squared =  0.1125
       Total |  .008478863    20  .000423943           Root MSE      =   .0194

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |    .010316   .0119697     0.86   0.402    -.0151967    .0358287
 logp_labour |  -.0257684   .0096692    -2.66   0.018    -.0463778   -.0051589
logp_physc~l |   .0006643   .0038949     0.17   0.867    -.0076374     .008966
logloans_t~4 |   .0109499    .009649     1.13   0.274    -.0096165    .0315163
logequity_~4 |   .0148268   .0111559     1.33   0.204    -.0089515    .0386051
       _cons |   -.020955    .045509    -0.46   0.652    -.1179551     .076045
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0147881   .0150407    -0.98   0.341    -.0468465    .0172704
------------------------------------------------------------------------------
```

Year 2006:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2006==1

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  5,    16) =    7.44
       Model |  .020994296     5  .004198859           Prob > F      =  0.0009
    Residual |  .009025049    16  .000564066           R-squared     =  0.6994
-------------+------------------------------           Adj R-squared =  0.6054
       Total |  .030019344    21  .001429493           Root MSE      =  .02375

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
  logp_funds |   .0080402   .0076116     1.06   0.307    -.0080956     .024176
 logp_labour |  -.0428854   .0111665    -3.84   0.001    -.0665574   -.0192135
logp_physc~l |   .0012949   .0040732     0.32   0.755    -.0073399    .0099297
logloans_t~4 |   .0167165   .0055595     3.01   0.008     .0049309     .028502
logequity_~4 |   .0168608   .0103289     1.63   0.122    -.0050356    .0387571
       _cons |  -.0972261   .0513618    -1.89   0.077    -.2061083    .0116561
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0335503   .0147811    -2.27   0.037    -.0648848   -.0022159
------------------------------------------------------------------------------
```

Year 2007:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2007==1

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  5,    15) =    3.90
       Model |  .132722572     5  .026544514           Prob > F      =  0.0182
    Residual |  .102060438    15  .006804029           R-squared     =  0.5653
-------------+------------------------------           Adj R-squared =  0.4204
       Total |  .234783011    20  .011739151           Root MSE      =  .08249

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   .0310365   .0545273     0.57   0.578    -.0851858    .1472588
 logp_labour |   -.104581   .0363585    -2.88   0.012    -.1820773   -.0270848
logp_physc~l |  -.0080992   .0166227    -0.49   0.633    -.0435296    .0273312
logloans_t~4 |   .0193048   .0246519     0.78   0.446    -.0332395    .0718491
logequity_~4 |   .0109373   .0447318     0.24   0.810    -.0844063     .106281
       _cons |  -.3032011   .2175806    -1.39   0.184    -.7669632     .160561
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0816437   .0612255    -1.33   0.202    -.2121427    .0488553
------------------------------------------------------------------------------
```

Year 2008:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2008==1

      Source |       SS       df       MS              Number of obs =      20
-------------+------------------------------           F(  5,    14) =    3.03
       Model |  .016832711     5  .003366542           Prob > F      =  0.0466
    Residual |  .015566793    14  .001111914           R-squared     =  0.5195
-------------+------------------------------           Adj R-squared =  0.3479
       Total |  .032399503    19  .001705237           Root MSE      =  .03335

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
  logp_funds |   .0099974   .0183151     0.55   0.594    -.0292844    .0492793
 logp_labour |  -.0618005   .0191281    -3.23   0.006    -.1028263   -.0207747
logp_physc~l |  -.0034986   .0074107    -0.47   0.644    -.0193929    .0123956
logloans_t~4 |   .0071823   .0097782     0.73   0.475    -.0137899    .0281546
logequity_~4 |   .0386862   .0151318     2.56   0.023     .0062317    .0711406
       _cons |  -.1271061    .105278    -1.21   0.247     -.352905    .0986927
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0553017   .0292648    -1.89   0.080    -.1180684     .007465
------------------------------------------------------------------------------
```

Year 2009:

```
regres logroaa logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4  if
dv_hun==1 & dv_2009==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    3.17
       Model |  .002084425     5  .000416885           Prob > F      =  0.0568
    Residual |  .001315074    10  .000131507           R-squared     =  0.6132
-------------+------------------------------           Adj R-squared =  0.4197
       Total |  .003399499    15  .000226633           Root MSE      =  .01147

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.0020682   .0053232    -0.39   0.706    -.0139291    .0097926
 logp_labour |   -.022207   .0079164    -2.81   0.019    -.0398458   -.0045682
logp_physc~l |  -.0047979    .003186    -1.51   0.163    -.0118966    .0023009
logloans_t~4 |  -.0122318   .0060696    -2.02   0.072    -.0257557     .001292
logequity_~4 |    .019382   .0075123     2.58   0.027     .0026435    .0361205
       _cons |    -.0544    .0318568    -1.71   0.119    -.1253813    .0165813
------------------------------------------------------------------------------

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
     logroaa |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0290731   .0095058    -3.06   0.012    -.0502533   -.0078929
------------------------------------------------------------------------------
```

Appendix 3.2 Estimates of Panzar-Rosse H-statistic (*h_stat1*) for each country/year using interest income as dependent variable

[standard errors in parentheses]

Year	Albania	Bosnia and Herzegovina	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia
1999	-	-	-	-0.948	-1.468	-	-7.902	-
				[1.265]	[2.209]		[7.196]	
2000	-	-	-	0.643	-0.636	-	-3.173	-
				[1.040]	[1.013]		[1.066]	
2001	-	-	-	-0.441	-1.388	-	-1.450	-
				[1.209]	[1.853]		[6.543]	
2002	-0.095	-	-1.597	-1.336	0.577	-11.030	-1.948	-0.466
	[0.715]		[1.244]	[1.033]	[1.521]	[27.054]	[1.068]	[1.056]
2003	0.041	-	-1.761	-2.836	0.693	-9.083	-1.819	-0.349
	[1.049]		[1.188]	[0.962]	[1.781]	[6.642]	[0.848]	[0.932]
2004	2.213	0.084	-0.927	-1.185	0.894	-4.239	-1.584	-1.365
	[1.913]	[1.047]	[0.779]	[0.802]	[1.522]	[17.196]	[0.922]	[0.768]
2005	2.932	-1.138	-1.879	-4.464	-1.306	-	-1.417	-1.746
	[1.235]	[0.960]	[1.409]	[0.860]	[1.765]		[1.017]	[1.002]
2006	2.191	-1.003	-1.073	-4.693	-1.407	-11.728	-1.318	-0.999
	[6.307]	[1.257]	[1.406]	[1.060]	[1.509]	[1.404]	[0.873]	[1.067]
2007	-1.132	-1.620	-1.357	-3.769	0.294	-6.001	-0.776	-0.363
	[3.036]	[0.991]	[1.688]	[1.705]	[1.797]	[1.476]	[1.023]	[1.067]
2008	0.148	0.343	-0.570	-3.935	-1.444	0.399	0.908	-0.119
	[2.713]	[1.590]	[1.578]	[1.321]	[1.843]	[10.779]	[1.095]	[0.738]
2009	-	-0.677	-0.798	-3.317	-2.730	-	-0.435	-0.955
		[1.513]	[1.336]	[1.293]	[2.317]		[1.006]	[0.653]

Year	Lithuania	Macedonia	Poland	Romania	Serbia	Slovakia	Slovenia
1999	-	-	0.262	5.187	-	-	-0.192
			[1.652]	[1.370]			[0.957]
2000	-	-	-4.222	0.555	-	2.618	-1.469
			[1.640]	[1.189]		[4.183]	[19.387]
2001	-	-	1.062	0.336	-	-1.526	-
			[1.396]	[1.666]		[3.386]	
2002	-4.995	-2.711	0.410	0.423	-	-1.134	-5.998
	[5.059]	[1.551]	[0.818]	[0.770]		[1.685]	[3.501]
2003	-2.272	-0.421	-0.091	-0.385	0.174	-2.368	-0.528
	[3.133]	[0.985]	[1.283]	[0.841]	[0.654]	[1.307]	[3.046]
2004	-4.095	0.298	-0.836	0.035	-0.104	-3.782	0.507
	[2.977]	[0.797]	[1.160]	[0.961]	[0.391]	[1.649]	[1.916]
2005	-4.412	0.489	-1.576	-1.114	0.101	-2.282	4.527
	[0.789]	[2.489]	[1.077]	[1.044]	[0.461]	[1.657]	[2.947]
2006	-6.173	-0.783	0.835	0.830	-0.363	-3.954	-3.609
	[0.890]	[0.722]	[0.593]	[1.097]	[0.644]	[2.338]	[3.091]

2007	-7.582	-2.247	1.351	-0.039	-0.931	-4.050	1.694
	[2.854]	[0.810]	[1.269]	[1.144]	[0.711]	[2.728]	[2.208]
2008	-9.199	-1.431	-1.984	-0.025	-0.864	-4.005	2.626
	[3.340]	[1.221]	[0.993]	[1.456]	[0.758]	[1.405]	[2.054]
2009	-7.042	0.400	-1.379	-0.473	-2.561	-2.573	2.200
	[1.324]	[1.201]	[0.884]	[1.167]	[0.591]	[2.103]	[2.182]

A sample of the STATA output from the estimation of the H-statistic (h_stat1) for each country/year using the interest income as dependent variable: the case of Hungary

Year 1999:

```
. regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
>   if  dv_hun==1 & dv_1999==1

      Source |       SS       df       MS              Number of obs =       7
-------------+------------------------------           F(  5,     1) =    0.61
       Model |  5.58366935     5  1.11673387           Prob > F      =  0.7444
    Residual |   1.8396795     1   1.8396795           R-squared     =  0.7522
-------------+------------------------------           Adj R-squared = -0.4869
       Total |  7.42334885     6  1.23722481           Root MSE      =  1.3563

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -6.262558   4.918355    -1.27   0.424    -68.75618    56.23106
 logp_labour |  -2.141667   2.860579    -0.75   0.591    -38.48877    34.20544
logp_physc~l |   .5017295   1.798784     0.28   0.827    -22.35399    23.35745
logloans_t~4 |    -2.7845   5.060597    -0.55   0.680    -67.08548    61.51648
logequity_~4 |   2.470567   3.863107     0.64   0.638    -46.61486      51.556
       _cons |  -8.822171   18.68431    -0.47   0.719    -246.2288    228.5845
------------------------------------------------------------------------------


. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     0.86
         Prob > chi2  =   0.3526


. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |       7.00      6    0.3208
            Skewness |       1.41      5    0.9236
            Kurtosis |       0.63      1    0.4277
---------------------+-----------------------------
               Total |       9.04     12    0.6999
---------------------------------------------------


. estat ovtest
powers of fitted values collinear with explanatory variables
(typically because all explanatory variables are indicator variables)
test not possible
r(499);


. lincom  logp_funds + logp_labour + logp_physcapital
```

```
 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -7.902495   7.196116    -1.10   0.470    -99.33781    83.53282
------------------------------------------------------------------------------
```

Year 2000:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2000==1

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  5,     5) =    6.40
       Model |  12.6358992     5  2.52717984           Prob > F      =  0.0313
    Residual |  1.97297263     5  .394594527           R-squared     =  0.8649
-------------+------------------------------           Adj R-squared =  0.7299
       Total |  14.6088718    10  1.46088718           Root MSE      =  .62817

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -2.548329   1.191894    -2.14   0.086    -5.612189    .5155313
 logp_labour |  -.6945389   .5230167    -1.33   0.242    -2.038996    .6499183
logp_physc~l |   .0699144   .2885669     0.24   0.818    -.6718704    .8116993
logloans_t~4 |  -2.079986   1.228043    -1.69   0.151    -5.236771    1.076799
logequity_~4 |   .0954596   1.525014     0.06   0.953    -3.824713    4.015633
       _cons |   .9782676    2.90594     0.34   0.750    -6.491689    8.448224
------------------------------------------------------------------------------


. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     0.17
         Prob > chi2  =   0.6825


. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      11.00     10    0.3575
            Skewness |       3.20      5    0.6685
            Kurtosis |       4.37      1    0.0366
---------------------+-----------------------------
               Total |      18.58     16    0.2913
---------------------------------------------------


. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 2) =      0.18
                 Prob > F =      0.9041


. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
         (1) |  -3.172953   1.066234    -2.98   0.031    -5.913796   -.4321107
------------------------------------------------------------------------------
```

Year 2001:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2001==1

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  5,     3) =    1.64
       Model |  19.0352033     5  3.80704065           Prob > F      =  0.3623
    Residual |  6.95259281     3  2.31753094           R-squared     =  0.7325
-------------+------------------------------           Adj R-squared =  0.2866
       Total |  25.9877961     8  3.24847451           Root MSE      =  1.5223

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   .2322633   7.724815     0.03   0.978    -24.35155    24.81607
 logp_labour |  -.9373112   1.458266    -0.64   0.566    -5.578164    3.703542
logp_physc~l |  -.7451659   .9202674    -0.81   0.477    -3.673867    2.183536
logloans_t~4 |  -.7516556   4.708797    -0.16   0.883    -15.73715    14.23384
logequity_~4 |  -1.573968   3.365386    -0.47   0.672    -12.28413    9.136193
       _cons |   4.405763   24.98118     0.18   0.871     -75.0955    83.90702
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     2.26
         Prob > chi2  =   0.1330

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |       9.00      8    0.3423
            Skewness |       5.33      5    0.3765
            Kurtosis |       0.22      1    0.6359
---------------------+-----------------------------
               Total |      14.56     14    0.4090
---------------------------------------------------

.
. estat ovtest
powers of fitted values collinear with explanatory variables
(typically because all explanatory variables are indicator variables)
test not possible
r(499);

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -1.450214   6.542502    -0.22   0.839    -22.27138    19.37095
------------------------------------------------------------------------------
```

Year 2002:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2002==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    4.12
       Model |  27.8387483     5  5.56774967           Prob > F      =  0.0271
    Residual |  13.5062623    10  1.35062623           R-squared     =  0.6733
-------------+------------------------------           Adj R-squared =  0.5100
       Total |  41.3450107    15  2.75633404           Root MSE      =  1.1622

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -1.055642   .9917498    -1.06   0.312    -3.265398    1.154114
 logp_labour |   -.569551   .7056674    -0.81   0.438    -2.141876    1.002774
logp_physc~l |  -.3224356    .343356    -0.94   0.370     -1.08748    .4426092
logloans_t~4 |   .5236653   .7434617     0.70   0.497    -1.132871    2.180201
logequity_~4 |  -1.517386   .7010155    -2.16   0.056    -3.079346    .0445735
       _cons |    2.72144   3.730062     0.73   0.482    -5.589656    11.03254
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     0.34
         Prob > chi2  =   0.5577

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      16.00     15    0.3821
            Skewness |       0.85      5    0.9740
            Kurtosis |       1.07      1    0.3018
---------------------+-----------------------------
               Total |      17.91     21    0.6546
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 7) =      0.23
                  Prob > F =      0.8718

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -1.947628    1.06815    -1.82   0.098    -4.327616    .4323588
------------------------------------------------------------------------------
```

Year 2003:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2003==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    4.19
       Model |  27.2283843     5  5.44567687           Prob > F      =  0.0259
    Residual |  13.0078615    10  1.30078615           R-squared     =  0.6767
-------------+------------------------------           Adj R-squared =  0.5151
       Total |  40.2362459    15  2.68241639           Root MSE      =  1.1405

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.1845946   .6445326    -0.29   0.780    -1.620703    1.251513
 logp_labour |  -.8205112   .6299262    -1.30   0.222    -2.224074    .5830519
logp_physc~l |  -.8137278   .3914786    -2.08   0.064    -1.685996    .0585408
logloans_t~4 |   .1702193   .8253122     0.21   0.841    -1.668691     2.00913
logequity_~4 |  -.7153332   .6009465    -1.19   0.261    -2.054326    .6236591
       _cons |   6.026974   3.453144     1.75   0.112     -1.66711    13.72106
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     0.00
         Prob > chi2  =   0.9657

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      16.00     15    0.3821
            Skewness |       3.57      5    0.6123
            Kurtosis |       0.10      1    0.7503
---------------------+-----------------------------
               Total |      19.67     21    0.5419
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 7) =      1.66
                 Prob > F =      0.2611

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -1.818834   .8482541    -2.14   0.058    -3.708862    .0711942
------------------------------------------------------------------------------
```

Year 2004:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2004==1

      Source |       SS       df       MS              Number of obs =      20
-------------+------------------------------           F(  5,    14) =    6.35
       Model |  41.9758093     5  8.39516187           Prob > F      =  0.0028
    Residual |   18.514129    14  1.32243779           R-squared     =  0.6939
-------------+------------------------------           Adj R-squared =  0.5846
       Total |  60.4899383    19  3.18368097           Root MSE      =    1.15

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.1856703    .696841    -0.27   0.794    -1.680246    1.308905
 logp_labour |  -.4134408   .6611934    -0.63   0.542     -1.83156    1.004678
logp_physc~l |   -.984931   .2975913    -3.31   0.005    -1.623201   -.3466612
logloans_t~4 |   .6212375   .6553603     0.95   0.359    -.7843705    2.026845
logequity_~4 |  -.6962825   .7422308    -0.94   0.364    -2.288209    .8956442
       _cons |   8.595648   2.911529     2.95   0.010      2.35104    14.84026
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     1.12
         Prob > chi2  =   0.2901

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      20.00     19    0.3946
            Skewness |       5.60      5    0.3471
            Kurtosis |       0.48      1    0.4890
---------------------+-----------------------------
               Total |      26.08     25    0.4034
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 11) =      3.97
                  Prob > F =      0.0385

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -1.584042   .9220065    -1.72   0.108     -3.56155    .3934652
------------------------------------------------------------------------------
```

Year 2005:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2005==1

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  5,    15) =    3.22
       Model |   27.723267     5  5.54465339           Prob > F      =  0.0357
    Residual |   25.800187    15  1.72001247           R-squared     =  0.5180
-------------+------------------------------           Adj R-squared =  0.3573
       Total |   53.523454    20   2.6761727           Root MSE      =  1.3115

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.3672263   .8092918    -0.45   0.656    -2.092191    1.357738
 logp_labour |   -.269897   .6537547    -0.41   0.686    -1.663342    1.123548
logp_physc~l |  -.7798022   .2633395    -2.96   0.010    -1.341097   -.2185073
logloans_t~4 |   .2469374   .6523887     0.38   0.710    -1.143596    1.637471
logequity_~4 |   -.539659   .7542736    -0.72   0.485    -2.147355    1.068037
       _cons |   8.488468   3.076949     2.76   0.015     1.930107    15.04683
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     0.06
         Prob > chi2  =   0.8135

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      21.00     20    0.3971
            Skewness |       4.46      5    0.4848
            Kurtosis |       0.15      1    0.7021
---------------------+-----------------------------
               Total |      25.61     26    0.4847
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 12) =      2.90
                  Prob > F =      0.0785

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -1.416925    1.01693    -1.39   0.184    -3.584461      .75061
------------------------------------------------------------------------------
```

Year 2006:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2006==1

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  5,    16) =    3.42
       Model |  33.6470161     5  6.72940322           Prob > F      =  0.0273
    Residual |   31.502247    16  1.96889044           R-squared     =  0.5165
-------------+------------------------------           Adj R-squared =  0.3654
       Total |  65.1492631    21  3.10234586           Root MSE      =  1.4032

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.0472656   .4496975    -0.11   0.918    -1.000582    .9060504
 logp_labour |  -.6282908   .6597266    -0.95   0.355    -2.026849    .7702672
logp_physc~l |  -.6423848   .2406477    -2.67   0.017    -1.152535   -.1322346
logloans_t~4 |   .3799455    .328458     1.16   0.264    -.3163544    1.076245
logequity_~4 |  -.4012942   .6102406    -0.66   0.520    -1.694946     .892358
       _cons |   8.354352   3.034495     2.75   0.014     1.921509    14.78719
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     0.59
         Prob > chi2  =   0.4436

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      21.82     20    0.3501
            Skewness |       1.31      5    0.9334
            Kurtosis |       0.44      1    0.5093
---------------------+-----------------------------
               Total |      23.57     26    0.6003
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 13) =      0.49
                  Prob > F =      0.6981

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -1.317941   .8732767    -1.51   0.151    -3.169205    .5333227
------------------------------------------------------------------------------
```

Year 2007:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2007==1

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  5,    15) =    4.94
       Model |  46.9665468     5  9.39330936           Prob > F      =  0.0071
    Residual |  28.5086843    15  1.90057895           R-squared     =  0.6223
-------------+------------------------------           Adj R-squared =  0.4964
       Total |  75.4752311    20  3.77376155           Root MSE      =  1.3786

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   .4645288    .911327     0.51   0.618    -1.477919    2.406976
 logp_labour |  -.4755127   .6076668    -0.78   0.446    -1.770724    .8196985
logp_physc~l |  -.7650031   .2778184    -2.75   0.015    -1.357159   -.1728473
logloans_t~4 |   .1831579   .4120126     0.44   0.663    -.6950261    1.061342
logequity_~4 |   -.780727   .7476126    -1.04   0.313    -2.374226    .8127717
       _cons |   9.954441    3.63647     2.74   0.015     2.203488    17.70539
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     3.36
         Prob > chi2  =   0.0670

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      21.00     20    0.3971
            Skewness |       6.59      5    0.2528
            Kurtosis |       1.67      1    0.1957
---------------------+-----------------------------
               Total |      29.27     26    0.2991
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 12) =      2.46
                  Prob > F =      0.1125

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   -.775987   1.023274    -0.76   0.460    -2.957044     1.40507
------------------------------------------------------------------------------
```

Year 2008:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2008==1

      Source |       SS       df       MS              Number of obs =      20
-------------+------------------------------           F(  5,    14) =    5.97
       Model |  46.4972354     5  9.29944708           Prob > F      =  0.0037
    Residual |  21.7961369    14  1.55686692           R-squared     =  0.6808
-------------+------------------------------           Adj R-squared =  0.5669
       Total |  68.2933723    19  3.59438802           Root MSE      =  1.2477

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   1.673787   .6853278     2.44   0.028     .2039048    3.143669
 logp_labour |   .1099458   .7157528     0.15   0.880    -1.425191    1.645083
logp_physc~l |  -.8753759    .277298    -3.16   0.007    -1.470121   -.2806308
logloans_t~4 |   .2195442   .3658903     0.60   0.558    -.5652125    1.004301
logequity_~4 |  -1.017871   .5662138    -1.80   0.094    -2.232279    .1965371
       _cons |   15.97316    3.93938     4.05   0.001     7.524035    24.42229
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     3.14
         Prob > chi2  =   0.0766

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      20.00     19    0.3946
            Skewness |       8.57      5    0.1274
            Kurtosis |       1.09      1    0.2960
---------------------+-----------------------------
               Total |      29.66     25    0.2371
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 11) =      0.74
                  Prob > F =      0.5493

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .9083566   1.095054     0.83   0.421    -1.440301    3.257014
------------------------------------------------------------------------------
```

Year 2009:

```
regres logint_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2009==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    6.08
       Model |  44.7200484     5  8.94400967           Prob > F      =  0.0077
    Residual |  14.7172475    10  1.47172475           R-squared     =  0.7524
-------------+------------------------------           Adj R-squared =  0.6286
       Total |  59.4372959    15  3.96248639           Root MSE      =  1.2131

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   1.556056   .5631335     2.76   0.020     .3013161    2.810795
 logp_labour |  -1.187547    .837462    -1.42   0.187    -3.053528    .6784348
logp_physc~l |  -.8038466   .3370372    -2.39   0.038    -1.554812   -.0528809
logloans_t~4 |   .3676475    .642091     0.57   0.580     -1.06302    1.798315
logequity_~4 |  -.1996797   .7947179    -0.25   0.807    -1.970422    1.571062
       _cons |   12.12355   3.370078     3.60   0.005     4.614551    19.63255
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logint_inc

         chi2(1)      =     0.66
         Prob > chi2  =   0.4162

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      16.00     15    0.3821
            Skewness |       2.71      5    0.7446
            Kurtosis |       0.57      1    0.4516
---------------------+-----------------------------
               Total |      19.28     21    0.5674
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logint_inc
       Ho:  model has no omitted variables
                  F(3, 7) =      0.22
                  Prob > F =      0.8809

.
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logint_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.4353376   1.005602    -0.43   0.674    -2.675958    1.805283
------------------------------------------------------------------------------
```

Appendix 3.3 Estimates of Panzar-Rosse H-statistic (*h_stat3*) for each country/year using total income as dependent variable

[standard errors in parentheses]

Year	Albania	Bosnia and Herzegovina	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia
1999	-	-	-	-0.979	-1.593	-	-8.410	-
				[0.021]	[0.005]		[0.149]	
2000	-	-	-	0.516	-0.662	-	-3.327	-
				[0.012]	[0.012]		[0.019]	
2001	-	-	-	-0.707	-0.795	-	-3.276	-
				[0.025]	[0.014]		[0.046]	
2002	-0.056	-	-1.591	-1.310	0.626	-10.205	-2.193	-0.127
	[0.010]		[0.009]	[0.006]	[0.008]	[0.172]	[0.018]	[0.006]
2003	0.032	-	-1.664	-2.823	0.441	-9.391	-2.039	-0.631
	[0.026]		[0.014]	[0.005]	[0.013]	[0.003]	[0.016]	[0.004]
2004	1.874	0.133	-0.812	-1.243	0.972	-4.397	-1.673	-1.227
	[0.027]	[0.034]	[0.010]	[0.003]	[0.010]	[0.077]	[0.020]	[0.006]
2005	2.512	-0.938	-1.743	-4.410	-1.018	-	-1.529	-1.773
	[0.044]	[0.030]	[0.013]	[0.010]	[0.010]		[0.015]	[0.010]
2006	1.333	-0.780	-1.130	-4.906	-1.231	-12.002	-1.318	-0.906
	[0.171]	[0.022]	[0.017]	[0.005]	[0.009]	[0.358]	[0.015]	[0.015]
2007	-1.223	-1.209	-1.498	-3.702	0.387	-6.041	-0.813	-0.404
	[0.042]	[0.012]	[0.020]	[0.010]	[0.009]	[0.025]	[0.061]	[0.010]
2008	-0.753	0.491	-0.704	-2.623	-1.369	0.514	0.748	-0.304
	[0.053]	[0.012]	[0.018]	[0.020]	[0.016]	[0.001]	[0.029]	[0.016]
2009	-	-0.440	-0.887	-3.820	-2.715	-	-0.520	-0.810
		[0.009]	[0.011]	[0.013]	[0.020]		[0.010]	[0.022]

Year	Lithuania	Macedonia	Poland	Romania	Serbia	Slovakia	Slovenia
1999	-	-	-0.067	4.660	-	-	-0.377
			[0.011]	[0.486]			[0.012]
2000	-	-	-4.297	0.519	-	1.627	-4.592
			[0.009]	[0.094]		[0.149]	[0.063]
2001	-	-	1.059	0.024	-	-1.854	-
			[0.010]	[0.060]		[0.038]	
2002	-5.400	-2.586	0.146	0.504	-	-1.106	-5.818
	[0.064]	[0.068]	[0.012]	[0.033]		[0.014]	[0.047]
2003	-2.109	-0.474	-0.400	-0.497	0.222	-2.316	-0.574
	[0.014]	[0.067]	[0.021]	[0.029]	[0.038]	[0.026]	[0.027]
2004	-4.212	0.359	-1.009	0.192	0.508	-3.833	0.355
	[0.013]	[0.022]	[0.013]	[0.018]	[0.056]	[0.006]	[0.019]
2005	-4.279	0.322	-1.830	-0.925	0.131	-2.347	4.270
	[0.003]	[0.023]	[0.015]	[0.016]	[0.038]	[0.007]	[0.014]
2006	-5.936	-0.572	0.821	0.889	-0.451	-3.980	-3.559
	[0.006]	[0.023]	[0.006]	[0.015]	[0.037]	[0.013]	[0.015]
2007	-7.848	-1.875	1.141	0.124	-0.394	-4.035	1.732
	[0.022]	[0.024]	[0.014]	[0.025]	[0.029]	[0.009]	[0.009]

2008	-9.314	-1.056	-2.097	0.166	-2.802	-4.335	2.516
	[0.045]	[0.024]	[0.026]	[0.052]	[0.058]	[0.015]	[0.007]
2009	-7.307	0.363	-1.615	-0.154	-2.714	-2.702	2.247
	[0.038]	[0.037]	[0.027]	[0.036]	[0.020]	[0.036]	[0.009]

A sample of the STATA output from the estimation of the H-statistic (h_stat3) for each country/year using the total income as dependent variable: the case of Hungary

Year 1999:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4 if
dv_hun==1 & dv_1999==1

      Source |       SS       df       MS              Number of obs =       7
-------------+------------------------------           F(  5,     1) =    0.62
       Model |  6.46545602     5   1.2930912           Prob > F      =  0.7387
    Residual |  2.07213857     1  2.07213857           R-squared     =  0.7573
-------------+------------------------------           Adj R-squared = -0.4562
       Total |  8.53759459     6  1.42293243           Root MSE      =  1.4395

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -6.653557   5.219852    -1.27   0.423    -72.97806    59.67095
 logp_labour |  -2.205905   3.035934    -0.73   0.600     -40.7811    36.36929
logp_physc~l |   .4492402    1.90905     0.24   0.853    -23.80755    24.70603
logloans_t~4 |  -3.025249   5.370813    -0.56   0.673     -71.2679     65.2174
logequity_~4 |   2.381969   4.099917     0.58   0.665    -49.71241    54.47635
       _cons |  -10.18528   19.82966    -0.51   0.698     -262.145    241.7745
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     0.88
         Prob > chi2  =   0.3482

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |       7.00      6    0.3208
            Skewness |       1.41      5    0.9236
            Kurtosis |       0.63      1    0.4277
---------------------+-----------------------------
               Total |       9.04     12    0.6999
---------------------------------------------------

.
. estat ovtest
powers of fitted values collinear with explanatory variables
(typically because all explanatory variables are indicator variables)
test not possible
r(499);

.
. lincom  logp_funds + logp_labour + logp_physcapital
```

```
 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -8.410222    7.63724    -1.10   0.469    -105.4506    88.63012
------------------------------------------------------------------------------
```

Year 2000:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4 if
dv_hun==1 & dv_2000==1

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  5,     5) =    7.30
       Model |  13.8313419     5  2.76626838           Prob > F      =  0.0239
    Residual |  1.89430933     5  .378861865           R-squared     =  0.8795
-------------+------------------------------           Adj R-squared =  0.7591
       Total |  15.7256512    10  1.57256512           Root MSE      =  .61552

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -2.682401   1.167891    -2.30   0.070    -5.684561     .319759
 logp_labour |  -.6583421   .5124842    -1.28   0.255    -1.975725    .6590404
logp_physc~l |   .0134621   .2827557     0.05   0.964    -.7133847    .7403089
logloans_t~4 |  -2.037055   1.203313    -1.69   0.151    -5.130268    1.056159
logequity_~4 |   .0599047   1.494303     0.04   0.970    -3.781324    3.901133
       _cons |   .9835645    2.84742     0.35   0.744    -6.335962    8.303091
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     0.28
         Prob > chi2  =   0.5952

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      11.00     10    0.3575
            Skewness |       3.47      5    0.6283
            Kurtosis |       5.17      1    0.0230
---------------------+-----------------------------
               Total |      19.64     16    0.2371
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                 F(3, 2) =      0.12
                Prob > F =      0.9419
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -3.327281   1.044763    -3.18   0.024    -6.012929   -.6416336
------------------------------------------------------------------------------
```

Year 2001:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2001==1

      Source |       SS       df       MS              Number of obs =       9
-------------+------------------------------           F(  5,     3) =    1.56
       Model |  19.3307905     5  3.86615811           Prob > F      =  0.3800
    Residual |  7.45356545     3  2.48452182           R-squared     =  0.7217
-------------+------------------------------           Adj R-squared =  0.2579
       Total |   26.784356     8   3.3480445           Root MSE      =  1.5762

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -1.706919   7.998283    -0.21   0.845    -27.16102    23.74719
 logp_labour |  -.8908757    1.50989    -0.59   0.597     -5.69602    3.914268
logp_physc~l |  -.6785285   .9528459    -0.71   0.528    -3.710909    2.353852
logloans_t~4 |   .2766926   4.875493     0.06   0.958     -15.2393    15.79269
logequity_~4 |  -2.168099   3.484525    -0.62   0.578    -13.25741    8.921214
       _cons |  -1.602016   25.86554    -0.06   0.955    -83.91771    80.71368
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     2.32
         Prob > chi2  =   0.1276

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |       9.00      8    0.3423
            Skewness |       5.58      5    0.3490
            Kurtosis |       0.23      1    0.6339
---------------------+-----------------------------
               Total |      14.81     14    0.3914
---------------------------------------------------

.
. estat ovtest
powers of fitted values collinear with explanatory variables
(typically because all explanatory variables are indicator variables)
test not possible
r(499);
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -3.276323   6.774114    -0.48   0.662    -24.83458    18.28193
------------------------------------------------------------------------------
```

Year 2002:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2002==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    3.67
       Model |  27.7664282     5  5.55328563           Prob > F      =  0.0380
    Residual |  15.1201256    10  1.51201256           R-squared     =  0.6474
-------------+------------------------------           Adj R-squared =  0.4712
       Total |  42.8865537    15  2.85910358           Root MSE      =  1.2296

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -1.281054    1.04933    -1.22   0.250    -3.619108       1.057
 logp_labour |   -.639196   .7466381    -0.86   0.412    -2.302809    1.024417
logp_physc~l |  -.2730654    .363291    -0.75   0.470    -1.082528    .5363975
logloans_t~4 |   .4576285   .7866267     0.58   0.574    -1.295085    2.210342
logequity_~4 |  -1.493046   .7417162    -2.01   0.072    -3.145692    .1596008
       _cons |   1.965846   3.946628     0.50   0.629    -6.827789    10.75948
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     0.27
         Prob > chi2  =   0.6043

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      16.00     15    0.3821
            Skewness |       0.40      5    0.9953
            Kurtosis |       1.35      1    0.2455
---------------------+-----------------------------
               Total |      17.75     21    0.6649
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                  F(3, 7) =      0.29
                 Prob > F =      0.8309
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -2.193315   1.130167    -1.94   0.081    -4.711483    .3248529
------------------------------------------------------------------------------
```

Year 2003:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2003==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    3.77
       Model |  26.8530751     5  5.37061502           Prob > F      =  0.0352
    Residual |  14.2441601    10  1.42441601           R-squared     =  0.6534
-------------+------------------------------           Adj R-squared =  0.4801
       Total |  41.0972352    15  2.73981568           Root MSE      =  1.1935

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.3668158   .6744664    -0.54   0.598    -1.869621    1.135989
 logp_labour |  -.8815634   .6591817    -1.34   0.211    -2.350312     .587185
logp_physc~l |  -.7910098   .4096599    -1.93   0.082    -1.703789    .1217694
logloans_t~4 |  -.0092056    .863642    -0.01   0.992     -1.93352    1.915109
logequity_~4 |  -.6794424   .6288561    -1.08   0.305    -2.080621    .7217364
       _cons |   5.418037   3.613517     1.50   0.165    -2.633381    13.46946
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     0.00
         Prob > chi2  =   0.9507

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      16.00     15    0.3821
            Skewness |       3.17      5    0.6734
            Kurtosis |       0.24      1    0.6208
---------------------+-----------------------------
               Total |      19.42     21    0.5584
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                  F(3, 7) =      7.94
                  Prob > F =      0.0118
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -2.039389   .8876493    -2.30   0.044    -4.017195   -.0615831
------------------------------------------------------------------------------
```

Year 2004:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2004==1

      Source |       SS       df       MS              Number of obs =      20
-------------+------------------------------           F(  5,    14) =    5.48
       Model |   40.600166     5  8.12003319           Prob > F      =  0.0053
    Residual |  20.7581414    14  1.48272439           R-squared     =  0.6617
-------------+------------------------------           Adj R-squared =  0.5409
       Total |  61.3583074    19   3.2293846           Root MSE      =  1.2177

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.2725631   .7378639    -0.37   0.717    -1.855124    1.309998
 logp_labour |  -.4072182   .7001178    -0.58   0.570    -1.908821    1.094385
logp_physc~l |  -.9931261   .3151105    -3.15   0.007    -1.668971   -.3172814
logloans_t~4 |   .3343896   .6939412     0.48   0.637    -1.153966    1.822746
logequity_~4 |   -.678811   .7859258    -0.86   0.402    -2.364454    1.006832
       _cons |   8.495004    3.08293     2.76   0.015     1.882777    15.10723
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     1.17
         Prob > chi2  =   0.2784

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      20.00     19    0.3946
            Skewness |       5.46      5    0.3621
            Kurtosis |       0.21      1    0.6439
---------------------+-----------------------------
               Total |      25.68     25    0.4250
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                  F(3, 11) =      2.38
                  Prob > F =      0.1251
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -1.672907   .9762849    -1.71   0.109     -3.76683    .4210155
------------------------------------------------------------------------------
```

Year 2005:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2005==1

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  5,    15) =    3.19
       Model |  28.6585188     5  5.73170376           Prob > F      =  0.0369
    Residual |  26.9454552    15  1.79636368           R-squared     =  0.5154
-------------+------------------------------           Adj R-squared =  0.3539
       Total |   55.603974    20   2.7801987           Root MSE      =  1.3403

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.5465667    .827059    -0.66   0.519    -2.309401    1.216268
 logp_labour |  -.1721685   .6681072    -0.26   0.800    -1.596205    1.251868
logp_physc~l |  -.8104452   .2691208    -3.01   0.009    -1.384063   -.2368276
logloans_t~4 |   .1069495   .6667112     0.16   0.875    -1.314112    1.528011
logequity_~4 |  -.5148672   .7708329    -0.67   0.514    -2.157859    1.128124
       _cons |   8.585131     3.1445     2.73   0.015     1.882788    15.28747
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     0.18
         Prob > chi2  =   0.6679

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      21.00     20    0.3971
            Skewness |       4.87      5    0.4319
            Kurtosis |       0.00      1    0.9804
---------------------+-----------------------------
               Total |      25.87     26    0.4702
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                  F(3, 12) =      1.63
                  Prob > F =      0.2352
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   -1.52918   1.039256    -1.47   0.162    -3.744302    .6859412
------------------------------------------------------------------------------
```

Year 2006:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2006==1

      Source |       SS       df       MS              Number of obs =      22
-------------+------------------------------           F(  5,    16) =    3.77
       Model |  40.0899735     5  8.0179947            Prob > F      =  0.0190
    Residual |  34.0008632    16  2.12505395           R-squared     =  0.5411
-------------+------------------------------           Adj R-squared =  0.3977
       Total |  74.0908367    21  3.52813508           Root MSE      =  1.4578

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |  -.0105539   .4671912    -0.02   0.982    -1.000955    .9798472
 logp_labour |   -.613954   .6853907    -0.90   0.384    -2.066917    .8390094
logp_physc~l |  -.6932992   .2500091    -2.77   0.014    -1.223295   -.1633036
logloans_t~4 |   .4471131   .3412354     1.31   0.209    -.2762737      1.1705
logequity_~4 |  -.4554263   .6339796    -0.72   0.483    -1.799403    .8885504
       _cons |   8.700234   3.152541     2.76   0.014     2.017147    15.38332
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     0.61
         Prob > chi2  =   0.4357

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      21.84     20    0.3493
            Skewness |       1.22      5    0.9427
            Kurtosis |       0.86      1    0.3529
---------------------+-----------------------------
               Total |      23.93     26    0.5802
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                  F(3, 13) =      0.51
                  Prob > F =      0.6853
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -1.317807   .9072481    -1.45   0.166    -3.241087     .605473
------------------------------------------------------------------------------
```

Year 2007:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2007==1

      Source |       SS       df       MS              Number of obs =      21
-------------+------------------------------           F(  5,    15) =    5.33
       Model |  52.0149758     5  10.4029952           Prob > F      =  0.0052
    Residual |  29.3005716    15  1.95337144           R-squared     =  0.6397
-------------+------------------------------           Adj R-squared =  0.5196
       Total |  81.3155474    20  4.06577737           Root MSE      =  1.3976

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   .5648212   .9238973     0.61   0.550    -1.404419    2.534062
 logp_labour |  -.5577504   .6160486    -0.91   0.380    -1.870827    .7553262
logp_physc~l |  -.8200611   .2816504    -2.91   0.011    -1.420385   -.2197374
logloans_t~4 |   .1580578   .4176956     0.38   0.710    -.7322394    1.048355
logequity_~4 |    -.74051   .7579248    -0.98   0.344    -2.355988    .8749684
       _cons |   10.27454    3.68663     2.79   0.014     2.416678    18.13241
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     4.67
         Prob > chi2  =   0.0307

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      21.00     20    0.3971
            Skewness |       6.47      5    0.2636
            Kurtosis |       1.77      1    0.1832
---------------------+-----------------------------
               Total |      29.24     26    0.3005
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                  F(3, 12) =      2.26
                  Prob > F =      0.1335
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.8129903   1.037388    -0.78   0.445    -3.024131    1.398151
------------------------------------------------------------------------------
```

Year 2008:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2008==1

      Source |       SS       df       MS              Number of obs =      20
-------------+------------------------------           F(  5,    14) =    5.46
       Model |  46.9277342     5  9.38554685           Prob > F      =  0.0054
    Residual |  24.0462643    14  1.71759031           R-squared     =  0.6612
-------------+------------------------------           Adj R-squared =  0.5402
       Total |  70.9739985    19  3.73547361           Root MSE      =  1.3106

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   1.600592    .719834     2.22   0.043     .0567011    3.144482
 logp_labour |   .0932964    .751791     0.12   0.903    -1.519135    1.705728
logp_physc~l |  -.9461706     .29126    -3.25   0.006    -1.570861   -.3214801
logloans_t~4 |   .1752183   .3843129     0.46   0.655    -.6490509    .9994875
logequity_~4 |   -.917842   .5947227    -1.54   0.145    -2.193395    .3577113
       _cons |   16.22648   4.137728     3.92   0.002     7.351934    25.10102
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     2.78
         Prob > chi2  =   0.0957

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      20.00     19    0.3946
            Skewness |       8.00      5    0.1565
            Kurtosis |       0.89      1    0.3463
---------------------+-----------------------------
               Total |      28.88     25    0.2689
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                  F(3, 11) =      0.36
                  Prob > F =      0.7863
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .7477174    1.15019     0.65   0.526    -1.719195     3.21463
------------------------------------------------------------------------------
```

Year 2009:

```
regres logtot_inc logp_funds logp_labour logp_physcapital logloans_ta_c4 logequity_ta_c4
if  dv_hun==1 & dv_2009==1

      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  5,    10) =    5.21
       Model |  41.1570531     5  8.23141063           Prob > F      =  0.0130
    Residual |  15.7917578    10  1.57917578           R-squared     =  0.7227
-------------+------------------------------           Adj R-squared =  0.5841
       Total |   56.948811    15   3.7965874           Root MSE      =  1.2567

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  logp_funds |   1.463598   .5833286     2.51   0.031      .163861    2.763335
 logp_labour |  -1.212342   .8674951    -1.40   0.192    -3.145242    .7205575
logp_physc~l |  -.7713701   .3491241    -2.21   0.052    -1.549267    .0065269
logloans_t~4 |   .3477781   .6651177     0.52   0.612    -1.134197    1.829753
logequity_~4 |  -.2292662   .8232182    -0.28   0.786    -2.063511    1.604978
       _cons |   11.91728   3.490936     3.41   0.007     4.138994    19.69557
------------------------------------------------------------------------------

.
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of logtot_inc

         chi2(1)      =     0.52
         Prob > chi2  =   0.4716

.
. estat imtest

Cameron & Trivedi's decomposition of IM-test

---------------------------------------------------
              Source |       chi2     df      p
---------------------+-----------------------------
  Heteroskedasticity |      16.00     15    0.3821
            Skewness |       3.27      5    0.6590
            Kurtosis |       0.64      1    0.4248
---------------------+-----------------------------
               Total |      19.90     21    0.5274
---------------------------------------------------

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of logtot_inc
       Ho:  model has no omitted variables
                  F(3, 7) =      0.28
                 Prob > F =      0.8360
```

```
. lincom  logp_funds+ logp_labour+ logp_physcapital

 ( 1)  logp_funds + logp_labour + logp_physcapital = 0

------------------------------------------------------------------------------
  logtot_inc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   -.520114   1.041665    -0.50   0.628    -2.841088     1.80086
------------------------------------------------------------------------------
```

Appendix 3.4 Lerner Index estimates for each country/year

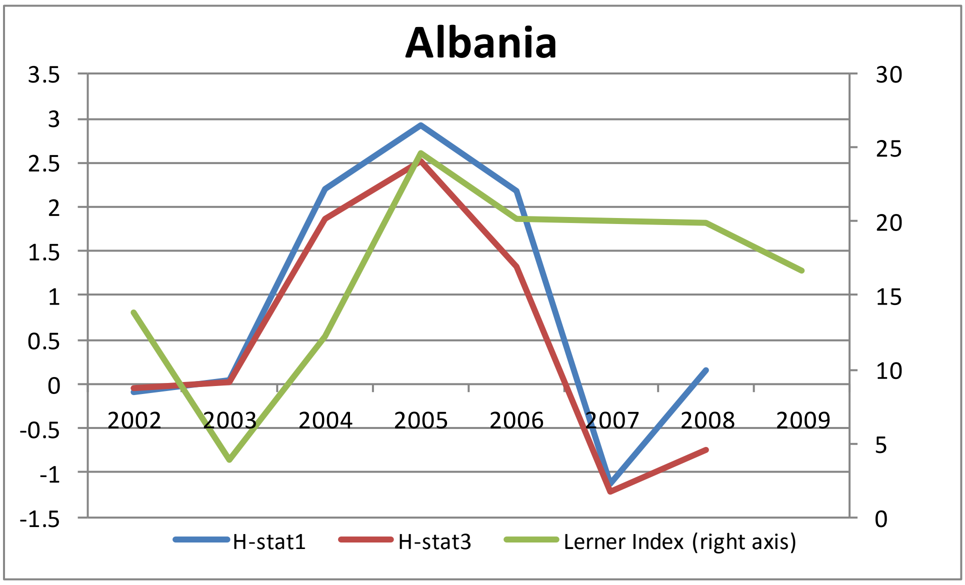
Source: Efthyvoulou, G. and Yildirim, C. (2013)

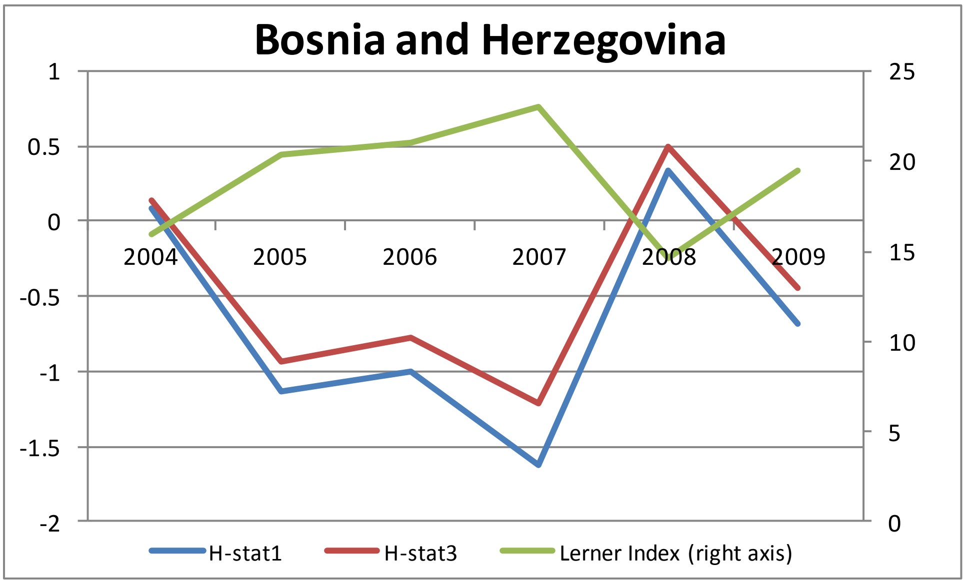
Year	Albania	Bosnia and Herzegovina	Bulgaria	Croatia	Czech Republic	Estonia	Hungary	Latvia
1999	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-
2001	-	-	-	-	-	-	-	-
2002	13.910	-	29.060	23.400	11.330	-	9.120	22.210
2003	3.880	-	24.190	25.380	7.860	-	4.490	21.130
2004	12.300	15.930	28.810	21.990	8.100	-	6.550	29.640
2005	24.580	20.380	19.040	20.230	11.560	-	9.690	34.420
2006	20.160	21.010	27.360	13.280	13.370	-	3.400	43.810
2007	20.110	22.990	31.320	16.310	17.490	-	-4.600	30.650
2008	19.900	14.590	24.710	12.860	22.420	-	-15.660	33.540
2009	16.710	19.500	23.830	16.620	26.970	-	-0.850	24.950

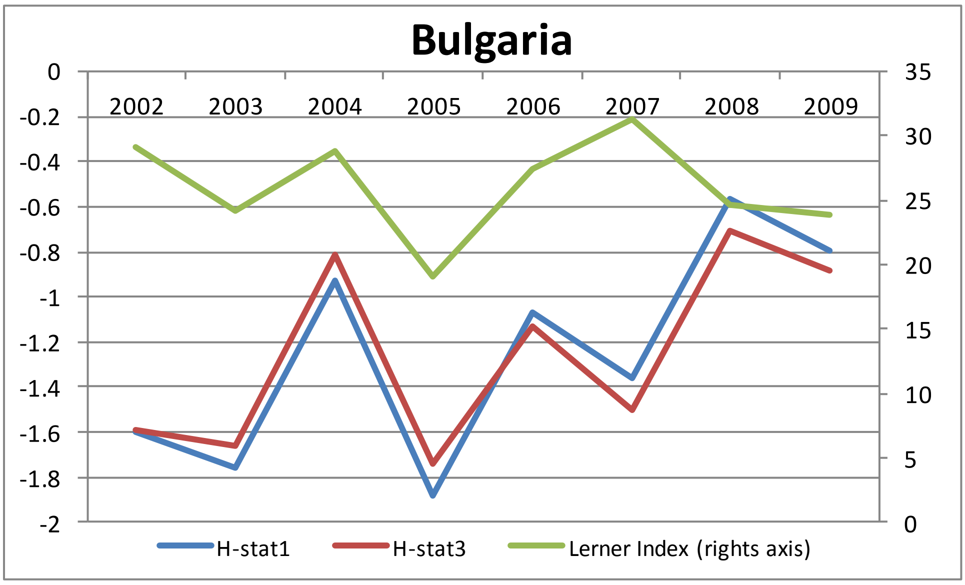
Year	Lithuania	Macedonia	Poland	Romania	Serbia	Slovakia	Slovenia
1999	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-
2001	-	-	-	-	-	-	-
2002	-	21.770	10.310	25.480	39.610	15.580	36.850
2003	-	28.360	-2.620	17.570	47.810	13.650	30.610
2004	-	28.380	11.350	24.870	30.930	8.620	34.370
2005	-	33.420	7.140	18.180	30.400	10.720	27.010
2006	-	33.840	20.890	10.330	15.200	18.240	21.860
2007	-	33.420	18.650	15.190	20.800	19.390	24.490
2008	-	27.750	14.630	22.050	10.100	29.880	16.180
2009	-	22.390	6.570	23.060	13.320	11.500	25.880

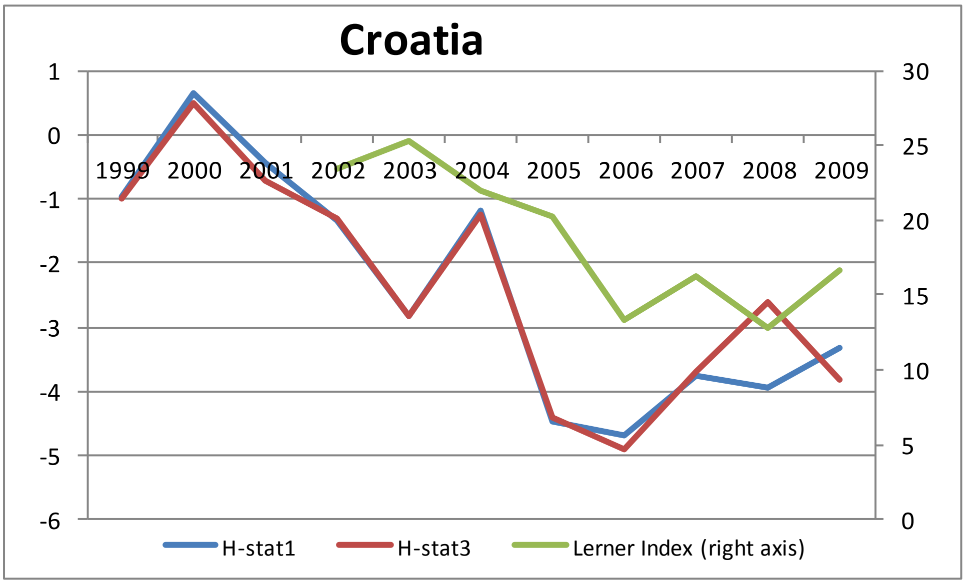
Appendix 3.5 Graphical presentation of *h_stat1*, *h_stat3*, and Lerner Index, by countries/years

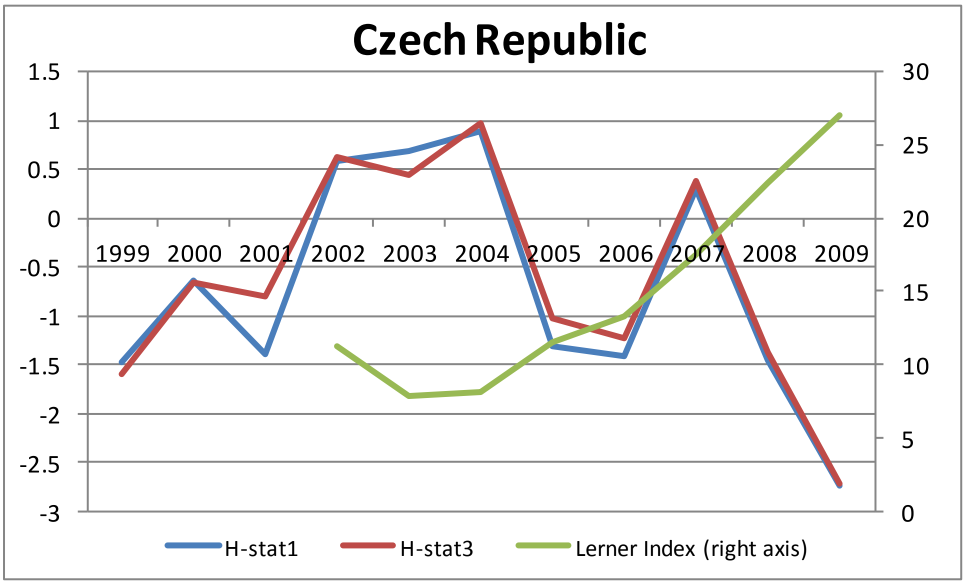
Note: *h_stat1* represents the Panzar-Rosse H-statistic estimated with interest income as dependent variable, whereas *h_stat3* represents the H-statistic estimated with total income as dependent variable.

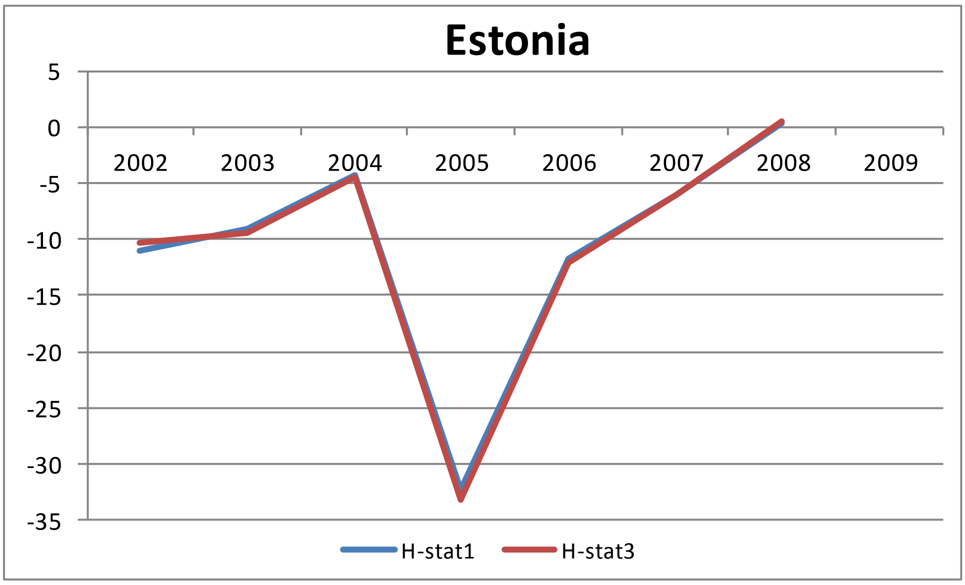


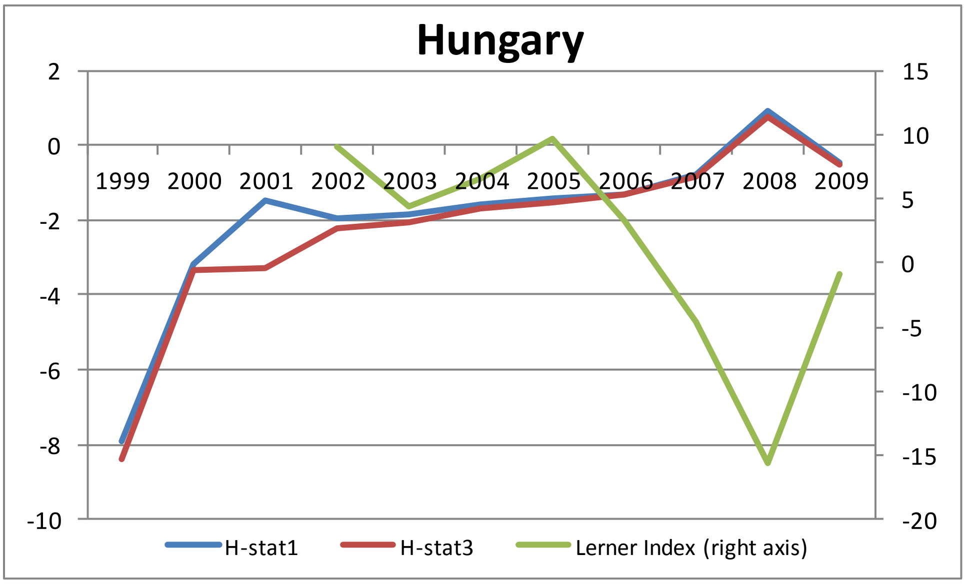


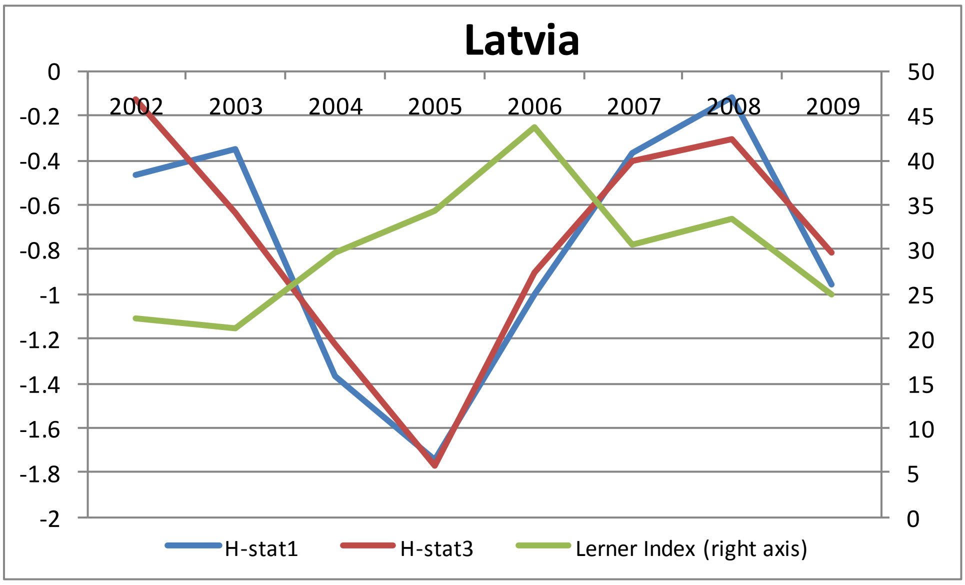

Bulgaria
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
2002 2003 2004 2005 2006 2007 2008 2009
35
30
25
20
15
10
5
0
H-stat1
H-stat3
Lerner Index (rights axis)

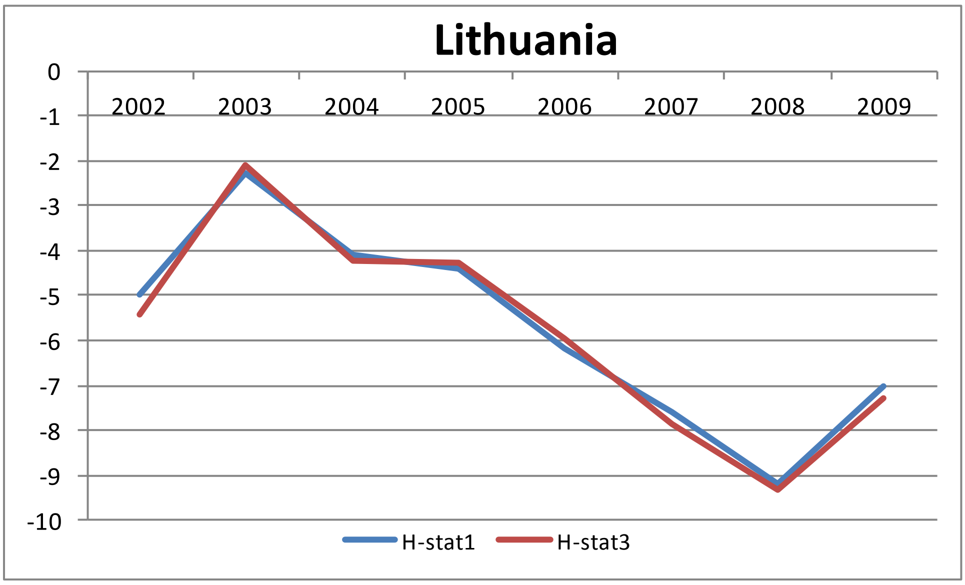

Croatia
1
0
-1
-2
-3
-4
-5
-6
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
30
25
20
15
10
5
0
H-stat1
H-stat3
Lerner Index (right axis)

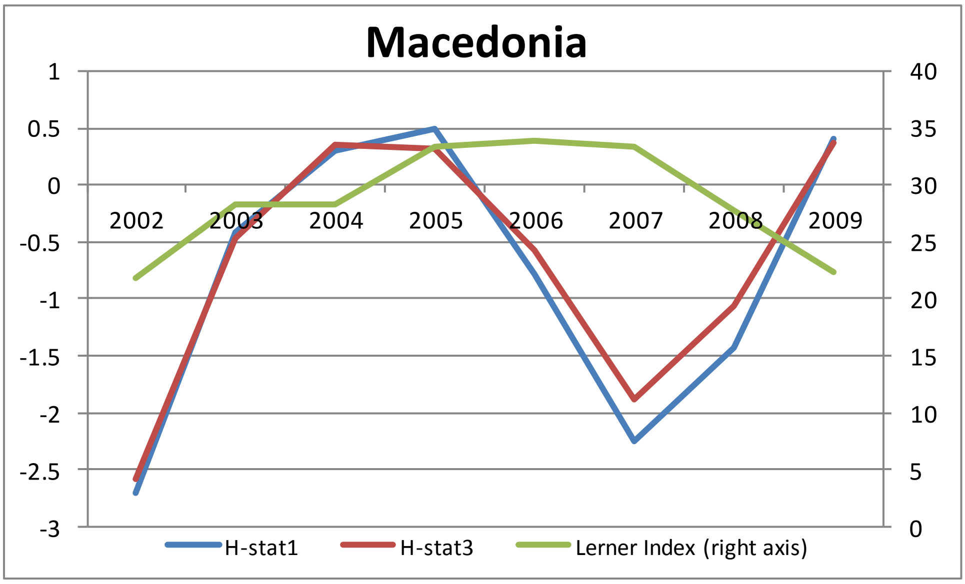

Czech Republic
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
30
25
20
15
10
5
0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
H-stat1
H-stat3
Lerner Index (right axis)

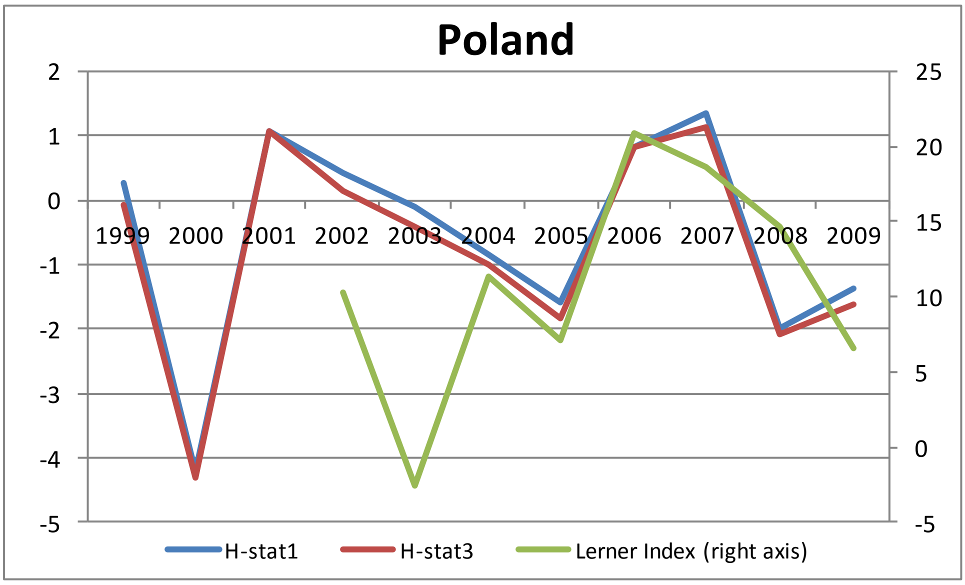

Estonia
5
0
-5
-10
-15
-20
-25
-30
-35
2002 2003 2004 2005 2006 2007 2008 2009
H-stat1
H-stat3

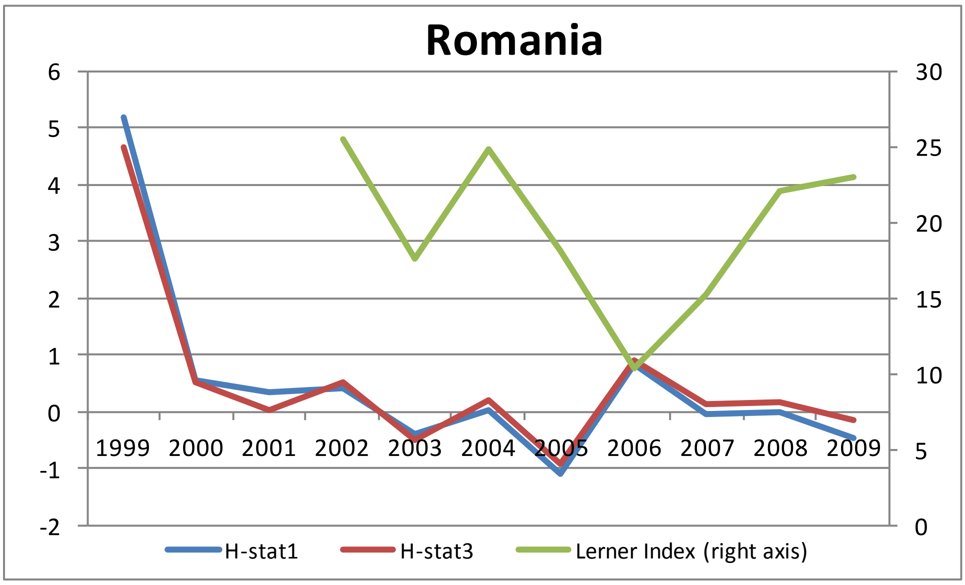

Hungary
2
0
-2
-4
-6
-8
-10
15
10
5
0
-5
-10
-15
-20
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
H-stat1
H-stat3
Lerner Index (right axis)

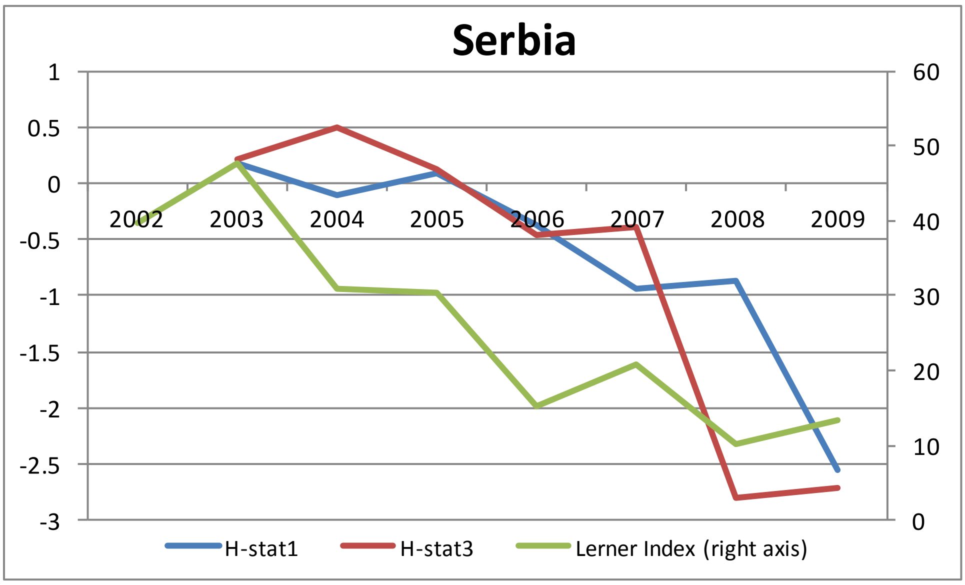

Latvia
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
-1.4
-1.6
-1.8
-2
50
45
40
35
30
25
20
15
10
5
0
2002
2003
2004
2005
2006
2007
2008
2009
H-stat1
H-stat3
Lerner Index (right axis)

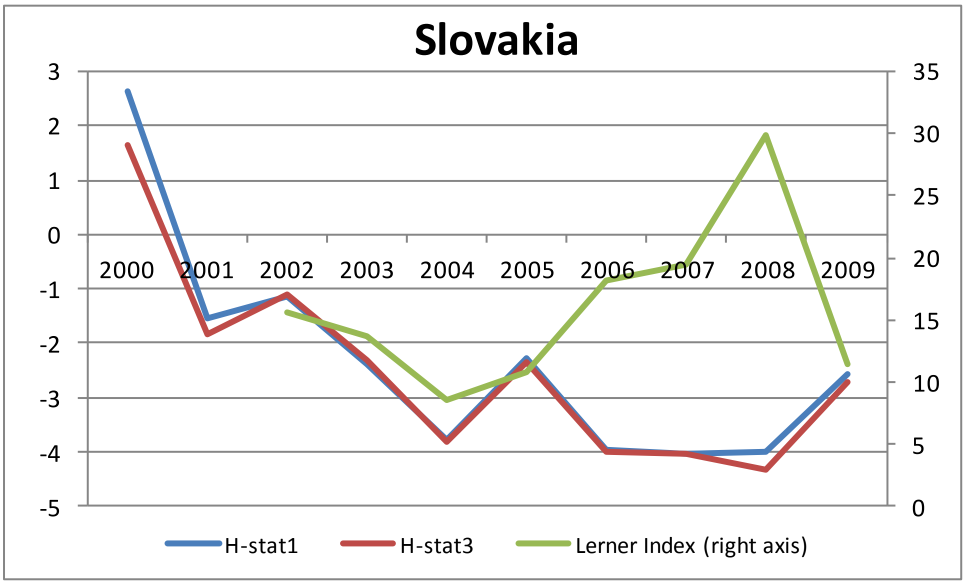

Lithuania
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
2002
2003
2004
2005
2006
2007
2008
2009
H-stat1
H-stat3


Macedonia
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
40
35
30
25
20
15
10
5
0
2002
2003
2004
2005
2006
2007
2008
2009
H-stat1
H-stat3
Lerner Index (right axis)

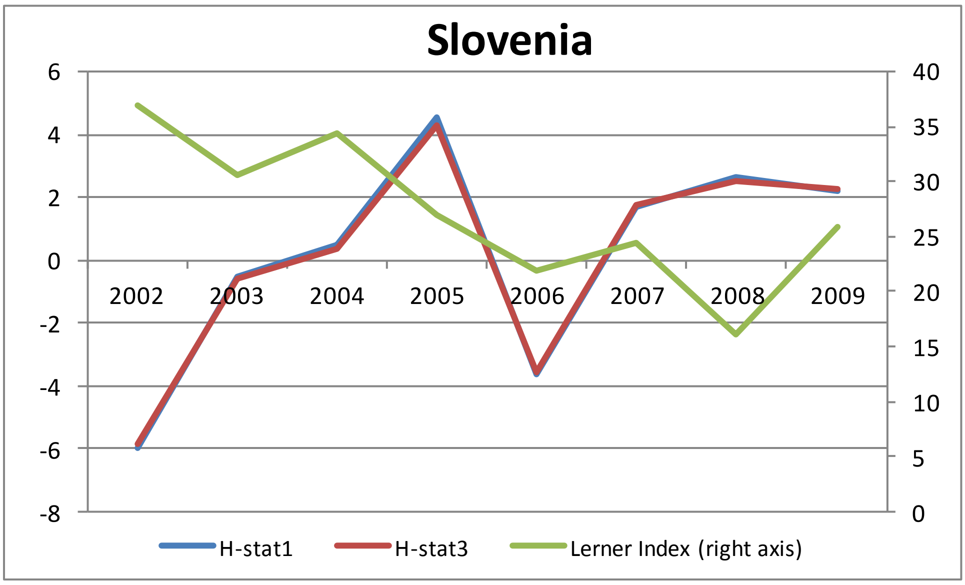

Poland
2
1
0
-1
-2
-3
-4
-5
25
20
15
10
5
0
-5
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
H-stat1
H-stat3
Lerner Index (right axis)


Romania
6
5
4
3
2
1
0
-1
-2
30
25
20
15
10
5
0
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
H-stat1
H-stat3
Lerner Index (right axis)


Serbia
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
60
50
40
30
20
10
0
2002 2003 2004 2005 2006 2007 2008 2009
H-stat1
H-stat3
Lerner Index (right axis)



Slovakia
3
2
1
0
-1
-2
-3
-4
-5
35
30
25
20
15
10
5
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
H-stat1
H-stat3
Lerner Index (right axis)



Slovenia
6
4
2
0
-2
-4
-6
-8
40
35
30
25
20
15
10
5
0
2002
2003
2004
2005
2006
2007
2008
2009
H-stat1
H-stat3
Lerner Index (right axis)

Appendix 3.6 The Hausman test for choosing between the Fixed Effects and Random Effects

Fixed Effects:

```
xtreg prov_loans  h_stat1 Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans rgdpgrowth
gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1  propertyrights_hrt  dv_foreign  dv_origin
dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo, fe
note: dv_bos omitted because of collinearity
note: dv_bul omitted because of collinearity
note: dv_cro omitted because of collinearity
note: dv_cze omitted because of collinearity
note: dv_est omitted because of collinearity
note: dv_hun omitted because of collinearity
note: dv_lat omitted because of collinearity
note: dv_lit omitted because of collinearity
note: dv_mac omitted because of collinearity
note: dv_pol omitted because of collinearity
note: dv_rom omitted because of collinearity
note: dv_ser omitted because of collinearity
note: dv_svk omitted because of collinearity
note: dv_slo omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      1497
Group variable: bank                            Number of groups   =       292

R-sq:  within  = 0.1766                         Obs per group: min =         1
       between = 0.0019                                        avg =       5.1
       overall = 0.0073                                        max =        10

                                                F(22,1183)         =     11.53
corr(u_i, Xb)  = -0.9029                        Prob > F           =    0.0000

------------------------------------------------------------------------------
  prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     h_stat1 |  -.0957351   .0424028    -2.26   0.024    -.1789281   -.0125421
Lagnoninti~a |    .016104   .0288117     0.56   0.576    -.0404237    .0726317
Lagequity_ta |  -.0105925   .0153113    -0.69   0.489    -.0406328    .0194478
      Lagnim |  -.0757136   .0512133    -1.48   0.140    -.1761927    .0247655
       logta |  -.7197035    .194424    -3.70   0.000    -1.101158   -.3382493
Laggr~_loans |    .003557   .0013026     2.73   0.006     .0010012    .0061127
  rgdpgrowth |  -.2315257   .0225565   -10.26   0.000    -.2757809   -.1872704
  gdp_percap |  -.0000895   .0000607    -1.47   0.141    -.0002086    .0000297
    cpi_ebrd |  -.0060324   .0260887    -0.23   0.817    -.0572176    .0451528
logexch_rate |  -1.739592   1.171073    -1.49   0.138    -4.037203    .5580185
ebrd_bankr~1 |  -.5000553   .5336176    -0.94   0.349    -1.546998    .5468871
propertyri~t |   -.051843   .0165678    -3.13   0.002    -.0843485   -.0193375
  dv_foreign |   .1873066   .4465228     0.42   0.675    -.6887584    1.063372
   dv_origin |   .3416529   .4555611     0.75   0.453     -.552145    1.235451
     dv_2002 |    1.03645   .5650874     1.83   0.067    -.0722357    2.145135
     dv_2003 |   .9343079   .5810351     1.61   0.108    -.2056663    2.074282
     dv_2004 |   .8765537   .6468743     1.36   0.176    -.3925952    2.145703
     dv_2005 |   1.023502   .6952292     1.47   0.141     -.340518    2.387521
     dv_2006 |   1.280578   .7375745     1.74   0.083    -.1665223    2.727678
     dv_2007 |     1.8616    .844517     2.20   0.028     .2046819    3.518518
     dv_2008 |   1.692532   .9386401     1.80   0.072    -.1490526    3.534117
     dv_2009 |    .947666    .924118     1.03   0.305    -.8654269    2.760759
      dv_bos |  (omitted)
      dv_bul |  (omitted)
      dv_cro |  (omitted)
      dv_cze |  (omitted)
      dv_est |  (omitted)
      dv_hun |  (omitted)
      dv_lat |  (omitted)
      dv_lit |  (omitted)
      dv_mac |  (omitted)
      dv_pol |  (omitted)
```

```
      dv_rom |  (omitted)
      dv_ser |  (omitted)
      dv_svk |  (omitted)
      dv_slo |  (omitted)
       _cons |   18.42042   3.510954     5.25   0.000     11.53203    25.30881
-------------+----------------------------------------------------------------
     sigma_u |  4.1905099
     sigma_e |  1.9630469
         rho |  .82004454   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(291, 1183) =     1.87           Prob > F = 0.0000



. estimates store FE
```

Random Effects:

```
xtreg prov_loans  h_stat1 Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans rgdp
> growth gdp_percap cpi_ebrd logexch_rate ebrd_bankref1 propertyrights_hrt  dv_foreign dv_
> origin  dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul d
> v_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo, re

Random-effects GLS regression                   Number of obs      =      1497
Group variable: bank                            Number of groups   =       292

R-sq:  within  = 0.1594                         Obs per group: min =         1
       between = 0.4818                                        avg =       5.1
       overall = 0.2325                                        max =        10

Random effects u_i ~ Gaussian                   Wald chi2(36)      =    409.53
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
  prov_loans |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     h_stat1 |   -.070693   .0413187    -1.71   0.087    -.1516762    .0102903
Lagnoninti~a |   .0734185   .0202337     3.63   0.000     .0337612    .1130759
Lagequity_ta |  -.0096986   .0094784    -1.02   0.306     -.028276    .0088788
      Lagnim |   .0474545   .0289787     1.64   0.102    -.0093427    .1042518
       logta |  -.0649677   .0630066    -1.03   0.302    -.1884585     .058523
Laggr~_loans |   .0034169    .001174     2.91   0.004     .0011159    .0057178
  rgdpgrowth |  -.2405471   .0220326   -10.92   0.000    -.2837302   -.1973639
  gdp_percap |  -.0000954   .0000589    -1.62   0.105    -.0002109      .00002
    cpi_ebrd |   .0064594   .0246753     0.26   0.793    -.0419033     .054822
logexch_rate |  -3.399164   1.098055    -3.10   0.002    -5.551312   -1.247016
ebrd_bankr~1 |  -1.086604   .5121693    -2.12   0.034    -2.090437   -.0827705
propertyri~t |   -.056238   .0160259    -3.51   0.000    -.0876482   -.0248278
  dv_foreign |  -.1053655    .226493    -0.47   0.642    -.5492836    .3385527
   dv_origin |   .0707703   .2202249     0.32   0.748    -.3608626    .5024032
     dv_2002 |   .6716817   .5089994     1.32   0.187    -.3259389    1.669302
     dv_2003 |   .8128463   .5117031     1.59   0.112    -.1900733    1.815766
     dv_2004 |   .6711675   .5769471     1.16   0.245     -.459628    1.801963
     dv_2005 |   .7305831   .6223163     1.17   0.240    -.4891344    1.950301
     dv_2006 |   .8621884   .6544935     1.32   0.188    -.4205953    2.144972
     dv_2007 |   1.347702    .749779     1.80   0.072    -.1218381    2.817242
     dv_2008 |   1.039272   .8384962     1.24   0.215    -.6041505    2.682694
     dv_2009 |   .2593323   .8374417     0.31   0.757    -1.382023    1.900688
      dv_bos |  -15.08388   4.509079    -3.35   0.001    -23.92152    -6.24625
      dv_bul |  -13.81152   4.590947    -3.01   0.003    -22.80961   -4.813425
      dv_cro |  -9.018391      2.994    -3.01   0.003    -14.88652   -3.150259
      dv_cze |   -1.65792   1.889972    -0.88   0.380    -5.362198    2.046358
      dv_est |  -3.500768   2.596954    -1.35   0.178    -8.590705    1.589169
      dv_hun |   5.894208   1.457783     4.04   0.000     3.037006     8.75141
      dv_lat |  -15.12698   5.728754    -2.64   0.008    -26.35513    -3.89883
      dv_lit |  -10.44628   3.958691    -2.64   0.008    -18.20517   -2.687392
      dv_mac |   -2.17254   1.049239    -2.07   0.038    -4.229011   -.1160697
      dv_pol |  -9.538179    3.80051    -2.51   0.012    -16.98704   -2.089317
      dv_rom |  -11.78983   3.878146    -3.04   0.002    -19.39085     -4.1888
```

```
     dv_ser |    1.50526    .901658     1.67   0.095    -.2619571    3.272477
     dv_svk |  -13.47323    5.01007    -2.69   0.007    -23.29279   -3.653674
     dv_slo |  -13.46575   5.079113    -2.65   0.008    -23.42063   -3.510869
      _cons |   23.72353   5.445004     4.36   0.000     13.05152    34.39554
-------------+----------------------------------------------------------------
     sigma_u |  .94385363
     sigma_e |  1.9630469
         rho |  .18777027   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
. estimates store RE
```

Hausman Test:

```
. hausman FE RE

Note: the rank of the differenced variance matrix (20) does not equal the number of
        coefficients being tested (22); be sure this is what you expect, or there may be
        problems computing the test.  Examine the output of your estimators for anything
        unexpected and possibly consider scaling your variables so that the coefficients
        are on a similar scale.

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       FE           RE         Difference          S.E.
-------------+----------------------------------------------------------------
      h_stat1 |   -.0957351     -.070693       -.0250421        .0095267
Lagnoninti~a |     .016104     .0734185       -.0573146        .0205112
Lagequity_ta |   -.0105925    -.0096986       -.0008939        .0120248
       Lagnim |   -.0757136     .0474545       -.1231681        .0422261
        logta |   -.7197035    -.0649677       -.6547358        .1839316
Laggr~_loans |     .003557     .0034169        .0001401        .0005645
  rgdpgrowth |   -.2315257    -.2405471        .0090214        .0048332
  gdp_percap |   -.0000895    -.0000954        5.97e-06        .0000147
    cpi_ebrd |   -.0060324     .0064594       -.0124917        .0084705
logexch_rate |   -1.739592    -3.399164        1.659571        .4070466
ebrd_bankr~1 |   -.5000553    -1.086604        .5865486        .1497675
propertyri~t |    -.051843     -.056238         .004395        .0042024
  dv_foreign |    .1873066    -.1053655        .2926721        .3848163
   dv_origin |    .3416529     .0707703        .2708826        .3987944
     dv_2002 |     1.03645     .6716817        .3647678        .2454451
     dv_2003 |    .9343079     .8128463        .1214616        .2752485
     dv_2004 |    .8765537     .6711675        .2053862         .292538
     dv_2005 |    1.023502     .7305831        .2929186        .3099451
     dv_2006 |    1.280578     .8621884        .4183893          .34008
     dv_2007 |      1.8616     1.347702        .5138982        .3886392
     dv_2008 |    1.692532     1.039272        .6532605        .4218642
     dv_2009 |     .947666     .2593323        .6883338        .3907499
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(20) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       65.69
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

Appendix 3.7 Diagnostic tests for the Fixed Effects model

Test for autocorrelation:

```
xtserial  prov_loans  h_stat1  Lagnonintinc_ta  Lagequity_ta  Lagnim  logta  Laggrowth_loans
rgdpgrowth gdp_percap cpi_ebrd logexch_rate ebrd_bankref1 propertyrights_hrt  dv_foreign
dv_origin dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro
dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo



Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     229) =      2.780
           Prob > F =      0.0968
```

In order verify if our regression should be estimated with a dynamic model, we include the lagged dependent variable and use the General Method of Moments as estimator:

```
xtabond2 prov_loans Lagprov_loans  h_stat1 nonintinc_ta equity_ta nim logta growth_loans
rgdpgrowth  gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1  propertyrights_hrt   dv_foreign
dv_origin  dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul
dv_cro  dv_cze  dv_est  dv_hun  dv_lat  dv_lit  dv_mac  dv_pol  dv_rom   dv_ser  dv_svk  dv_slo,
gmm(Lagprov_loans, laglimits (1 2)) gmm(nonintinc_ta equity_ta nim growth_loans, laglimits (2
3))  iv(  h_stat1  logta  rgdpgrowth  gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1
propertyrights_hrt  dv_foreign dv_origin  dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom
dv_ser dv_svk dv_slo) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per m.
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1528
Time variable : year                            Number of groups   =       300
Number of instruments = 163                     Obs per group: min =         1
Wald chi2(37) =    291.86                                      avg =      5.09
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
  prov_loans |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Lagprov_lo~s |  -.0175686   .0548807    -0.32   0.749    -.1251327    .0899955
     h_stat1 |  -.0083427   .0221235    -0.38   0.706    -.0517039    .0350186
nonintinc_ta |   .3689671   .1413551     2.61   0.009     .0919162    .6460181
   equity_ta |   .0243575   .0299825     0.81   0.417    -.0344071     .083122
         nim |   .0586261   .0791432     0.74   0.459    -.0964918     .213744
       logta |  -.0145896   .0860434    -0.17   0.865    -.1832316    .1540524
growth_loans |  -.0099055   .0040528    -2.44   0.015    -.0178489   -.0019621
  rgdpgrowth |   -.148099    .028454    -5.20   0.000    -.2038679   -.0923301
  gdp_percap |  -.0000151   .0000631    -0.24   0.811    -.0001388    .0001086
    cpi_ebrd |  -.0100735   .0268291    -0.38   0.707    -.0626575    .0425105
logexch_rate |  -.4789595    1.40549    -0.34   0.733     -3.23367    2.275751
ebrd_bankr~1 |  -.6758456   .5473154    -1.23   0.217    -1.748564    .3968728
propertyri~t |  -.0258831   .0135954    -1.90   0.057    -.0525296    .0007635
  dv_foreign |   .3269181   .2409231     1.36   0.175    -.1452826    .7991188
   dv_origin |  -.1279041   .2114391    -0.60   0.545    -.5423171     .286509
     dv_2002 |   .6170778   .7260065     0.85   0.395    -.8058688    2.040024
     dv_2003 |   .1504611   .5891721     0.26   0.798    -1.004295    1.305217
     dv_2004 |   .0957789   .6040941     0.16   0.874    -1.088224    1.279782
     dv_2005 |   .1659445   .6160284     0.27   0.788    -1.041449    1.373338
```

```
     dv_2006 |   .2103839   .6115871     0.34   0.731    -.9883048    1.409073
     dv_2007 |   .5765735   .7211564     0.80   0.424     -.836867    1.990014
     dv_2008 |   .3539267   .8121203     0.44   0.663      -1.2378    1.945653
     dv_2009 |   .1527383   .8708659     0.18   0.861    -1.554128    1.859604
      dv_bos |  -2.843078    5.72318    -0.50   0.619     -14.0603    8.374149
      dv_bul |  -2.015144   5.666873    -0.36   0.722    -13.12201    9.091723
      dv_cro |  -1.800209    3.51249    -0.51   0.608    -8.684563    5.084144
      dv_cze |   .2193141     1.8535     0.12   0.906    -3.413479    3.852107
      dv_est |  -.0612662   2.639683    -0.02   0.981     -5.23495    5.112418
      dv_hun |   .9901315   2.046605     0.48   0.629     -3.02114    5.001403
      dv_lat |  -1.579957   6.935828    -0.23   0.820    -15.17393    12.01402
      dv_lit |  -1.055322   4.741524    -0.22   0.824    -10.34854    8.237894
      dv_mac |  -1.095915   1.114547    -0.98   0.325    -3.280387    1.088558
      dv_pol |  -1.326879   4.444102    -0.30   0.765    -10.03716    7.383402
      dv_rom |  -2.174143   4.697521    -0.46   0.643    -11.38112    7.032829
      dv_ser |   .8117405   .8570386     0.95   0.344    -.8680242    2.491505
      dv_svk |  -1.821448    6.18004    -0.29   0.768     -13.9341    10.29121
      dv_slo |  -2.006457   6.233746    -0.32   0.748    -14.22438    10.21146
       _cons |   6.467991   7.768231     0.83   0.405    -8.757461    21.69344
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(h_stat1 logta rgdpgrowth gdp_percap cpi_ebrd logexch_rate ebrd_bankref1
    propertyrights_hrt dv_foreign dv_origin dv_2002 dv_2003 dv_2004 dv_2005
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(1/2).Lagprov_loans
    L(2/3).(nonintinc_ta equity_ta nim growth_loans)
Instruments for levels equation
  Standard
    _cons
    h_stat1 logta rgdpgrowth gdp_percap cpi_ebrd logexch_rate ebrd_bankref1
    propertyrights_hrt dv_foreign dv_origin dv_2002 dv_2003 dv_2004 dv_2005
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.Lagprov_loans
    DL.(nonintinc_ta equity_ta nim growth_loans)
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -1.36  Pr > z =  0.174
Arellano-Bond test for AR(2) in first differences: z =  -0.70  Pr > z =  0.484
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(125)  = 475.56  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(125)  = 122.30  Prob > chi2 =  0.552
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(79)   =  84.00  Prob > chi2 =  0.329
    Difference (null H = exogenous): chi2(46)   =  38.30  Prob > chi2 =  0.783
  gmm(Lagprov_loans, lag(1 2))
    Hansen test excluding group:     chi2(102)  =  97.80  Prob > chi2 =  0.599
    Difference (null H = exogenous): chi2(23)   =  24.51  Prob > chi2 =  0.376
  gmm(nonintinc_ta equity_ta nim growth_loans, lag(2 3))
    Hansen test excluding group:     chi2(18)   =  20.11  Prob > chi2 =  0.326
    Difference (null H = exogenous): chi2(107)  = 102.19  Prob > chi2 =  0.613
  iv(h_stat1 logta rgdpgrowth gdp_percap cpi_ebrd logexch_rate ebrd_bankref1 propertyright
> s_hrt dv_foreign dv_origin dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_20
> 09 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser d
> v_svk dv_slo)
    Hansen test excluding group:     chi2(93)   =  92.98  Prob > chi2 =  0.481
    Difference (null H = exogenous): chi2(32)   =  29.33  Prob > chi2 =  0.602
```

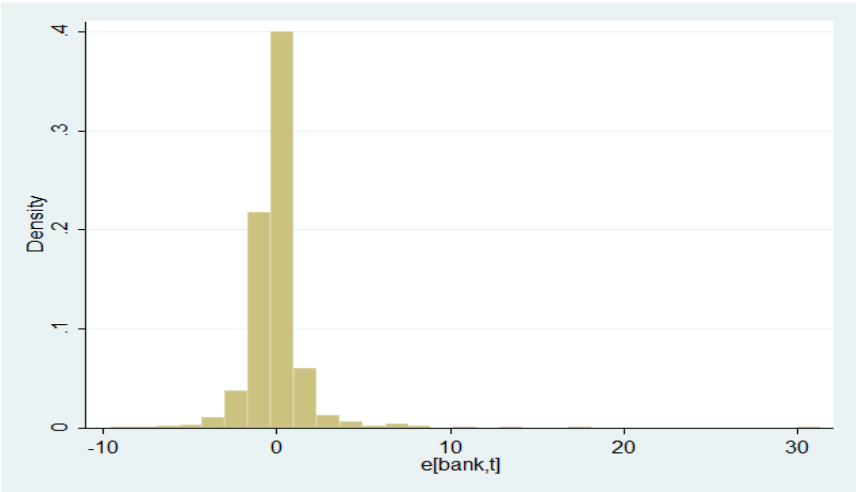
The results from the above regression suggest that the lagged dependent variable is statistically insignificant, thus suggesting that a dynamic model is not recommended for our regression.

Test for normality:

```
pantest2  prov_loans  h_stat1  Lagnonintinc_ta  Lagequity_ta  Lagnim  logta  Laggrowth_loans
rgdpgrowth  gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1  propertyrights_hrt  dv_foreign
dv_origin dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro
dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo

Test for serial correlation in residuals
Null hypothesis is either that rho=0 if residuals are AR(1)
or that lamda=0 if residuals are MA(1)
Following tests only approximate for unbalanced panels
LM= 28.966522
which is asy. distributed as chisq(1) under null, so:
Probability of value greater than LM is 7.364e-08
LM5= 5.3820556
which is asy. distributed as N(0,1) under null, so:
Probability of value greater than abs(LM5) is 3.682e-08


Test for significance of fixed effects
F= 1.8680556
Probability>F= 3.524e-13


Test for normality of residuals

                    Skewness/Kurtosis tests for Normality
                                                         ------- joint ------
    Variable |     Obs    Pr(Skewness)    Pr(Kurtosis)  adj chi2(2)     Prob>chi2
-------------+---------------------------------------------------------------
    __00000B |    1.5e+03    0.0000         0.0000            .              .
```

Histogram of the residuals:

```
predict residuals, e

histogram residuals
```



Test for heteroscedasticity:

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (292)  =   9.9e+05
Prob>chi2 =      0.0000
```

Appendix 3.8 Estimation of the impact of competition on risk-taking using Fixed Effect Vector Decomposition: 3-stage approach

First stage: Estimate the FE regression and predict the FE vector

In the first stage, Equation 5.2 is estimated using the normal fixed effects model. After running the regression, we perform the diagnostic tests to check whether the model is well specified. The test for serial correlation is done using the Wooldridge test for autocorrelation in panel data (xtserial) which shows a p-value of 0.097 suggesting that the null hypothesis of no autocorrelation may be rejected at the 5% confidence level. However, since the null hypothesis cannot be rejected at the 10% confidence level, we transform the Equation 5.2 into a dynamic model by including the lagged dependent variable among the explanatory variables and using the General Method of Moments as estimator (Appendix 3.7). The lagged dependent variable in this estimation is insignificant, thus not providing evidence that our regression should be estimated with a dynamic model. The test for normality is conducted using the Stata command pantest2, which rejected the null hypothesis of normality in the residuals. However, the histogram of the residuals shows that the residuals are quite normally distributed (Appendix 3.7). Next, we test for heteroscedasticity by using the Stata command xttest3, which rejects the null hypothesis of homoscedastic variance (Appendix 3.7). In order to overcome the problem of heteroscedasticity, we run the regression using robust standard errors. Given the large number of groups in our sample we expect robust standard errors to be larger than the default standard errors, thus reflecting the loss of information because of the clustering. This is confirmed by our results; hence, we adopt the conservative approach to inference, by using robust standard errors to estimate the first stage of our FEVD model.

```
xtreg prov_loans  h_stat1 Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans rgdpgrowth
gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1  propertyrights_hrt   dv_foreign  dv_origin
dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo, fe robust
note: dv_bos omitted because of collinearity
note: dv_bul omitted because of collinearity
note: dv_cro omitted because of collinearity
note: dv_cze omitted because of collinearity
note: dv_est omitted because of collinearity
note: dv_hun omitted because of collinearity
note: dv_lat omitted because of collinearity
note: dv_lit omitted because of collinearity
note: dv_mac omitted because of collinearity
note: dv_pol omitted because of collinearity
note: dv_rom omitted because of collinearity
note: dv_ser omitted because of collinearity
note: dv_svk omitted because of collinearity
note: dv_slo omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      1497
Group variable: bank                            Number of groups   =       292

R-sq:  within  = 0.1766                         Obs per group: min =         1
       between = 0.0019                                        avg =       5.1
       overall = 0.0073                                        max =        10

                                                F(22,291)          =      7.27
corr(u_i, Xb)  = -0.9029                        Prob > F           =    0.0000

                                 (Std. Err. adjusted for 292 clusters in bank)
------------------------------------------------------------------------------
             |               Robust
  prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     h_stat1 |  -.0957351   .0701747    -1.36   0.174    -.2338493    .0423791
Lagnoninti~a |    .016104   .0317533     0.51   0.612    -.0463913    .0785992
Lagequity_ta |  -.0105925   .0337213    -0.31   0.754    -.0769611    .0557761
      Lagnim |  -.0757136   .0555341    -1.36   0.174    -.1850129    .0335857
        logta |  -.7197035   .3214137    -2.24   0.026    -1.352294   -.0871132
Laggr~_loans |    .003557   .0026119     1.36   0.174    -.0015837    .0086976
  rgdpgrowth |  -.2315257   .0389193    -5.95   0.000    -.3081247   -.1549266
  gdp_percap |  -.0000895   .0001217    -0.74   0.463    -.0003289      .00015
    cpi_ebrd |  -.0060324   .0312622    -0.19   0.847    -.0675611    .0554964
logexch_rate |  -1.739592   1.784952    -0.97   0.331    -5.252644    1.773459
ebrd_bankr~1 |  -.5000553    .641906    -0.78   0.437    -1.763422    .7633117
propertyri~t |   -.051843   .0197138    -2.63   0.009    -.0906427   -.0130433
  dv_foreign |   .1873066     .36604     0.51   0.609    -.5331148    .9077281
   dv_origin |   .3416529   .4678841     0.73   0.466     -.579213    1.262519
     dv_2002 |    1.03645   .5085984     2.04   0.042     .0354518    2.037447
     dv_2003 |   .9343079    .544793     1.71   0.087    -.1379262    2.006542
     dv_2004 |   .8765537   .6856701     1.28   0.202    -.4729477    2.226055
     dv_2005 |   1.023502   .7586778     1.35   0.178    -.4696897    2.516693
     dv_2006 |   1.280578   .8920514     1.44   0.152    -.4751129    3.036268
     dv_2007 |     1.8616   1.204023     1.55   0.123    -.5080975    4.231298
     dv_2008 |   1.692532   1.313413     1.29   0.199    -.8924618    4.277526
     dv_2009 |    .947666   1.194254     0.79   0.428    -1.402805    3.298137
      dv_bos |  (omitted)
      dv_bul |  (omitted)
      dv_cro |  (omitted)
      dv_cze |  (omitted)
      dv_est |  (omitted)
      dv_hun |  (omitted)
      dv_lat |  (omitted)
      dv_lit |  (omitted)
      dv_mac |  (omitted)
      dv_pol |  (omitted)
      dv_rom |  (omitted)
```

```
     dv_ser |  (omitted)
     dv_svk |  (omitted)
     dv_slo |  (omitted)
      _cons |   18.42042   6.274419     2.94   0.004     6.071427    30.76942
-------------+----------------------------------------------------------------
     sigma_u |  4.1905099
     sigma_e |  1.9630469
         rho |  .82004454   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

After the estimation of the regression, we predict the fixed effects vector, which is going to be used in the second stage of the regression.

```
. predict fixed_effects, u
(1429 missing values generated)
```

Second stage: Regress the FE vector on the time-invariant and slowly-moving variables and predict the residuals

In the second stage, the fixed effects vector is regressed on the time-invariant and the “rarely changing” explanatory variables, which in our case are the country dummies and the variables propertyrights_hrt, dv_origin, and exch_rate. The regression is estimated using Ordinary Least Squares (OLS).

```
reg fixed_effects propertyrights_hrt dv_origin logexch_rate dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo

      Source |       SS       df       MS              Number of obs =    1497
-------------+------------------------------           F( 17,  1479) =  478.89
       Model |   18655.394    17  1097.37612           Prob > F      =  0.0000
    Residual |  3389.09644  1479  2.29147833           R-squared     =  0.8463
-------------+------------------------------           Adj R-squared =  0.8445
       Total |  22044.4904  1496  14.7356219           Root MSE      =  1.5138

------------------------------------------------------------------------------
fixed_effe~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
propertyri~t |  -.0075089   .0092238    -0.81   0.416    -.0256019    .0105842
   dv_origin |  -.0734024   .0839788    -0.87   0.382    -.2381326    .0913278
logexch_rate |  -2.124775    .639714    -3.32   0.001    -3.379618   -.8699317
      dv_bos |  -17.20845   2.662836    -6.46   0.000    -22.43179   -11.98512
      dv_bul |   -15.9186    2.68871    -5.92   0.000    -21.19269   -10.64451
      dv_cro |  -10.83444   1.840133    -5.89   0.000    -14.44399   -7.224893
      dv_cze |  -1.795849   1.104988    -1.63   0.104    -3.963359    .3716619
      dv_est |  -4.387706   1.523541    -2.88   0.004    -7.376236   -1.399175
      dv_hun |   6.845226   .6263479    10.93   0.000     5.616601    8.073851
      dv_lat |  -18.01964   3.386324    -5.32   0.000    -24.66215   -11.37713
      dv_lit |  -12.22211   2.361795    -5.17   0.000    -16.85493   -7.589283
      dv_mac |  -2.878854   .5772006    -4.99   0.000    -4.011072   -1.746635
      dv_pol |  -10.55254   2.266646    -4.66   0.000    -14.99872   -6.106356
      dv_rom |  -12.50347   2.280155    -5.48   0.000    -16.97616   -8.030792
      dv_ser |   2.050643   .4803693     4.27   0.000     1.108365     2.99292
      dv_svk |  -15.59856   3.028052    -5.15   0.000    -21.53829   -9.658826
      dv_slo |  -15.11279   3.151095    -4.80   0.000    -21.29388     -8.9317
       _cons |   14.28645   3.074752     4.65   0.000     8.255113    20.31779
------------------------------------------------------------------------------
```

After running the regression, we predict the residuals which are included among the explanatory variables in the third stage of the FEVD model.

```
. predict resid_stage2, residuals
(1429 missing values generated)
```

Third stage: Estimate the regression using the pooled OLS method and including the residuals estimated in the second stage (*resid_stage2*) among the regressors

In the third stage, which is the final step of the FEVD model, the regression is estimated by pooled OLS and includes all the time-variant and time-invariant variables, and also the *residuals* from the second stage among the explanatory variables.

```
reg prov_loans  h_stat1 Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans rgdpgrowth
gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1  propertyrights_hrt   dv_foreign  dv_origin
dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo resid_stage2, robust

Linear regression                                      Number of obs =    1497
                                                       F( 37,  1459) =   15.35
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.4758
                                                       Root MSE      =  1.7676

------------------------------------------------------------------------------
             |               Robust
  prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     h_stat1 |  -.0957351   .0507224    -1.89   0.059    -.1952317    .0037615
Lagnoninti~a |    .016104   .0168365     0.96   0.339    -.0169224    .0491303
Lagequity_ta |  -.0105925   .0088097    -1.20   0.229    -.0278735    .0066885
      Lagnim |  -.0757136   .0353142    -2.14   0.032    -.1449856   -.0064416
       logta |  -.7197035   .1281544    -5.62   0.000      -.97109    -.468317
Laggr~_loans |    .003557   .0016322     2.18   0.029     .0003553    .0067587
  rgdpgrowth |  -.2315257   .0298947    -7.74   0.000    -.2901669   -.1728845
  gdp_percap |  -.0000895   .0000825    -1.08   0.278    -.0002513    .0000723
    cpi_ebrd |  -.0060324   .0234459    -0.26   0.797    -.0520236    .0399589
logexch_rate |  -3.864367   1.347682    -2.87   0.004    -6.507968   -1.220767
ebrd_bankr~1 |  -.5000553   .4527366    -1.10   0.270    -1.388139    .3880288
propertyri~t |  -.0593519   .0157922    -3.76   0.000    -.0903298    -.028374
  dv_foreign |   .1873066   .1299717     1.44   0.150    -.0676447    .4422579
   dv_origin |   .2682505   .1394815     1.92   0.055    -.0053553    .5418563
     dv_2002 |    1.03645   .4550925     2.28   0.023     .1437441    1.929155
     dv_2003 |    .934308   .3703099     2.52   0.012     .2079114    1.660705
     dv_2004 |   .8765538    .498295     1.76   0.079    -.1008974    1.854005
     dv_2005 |   1.023502    .561447     1.82   0.069    -.0778277    2.124831
     dv_2006 |   1.280578   .6355482     2.01   0.044      .033892    2.527263
     dv_2007 |     1.8616    .874087     2.13   0.033     .1469986    3.576202
     dv_2008 |   1.692532   .9010555     1.88   0.061    -.0749702    3.460035
     dv_2009 |   .9476661   .8508842     1.11   0.266     -.721421    2.616753
      dv_bos |  -17.20845   5.329429    -3.23   0.001    -27.66261   -6.754291
      dv_bul |   -15.9186   5.373854    -2.96   0.003    -26.45991   -5.377297
      dv_cro |  -10.83444   3.257707    -3.33   0.001    -17.22473   -4.444151
      dv_cze |  -1.795849   1.611697    -1.11   0.265    -4.957339    1.365642
      dv_est |  -4.387706   2.545991    -1.72   0.085    -9.381899    .6064872
      dv_hun |   6.845226   1.868469     3.66   0.000     3.180054     10.5104
      dv_lat |  -18.01964   6.639146    -2.71   0.007    -31.04293   -4.996346
      dv_lit |  -12.22211   4.468503    -2.74   0.006    -20.98748   -3.456731
      dv_mac |  -2.878854   .9664294    -2.98   0.003    -4.774593    -.983114
      dv_pol |  -10.55254   4.200733    -2.51   0.012    -18.79266   -2.312417
```

```
      dv_rom |  -12.50347   4.440428    -2.82   0.005    -21.21378   -3.793169
      dv_ser |   2.050643   .8927914     2.30   0.022     .2993508    3.801935
      dv_svk |  -15.59856     5.6752    -2.75   0.006    -26.73098   -4.466136
      dv_slo |  -15.11279   5.519958    -2.74   0.006    -25.94069   -4.284889
resid_stage2 |          1   .1260932     7.93   0.000     .7526567    1.247343
       _cons |   32.70687   6.688868     4.89   0.000     19.58605     45.8277
------------------------------------------------------------------------------
```

Appendix 3.9 Diagnostic tests for the third stage of the FEVD regression

After running the third stage regression, we perform the diagnostic tests applicable to OLS estimation to check whether the model is well specified. The test results suggest that the model suffers from heteroscedasticity; hence, the final model is estimated using robust standard errors. The diagnostic test for linearity (*estat ovtest*) displays evidence of a non-linear relationship among the variables, but no solution could be found to this problem. However, looking at the scatter plots for the relationship between the dependent variable and each of the explanatory variables, no non-linear relationship could be observed; hence, we maintain the linear functional form for our model.

```
reg prov_loans  h_stat1 Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans rgdpgrowth
gdp_percap cpi_ebrd logexch_rate ebrd_bankref1 propertyrights_hrt  dv_foreign dv_origin
dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo resid_stage2

      Source |       SS       df       MS              Number of obs =    1497
-------------+------------------------------           F( 37,  1459) =   35.80
       Model |  4138.63344    37  111.854958           Prob > F      =  0.0000
    Residual |  4558.75329  1459  3.12457388           R-squared     =  0.4758
-------------+------------------------------           Adj R-squared =  0.4626
       Total |  8697.38674  1496  5.81376119           Root MSE      =  1.7676

------------------------------------------------------------------------------
  prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     h_stat1 |  -.0957351   .0362469    -2.64   0.008    -.1668367   -.0246335
Lagnoninti~a |    .016104   .0165044     0.98   0.329     -.016271    .0484789
Lagequity_ta |  -.0105925   .0066568    -1.59   0.112    -.0236504    .0024653
      Lagnim |  -.0757136   .0202658    -3.74   0.000    -.1154669   -.0359603
       logta |  -.7197035   .0474266   -15.18   0.000    -.8127352   -.6266719
Laggr~_loans |    .003557   .0009736     3.65   0.000     .0016472    .0054667
  rgdpgrowth |  -.2315257   .0194021   -11.93   0.000    -.2695847   -.1934666
  gdp_percap |  -.0000895   .0000515    -1.74   0.083    -.0001905    .0000116
    cpi_ebrd |  -.0060324   .0214261    -0.28   0.778    -.0480616    .0359968
logexch_rate |  -3.864367   .9529216    -4.06   0.000     -5.73361   -1.995125
ebrd_bankr~1 |  -.5000553    .449215    -1.11   0.266    -1.381232     .381121
propertyri~t |  -.0593519   .0139599    -4.25   0.000    -.0867355   -.0319683
  dv_foreign |   .1873066   .1451511     1.29   0.197    -.0974205    .4720337
   dv_origin |   .2682505   .1408628     1.90   0.057    -.0080647    .5445657
     dv_2002 |    1.03645   .4313997     2.40   0.016     .1902197    1.882679
     dv_2003 |    .934308   .4280355     2.18   0.029     .0946773    1.773939
     dv_2004 |   .8765538   .4874395     1.80   0.072    -.0796033    1.832711
     dv_2005 |   1.023502   .5284927     1.94   0.053     -.013185    2.060189
     dv_2006 |   1.280578   .5570977     2.30   0.022     .1877797    2.373376
     dv_2007 |     1.8616   .6414654     2.90   0.004     .6033073    3.119893
```

```
     dv_2008 |   1.692532    .720753     2.35   0.019     .2787096    3.106355
     dv_2009 |   .9476661   .7209764     1.31   0.189    -.4665949    2.361927
      dv_bos |  -17.20845   3.892661    -4.42   0.000    -24.84426   -9.572644
      dv_bul |   -15.9186   3.968528    -4.01   0.000    -23.70323   -8.133972
      dv_cro |  -10.83444   2.572701    -4.21   0.000    -15.88103   -5.787854
      dv_cze |  -1.795849   1.592947    -1.13   0.260     -4.92056    1.328863
      dv_est |  -4.387706   2.200416    -1.99   0.046    -8.704023   -.0713882
      dv_hun |   6.845226   1.203786     5.69   0.000      4.48389    9.206562
      dv_lat |  -18.01964   4.957617    -3.63   0.000    -27.74446   -8.294821
      dv_lit |  -12.22211   3.408776    -3.59   0.000    -18.90873   -5.535482
      dv_mac |  -2.878854   .8015581    -3.59   0.000    -4.451183   -1.306524
      dv_pol |  -10.55254   3.277951    -3.22   0.001    -16.98254   -4.122539
      dv_rom |  -12.50347   3.342882    -3.74   0.000    -19.06084   -5.946106
      dv_ser |   2.050643   .6848369     2.99   0.003     .7072726    3.394013
      dv_svk |  -15.59856   4.324928    -3.61   0.000     -24.0823   -7.114819
      dv_slo |  -15.11279   4.382221    -3.45   0.001    -23.70892   -6.516664
resid_stage2 |          1    .038621    25.89   0.000     .9242414    1.075759
       _cons |   32.70687   4.706843     6.95   0.000     23.47397    41.93978
------------------------------------------------------------------------------
```

Test for heteroscedasticity:

Note: because the below test rejected the null hypothesis of no heteroscedasticity, the third stage of the FEVD regression was run with robust standard errors.

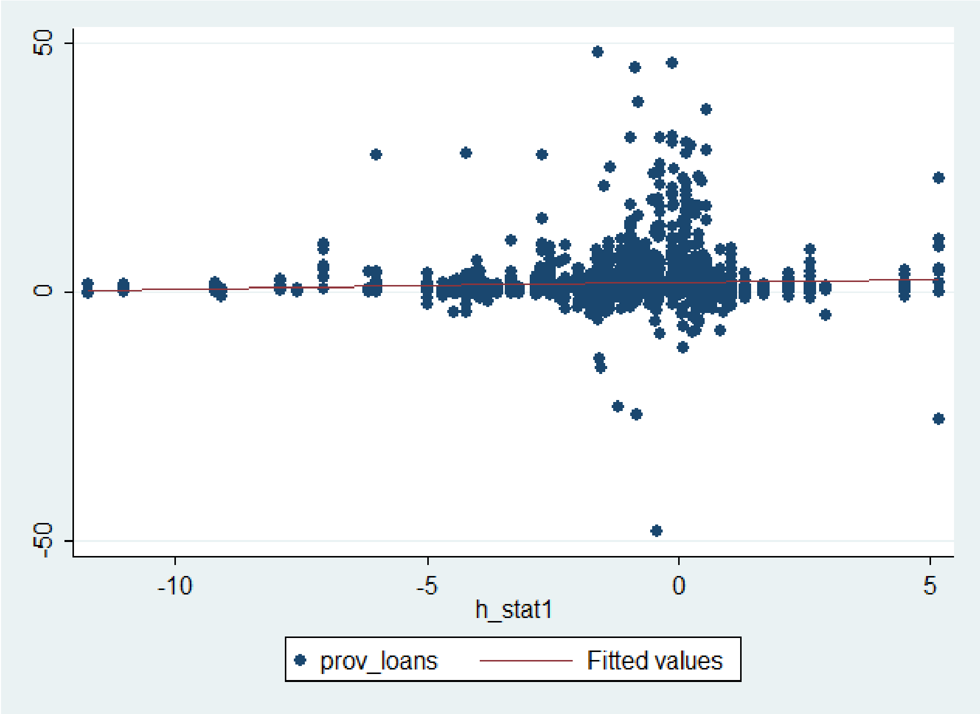
```
estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of prov_loans

         chi2(1)      =  3770.72
         Prob > chi2  =   0.0000
```

Test for linearity:

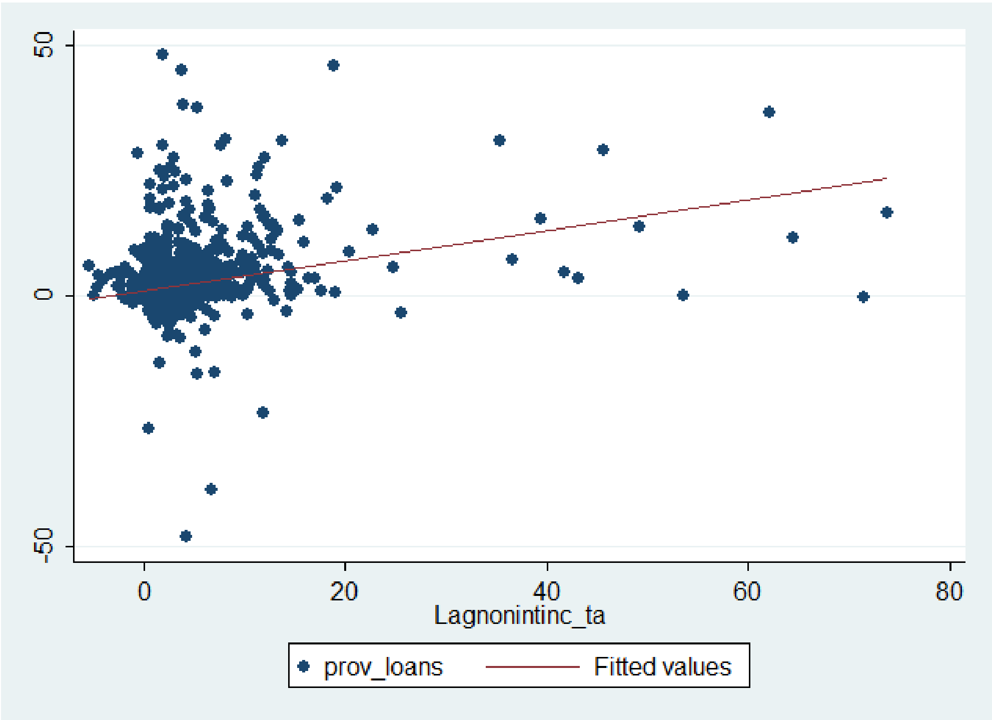
```
estat ovtest

Ramsey RESET test using powers of the fitted values of prov_loans
       Ho:  model has no omitted variables
                F(3, 1456) =     19.43
                  Prob > F =      0.0000
```

Scatter graphs for the relationship between the dependent variable and each of the explanatory variables:

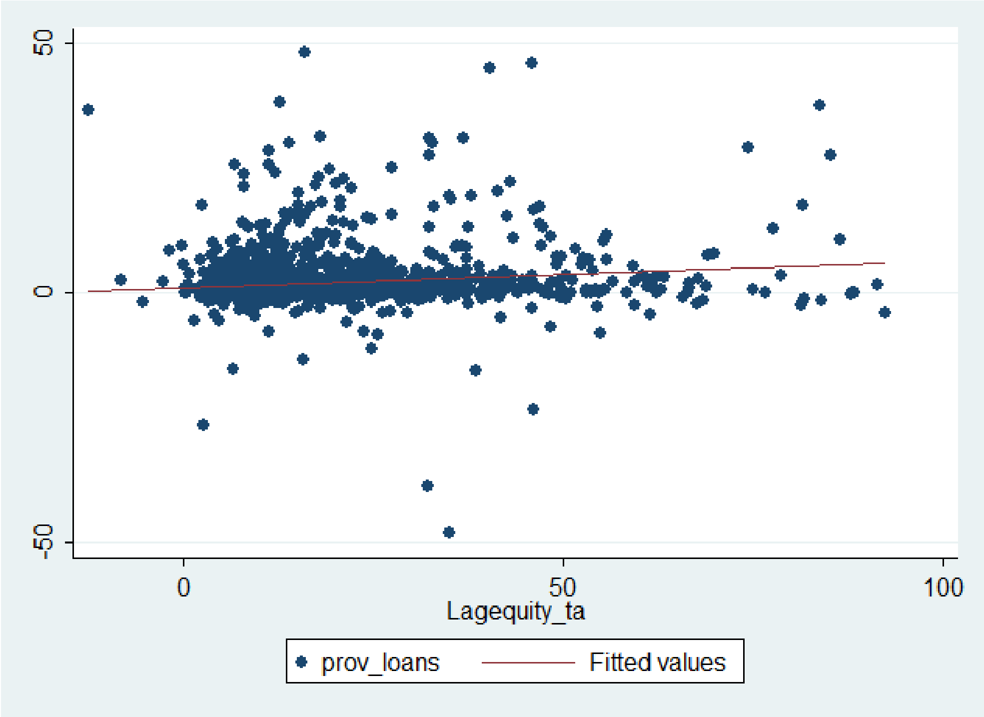
```
twoway (scatter prov_loans h_stat1) (lfit prov_loans h_stat1)
```



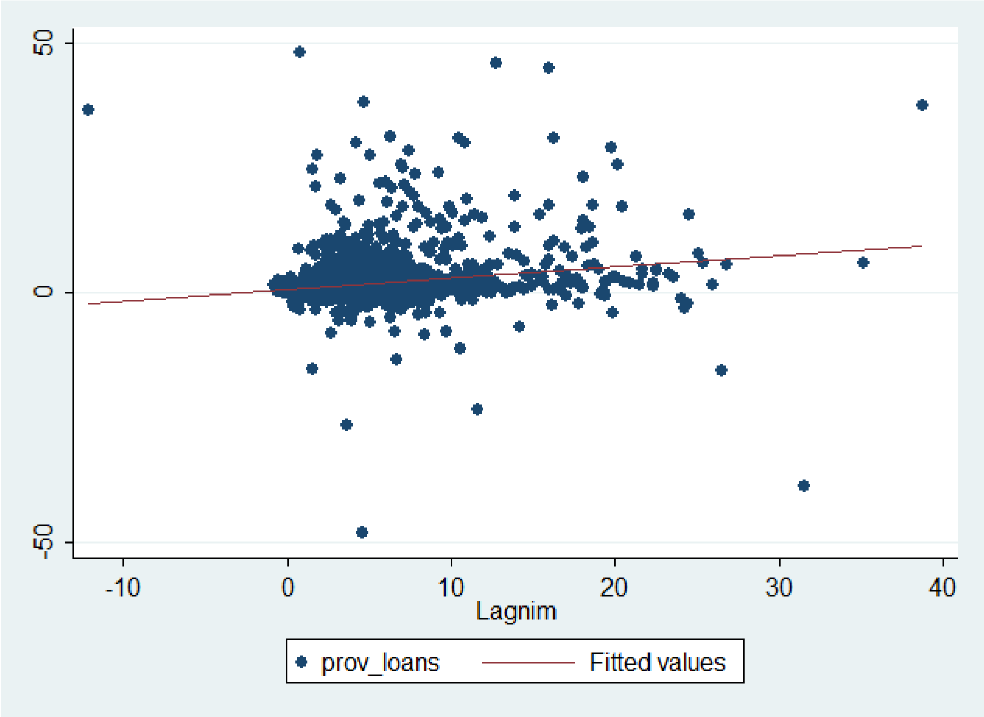
twoway (scatter prov_loans Lagnonintinc_ta) (lfit prov_loans Lagnonintinc_ta)



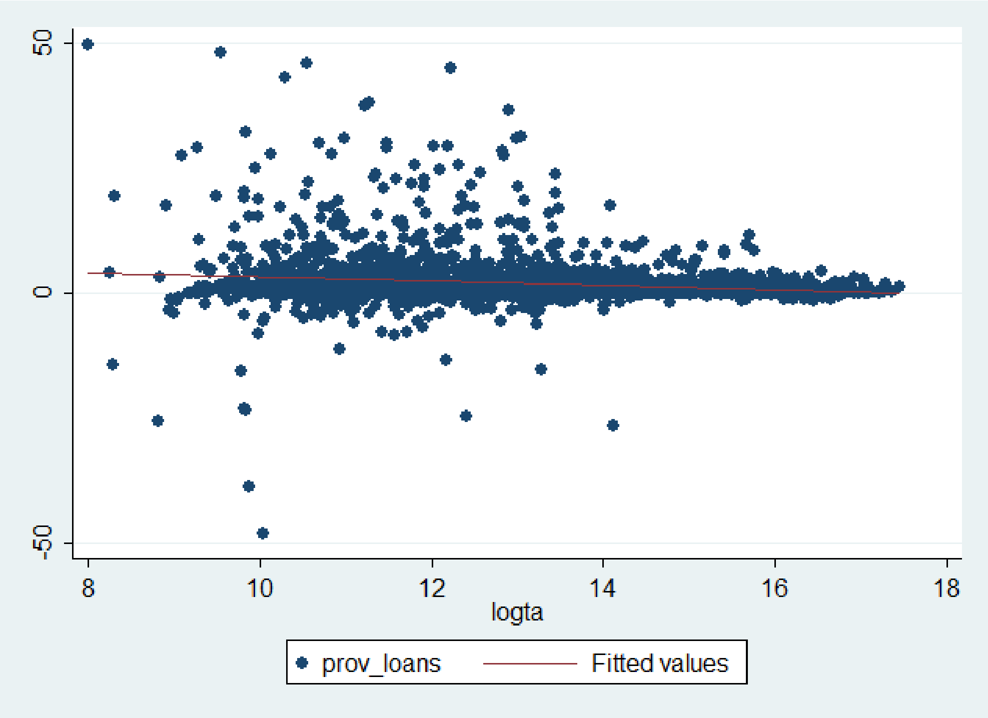
twoway (scatter prov_loans Lagequity_ta) (lfit prov_loans Lagequity_ta)



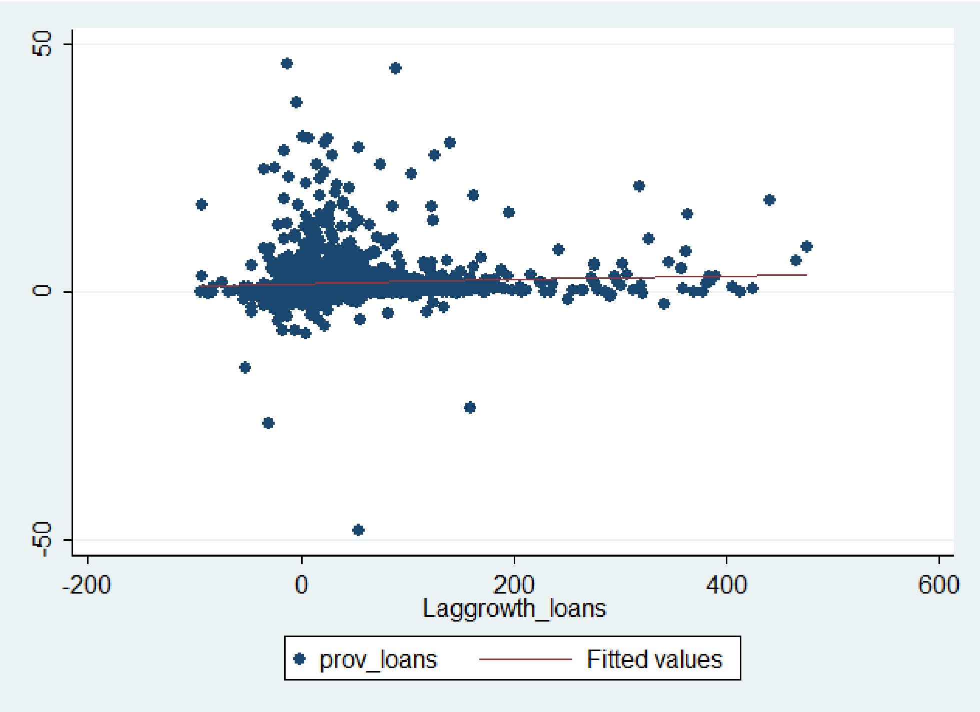
twoway (scatter prov_loans Lagnim) (lfit prov_loans Lagnim)



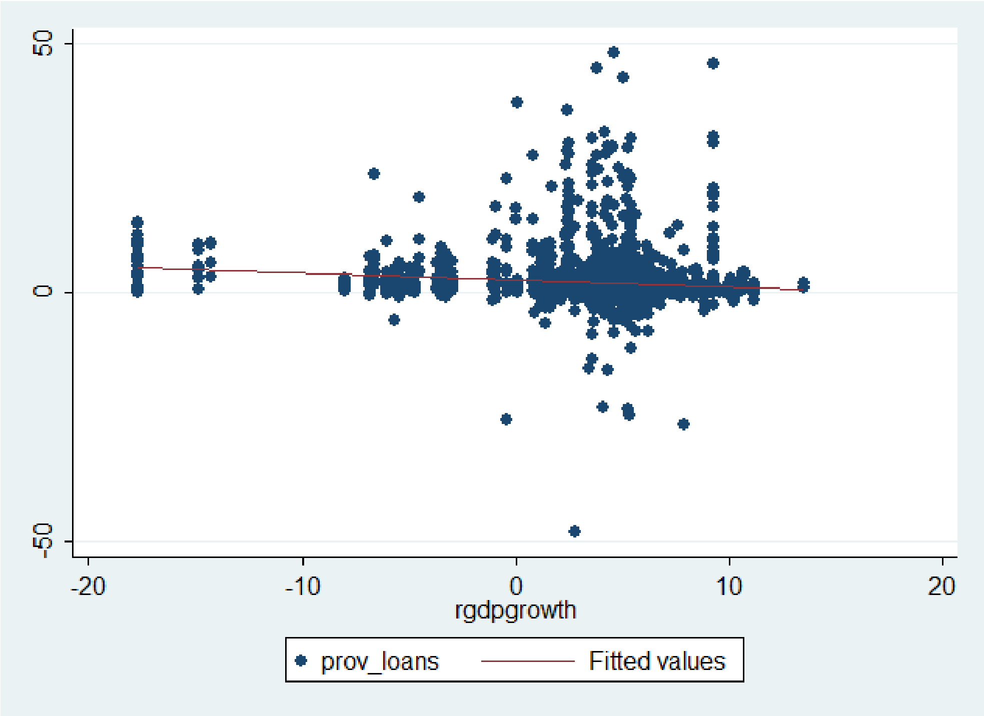
twoway (scatter prov_loans logta) (lfit prov_loans logta)



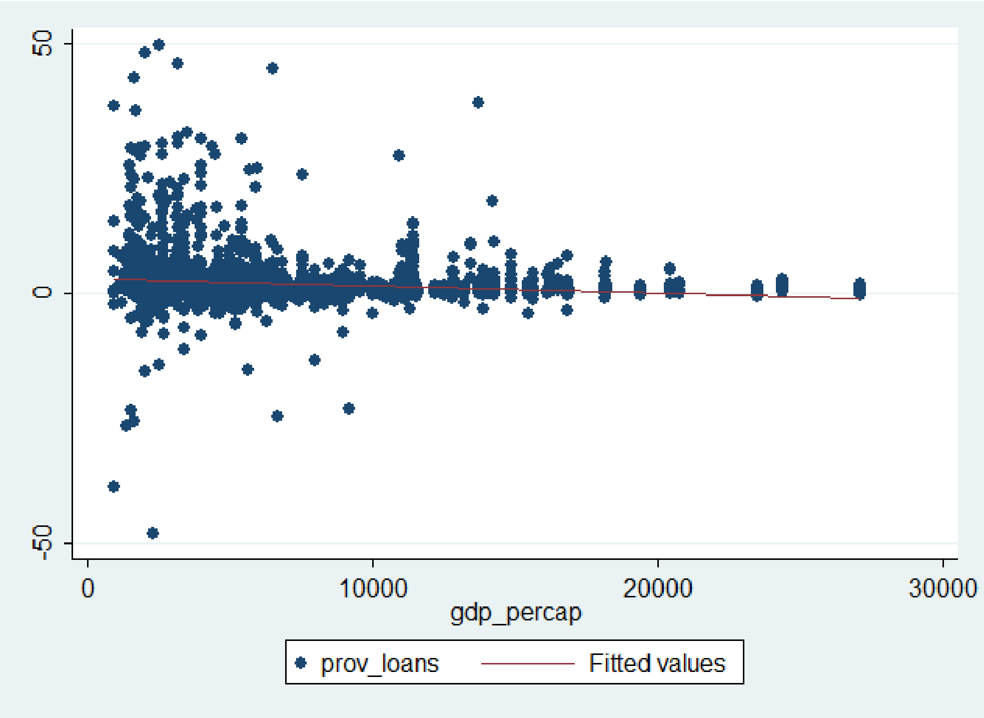
twoway (scatter prov_loans Laggrowth_loans) (lfit prov_loans Laggrowth_loans)



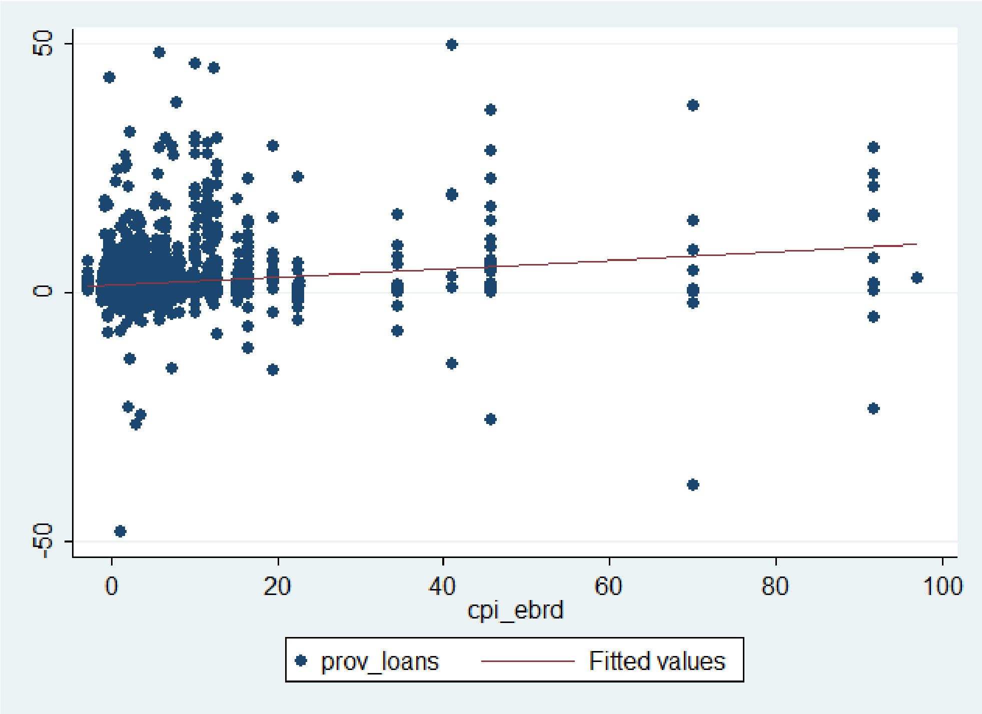
twoway (scatter prov_loans rgdpgrowth) (lfit prov_loans rgdpgrowth)



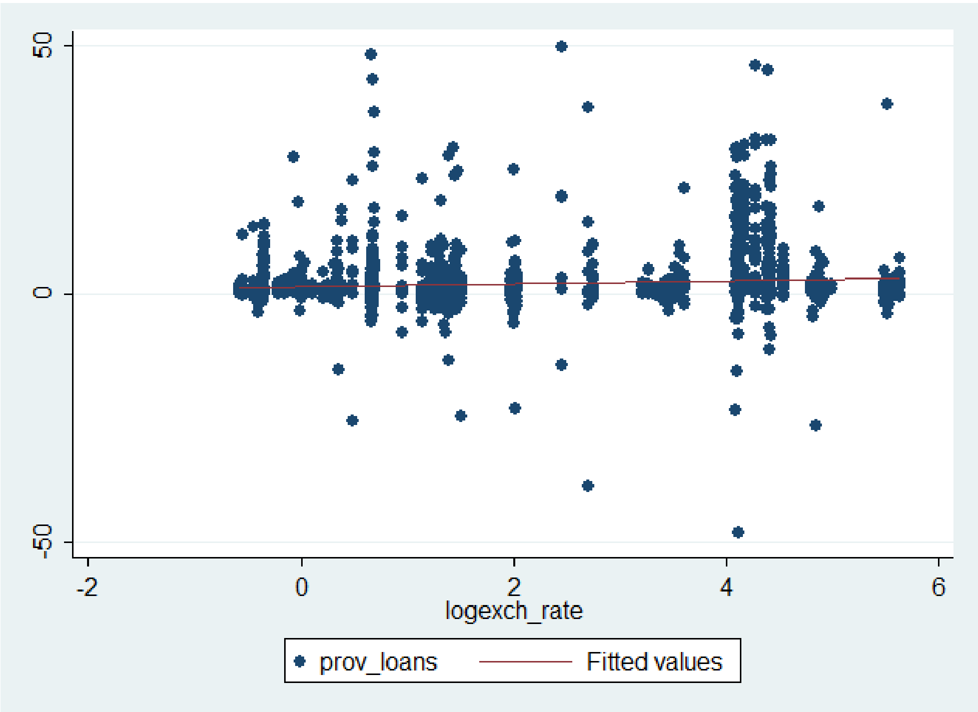
twoway (scatter prov_loans gdp_percap) (lfit prov_loans gdp_percap)



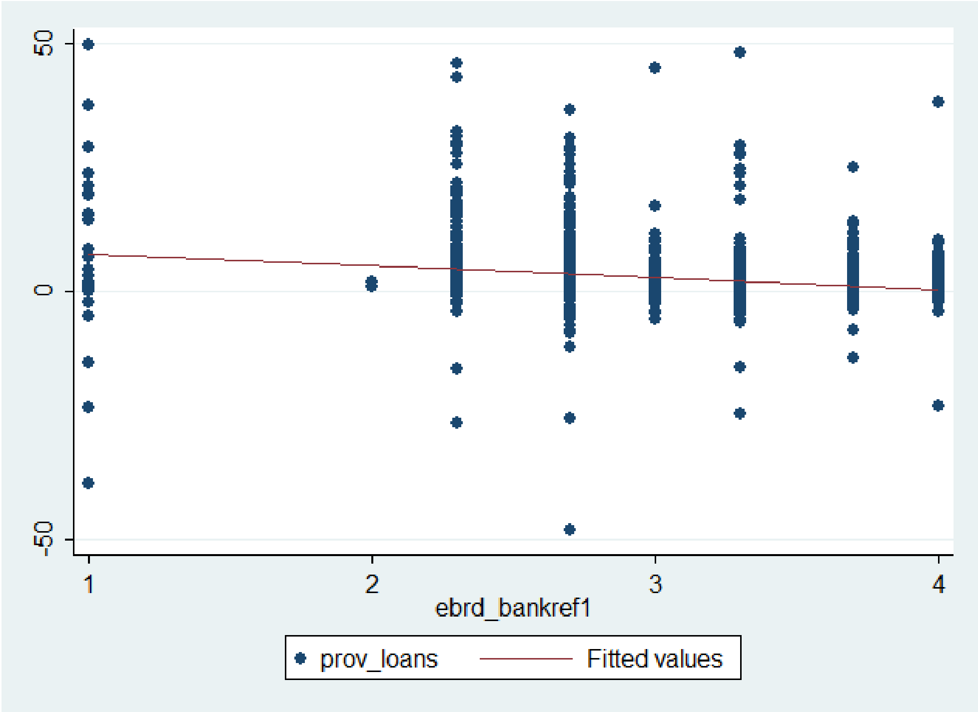
twoway (scatter prov_loans cpi_ebrd) (lfit prov_loans cpi_ebrd)



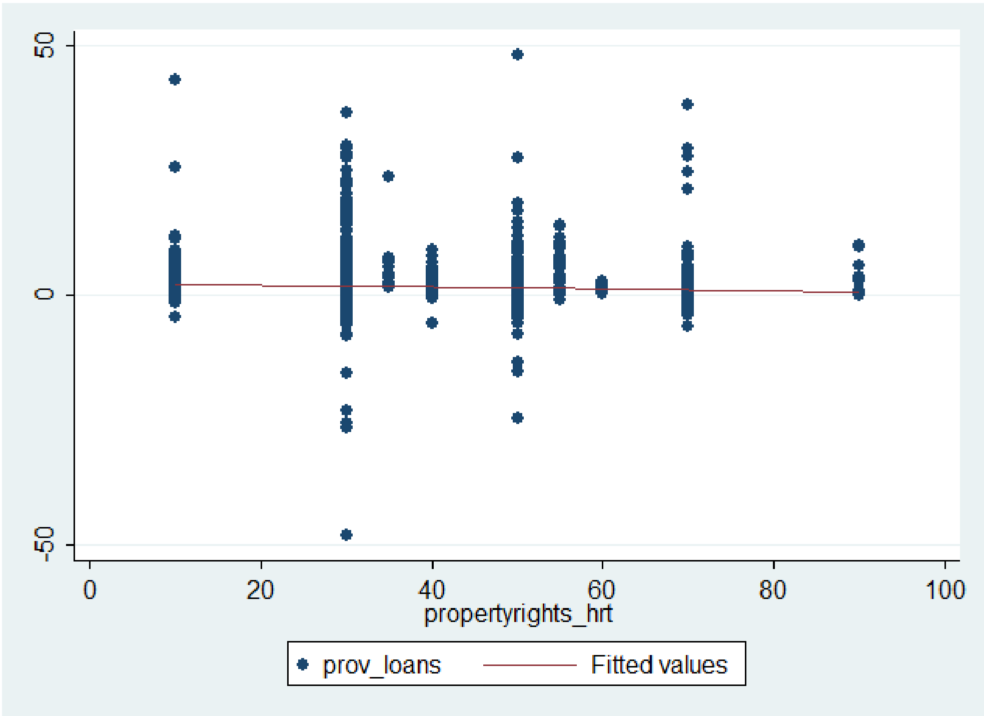

```
twoway (scatter prov_loans logexch_rate) (lfit prov_loans logexch_rate)
```




```
twoway (scatter prov_loans ebrd_bankref1) (lfit prov_loans ebrd_bankref1)
```




```
twoway (scatter prov_loans propertyrights_hrt) (lfit prov_loans propertyrights_hrt)
```



Appendix 3.10 Estimation of the impact of banking competition on risk-taking using FEVD: the *XTFEVD* approach

Note: The *xtfevd* approach is a STATA *ado file* provided by Plümper and Troeger (2004) which executes all the three stages of the FEVD and adjusts the degrees of freedom. The tables below present the STATA outputs for the five model specifications that were presented in Table 5.4.

Specification 1

Note: uses the *h_stat1* (i.e. the H-statistic estimated by using the interest income as dependent variable in the Panzar-Rosse model)

```
xtfevd prov_loans h_stat1 Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans rgdpgrowth
gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1  propertyrights_hrt  dv_foreign  dv_origin
dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est  dv_hun  dv_lat  dv_lit  dv_mac  dv_pol  dv_rom  dv_ser  dv_svk  dv_slo,  invariant
(propertyrights_hrt dv_origin logexch_rate dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo)
```

```
panel fixed effects regression with vector decomposition

degrees of freedom fevd    =      1169          number of obs       =      1497
mean squared error         = 3.045259          F( 38, 1169)        = 8.362461
root mean squared error    = 1.745067          Prob > F            = 5.93e-38
Residual Sum of Squares    = 4558.753          R-squared           = .4758479
Total Sum of Squares       = 8697.387          adj. R-squared      = .3292288
Estimation Sum of Squares  = 4138.633

------------------------------------------------------------------------------
             |                fevd
  prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     h_stat1 |  -.0957351   .0501941    -1.91   0.057    -.1942156    .0027455
Lagnoninti~a |    .016104   .0259122     0.62   0.534    -.0347357    .0669437
Lagequity_ta |  -.0105925   .0240948    -0.44   0.660    -.0578663    .0366813
      Lagnim |  -.0757136   .0689996    -1.10   0.273    -.2110905    .0596634
       logta |  -.7197035   .2473585    -2.91   0.004     -1.20502   -.2343874
Laggr~_loans |    .003557   .0015579     2.28   0.023     .0005004    .0066136
  rgdpgrowth |  -.2315257   .0267588    -8.65   0.000    -.2840263    -.179025
  gdp_percap |  -.0000895   .0000838    -1.07   0.286    -.0002539     .000075
    cpi_ebrd |  -.0060324   .0433614    -0.14   0.889    -.0911072    .0790424
ebrd_bankr~1 |  -.5000553    .694771    -0.72   0.472    -1.863193    .8630822
  dv_foreign |   .1873066   .7048409     0.27   0.790    -1.195588    1.570201
     dv_2002 |    1.03645   1.182017     0.88   0.381    -1.282662    3.355561
     dv_2003 |    .934308   1.152827     0.81   0.418    -1.327534     3.19615
     dv_2004 |   .8765538   1.169892     0.75   0.454     -1.41877    3.171877
     dv_2005 |   1.023502   1.195846     0.86   0.392    -1.322742    3.369746
     dv_2006 |   1.280578   1.232276     1.04   0.299    -1.137142    3.698298
     dv_2007 |     1.8616   1.330206     1.40   0.162    -.7482571    4.471457
     dv_2008 |   1.692532   1.445699     1.17   0.242    -1.143923    4.528988
     dv_2009 |   .9476661   1.405023     0.67   0.500    -1.808982    3.704315
propertyri~t |  -.0593519   .0209007    -2.84   0.005    -.1003589   -.0183448
   dv_origin |   .2682505   .6081573     0.44   0.659    -.9249513    1.461452
logexch_rate |  -3.864367   1.529711    -2.53   0.012    -6.865654   -.8630808
      dv_bos |  -17.20845   6.256004    -2.75   0.006     -29.4827   -4.934201
      dv_bul |   -15.9186   6.366891    -2.50   0.013    -28.41041   -3.426792
      dv_cro |  -10.83444   4.065071    -2.67   0.008    -18.81009   -2.858791
      dv_cze |  -1.795849   2.560747    -0.70   0.483    -6.820023    3.228326
      dv_est |  -4.387706   3.539408    -1.24   0.215    -11.33201    2.556596
```

```
     dv_hun |   6.845226   2.048251     3.34   0.001     2.826567    10.86388
     dv_lat |  -18.01964   7.962693    -2.26   0.024     -33.6424   -2.396872
     dv_lit |  -12.22211    5.45252    -2.24   0.025    -22.91993   -1.524288
     dv_mac |  -2.878854   1.448984    -1.99   0.047    -5.721752   -.0359546
     dv_pol |  -10.55254   5.215643    -2.02   0.043    -20.78561   -.3194702
     dv_rom |  -12.50347     5.3767    -2.33   0.020    -23.05253   -1.954414
     dv_ser |   2.050643   1.253733     1.64   0.102    -.4091766    4.510462
     dv_svk |  -15.59856   6.920776    -2.25   0.024    -29.17709   -2.020029
     dv_slo |  -15.11279   6.985738    -2.16   0.031    -28.81878   -1.406804
        eta |          1          .        .       .            .           .
      _cons |   32.70687    8.78207     3.72   0.000     15.47649    49.93725
------------------------------------------------------------------------------
```

Specification 2

Note: includes the interaction term between the competition (*h_stat1*) and the dummy variable for the non-EU countries (*dv_noneu*=1), i.e. the variable *hstat1_dvnoneu*, to check if the relationship between banking sector competition and risk-taking in the non-EU countries differs from the EU countries.

```
xtfevd  prov_loans  h_stat1  hstat1_dvnoneu  Lagnonintinc_ta  Lagequity_ta  Lagnim  logta
Laggrowth_loans rgdpgrowth gdp_percap cpi_ebrd logexch_rate ebrd_bankref1 propertyrights_hrt
dv_foreign dv_origin dv_noneu dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk
dv_slo, invariant (propertyrights_hrt dv_origin logexch_rate dv_noneu dv_bos dv_bul dv_cro
dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo)
       note: dv_hun dropped because of collinearity

       panel fixed effects regression with vector decomposition

       degrees of freedom fevd    =      1168          number of obs       =      1497
       mean squared error         = 2.998285          F( 39, 1168)        = 8.525002
       root mean squared error    = 1.731556          Prob > F            = 1.02e-39
       Residual Sum of Squares    = 4488.433          R-squared           = .4839332
       Total Sum of Squares       = 8697.387          adj. R-squared      = .3390103
       Estimation Sum of Squares  = 4208.954

       ------------------------------------------------------------------------------
                    |                 fevd
         prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
       -------------+----------------------------------------------------------------
            h_stat1 |  -.1826013   .0570902    -3.20   0.001    -.2946122   -.0705904
       hstat1_dvn~u |   .5010093   .1452572     3.45   0.001     .2160152    .7860035
       Lagnoninti~a |   .0163956   .0259656     0.63   0.528    -.0345489    .0673401
       Lagequity_ta |  -.0118712   .0242353    -0.49   0.624    -.0594209    .0356784
             Lagnim |   -.078207   .0693873    -1.13   0.260    -.2143446    .0579306
              logta |  -.7716803   .2472087    -3.12   0.002    -1.256703   -.2866575
       Laggr~_loans |   .0032308    .001565     2.06   0.039     .0001603    .0063013
         rgdpgrowth |   -.235163   .0268336    -8.76   0.000    -.2878104   -.1825156
         gdp_percap |  -.0001204    .000085    -1.42   0.157    -.0002872    .0000463
           cpi_ebrd |  -.0051858   .0435845    -0.12   0.905    -.0906984    .0803269
       ebrd_bankr~1 |  -.8019777   .7014031    -1.14   0.253    -2.178129    .5741731
         dv_foreign |   .2565852   .7109609     0.36   0.718    -1.138318    1.651488
            dv_2002 |   1.459536   1.223549     1.19   0.233    -.9410633    3.860136
            dv_2003 |   1.451596   1.203442     1.21   0.228    -.9095534    3.812746
            dv_2004 |   1.429097   1.225116     1.17   0.244    -.9745757    3.832771
            dv_2005 |   1.823094   1.273977     1.43   0.153    -.6764452    4.322632
            dv_2006 |   2.152529   1.315621     1.64   0.102    -.4287161    4.733775
            dv_2007 |   2.914062   1.429882     2.04   0.042      .108638    5.719486
            dv_2008 |   2.731548   1.542441     1.77   0.077    -.2947176    5.757814
            dv_2009 |   1.797524   1.475626     1.22   0.223    -1.097651    4.692698
       propertyri~t |   -.050926   .0211452    -2.41   0.016    -.0924127   -.0094392
          dv_origin |   .2864087   .6128719     0.47   0.640    -.9160443    1.488862
       logexch_rate |  -3.221695   1.566792    -2.06   0.040    -6.295736   -.1476547
           dv_noneu |  -7.194507   2.055818    -3.50   0.000    -11.22802   -3.160997
             dv_bos |  -13.61251   6.480971    -2.10   0.036    -26.32815   -.8968615
             dv_bul |   -19.7281   7.761689    -2.54   0.011    -34.95651   -4.499686
             dv_cro |  -6.518114   4.407869    -1.48   0.139    -15.16634    2.130112
             dv_cze |  -7.100724   3.364177    -2.11   0.035    -13.70123   -.5002189
             dv_est |  -9.991139   4.465254    -2.24   0.025    -18.75196   -1.230323
             dv_lat |  -21.11098    9.35607    -2.26   0.024    -39.46756   -2.754395
             dv_lit |   -16.8286   6.742646    -2.50   0.013    -30.05765    -3.59955
             dv_mac |  -1.673796   1.529889    -1.09   0.274    -4.675433    1.327841
             dv_pol |  -14.75551   6.500401    -2.27   0.023    -27.50928   -2.001743
             dv_rom |  -16.70256   6.788608    -2.46   0.014    -30.02179    -3.38333
             dv_ser |   3.626241   1.372833     2.64   0.008     .9327462    6.319735
             dv_svk |  -19.13251   8.270573    -2.31   0.021    -35.35935   -2.905669
             dv_slo |  -18.01262   8.359754    -2.15   0.031    -34.41443   -1.610809
                eta |          1          .        .       .            .           .
              _cons |   36.82434   10.46441     3.52   0.000     16.29321    57.35548
       ------------------------------------------------------------------------------
```

Joint impact of *h_stat1* and *hstat1_dvnoneu*:

```
. lincom h_stat1+hstat1_dvnoneu

 ( 1)  h_stat1 + hstat1_dvnoneu = 0

------------------------------------------------------------------------------
  prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |    .318408    .128345     2.48   0.013     .0665955    .5702205
------------------------------------------------------------------------------
```

Specification 3

Note: the measure of competition in this regression is the *h_stat3* which has been estimated by using the total income as dependent variable in the Panzar-Rosse model.

```
xtfevd prov_loans h_stat3 Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans rgdpgrowth
gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1  propertyrights_hrt   dv_foreign  dv_origin
dv_2002  dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est  dv_hun  dv_lat  dv_lit  dv_mac  dv_pol  dv_rom  dv_ser  dv_svk  dv_slo,  invariant
(propertyrights_hrt dv_origin logexch_rate dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo)

       panel fixed effects regression with vector decomposition

       degrees of freedom fevd    =      1169          number of obs        =      1497
       mean squared error         = 3.047343          F( 38, 1169)         = 8.335003
       root mean squared error    = 1.745664          Prob > F             = 8.40e-38
       Residual Sum of Squares    = 4561.872          R-squared            = .4754893
       Total Sum of Squares       = 8697.387          adj. R-squared       = .3287699
       Estimation Sum of Squares  = 4135.514

       ------------------------------------------------------------------------------
                    |                fevd
         prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
       -------------+----------------------------------------------------------------
            h_stat3 |  -.0893871   .0511033    -1.75   0.081    -.1896515    .0108774
       Lagnoninti~a |   .0159559   .0259377     0.62   0.539    -.0349338    .0668456
       Lagequity_ta |  -.0107366   .0241301    -0.44   0.656    -.0580797    .0366064
             Lagnim |  -.0763115   .0691001    -1.10   0.270    -.2118856    .0592625
              logta |  -.7247674    .247597    -2.93   0.003    -1.210552   -.2389832
       Laggr~_loans |   .0035343   .0015593     2.27   0.024     .0004751    .0065936
         rgdpgrowth |   -.231437   .0268227    -8.63   0.000    -.2840629    -.178811
         gdp_percap |  -.0000914   .0000838    -1.09   0.276    -.0002558    .0000731
           cpi_ebrd |  -.0063216   .0436872    -0.14   0.885    -.0920356    .0793924
       ebrd_bankr~1 |  -.5127645   .6959897    -0.74   0.461    -1.878293     .852764
         dv_foreign |   .1843375   .7060984     0.26   0.794    -1.201024    1.569699
            dv_2002 |   1.070764   1.184369     0.90   0.366    -1.252963    3.394491
            dv_2003 |   .9595762     1.1546     0.83   0.406    -1.305743    3.224895
            dv_2004 |   .9123577   1.172036     0.78   0.436    -1.387172    3.211888
            dv_2005 |   1.068914   1.197159     0.89   0.372    -1.279906    3.417735
            dv_2006 |   1.331149   1.233094     1.08   0.281    -1.088177    3.750474
            dv_2007 |   1.917971   1.331372     1.44   0.150    -.6941747    4.530116
            dv_2008 |   1.766651   1.447477     1.22   0.223    -1.073292    4.606593
            dv_2009 |   .9946709   1.405166     0.71   0.479    -1.762259      3.7516
       propertyri~t |  -.0593437   .0209266    -2.84   0.005    -.1004017   -.0182858
          dv_origin |   .2748146   .6093757     0.45   0.652    -.9207777    1.470407
       logexch_rate |  -3.839368   1.534723    -2.50   0.012    -6.850487   -.8282478
             dv_bos |  -17.03555   6.277427    -2.71   0.007    -29.35183   -4.719266
             dv_bul |   -15.7417   6.390707    -2.46   0.014    -28.28023    -3.20316
             dv_cro |  -10.65493   4.078121    -2.61   0.009    -18.65619   -2.653681
             dv_cze |  -1.656316    2.57023    -0.64   0.519    -6.699096    3.386463
             dv_est |  -4.212003   3.544171    -1.19   0.235    -11.16565    2.741645
             dv_hun |   6.908633   2.049183     3.37   0.001     2.888145    10.92912
             dv_lat |  -17.81267   7.993112    -2.23   0.026    -33.49512   -2.130222
             dv_lit |  -12.02684    5.46567    -2.20   0.028    -22.75046   -1.303221
             dv_mac |  -2.799732   1.452597    -1.93   0.054     -5.64972    .0502555
             dv_pol |  -10.40595    5.23389    -1.99   0.047    -20.67481   -.1370764
             dv_rom |   -12.3363   5.399322    -2.28   0.023    -22.92974   -1.742852
             dv_ser |   2.127907   1.256049     1.69   0.091    -.3364554    4.592269
             dv_svk |  -15.38769   6.943419    -2.22   0.027    -29.01064   -1.764731
             dv_slo |  -14.90976   7.012889    -2.13   0.034    -28.66902   -1.150507
                eta |          1          .        .       .            .           .
              _cons |   32.60204   8.799853     3.70   0.000     15.33677    49.86731
       ------------------------------------------------------------------------------
```

Specification 4

Note: includes the Lerner Index (*lerner_index*) as a measure of market power.

```
xtfevd prov_loans lerner_index Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans
rgdpgrowth  gdp_percap  cpi_ebrd  logexch_rate  ebrd_bankref1  propertyrights_hrt  dv_foreign
dv_origin dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est  dv_hun  dv_lat  dv_lit  dv_mac  dv_pol  dv_rom    dv_ser  dv_svk  dv_slo,  invariant
(propertyrights_hrt dv_origin logexch_rate dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom  dv_ser dv_svk dv_slo)
       note: dv_est dropped because of collinearity
       note: dv_lit dropped because of collinearity

       panel fixed effects regression with vector decomposition

       degrees of freedom fevd    =      1079          number of obs        =      1385
       mean squared error         = 3.170494          F( 35, 1079)         = 7.612865
       root mean squared error    = 1.780588          Prob > F             = 3.36e-31
       Residual Sum of Squares    = 4391.134          R-squared            = .4681283
       Total Sum of Squares       = 8256.001          adj. R-squared       = .3177846
       Estimation Sum of Squares  = 3864.868

       ------------------------------------------------------------------------------
                    |               fevd
         prov_loans |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
       -------------+----------------------------------------------------------------
       lerner_index |   .0277551   .0130296     2.13   0.033      .0021889    .0533212
       Lagnoninti~a |   .0090551   .0269782     0.34   0.737     -.0438805    .0619907
       Lagequity_ta |  -.0096796   .0277872    -0.35   0.728     -.0642026    .0448434
             Lagnim |  -.0721009   .0763156    -0.94   0.345     -.2218448    .0776429
              logta |  -.8230911   .2889904    -2.85   0.004     -1.390138   -.2560443
       Laggr~_loans |   .0032746   .0016209     2.02   0.044      .0000941     .006455
         rgdpgrowth |  -.2185741   .0307509    -7.11   0.000     -.2789123   -.1582358
         gdp_percap |  -.0001179   .0000923    -1.28   0.202      -.000299    .0000632
           cpi_ebrd |  -.0205083   .0495372    -0.41   0.679     -.1177085    .0766919
       ebrd_bankr~1 |  -.6778074   .9140705    -0.74   0.459     -2.471365     1.11575
         dv_foreign |   .4458363   .7605949     0.59   0.558     -1.046576    1.938249
            dv_2003 |   .0059053   .4431045     0.01   0.989     -.8635389    .8753495
            dv_2004 |   -.121385   .5668782    -0.21   0.830     -1.233694    .9909236
            dv_2005 |   .1735542   .6356988     0.27   0.785     -1.073792      1.4209
            dv_2006 |   .4461193   .7189389     0.62   0.535     -.9645574    1.856796
            dv_2007 |   1.076851   .9041769     1.19   0.234     -.6972933    2.850995
            dv_2008 |   1.207179   1.068291     1.13   0.259     -.8889844    3.303343
            dv_2009 |   .4215663   1.044924     0.40   0.687     -1.628747    2.471879
       propertyri~t |  -.0617858   .0250599    -2.47   0.014     -.1109575   -.0126142
          dv_origin |   .1778171   .6723433     0.26   0.791     -1.141431    1.497066
       logexch_rate |  -3.244951   1.641553    -1.98   0.048      -6.46595   -.0239531
             dv_bos |  -14.75547   6.686893    -2.21   0.028     -27.87626   -1.634687
             dv_bul |  -13.20488   6.755198    -1.95   0.051     -26.45969     .049933
             dv_cro |  -8.282735   4.338483    -1.91   0.057     -16.79555    .2300845
             dv_cze |   .0594528    2.94499     0.02   0.984     -5.719103    5.838008
             dv_hun |   7.712854   2.531679     3.05   0.002      2.745283    12.68042
             dv_lat |   -14.6204   8.438957    -1.73   0.083     -31.17903    1.938227
             dv_mac |  -2.849413   1.486325    -1.92   0.055     -5.765828    .0670015
             dv_pol |  -7.650588   5.588687    -1.37   0.171     -18.61651    3.315338
             dv_rom |  -10.07485   5.712005    -1.76   0.078     -21.28274    1.133048
             dv_ser |   2.410278   1.275951     1.89   0.059     -.0933482    4.913903
             dv_svk |  -11.82272   7.392529    -1.60   0.110     -26.32808     2.68264
             dv_slo |  -11.57049   7.388566    -1.57   0.118     -26.06808    2.927096
                eta |          1          .        .       .             .           .
              _cons |   31.85578   9.449247     3.37   0.001       13.3148    50.39676
       ------------------------------------------------------------------------------
```

Specification 5

Note: replaces the measure of competition with the degree of market concentration (i.e. Herfindahl-Hirschman Index: *HHI_dep*).

```
xtfevd prov_loans hhi_dep Lagnonintinc_ta Lagequity_ta Lagnim logta Laggrowth_loans rgdpgrowth
gdp_percap cpi_ebrd logexch_rate ebrd_bankref1 propertyrights_hrt dv_foreign dv_origin
dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, invariant
(propertyrights_hrt dv_origin logexch_rate dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo)
```

panel fixed effects regression with vector decomposition

degrees of freedom fevd	= 1199	number of obs	= 1527
mean squared error	= 3.418447	F(38, 1199)	= 8.693869
root mean squared error	= 1.848904	Prob > F	= 6.55e-40
Residual Sum of Squares	= 5219.969	R-squared	= .4623486
Total Sum of Squares	= 9708.834	adj. R-squared	= .3157163
Estimation Sum of Squares	= 4488.865		

prov_loans	Coef.	fevd Std. Err.	t	P>|t|	[95% Conf.	Interval]
hhi_dep	-.0018808	.0005445	-3.45	0.001	-.0029491	-.0008125
Lagnoninti~a	.0332252	.0263987	1.26	0.208	-.0185675	.0850179
Lagequity_ta	-.0048962	.0240846	-0.20	0.839	-.0521489	.0423565
Lagnim	-.1235685	.0674007	-1.83	0.067	-.255805	.0086679
logta	-.7125681	.2649879	-2.69	0.007	-1.23246	-.1926765
Laggr~_loans	.0034403	.0015851	2.17	0.030	.0003304	.0065503
rgdpgrowth	-.2368843	.0271288	-8.73	0.000	-.2901096	-.183659
gdp_percap	-.0001266	.0000834	-1.52	0.129	-.0002901	.000037
cpi_ebrd	.039696	.0429673	0.92	0.356	-.0446034	.1239954
ebrd_bankr~1	-.7857679	.6939401	-1.13	0.258	-2.14724	.5757041
dv_foreign	.1500757	.7534475	0.20	0.842	-1.328147	1.628298
dv_2002	1.026548	.9358176	1.10	0.273	-.8094742	2.86257
dv_2003	1.065025	.9177805	1.16	0.246	-.7356097	2.865659
dv_2004	.8591638	.9849077	0.87	0.383	-1.07317	2.791498
dv_2005	.9621644	1.039154	0.93	0.355	-1.076598	3.000927
dv_2006	1.246353	1.081569	1.15	0.249	-.8756255	3.368331
dv_2007	1.798043	1.193527	1.51	0.132	-.5435913	4.139677
dv_2008	1.532471	1.325498	1.16	0.248	-1.068083	4.133025
dv_2009	1.153587	1.286621	0.90	0.370	-1.370692	3.677867
propertyri~t	-.0502838	.0214859	-2.34	0.019	-.0924379	-.0081297
dv_origin	.2559934	.6444022	0.40	0.691	-1.008288	1.520275
logexch_rate	-4.878432	1.524019	-3.20	0.001	-7.868472	-1.888392
dv_bos	-23.65363	6.378417	-3.71	0.000	-36.16773	-11.13953
dv_bul	-23.02851	6.571485	-3.50	0.000	-35.9214	-10.13562
dv_cro	-15.62475	4.326088	-3.61	0.000	-24.1123	-7.137211
dv_cze	-4.941496	2.794805	-1.77	0.077	-10.42475	.5417552
dv_est	-7.719805	3.715353	-2.08	0.038	-15.00912	-.4304874
dv_hun	5.238955	2.205176	2.38	0.018	.912521	9.565389
dv_lat	-26.20177	8.128866	-3.22	0.001	-42.15015	-10.25338
dv_lit	-16.18269	5.53428	-2.92	0.004	-27.04064	-5.324737
dv_mac	-4.34445	1.473333	-2.95	0.003	-7.235047	-1.453853
dv_pol	-17.16372	5.48174	-3.13	0.002	-27.91859	-6.40885
dv_rom	-18.88477	5.572726	-3.39	0.001	-29.81815	-7.95139
dv_ser	-2.133941	1.722679	-1.24	0.216	-5.513742	1.24586
dv_svk	-21.95543	7.101419	-3.09	0.002	-35.88802	-8.022846
dv_slo	-21.75577	7.132356	-3.05	0.002	-35.74905	-7.76248
eta	1	.	.	.	.	.
_cons	43.28637	8.719196	4.96	0.000	26.17979	60.39295

Chapter 6

Appendix 4.1 Wooldridge test for autocorrelation in panel data

```
xtserial nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans lqdassets_custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo
```

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     220) =    102.477
           Prob > F =      0.0000
```

Appendix 4.2 Estimation of equation 6.1 with the Ordinary Least Squares and the Fixed Effects methods

Note: These two estimations are conducted in order to compare the coefficient of the lagged dependent variable obtained through the OLS and FE methods, with the coefficient of the lagged dependent variable obtained through the GMM approach.

Ordinary Least Squares:

```
regres nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans
lqdassets_custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001
dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo
note: dv_2001 omitted because of collinearity

      Source |       SS       df       MS              Number of obs =    1498
-------------+------------------------------           F( 40,  1457) =  212.03
       Model |  9337.19799    40   233.42995           Prob > F      =  0.0000
    Residual |  1604.02421  1457  1.10090886           R-squared     =  0.8534
-------------+------------------------------           Adj R-squared =  0.8494
       Total |  10941.2222  1497  7.30876567           Root MSE      =  1.0492

------------------------------------------------------------------------------
         nim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |   .7550561   .0129541    58.29   0.000     .7296454    .7804669
     h_stat1 |  -.0027163   .0213402    -0.13   0.899     -.044577    .0391445
   equity_ta |   .0162838   .0044706     3.64   0.000     .0075143    .0250534
nonintinc_ta |  -.1550738   .0256171    -6.05   0.000    -.2053241   -.1048234
loggross_l~s |   .0629569   .0238472     2.64   0.008     .0161783    .1097355
  prov_loans |   .0282782   .0121904     2.32   0.020     .0043656    .0521907
lqdassets_~g |  -.0018191   .0009619    -1.89   0.059    -.0037059    .0000677
nonintexp_ta |   .1802453   .0228778     7.88   0.000     .1353683    .2251223
earningsas~a |  -.0203198   .0039668    -5.12   0.000    -.0281012   -.0125385
bankdep_cu~4 |   .0009211   .0017549     0.52   0.600    -.0025213    .0043634
ebrd_bankr~1 |   .1699463   .2684945     0.63   0.527    -.3567306    .6966233
economic_f~t |    -.01901   .0143947    -1.32   0.187    -.0472465    .0092266
  rgdpgrowth |   .0542254   .0110595     4.90   0.000     .0325311    .0759197
  gdp_percap |    .000046   .0000266     1.73   0.084    -6.23e-06    .0000982
    cpi_ebrd |   .0169218   .0131077     1.29   0.197    -.0087902    .0426338
  dv_foreign |   -.139552   .0871542    -1.60   0.110    -.3105132    .0314092
   dv_origin |   .1424467   .0822883     1.73   0.084    -.0189695    .3038629
     dv_2000 |  -.3262781   .3989633    -0.82   0.414    -1.108882    .4563258
     dv_2001 |  (omitted)
     dv_2002 |  -.5781925   .3059019    -1.89   0.059    -1.178248    .0218626
     dv_2003 |  -.3016634   .3061498    -0.99   0.325    -.9022048     .298878
     dv_2004 |  -.2759207   .3251452    -0.85   0.396    -.9137234     .361882
     dv_2005 |  -.5138004   .3453282    -1.49   0.137    -1.191194    .1635931
     dv_2006 |  -.6183222   .3575624    -1.73   0.084    -1.319714    .0830698
     dv_2007 |  -.6750052   .3981354    -1.70   0.090    -1.455985    .1059746
     dv_2008 |   -.685943   .4382488    -1.57   0.118    -1.545609    .1737229
     dv_2009 |  -.3956046   .4194961    -0.94   0.346    -1.218485    .4272762
      dv_bos |  -.6342643   .2588317    -2.45   0.014    -1.141987   -.1265417
      dv_bul |  -.4425738   .3260027    -1.36   0.175    -1.082059    .1969109
      dv_cro |  -1.204745   .4783771    -2.52   0.012    -2.143127    -.266364
      dv_cze |   -1.00841    .512801    -1.97   0.049    -2.014317   -.0025027
      dv_est |  -.9939717   .5682514    -1.75   0.080     -2.10865    .1207065
      dv_hun |  -.7887871   .4957809    -1.59   0.112    -1.761308    .1837335
      dv_lat |  -.8179043   .4145161    -1.97   0.049    -1.631016   -.0047923
      dv_lit |    -.99908   .4052967    -2.47   0.014    -1.794107   -.2040527
      dv_mac |  -.1708372   .2330504    -0.73   0.464    -.6279873     .286313
      dv_pol |  -.9704082   .3619456    -2.68   0.007    -1.680398   -.2604181
      dv_rom |  -1.035815   .2650684    -3.91   0.000    -1.555771   -.5158582
      dv_ser |  -.9810982   .3234965    -3.03   0.002    -1.615667   -.3465295
      dv_svk |  -1.070749   .4488933    -2.39   0.017    -1.951295   -.1902032
```

```
      dv_slo |   -1.41001   .5439832    -2.59   0.010    -2.477084   -.3429363
       _cons |   2.619193   1.135353     2.31   0.021     .3920927    4.846293
------------------------------------------------------------------------------
```

Fixed Effects:

```
xtreg nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans
lqdassets_custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001
dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009, fe
note: dv_2008 omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =      1498
Group variable: bank                            Number of groups   =       285

R-sq:  within  = 0.4403                         Obs per group: min =         1
       between = 0.8087                                        avg =       5.3
       overall = 0.7554                                        max =        10

                                                F(26,1187)         =     35.92
corr(u_i, Xb)  = 0.5698                         Prob > F           =    0.0000

------------------------------------------------------------------------------
         nim |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |   .3647795   .0211656    17.23   0.000     .3232534    .4063056
     h_stat1 |   -.004604   .0184645    -0.25   0.803    -.0408307    .0316226
   equity_ta |   .0395962   .0074675     5.30   0.000     .0249451    .0542473
nonintinc_ta |  -.1066374   .0311859    -3.42   0.001    -.1678231   -.0454517
loggross_l~s |   .1631828    .074595     2.19   0.029     .0168301    .3095355
  prov_loans |  -.0174002    .012089    -1.44   0.150    -.0411183    .0063179
lqdassets_~g |  -.0033645   .0014325    -2.35   0.019     -.006175    -.000554
nonintexp_ta |   .1869746   .0313838     5.96   0.000     .1254007    .2485486
earningsas~a |  -.0405721   .0044261    -9.17   0.000    -.0492559   -.0318882
bankdep_cu~4 |   .0010798   .0026424     0.41   0.683    -.0041045    .0062641
ebrd_bankr~1 |   .2488992   .2374885     1.05   0.295    -.2170448    .7148433
economic_f~t |  -.0306165   .0130628    -2.34   0.019    -.0562451   -.0049878
  rgdpgrowth |   .0467094   .0096448     4.84   0.000     .0277867    .0656322
  gdp_percap |   .0000367   .0000237     1.55   0.122    -9.83e-06    .0000832
    cpi_ebrd |   .0469551   .0116388     4.03   0.000     .0241202    .0697899
  dv_foreign |  -.3826849   .1934263    -1.98   0.048    -.7621805   -.0031893
   dv_origin |   .3149667   .2002897     1.57   0.116    -.0779946    .7079279
     dv_2000 |   .8454403   .4480064     1.89   0.059    -.0335323    1.724413
     dv_2001 |    .995551   .4242941     2.35   0.019     .1631011    1.828001
     dv_2002 |   .7686482   .2992075     2.57   0.010     .1816137    1.355683
     dv_2003 |   .8716226   .2644715     3.30   0.001     .3527389    1.390506
     dv_2004 |    .763551   .2187082     3.49   0.000     .3344532    1.192649
     dv_2005 |   .5072475   .1893273     2.68   0.007     .1357939     .878701
     dv_2006 |   .3462478   .1575078     2.20   0.028     .0372231    .6552725
     dv_2007 |    .152017   .1130063     1.35   0.179    -.0696974    .3737313
     dv_2008 |  (omitted)
     dv_2009 |   .4336766   .1480088     2.93   0.003     .1432886    .7240646
       _cons |   3.177785    1.52762     2.08   0.038     .1806485    6.174922
-------------+----------------------------------------------------------------
     sigma_u |  1.4313751
     sigma_e |   .8672532
         rho |  .73147515   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(284, 1187) =     3.54           Prob > F = 0.0000
```

Appendix 4.3 Estimation of the impact of banking competition on net interest margins using the General Method of Moments

Specification 1

Note: uses the *h_stat1* (i.e. the H-statistic estimated by using the interest income as dependent variable in the Panzar-Rosse model)

```
xtabond2 nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans
lqdassets_custstfunding nonintexp_ta earningsassets_ta bankdep_custdep economic_freedom_hrt
ebrd_bankref1 rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1))
gmm( equity_ta nonintexp_ta nonintinc_ta loggross_loans, laglimits (2 2)) gmm (prov_loans,
laglimits (2 5)) iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_ori
> gin ebrd_bankref1) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per m.
dv_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1498
Time variable : year                            Number of groups   =       285
Number of instruments = 164                     Obs per group: min =         1
Wald chi2(40) =   3254.26                                      avg =      5.26
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |   .6284701   .0860109     7.31   0.000     .4598919    .7970483
     h_stat1 |  -.0288019   .0161301    -1.79   0.074    -.0604163    .0028125
   equity_ta |   .0358708   .0182631     1.96   0.050     .0000759    .0716657
nonintinc_ta |  -.1075373   .0993104    -1.08   0.279     -.302182    .0871074
loggross_l~s |   .1897127   .0979717     1.94   0.053    -.0023083    .3817337
  prov_loans |   .0755585   .0503155     1.50   0.133    -.0230582    .1741752
lqdassets_~g |  -.0026532   .0026808    -0.99   0.322    -.0079075    .0026011
nonintexp_ta |   .1322381    .100609     1.31   0.189    -.0649518    .3294281
earningsas~a |  -.0345173   .0067369    -5.12   0.000    -.0477213   -.0213133
bankdep_cu~4 |   .0041043   .0029933     1.37   0.170    -.0017624    .0099711
economic_f~t |  -.0278754   .0141501    -1.97   0.049    -.0556092   -.0001417
ebrd_bankr~1 |  -.0048003   .2298913    -0.02   0.983     -.455379    .4457784
  rgdpgrowth |   .0483005   .0149176     3.24   0.001     .0190625    .0775384
  gdp_percap |    .000053   .0000217     2.44   0.015     .0000104    .0000955
    cpi_ebrd |   .0103705   .0143381     0.72   0.470    -.0177316    .0384726
  dv_foreign |  -.1333225   .0887993    -1.50   0.133    -.3073659    .0407208
   dv_origin |  -.0133703   .0994905    -0.13   0.893    -.2083682    .1816275
     dv_2000 |   .4300774   .3925354     1.10   0.273    -.3392778    1.199433
     dv_2001 |   .6627161   .3892915     1.70   0.089    -.1002811    1.425713
     dv_2002 |   .1799218   .2889763     0.62   0.534    -.3864612    .7463048
     dv_2003 |   .3203835   .3021977     1.06   0.289    -.2719132    .9126802
     dv_2004 |   .3856536   .2490378     1.55   0.121    -.1024516    .8737587
     dv_2005 |   .1012682   .2419641     0.42   0.676    -.3729727     .575509
     dv_2006 |  -.0206907   .2133744    -0.10   0.923    -.4388968    .3975153
     dv_2007 |  -.1078613   .1951496    -0.55   0.580    -.4903476    .2746249
     dv_2008 |  -.2234114   .1766712    -1.26   0.206    -.5696806    .1228578
      dv_bos |  -.9723342   .2189058    -4.44   0.000    -1.401382   -.5432868
      dv_bul |  -.4008383    .317344    -1.26   0.207    -1.022821    .2211445
      dv_cro |  -1.340346    .409239    -3.28   0.001     -2.14244   -.5382522
      dv_cze |  -1.271355   .4520223    -2.81   0.005    -2.157302   -.3854076
      dv_est |  -1.156278   .5183226    -2.23   0.026    -2.172171    -.140384
      dv_hun |  -.7119654   .5147509    -1.38   0.167    -1.720859    .2969279
```

```
      dv_lat |  -.8770008   .3621656    -2.42   0.015    -1.586832   -.1671693
      dv_lit |  -1.321526   .3359308    -3.93   0.000    -1.979938   -.6631134
      dv_mac |  -.3267559   .2722123    -1.20   0.230    -.8602822    .2067703
      dv_pol |  -1.230255   .3805123    -3.23   0.001    -1.976046    -.484465
      dv_rom |  -1.010666   .3440879    -2.94   0.003    -1.685065   -.3362659
      dv_ser |  -.8297926   .5359926    -1.55   0.122    -1.880319    .2207337
      dv_svk |  -1.316694   .3744406    -3.52   0.000    -2.050584   -.5828043
      dv_slo |  -1.800538   .4531861    -3.97   0.000    -2.688767   -.9123097
       _cons |   3.320432   2.127407     1.56   0.119    -.8492096    7.490073
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001
    dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos
    dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom
    dv_ser dv_svk dv_slo dv_foreign dv_origin ebrd_bankref1)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/5).prov_loans
    L2.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    L.Lagnim
Instruments for levels equation
  Standard
    h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001
    dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos
    dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom
    dv_ser dv_svk dv_slo dv_foreign dv_origin ebrd_bankref1
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.prov_loans
    DL.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    D.Lagnim
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -4.66  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.83  Pr > z =  0.407
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(123)  = 416.07  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(123)  = 120.19  Prob > chi2 =  0.555
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(67)   =  78.77  Prob > chi2 =  0.154
    Difference (null H = exogenous): chi2(56)   =  41.42  Prob > chi2 =  0.927
  gmm(Lagnim, lag(1 1))
    Hansen test excluding group:     chi2(109)  = 111.33  Prob > chi2 =  0.420
    Difference (null H = exogenous): chi2(14)   =   8.87  Prob > chi2 =  0.840
  gmm(equity_ta nonintexp_ta nonintinc_ta loggross_loans, lag(2 2))
    Hansen test excluding group:     chi2(48)   =  51.10  Prob > chi2 =  0.353
    Difference (null H = exogenous): chi2(75)   =  69.10  Prob > chi2 =  0.670
  gmm(prov_loans, lag(2 5))
    Hansen test excluding group:     chi2(83)   =  82.48  Prob > chi2 =  0.496
    Difference (null H = exogenous): chi2(40)   =  37.71  Prob > chi2 =  0.574
  iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 economic_freedom_hrt
rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom
dv_ser dv_svk dv_slo dv_foreign dv_origin ebrd_bankref1)
    Hansen test excluding group:     chi2(89)   =  90.93  Prob > chi2 =  0.423
    Difference (null H = exogenous): chi2(34)   =  29.26  Prob > chi2 =  0.699
```

Bootstrapped standard errors:

```
bootstrap _b[h_stat1], reps(500) cluster(bank) idcluster(myclid) group(bank) seed (22):
xtabond2 nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans  lqdassets_
custstfunding    nonintexp_ta    earningsassets_ta    bankdep_custdep    economic_freedom_hrt
ebrd_bankref1  rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000  dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1))
gmm( equity_ta  nonintexp_ta  nonintinc_ta  loggross_loans,  laglimits  (2  2))  gmm  (prov_loans,
laglimits   (2   5))   iv(h_stat1   lqdassets_custstfunding   earningsassets_ta   bankdep_custdep
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin ebrd_bankref1) robust
twostep
        (running xtabond2 on estimation sample)

        Bootstrap replications (500)
        ----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
        ..................................................    50
        ............................x.....................   100
        ..................................................   150
        ..................................................   200
        ..................................................   250
        ..................................................   300
        ..................................................   350
        x.................................................   400
        ..................................................   450
        ..................................................   500

        Bootstrap results                               Number of obs      =      1498
                                                        Replications       =       498

              command:  xtabond2 nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans
                            prov_loans lqdassets_custstfunding nonintexp_ta earningsassets_ta
                            bankdep_custdep economic_freedom_hrt ebrd_bankref1 rgdpgrowth
                            gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001 dv_2002
                            dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos
                            dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
                            dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1)) gmm(
                            equity_ta nonintexp_ta nonintinc_ta loggross_loans, laglimits (2
                            2)) gmm(prov_loans, laglimits (2 5)) iv(h_stat1
                            lqdassets_custstfunding earningsassets_ta bankdep_custdep
                            economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
                            dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008
                            dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit
                            dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
                            ebrd_bankref1) robust twostep
                _bs_1:  _b[h_stat1]

                                          (Replications based on 285 clusters in bank)
        ------------------------------------------------------------------------------
                     |   Observed   Bootstrap                         Normal-based
                     |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
        -------------+----------------------------------------------------------------
               _bs_1 |  -.0288019   .0166753    -1.73   0.084     -.061485    .0038812
        ------------------------------------------------------------------------------
        Note: one or more parameters could not be estimated in 2 bootstrap replicates;
              standard-error estimates include only complete replications.
```

Specification 2

Note: includes the interaction term between the competition variable (*h_stat1*) and the dummy variable for the non-EU countries (*dv_noneu*=1), i.e. variable *hstat1_dvnoneu*, to test if the relationship between banking sector competition and net interest margins in the non-EU countries differs from the EU countries.

```
xtabond2 nim Lagnim h_stat1 hstat1_dvnoneu equity_ta nonintinc_ta loggross_loans prov_loans
lqdassets_custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_noneu
hstat1_dvnoneu dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk
dv_slo, gmm(Lagnim, laglimits (1 1)) gmm( equity_ta nonintexp_ta nonintinc_ta loggross_loans,
laglimits (2 2)) gmm(prov_loans, laglimits (4 5)) iv(h_stat1 lqdassets_custstfunding
earningsassets_ta bankdep_custdep ebrd_bankref1  economic_freedom
> _hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006
dv_2007 dv_2008 dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin hstat1_dvnoneu dv_noneu) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per m.
hstat1_dvnoneu dropped due to collinearity
dv_2009 dropped due to collinearity
dv_slo dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1498
Time variable : year                            Number of groups   =       285
Number of instruments = 146                     Obs per group: min =         1
Wald chi2(41) =   3372.34                                      avg =      5.26
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
```

nim	Coef.	Corrected Std. Err.	z	P>|z|	[95% Conf.	Interval]
Lagnim	.6379345	.0821733	7.76	0.000	.4768779	.7989911
h_stat1	-.0157332	.0170646	-0.92	0.357	-.0491791	.0177127
hstat1_dvn~u	-.0692178	.0549594	-1.26	0.208	-.1769362	.0385007
equity_ta	.0409421	.020287	2.02	0.044	.0011803	.080704
nonintinc_ta	-.1421073	.10563	-1.35	0.179	-.3491384	.0649237
loggross_l~s	.1904054	.1007934	1.89	0.059	-.007146	.3879568
prov_loans	.0933314	.0724546	1.29	0.198	-.048677	.2353397
lqdassets_~g	-.0026884	.0024324	-1.11	0.269	-.0074559	.002079
nonintexp_ta	.1196146	.1191574	1.00	0.315	-.1139297	.3531588
earningsas~a	-.0353581	.0077604	-4.56	0.000	-.0505682	-.020148
bankdep_cu~4	.0031736	.0034057	0.93	0.351	-.0035014	.0098486
ebrd_bankr~1	.0926305	.2686951	0.34	0.730	-.4340023	.6192633
economic_f~t	-.022625	.0151145	-1.50	0.134	-.0522489	.0069989
rgdpgrowth	.0541776	.0198634	2.73	0.006	.015246	.0931091
gdp_percap	.0000506	.0000239	2.12	0.034	3.81e-06	.0000974
cpi_ebrd	.0142765	.014618	0.98	0.329	-.0143742	.0429272
dv_foreign	-.1583045	.1044092	-1.52	0.129	-.3629427	.0463337
dv_origin	.0103652	.1055119	0.10	0.922	-.1964344	.2171647
dv_noneu	1.855756	.4928864	3.77	0.000	.8897162	2.821796
dv_2000	.5062109	.4168798	1.21	0.225	-.3108584	1.32328
dv_2001	.7442915	.4071114	1.83	0.068	-.0536322	1.542215
dv_2002	.1601319	.3241133	0.49	0.621	-.4751186	.7953824
dv_2003	.3365268	.2948935	1.14	0.254	-.2414538	.9145074
dv_2004	.3795534	.2540504	1.49	0.135	-.1183762	.877483
dv_2005	.1071803	.2530786	0.42	0.672	-.3888446	.6032052
dv_2006	-.0842323	.2264455	-0.37	0.710	-.5280574	.3595928
dv_2007	-.1638941	.2101465	-0.78	0.435	-.5757737	.2479856
dv_2008	-.2751078	.1899644	-1.45	0.148	-.6474312	.0972155
dv_bos	-1.017405	.2852026	-3.57	0.000	-1.576392	-.458418
dv_bul	1.355372	.4257223	3.18	0.001	.5209715	2.189772
dv_cro	-1.596823	.5760398	-2.77	0.006	-2.72584	-.4678056
dv_cze	.4667431	.2233869	2.09	0.037	.0289129	.9045734
dv_est	.5956041	.4493397	1.33	0.185	-.2850855	1.476294
dv_hun	1.040625	.427333	2.44	0.015	.2030677	1.878182
dv_lat	.7988012	.3366498	2.37	0.018	.1389797	1.458623
dv_lit	.4859253	.333224	1.46	0.145	-.1671817	1.139032
dv_mac	-.4161998	.3698755	-1.13	0.260	-1.141142	.3087429

```
      dv_pol |    .599121   .3738142     1.60   0.109    -.1335413    1.331783
      dv_rom |   .8222092   .4901225     1.68   0.093    -.1384131    1.782832
      dv_ser |  -.8933469   .6592378    -1.36   0.175    -2.185429    .3987354
      dv_svk |   .5130697    .239548     2.14   0.032     .0435642    .9825752
       _cons |   .9542446   2.480998     0.38   0.701    -3.908423    5.816912
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin hstat1_dvnoneu dv_noneu)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(4/5).prov_loans
    L2.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    L.Lagnim
Instruments for levels equation
  Standard
    h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin hstat1_dvnoneu dv_noneu
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL3.prov_loans
    DL.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    D.Lagnim
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -4.66  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.68  Pr > z =  0.494
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(104)  = 357.80  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(104)  = 109.86  Prob > chi2 =  0.328
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(48)   =  54.05  Prob > chi2 =  0.254
    Difference (null H = exogenous): chi2(56)   =  55.81  Prob > chi2 =  0.482
  gmm(Lagnim, lag(1 1))
    Hansen test excluding group:     chi2(92)   =  97.03  Prob > chi2 =  0.340
    Difference (null H = exogenous): chi2(12)   =  12.83  Prob > chi2 =  0.382
  gmm(equity_ta nonintexp_ta nonintinc_ta loggross_loans, lag(2 2))
    Hansen test excluding group:     chi2(29)   =  34.73  Prob > chi2 =  0.214
    Difference (null H = exogenous): chi2(75)   =  75.13  Prob > chi2 =  0.474
  gmm(prov_loans, lag(4 5))
    Hansen test excluding group:     chi2(81)   =  80.52  Prob > chi2 =  0.494
    Difference (null H = exogenous): chi2(23)   =  29.34  Prob > chi2 =  0.169
  iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin hstat1_dvnoneu dv_noneu)
    Hansen test excluding group:     chi2(68)   =  75.60  Prob > chi2 =  0.246
    Difference (null H = exogenous): chi2(36)   =  34.26  Prob > chi2 =  0.552
```

Bootstrapped standard errors:

```
bootstrap _b[hstat1_dvnoneu], reps(500) cluster(bank) idcluster(myclid) group(bank) seed(22):
xtabond2 nim Lagnim h_stat1 hstat1_dvnoneu equity_ta nonintinc_ta loggross_loans prov_loans
lqdassets_custstfunding nonintexp_ta earningsassets_ta  bankdep_custdep ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_noneu
hstat1_dvnoneu  dv_2000  dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008
dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser
dv_svk dv_slo, gmm(Lagnim, laglimits (1 1)) gmm( equity_ta nonintexp_ta nonintinc_ta
loggross_loans, laglimits (2 2)) gmm(prov_loans, laglimits (4 5)) iv(h_stat1
lqdassets_custstfunding earningsassets_ta bankdep_custdep ebrd_bankref1  economic_ freedom_hrt
rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
dv_2008 dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom
dv_ser dv_svk dv_slo dv_foreign dv_origin hstat1_dvnoneu dv_noneu) robust twostep
```

```
(running xtabond2 on estimation sample)

Bootstrap replications (500)
----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
..................x.............................    50
............x...................................   100
................................x.....x..........   150
...x.............................................   200
..................................................   250
...........................x....................   300
.................x..........x.................   350
x.................................................   400
....................................x........x   450
.........................................x......   500

Bootstrap results                               Number of obs      =      1498
                                                Replications       =       488

      command:  xtabond2 nim Lagnim h_stat1 hstat1_dvnoneu equity_ta nonintinc_ta
                    loggross_loans prov_loans lqdassets_custstfunding nonintexp_ta
                    earningsassets_ta bankdep_custdep ebrd_bankref1 economic_freedom_hrt
                    rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_noneu
                    hstat1_dvnoneu dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
                    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
                    dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo,
                    gmm(Lagnim, laglimits (1 1)) gmm( equity_ta nonintexp_ta
                    nonintinc_ta loggross_loans, laglimits (2 2)) gmm(prov_loans,
                    laglimits (4 5)) iv(h_stat1 lqdassets_custstfunding
                    earningsassets_ta bankdep_custdep ebrd_bankref1 economic_freedom_hrt
                    rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003
                    dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro
                    dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser
                    dv_svk dv_slo dv_foreign dv_origin hstat1_dvnoneu dv_noneu) robust
                    twostep
        _bs_1:  _b[hstat1_dvnoneu]

                                  (Replications based on 285 clusters in bank)
------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _bs_1 |  -.0692178   .0537535    -1.29   0.198    -.1745726    .0361371
------------------------------------------------------------------------------
Note: one or more parameters could not be estimated in 12 bootstrap replicates;
      standard-error estimates include only complete replications.
```

Joint impact of ***h_stat1*** and ***hstat1_dvnoneu***:

```
. lincom h_stat1 + hstat1_dvnoneu

 ( 1)  h_stat1 + hstat1_dvnoneu = 0

------------------------------------------------------------------------------
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |  -.0849509   .0511693    -1.66   0.097     -.185241    .0153391
------------------------------------------------------------------------------
```

Specification 3

Note: the measure of competition in this regression is the *h_stat3* which has been estimated by using the total income as dependent variable in the Panzar-Rosse model.

```
xtabond2  nim  Lagnim  h_stat3  equity_ta  nonintinc_ta  loggross_loans  prov_loans  lqdassets_
custstfunding   nonintexp_ta   earningsassets_ta   bankdep_custdep   ebrd_bankref1   economic_
freedom_hrt   rgdpgrowth  gdp_percap  cpi_ebrd  dv_foreign  dv_origin  dv_2000   dv_2001  dv_2002
dv_2003  dv_2004  dv_2005  dv_2006  dv_2007  dv_2008  dv_2009   dv_bos  dv_bul  dv_cro  dv_cze  dv_est
dv_hun  dv_lat  dv_lit  dv_mac  dv_pol  dv_rom  dv_ser  dv_svk  dv_slo,  gmm(Lagnim,  laglimits  (1  1))
gmm(  equity_ta  nonintexp_ta  nonintinc_ta  loggross_loans,  laglimits  (2  2))  gmm  (prov_loans,
laglimits   (2   2))   iv(h_stat3   lqdassets_custstfunding   earningsassets_ta   bankdep_custdep
ebrd_bankref1  economic_freedom_hrt  rgdpgrowth  gdp_percap  cpi_ebrd  dv_2000  dv_2001  dv_2002
dv_2003  dv_2004  dv_2005  dv_2006  dv_2007  dv_2008  dv_2009   dv_bos  dv_bul  dv_cro  dv_cze  dv_est
dv_hun  dv_lat  dv_lit  dv_mac  dv_pol  dv_rom  dv_ser  dv_svk  dv_slo  dv_foreign  dv_origin)  robust
twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per
> m.
dv_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimatio
> n.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1498
Time variable : year                            Number of groups   =       285
Number of instruments = 143                     Obs per group: min =         1
Wald chi2(40) =   3637.83                                      avg =      5.26
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |   .6392185   .0876779     7.29   0.000      .467373     .811064
     h_stat3 |   -.030094    .016312    -1.84   0.065     -.062065     .001877
   equity_ta |   .0309601   .0181781     1.70   0.089    -.0046683    .0665886
nonintinc_ta |  -.0783469   .0839993    -0.93   0.351    -.2429826    .0862887
loggross_l~s |   .1490617   .0997578     1.49   0.135    -.0464601    .3445834
  prov_loans |   .0715077   .0661161     1.08   0.279    -.0580775     .201093
lqdassets_~g |  -.0028532   .0021497    -1.33   0.184    -.0070665    .0013601
nonintexp_ta |   .0982629   .1012741     0.97   0.332    -.1002306    .2967564
earningsas~a |  -.0301337   .0074702    -4.03   0.000     -.044775   -.0154925
bankdep_cu~4 |   .0020491   .0034084     0.60   0.548    -.0046313    .0087295
ebrd_bankr~1 |  -.0349231   .2415437    -0.14   0.885    -.5083401    .4384938
economic_f~t |  -.0272822   .0137194    -1.99   0.047    -.0541718   -.0003926
  rgdpgrowth |    .044644   .0151719     2.94   0.003     .0149077    .0743803
  gdp_percap |   .0000448   .0000225     1.99   0.046     7.49e-07    .0000889
    cpi_ebrd |    .012719   .0135246     0.94   0.347    -.0137888    .0392268
  dv_foreign |  -.0903922   .0942315    -0.96   0.337    -.2750826    .0942983
   dv_origin |   -.004709   .0990846    -0.05   0.962    -.1989113    .1894934
     dv_2000 |   .3908999   .3771377     1.04   0.300    -.3482765    1.130076
     dv_2001 |   .6161103    .360216     1.71   0.087    -.0899001    1.322121
     dv_2002 |   .0858895   .2975053     0.29   0.773    -.4972101    .6689891
     dv_2003 |   .2706731   .2798293     0.97   0.333    -.2777822    .8191285
     dv_2004 |   .3252969   .2394423     1.36   0.174    -.1440014    .7945951
     dv_2005 |   .0852346   .2111818     0.40   0.687    -.3286741    .4991433
     dv_2006 |  -.0351202   .1960315    -0.18   0.858     -.419335    .3490945
     dv_2007 |  -.0677027   .1770273    -0.38   0.702    -.4146699    .2792644
     dv_2008 |  -.1737066   .1659212    -1.05   0.295    -.4989061    .1514929
      dv_bos |  -.8233293   .2461281    -3.35   0.001    -1.305731   -.3409271
      dv_bul |  -.2629539   .3508937    -0.75   0.454     -.950693    .4247852
      dv_cro |  -1.115393   .4705851    -2.37   0.018    -2.037723   -.1930635
      dv_cze |  -1.054614   .5572024    -1.89   0.058    -2.146711    .0374823
      dv_est |  -.9181797   .6124369    -1.50   0.134    -2.118534    .2821745
      dv_hun |  -.4896366   .5491969    -0.89   0.373    -1.566043    .5867696
      dv_lat |  -.7061448   .4101323    -1.72   0.085    -1.509989    .0976997
      dv_lit |  -1.135503   .3792404    -2.99   0.003    -1.878801   -.3922059
      dv_mac |  -.1462047   .3341719    -0.44   0.662    -.8011695    .5087601
      dv_pol |  -1.008987   .4651515    -2.17   0.030    -1.920667   -.0973067
      dv_rom |  -.7663042   .3826314    -2.00   0.045    -1.516248   -.0163605
      dv_ser |  -.5202061   .5359437    -0.97   0.332    -1.570636    .5302242
```

```
      dv_svk |  -1.137506   .4423516    -2.57   0.010    -2.004499   -.2705125
      dv_slo |  -1.554524   .5458076    -2.85   0.004    -2.624287   -.4847612
       _cons |    3.46343   2.287095     1.51   0.130    -1.019194    7.946054
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(h_stat3 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L2.prov_loans
    L2.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    L.Lagnim
Instruments for levels equation
  Standard
    h_stat3 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.prov_loans
    DL.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    D.Lagnim
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -4.65  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.92  Pr > z =  0.360
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(102)  = 353.51  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(102)  =  97.84  Prob > chi2 =  0.598
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(46)   =  45.58  Prob > chi2 =  0.490
    Difference (null H = exogenous): chi2(56)   =  52.26  Prob > chi2 =  0.617
  gmm(Lagnim, lag(1 1))
    Hansen test excluding group:     chi2(88)   =  91.10  Prob > chi2 =  0.389
    Difference (null H = exogenous): chi2(14)   =   6.74  Prob > chi2 =  0.944
  gmm(equity_ta nonintexp_ta nonintinc_ta loggross_loans, lag(2 2))
    Hansen test excluding group:     chi2(27)   =  28.33  Prob > chi2 =  0.394
    Difference (null H = exogenous): chi2(75)   =  69.51  Prob > chi2 =  0.657
  gmm(prov_loans, lag(2 2))
    Hansen test excluding group:     chi2(83)   =  81.46  Prob > chi2 =  0.527
    Difference (null H = exogenous): chi2(19)   =  16.38  Prob > chi2 =  0.632
  iv(h_stat3 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
    Hansen test excluding group:     chi2(68)   =  70.43  Prob > chi2 =  0.396
    Difference (null H = exogenous): chi2(34)   =  27.41  Prob > chi2 =  0.781
```

Bootstrapped standard errors:

```
bootstrap _b[h_stat3], reps(500) cluster(bank) idcluster(myclid) group(bank) seed (22):
xtabond2 nim Lagnim h_stat3 equity_ta nonintinc_ta loggross_loans prov_loans lqdassets_
custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1 economic_
freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1))
gmm( equity_ta nonintexp_ta nonintinc_ta loggross_loans, laglimits (2 2)) gmm (prov_loans,
laglimits (2 2)) iv(h_stat3 lqdassets_custstfunding earningsassets_ta bankdep_custdep
ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin) robust
twostep
(running xtabond2 on estimation sample)

Bootstrap replications (500)
----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
..................................................    50
..................................................   100
..................................................   150
..................................................   200
..................................................   250
....x.............................................   300
..................................................   350
x..........x......................................   400
..................................................   450
..................................................   500

Bootstrap results                               Number of obs      =      1498
                                                Replications       =       497

      command:  xtabond2 nim Lagnim h_stat3 equity_ta nonintinc_ta loggross_loans
                    prov_loans lqdassets_custstfunding nonintexp_ta earningsassets_ta
                    bankdep_custdep ebrd_bankref1 economic_freedom_hrt rgdpgrowth
                    gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001 dv_2002
                    dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos
                    dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
                    dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1)) gmm(
                    equity_ta nonintexp_ta nonintinc_ta loggross_loans, laglimits (2 2))
                    gmm(prov_loans, laglimits (2 2)) iv(h_stat3 lqdassets_custstfunding
                    earningsassets_ta bankdep_custdep ebrd_bankref1 economic_freedom_hrt
                    rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003
                    dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro
                    dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser
                    dv_svk dv_slo dv_foreign dv_origin) robust twostep
        _bs_1:  _b[h_stat3]

                                  (Replications based on 285 clusters in bank)
------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _bs_1 |   -.030094   .0154149    -1.95   0.051    -.0603067    .0001187
------------------------------------------------------------------------------
Note: one or more parameters could not be estimated in 3 bootstrap replicates;
      standard-error estimates include only complete replications.
```

Specification 4

Note: includes the Lerner Index (*lerner_index*) as a measure of market power.

```
xtabond2 nim Lagnim lerner_index equity_ta nonintinc_ta loggross_loans prov_loans
lqdassets_custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1 econ
> omic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1))
gmm(equity_ta nonintexp_ta nonintinc_ta loggross_loans, laglimits (2 2)) gmm(prov_loans,
laglimits (2 5)) iv(lerner_index lqdassets_custstfunding earningsassets_ta bankdep_custdep
ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin) robust
twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per
> m.
dv_2000 dropped due to collinearity
dv_2001 dropped due to collinearity
dv_2009 dropped due to collinearity
dv_est dropped due to collinearity
dv_lit dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimatio
> n.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1380
Time variable : year                            Number of groups   =       265
Number of instruments = 141                     Obs per group: min =         1
Wald chi2(36) =   2484.03                                      avg =      5.21
Prob > chi2   =     0.000                                      max =         8
------------------------------------------------------------------------------
             |              Corrected
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |    .612043   .1058305     5.78   0.000      .404619    .8194671
lerner_index |   .0123626   .0043128     2.87   0.004     .0039097    .0208156
   equity_ta |   .0375567   .0206554     1.82   0.069    -.0029272    .0780405
nonintinc_ta |  -.1003639   .1043116    -0.96   0.336    -.3048109    .1040831
loggross_l~s |   .1700048   .1017186     1.67   0.095      -.02936    .3693697
  prov_loans |   .0855729   .0603713     1.42   0.156    -.0327528    .2038985
lqdassets_~g |  -.0038185   .0031999    -1.19   0.233    -.0100902    .0024531
nonintexp_ta |   .1362424    .112924     1.21   0.228    -.0850846    .3575694
earningsas~a |  -.0359109   .0072399    -4.96   0.000    -.0501009   -.0217209
bankdep_cu~4 |   .0044094   .0034028     1.30   0.195      -.00226    .0110788
ebrd_bankr~1 |   .2390418   .2638784     0.91   0.365    -.2781504     .756234
economic_f~t |  -.0217024   .0144512    -1.50   0.133    -.0500264    .0066215
  rgdpgrowth |    .049881   .0163878     3.04   0.002     .0177616    .0820004
  gdp_percap |    .000031   .0000208     1.49   0.135    -9.66e-06    .0000717
    cpi_ebrd |    .006733   .0149794     0.45   0.653     -.022626    .0360921
  dv_foreign |  -.1217163   .1003094    -1.21   0.225    -.3183192    .0748865
   dv_origin |   .0150561   .1079641     0.14   0.889    -.1965496    .2266617
     dv_2002 |   .0143711   .2809377     0.05   0.959    -.5362566    .5649989
     dv_2003 |    .297557   .2855127     1.04   0.297    -.2620377    .8571518
     dv_2004 |   .2794973   .2391043     1.17   0.242    -.1891385     .748133
     dv_2005 |   .0388099   .2296473     0.17   0.866    -.4112905    .4889104
     dv_2006 |  -.1045529   .2057455    -0.51   0.611    -.5078067    .2987008
     dv_2007 |  -.1631315   .1947168    -0.84   0.402    -.5447694    .2185063
     dv_2008 |  -.1974446   .1845539    -1.07   0.285    -.5591635    .1642744
      dv_bos |  -.8389226   .2217989    -3.78   0.000     -1.27364   -.4042048
      dv_bul |  -.5411433   .3330156    -1.62   0.104    -1.193842    .1115554
      dv_cro |  -1.180014   .4284289    -2.75   0.006    -2.019719   -.3403085
      dv_cze |  -1.175681   .4977446    -2.36   0.018    -2.151243     -.20012
      dv_hun |   -.571285   .5323599    -1.07   0.283    -1.614691    .4721212
      dv_lat |  -1.052516   .3904654    -2.70   0.007    -1.817815   -.2872183
      dv_mac |  -.3665997   .2712641    -1.35   0.177    -.8982675    .1650681
      dv_pol |  -1.069334   .4484316    -2.38   0.017    -1.948244   -.1904245
      dv_rom |  -.8241714   .3374803    -2.44   0.015    -1.485621   -.1627222
      dv_ser |  -.7572893   .5309211    -1.43   0.154    -1.797876    .2832969
      dv_svk |  -1.131893   .4103661    -2.76   0.006    -1.936195   -.3275899
      dv_slo |  -1.540211   .4645305    -3.32   0.001    -2.450674   -.6297476
       _cons |   2.457656   2.183527     1.13   0.260    -1.821978    6.737291
```

```
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(lerner_index lqdassets_custstfunding earningsassets_ta
    bankdep_custdep_c4 ebrd_bankref1 economic_freedom_hrt rgdpgrowth
    gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
    dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun
    dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
    dv_origin)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/5).prov_loans
    L2.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    L.Lagnim
Instruments for levels equation
  Standard
    lerner_index lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.prov_loans
    DL.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    D.Lagnim
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -4.09  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.95  Pr > z =  0.340
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(104)  = 369.16  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(104)  = 109.56  Prob > chi2 =  0.335
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(56)   =  69.05  Prob > chi2 =  0.113
    Difference (null H = exogenous): chi2(48)   =  40.51  Prob > chi2 =  0.770
  gmm(Lagnim, lag(1 1))
    Hansen test excluding group:     chi2(91)   =  99.18  Prob > chi2 =  0.262
    Difference (null H = exogenous): chi2(13)   =  10.38  Prob > chi2 =  0.663
  gmm(equity_ta nonintexp_ta nonintinc_ta loggross_loans, lag(2 2))
    Hansen test excluding group:     chi2(42)   =  51.82  Prob > chi2 =  0.142
    Difference (null H = exogenous): chi2(62)   =  57.73  Prob > chi2 =  0.630
  gmm(prov_loans, lag(2 5))
    Hansen test excluding group:     chi2(69)   =  72.81  Prob > chi2 =  0.354
    Difference (null H = exogenous): chi2(35)   =  36.75  Prob > chi2 =  0.388
  iv(lerner_index lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
    Hansen test excluding group:     chi2(73)   =  75.92  Prob > chi2 =  0.385
    Difference (null H = exogenous): chi2(31)   =  33.64  Prob > chi2 =  0.341
```

Bootstrapped standard errors:

```
bootstrap _b[lerner_index], reps(500) cluster(bank) idcluster(myclid) group(bank) seed (22):
xtabond2 nim Lagnim lerner_index equity_ta nonintinc_ta loggross_loans prov_loans
lqdassets_custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001
dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze
dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits
(1 1)) gmm( equity_ta nonintexp_ta nonintinc_ta loggross_loans, laglimits (2 2)) gmm(
prov_loans, laglimits (2 5)) iv(lerner_index lqdassets_custstfunding earningsassets_ta
bankdep_custdep ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro
dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
dv_origin) robust twostep
(running xtabond2 on estimation sample)

Bootstrap replications (500)
----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
..................................................    50
..................................................   100
..................................................   150
..................................................   200
..................................................   250
..................................................   300
..................................................   350
..................................................   400
..................................................   450
..................................................   500

Bootstrap results                               Number of obs      =      1380
                                                Replications       =       500

      command:  xtabond2 nim Lagnim lerner_index equity_ta nonintinc_ta loggross_loans
                    prov_loans lqdassets_custstfunding nonintexp_ta earningsassets_ta
                    bankdep_custdep ebrd_bankref1 economic_freedom_hrt rgdpgrowth
                    gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001 dv_2002
                    dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos
                    dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
                    dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1)) gmm(
                    equity_ta nonintexp_ta nonintinc_ta loggross_loans, laglimits (2 2))
                    gmm(prov_loans, laglimits (2 5)) iv(lerner_index
                    lqdassets_custstfunding earningsassets_ta bankdep_custdep
                    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd
                    dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
                    dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
                    dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
                    dv_origin) robust twostep
        _bs_1:  _b[lerner_index]

                                  (Replications based on 265 clusters in bank)
------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _bs_1 |   .0123626   .0048756     2.54   0.011     .0028066    .0219187
------------------------------------------------------------------------------
```

Specification 5

Note: replaces the measure of competition with the degree of market concentration (i.e. Herfindahl-Hirschman Index: *HHI_dep*).

```
xtabond2 nim Lagnim hhi_dep equity_ta nonintinc_ta loggross_loans prov_loans lqdassets_
custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1 economic_
freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 2))
gmm( equity_ta nonintexp_ta nonintinc_ta loggross_loans, laglimits (2 2)) gmm(prov_loans,
laglimits (2 5)) iv(hhi_dep lqdassets_custstfunding earningsassets_ta bankdep_custdep
ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin) robust
twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per
> m.
dv_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimatio
> n.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1530
Time variable : year                            Number of groups   =       285
Number of instruments = 172                     Obs per group: min =         1
Wald chi2(40) =   2834.88                                      avg =      5.37
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |   .6472319   .0827422     7.82   0.000     .4850602    .8094036
     hhi_dep |    .000313    .000144     2.17   0.030     .0000308    .0005953
   equity_ta |   .0410104   .0201206     2.04   0.042     .0015747    .0804461
nonintinc_ta |  -.1122743   .1057285    -1.06   0.288    -.3194984    .0949498
loggross_l~s |   .2139026   .0836558     2.56   0.011     .0499402     .377865
  prov_loans |   .0969084   .0493323     1.96   0.049     .0002188     .193598
lqdassets_~g |  -.0020262   .0023327    -0.87   0.385    -.0065983    .0025458
nonintexp_ta |   .1713151   .0972837     1.76   0.078    -.0193574    .3619875
earningsas~a |  -.0311906   .0065015    -4.80   0.000    -.0439333   -.0184479
bankdep_cu~4 |   .0040645   .0031856     1.28   0.202    -.0021792    .0103082
ebrd_bankr~1 |    .211067   .2375889     0.89   0.374    -.2545987    .6767328
economic_f~t |  -.0214992   .0131085    -1.64   0.101    -.0471913     .004193
  rgdpgrowth |   .0577727   .0141938     4.07   0.000     .0299534     .085592
  gdp_percap |   .0000379   .0000214     1.77   0.077    -4.04e-06    .0000798
    cpi_ebrd |   .0010431   .0147022     0.07   0.943    -.0277727    .0298588
  dv_foreign |  -.1653948   .0974986    -1.70   0.090    -.3564886     .025699
   dv_origin |   .0048537   .1171384     0.04   0.967    -.2247333    .2344407
     dv_2000 |    .253144   .4025542     0.63   0.529    -.5358477    1.042136
     dv_2001 |    .383443   .3990165     0.96   0.337    -.3986149    1.165501
     dv_2002 |  -.0324125   .2651962    -0.12   0.903    -.5521876    .4873626
     dv_2003 |   .1774244   .2640554     0.67   0.502    -.3401146    .6949634
     dv_2004 |   .2441769    .216172     1.13   0.259    -.1795123    .6678661
     dv_2005 |   .0205987    .210159     0.10   0.922    -.3913054    .4325028
     dv_2006 |  -.0979109    .188528    -0.52   0.604     -.467419    .2715972
     dv_2007 |   -.138334   .1829703    -0.76   0.450    -.4969493    .2202813
     dv_2008 |  -.1775598   .1657339    -1.07   0.284    -.5023922    .1472726
      dv_bos |   -.386209    .248484    -1.55   0.120    -.8732287    .1008107
      dv_bul |   .0688352   .3299373     0.21   0.835    -.5778301    .7155005
      dv_cro |  -.7402066   .4206958    -1.76   0.078    -1.564755     .084342
      dv_cze |  -.8809404   .4631568    -1.90   0.057    -1.788711    .0268302
      dv_est |  -.6823797   .5039394    -1.35   0.176    -1.670083    .3053234
      dv_hun |  -.3694582   .4772309    -0.77   0.439    -1.304814    .5658972
      dv_lat |  -.3832532    .430006    -0.89   0.373    -1.226049    .4595432
      dv_lit |  -.9602804   .3062741    -3.14   0.002    -1.560567   -.3599942
      dv_mac |  -.1373057   .2732893    -0.50   0.615    -.6729428    .3983314
      dv_pol |   -.649292   .4693267    -1.38   0.167    -1.569155    .2705715
      dv_rom |    -.44471   .2884214    -1.54   0.123    -1.010006    .1205855
      dv_ser |  -.5176591   .4552193    -1.14   0.255    -1.409872    .3745543
```

```
      dv_svk |  -.8276732   .3894139    -2.13   0.034     -1.59091   -.0644359
      dv_slo |  -1.175224   .4777509    -2.46   0.014    -2.111599   -.2388498
       _cons |   .5984094   1.987547     0.30   0.763    -3.297112     4.49393
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(hhi_dep lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/5).prov_loans
    L2.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    L(1/2).Lagnim
Instruments for levels equation
  Standard
    hhi_dep lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.prov_loans
    DL.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    D.Lagnim
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -4.52  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.66  Pr > z =  0.508
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(131)  = 403.98  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(131)  = 134.56  Prob > chi2 =  0.398
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(75)   =  88.88  Prob > chi2 =  0.131
    Difference (null H = exogenous): chi2(56)   =  45.68  Prob > chi2 =  0.836
  gmm(Lagnim, lag(1 2))
    Hansen test excluding group:     chi2(109)  = 115.38  Prob > chi2 =  0.320
    Difference (null H = exogenous): chi2(22)   =  19.18  Prob > chi2 =  0.634
  gmm(equity_ta nonintexp_ta nonintinc_ta loggross_loans, lag(2 2))
    Hansen test excluding group:     chi2(56)   =  71.66  Prob > chi2 =  0.077
    Difference (null H = exogenous): chi2(75)   =  62.89  Prob > chi2 =  0.839
  gmm(prov_loans, lag(2 5))
    Hansen test excluding group:     chi2(91)   =  92.03  Prob > chi2 =  0.450
    Difference (null H = exogenous): chi2(40)   =  42.53  Prob > chi2 =  0.363
  iv(hhi_dep lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
    Hansen test excluding group:     chi2(97)   =  97.77  Prob > chi2 =  0.459
    Difference (null H = exogenous): chi2(34)   =  36.79  Prob > chi2 =  0.341
```

Specification 6

Note: excludes the foreign ownership variables.

```
xtabond2 nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans lqdassets_
custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1 economic_
freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005
dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit
dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 2)) gmm(equity_ta
nonintexp_ta nonintinc_ta loggross_loans, laglimits (2 2)) gmm(prov_loans, laglimits (3 5))
iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per
> m.
dv_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimatio
> n.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1822
Time variable : year                            Number of groups   =       347
Number of instruments = 160                     Obs per group: min =         1
Wald chi2(38) =   2812.63                                      avg =      5.25
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |    .666222   .0696984     9.56   0.000     .5296156    .8028284
     h_stat1 |   -.032948   .0177142    -1.86   0.063    -.0676673    .0017712
   equity_ta |    .033818   .0176882     1.91   0.056    -.0008502    .0684861
nonintinc_ta |  -.1709283   .0894924    -1.91   0.056    -.3463302    .0044736
loggross_l~s |    .236889   .1013366     2.34   0.019     .0382729    .4355052
  prov_loans |   .0751385   .0717849     1.05   0.295    -.0655574    .2158343
lqdassets_~g |  -.0022922     .00282    -0.81   0.416    -.0078192    .0032348
nonintexp_ta |   .1791825   .0826646     2.17   0.030     .0171629    .3412022
earningsas~a |  -.0294618    .006739    -4.37   0.000      -.04267   -.0162537
bankdep_cu~4 |   .0030436   .0032422     0.94   0.348    -.0033109    .0093982
ebrd_bankr~1 |  -.1556325   .2050613    -0.76   0.448    -.5575453    .2462803
economic_f~t |  -.0185298   .0155517    -1.19   0.233    -.0490106    .0119509
  rgdpgrowth |   .0509151   .0170717     2.98   0.003     .0174552     .084375
  gdp_percap |   .0000206   .0000206     1.00   0.318    -.0000198     .000061
    cpi_ebrd |    .010576   .0236156     0.45   0.654    -.0357097    .0568617
     dv_2000 |   .4045686   .3732272     1.08   0.278    -.3269433    1.136081
     dv_2001 |   .1979183   .3797732     0.52   0.602    -.5464235      .94226
     dv_2002 |  -.0395011    .244661    -0.16   0.872     -.519028    .4400257
     dv_2003 |   .2177238   .2587595     0.84   0.400    -.2894355    .7248831
     dv_2004 |   .3598842   .2320604     1.55   0.121    -.0949459    .8147143
     dv_2005 |   .1170714   .2094731     0.56   0.576    -.2934883    .5276312
     dv_2006 |  -.0499989   .1916805    -0.26   0.794    -.4256858     .325688
     dv_2007 |  -.0532775   .1847447    -0.29   0.773    -.4153705    .3088154
     dv_2008 |  -.1049062   .2112182    -0.50   0.619    -.5188863     .309074
      dv_bos |  -.7277752    .312383    -2.33   0.020    -1.340035   -.1155157
      dv_bul |  -.2171703   .3114715    -0.70   0.486    -.8276433    .3933027
      dv_cro |  -.6958974   .3657216    -1.90   0.057    -1.412699    .0209037
      dv_cze |  -.7363076   .4913444    -1.50   0.134    -1.699325    .2267097
      dv_est |  -.6759697   .6393661    -1.06   0.290    -1.929104    .5771648
      dv_hun |  -.4452224   .4734621    -0.94   0.347    -1.373191    .4827463
      dv_lat |  -.4733736   .4099593    -1.15   0.248    -1.276879    .3301318
      dv_lit |  -1.107461   .3972046    -2.79   0.005    -1.885968   -.3289545
      dv_mac |  -.1184003   .2872237    -0.41   0.680    -.6813485    .4445479
      dv_pol |  -.8805344   .3840232    -2.29   0.022    -1.633206   -.1278628
      dv_rom |  -.9253582   .3883513    -2.38   0.017    -1.686513   -.1642036
      dv_ser |  -.5557227   .6048226    -0.92   0.358    -1.741153    .6297079
      dv_svk |  -.8583886   .4040345    -2.12   0.034    -1.650282   -.0664956
      dv_slo |   -1.01005   .4840212    -2.09   0.037    -1.958714   -.0613862
       _cons |   1.860295   2.238938     0.83   0.406    -2.527943    6.248532
------------------------------------------------------------------------------
Instruments for first differences equation
```

```
  Standard
    D.(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(3/5).prov_loans
    L2.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    L(1/2).Lagnim
Instruments for levels equation
  Standard
    h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL2.prov_loans
    DL.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    D.Lagnim
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -5.40  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -1.42  Pr > z =  0.154
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(121)  = 445.97  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(121)  = 137.21  Prob > chi2 =  0.149
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(65)   =  90.99  Prob > chi2 =  0.018
    Difference (null H = exogenous): chi2(56)   =  46.23  Prob > chi2 =  0.821
  gmm(Lagnim, lag(1 2))
    Hansen test excluding group:     chi2(100)  = 115.65  Prob > chi2 =  0.136
    Difference (null H = exogenous): chi2(21)   =  21.57  Prob > chi2 =  0.425
  gmm(equity_ta nonintexp_ta nonintinc_ta loggross_loans, lag(2 2))
    Hansen test excluding group:     chi2(46)   =  54.35  Prob > chi2 =  0.186
    Difference (null H = exogenous): chi2(75)   =  82.87  Prob > chi2 =  0.250
  gmm(prov_loans, lag(3 5))
    Hansen test excluding group:     chi2(90)   =  98.14  Prob > chi2 =  0.261
    Difference (null H = exogenous): chi2(31)   =  39.07  Prob > chi2 =  0.151
  iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo)
    Hansen test excluding group:     chi2(88)   = 106.09  Prob > chi2 =  0.092
    Difference (null H = exogenous): chi2(33)   =  31.12  Prob > chi2 =  0.561
```

Specification 7

Note: includes the interaction term between operating expenses (*nonintexp_ta*) and the degree of competition (*h_stat1*) in order test if the relationship between operating expenses and net interest margins is affected by the degree of competition.

```
xtabond2 nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans lqdassets_custstfunding nonintexp_ta hstat1_nonintexpta earningsassets_ta bankdep_custdep ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1)) gmm( equity_ta nonintexp_ta hstat1_nonintexpta nonintinc_ta loggross_loans, laglimits (3 5)) gmm(prov_loans, laglimits (2 5)) iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per
> m.
dv_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimatio
> n.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1498
Time variable : year                            Number of groups   =       285
Number of instruments = 237                     Obs per group: min =         0
Wald chi2(39) =   2464.74                                      avg =      5.26
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |   .5920681   .0811304     7.30   0.000     .4330555    .7510806
     h_stat1 |   .1776263   .0863571     2.06   0.040     .0083695     .346883
   equity_ta |  -.0066934   .0210389    -0.32   0.750    -.0479288    .0345421
nonintinc_ta |  -.2387481   .1131023    -2.11   0.035    -.4604245   -.0170717
loggross_l~s |    .035451   .0633493     0.56   0.576    -.0887114    .1596134
  prov_loans |    .021783   .0504771     0.43   0.666    -.0771504    .1207164
lqdassets_~g |  -.0006222   .0034035    -0.18   0.855    -.0072929    .0060486
nonintexp_ta |   .2705715   .0906344     2.99   0.003     .0929314    .4482116
hstat1_non~a |  -.0673198   .0343931    -1.96   0.050    -.1347289    .0000894
earningsas~a |  -.0247175   .0067338    -3.67   0.000    -.0379155   -.0115196
bankdep_cu~4 |   .0034737   .0035761     0.97   0.331    -.0035354    .0104828
ebrd_bankr~1 |   .1856335   .2399247     0.77   0.439    -.2846103    .6558773
economic_f~t |  -.0319694   .0167246    -1.91   0.056     -.064749    .0008102
  rgdpgrowth |   .0545033   .0115879     4.70   0.000     .0317914    .0772152
  gdp_percap |   .0000607   .0000245     2.48   0.013     .0000127    .0001086
    cpi_ebrd |   .0147725   .0151324     0.98   0.329    -.0148865    .0444315
     dv_2000 |   .1165867   .4813689     0.24   0.809     -.826879    1.060053
     dv_2001 |   .3549072   .3671046     0.97   0.334    -.3646046    1.074419
     dv_2002 |   -.097979   .2771589    -0.35   0.724    -.6412004    .4452424
     dv_2003 |   .0562077   .3020471     0.19   0.852    -.5357937    .6482091
     dv_2004 |   .0985603   .2526203     0.39   0.696    -.3965665    .5936871
     dv_2005 |  -.1800122   .2236587    -0.80   0.421    -.6183752    .2583507
     dv_2006 |  -.1713722   .2076501    -0.83   0.409    -.5783589    .2356145
     dv_2007 |  -.2750673   .1951268    -1.41   0.159    -.6575089    .1073743
     dv_2008 |    -.35064   .1810829    -1.94   0.053    -.7055559    .0042759
      dv_bos |  -.4826847   .2618775    -1.84   0.065    -.9959551    .0305857
      dv_bul |  -.1609074   .3492055    -0.46   0.645    -.8453377    .5235228
      dv_cro |  -1.248147    .443096    -2.82   0.005    -2.116599    -.379695
      dv_cze |  -1.017631   .4627449    -2.20   0.028    -1.924594   -.1106677
      dv_est |  -.5255971   .5257858    -1.00   0.317    -1.556118    .5049242
      dv_hun |  -.5738117   .5233759    -1.10   0.273     -1.59961    .4519863
      dv_lat |  -.6913515     .37033    -1.87   0.062    -1.417185     .034482
      dv_lit |  -.8701696   .3311021    -2.63   0.009    -1.519118   -.2212213
      dv_mac |   .3097726   .2655878     1.17   0.243    -.2107699     .830315
      dv_pol |  -.8616298   .4582479    -1.88   0.060    -1.759779    .0365197
      dv_rom |  -.5425918   .3205402    -1.69   0.091    -1.170839    .0856555
      dv_ser |   .0270941   .5435941     0.05   0.960    -1.038331    1.092519
      dv_svk |  -1.091232   .3605794    -3.03   0.002    -1.797955   -.3845095
```

```
      dv_slo |  -1.650145   .5006479    -3.30   0.001    -2.631397   -.6688936
       _cons |   4.161045   1.971967     2.11   0.035     .2960607    8.026029
------------------------------------------------------------------------------
Instruments for first differences equation
  Standard
    D.(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.Lagnim
    L(3/5).(equity_ta nonintexp_ta hstat1_nonintexpta nonintinc_ta
    loggross_loans)
    L(2/5).prov_loans
Instruments for levels equation
  Standard
    _cons
    h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.Lagnim
    DL2.(equity_ta nonintexp_ta hstat1_nonintexpta nonintinc_ta
    loggross_loans)
    DL.prov_loans
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -4.55  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -1.01  Pr > z =  0.315
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(197)  = 623.07  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(197)  = 209.33  Prob > chi2 =  0.260
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(138)  = 157.17  Prob > chi2 =  0.126
    Difference (null H = exogenous): chi2(59)   =  52.17  Prob > chi2 =  0.723
  gmm(Lagnim, lag(1 1))
    Hansen test excluding group:     chi2(188)  = 197.16  Prob > chi2 =  0.309
    Difference (null H = exogenous): chi2(9)    =  12.18  Prob > chi2 =  0.203
  gmm(equity_ta nonintexp_ta hstat1_nonintexpta nonintinc_ta loggross_loans, lag(3 5))
    Hansen test excluding group:     chi2(44)   =  43.69  Prob > chi2 =  0.485
    Difference (null H = exogenous): chi2(153)  = 165.64  Prob > chi2 =  0.229
  gmm(prov_loans, lag(2 5))
    Hansen test excluding group:     chi2(157)  = 174.75  Prob > chi2 =  0.158
    Difference (null H = exogenous): chi2(40)   =  34.59  Prob > chi2 =  0.712
  iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
    Hansen test excluding group:     chi2(163)  = 175.74  Prob > chi2 =  0.234
    Difference (null H = exogenous): chi2(34)   =  33.59  Prob > chi2 =  0.488
```

Bootstrapped standard errors:

```
bootstrap _b[hstat1_nonintexpta], reps(500) cluster(bank) idcluster(myclid) group(bank)seed
(22): xtabond2 nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans
lqdassets_custstfunding nonintexp_ta hstat1_nonintexpta  earningsassets_ta bankdep_custdep
ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd  dv_2000 dv_2001 dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1))
gmm( equity_ta nonintexp_ta hstat1_nonintexpta nonintinc_ta loggross_loans, laglimits (3 5))
gmm(prov_loans, laglimits (2 5)) iv(h_stat1 lqdassets_custstfunding earningsassets_ta
bankdep_custdep ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009  dv_bos dv_bul dv_cro
```

```
dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
dv_origin) robust twostep
(running xtabond2 on estimation sample)
    D.(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
    L.Lagnim
    L(3/5).(equity_ta nonintexp_ta hstat1_nonintexpta nonintinc_ta
    loggross_loans)
    L(2/5).prov_loans
    _cons
    h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
    D.Lagnim
    DL2.(equity_ta nonintexp_ta hstat1_nonintexpta nonintinc_ta
    loggross_loans)
    DL.prov_loans
  GMM instruments for levels
  gmm(Lagnim, lag(1 1))
  gmm(equity_ta nonintexp_ta hstat1_nonintexpta nonintinc_ta loggross_loans, lag(3 5))
  gmm(prov_loans, lag(2 5))
  iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1 ec
> onomic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_200
> 4 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_l
> at dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)

Bootstrap replications (500)
----+--- 1 ---+--- 2 ---+--- 3 ---+--- 4 ---+--- 5
...x..............................x.........x...    50
..............x.................................   100
...............x................................   150
................................................   200
..........................x.....................   250
................................................   300
................................................   350
x..................x.....x......................   400
.....x..........................................   450
................x...............................   500

Bootstrap results                               Number of obs      =      1498
                                                Replications       =       489

      command:  xtabond2 nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans
                    prov_loans lqdassets_custstfunding nonintexp_ta hstat1_nonintexpta
                    earningsassets_ta bankdep_custdep ebrd_bankref1 economic_freedom_hrt
                    rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003
                    dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro
                    dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser
                    dv_svk dv_slo, gmm(Lagnim, laglimits (1 1)) gmm( equity_ta
                    nonintexp_ta hstat1_nonintexpta nonintinc_ta loggross_loans,
                    laglimits (3 5)) gmm(prov_loans, laglimits (2 5)) iv(h_stat1
                    lqdassets_custstfunding earningsassets_ta bankdep_custdep
                    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd
                    dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007
                    dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
                    dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign
                    dv_origin) robust twostep
        _bs_1:  _b[hstat1_nonintexpta]

                                  (Replications based on 285 clusters in bank)
------------------------------------------------------------------------------
             |   Observed   Bootstrap                         Normal-based
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       _bs_1 |  -.0673198    .0360029    -1.87   0.062    -.1378842    .0032446
------------------------------------------------------------------------------
Note: one or more parameters could not be estimated in 11 bootstrap replicates;
      standard-error estimates include only complete replications.
```

Specification 8

Note: includes the implicit payments variable among the control variables (*implicit_rate1*).

```
xtabond2 nim Lagnim h_stat1 equity_ta  implicit_rate1 loggross_loans prov_loans  lqdasse
ts_custstfunding  earningsassets_ta  bankdep_custdep  ebrd_bankref1  economic_freedom_hrt
rgdpgrowth gdp_percap cpi_ebrd dv_foreign dv_origin dv_2000  dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009  dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo, gmm(Lagnim, laglimits (1 1)) gmm( equity_ta
loggross_loans  ,  laglimits  (2  2))  gmm(implicit_rate1,  laglimits  (3  3))  gmm(prov_loans,
laglimits   (2   5))   iv(h_stat1   lqdassets_custstfunding   earningsassets_ta   bankdep_custdep
ebrd_bankref1  economic_freedom_hrt  rgdpgrowth  gdp_percap  cpi_ebrd  dv_2000  dv_2001  dv_2002
dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est
dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin) robust
twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per
> m.
dv_2009 dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimatio
> n.
  Difference-in-Sargan/Hansen statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1499
Time variable : year                            Number of groups   =       285
Number of instruments = 144                     Obs per group: min =         1
Wald chi2(39) =   2921.45                                      avg =      5.26
Prob > chi2   =     0.000                                      max =        10
------------------------------------------------------------------------------
             |              Corrected
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |   .6719472   .0771298     8.71   0.000     .5207755    .8231189
     h_stat1 |  -.0314095   .0152226    -2.06   0.039    -.0612452   -.0015738
   equity_ta |    .019952   .0215568     0.93   0.355    -.0222986    .0622027
implicit_r~1 |   .1771207   .0838161     2.11   0.035     .0128443    .3413972
loggross_l~s |   .2142418   .0849631     2.52   0.012     .0477171    .3807664
  prov_loans |   .0555915   .0580649     0.96   0.338    -.0582135    .1693965
lqdassets_~g |  -.0003707    .002612    -0.14   0.887    -.0054902    .0047488
earningsas~a |  -.0289886   .0061961    -4.68   0.000    -.0411327   -.0168445
bankdep_cu~4 |   .0042135   .0028187     1.49   0.135    -.0013111    .0097381
ebrd_bankr~1 |   -.034588    .214308    -0.16   0.872     -.454624     .385448
economic_f~t |  -.0252015   .0156036    -1.62   0.106     -.055784    .0053809
  rgdpgrowth |   .0411411   .0148439     2.77   0.006     .0120476    .0702345
  gdp_percap |    .000046   .0000206     2.23   0.026     5.62e-06    .0000864
    cpi_ebrd |   .0112076   .0131511     0.85   0.394    -.0145681    .0369834
  dv_foreign |  -.1279173   .0915173    -1.40   0.162    -.3072879    .0514532
   dv_origin |  -.0247742   .0880054    -0.28   0.778    -.1972616    .1477132
     dv_2000 |   .4282867   .3994238     1.07   0.284    -.3545696    1.211143
     dv_2001 |   .6597668   .3496206     1.89   0.059    -.0254769     1.34501
     dv_2002 |   .1403464   .2591481     0.54   0.588    -.3675746    .6482673
     dv_2003 |   .3104185   .2659684     1.17   0.243    -.2108701     .831707
     dv_2004 |   .3485655   .2311379     1.51   0.132    -.1044565    .8015876
     dv_2005 |   .1271492   .2081693     0.61   0.541     -.280855    .5351535
     dv_2006 |    .006868   .1941928     0.04   0.972    -.3737429    .3874788
     dv_2007 |  -.0712809   .1793427    -0.40   0.691    -.4227862    .2802244
     dv_2008 |  -.1867387   .1616407    -1.16   0.248    -.5035487    .1300713
      dv_bos |  -.8754063    .223421    -3.92   0.000    -1.313303   -.4375092
      dv_bul |  -.3783128   .2904588    -1.30   0.193    -.9476016     .190976
      dv_cro |  -1.208663   .4033474    -3.00   0.003    -1.999209   -.4181166
      dv_cze |  -1.210489   .4560527    -2.65   0.008    -2.104336   -.3166425
      dv_est |  -1.130078   .5459221    -2.07   0.038    -2.200065   -.0600899
      dv_hun |  -.6980003   .4884387    -1.43   0.153    -1.655323     .259322
      dv_lat |  -.7456895    .353317    -2.11   0.035    -1.438178   -.0532009
      dv_lit |  -1.196823   .3315732    -3.61   0.000    -1.846694    -.546951
      dv_mac |  -.1328249   .3391877    -0.39   0.695    -.7976206    .5319709
      dv_pol |  -1.112616   .3176553    -3.50   0.000    -1.735208   -.4900227
      dv_rom |  -.9549214   .3345333    -2.85   0.004    -1.610595   -.2992482
      dv_ser |  -.4055439   .5198461    -0.78   0.435    -1.424424    .6133359
      dv_svk |  -1.182332   .3768079    -3.14   0.002    -1.920862   -.4438019
      dv_slo |  -1.619861   .4728329    -3.43   0.001    -2.546596   -.6931252
       _cons |   2.343235   2.072001     1.13   0.258    -1.717811    6.404282
------------------------------------------------------------------------------
```

```
Instruments for first differences equation
  Standard
    D.(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L(2/5).prov_loans
    L3.implicit_rate1
    L2.(equity_ta loggross_loans)
    L.Lagnim
Instruments for levels equation
  Standard
    h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin
    _cons
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    DL.prov_loans
    DL2.implicit_rate1
    DL.(equity_ta loggross_loans)
    D.Lagnim
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -5.02  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.85  Pr > z =  0.395
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(104)  = 345.06  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(104)  =  99.37  Prob > chi2 =  0.610
  (Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(56)   =  64.31  Prob > chi2 =  0.208
    Difference (null H = exogenous): chi2(48)   =  35.06  Prob > chi2 =  0.918
  gmm(Lagnim, lag(1 1))
    Hansen test excluding group:     chi2(90)   =  86.91  Prob > chi2 =  0.573
    Difference (null H = exogenous): chi2(14)   =  12.47  Prob > chi2 =  0.569
  gmm(equity_ta loggross_loans, lag(2 2))
    Hansen test excluding group:     chi2(67)   =  71.14  Prob > chi2 =  0.342
    Difference (null H = exogenous): chi2(37)   =  28.24  Prob > chi2 =  0.849
  gmm(implicit_rate1, lag(3 3))
    Hansen test excluding group:     chi2(86)   =  89.07  Prob > chi2 =  0.389
    Difference (null H = exogenous): chi2(18)   =  10.31  Prob > chi2 =  0.921
  gmm(prov_loans, lag(2 5))
    Hansen test excluding group:     chi2(64)   =  71.29  Prob > chi2 =  0.248
    Difference (null H = exogenous): chi2(40)   =  28.08  Prob > chi2 =  0.922
  iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin)
    Hansen test excluding group:     chi2(70)   =  68.23  Prob > chi2 =  0.538
    Difference (null H = exogenous): chi2(34)   =  31.15  Prob > chi2 =  0.608
```

Specification 9

Note: includes the volatility of money market interest rates (*stdev_interbank*) among the control variables.

```
xtabond2 nim Lagnim h_stat1 equity_ta nonintinc_ta loggross_loans prov_loans lqdassets_
custstfunding nonintexp_ta earningsassets_ta bankdep_custdep ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd stdev_interbank dv_foreign dv_origin
dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos
dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo,
gmm(Lagnim, laglimits (1 1)) gmm( equity_ta nonintexp_ta nonintinc_ta loggross_loans,
laglimits (2 2)) gmm(prov_loans, laglimits (2 3)) iv(h_stat1 lqdassets_custstfunding
earningsassets_ta bankdep_custdep ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap
cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk
dv_slo dv_foreign dv_origin stdev_interbank) robust twostep
Favoring space over speed. To switch, type or click on mata: mata set matafavor speed, per m.
dv_2000 dropped due to collinearity
dv_2001 dropped due to collinearity
dv_2009 dropped due to collinearity
dv_bos dropped due to collinearity
Warning: Two-step estimated covariance matrix of moments is singular.
  Using a generalized inverse to calculate optimal weighting matrix for two-step estimation.
  Difference-in-Sargan statistics may be negative.

Dynamic panel-data estimation, two-step system GMM
------------------------------------------------------------------------------
Group variable: bank                            Number of obs      =      1326
Time variable : year                            Number of groups   =       260
Number of instruments = 130                     Obs per group: min =         1
Wald chi2(38) =   2498.63                                      avg =      5.10
Prob > chi2   =     0.000                                      max =         8
------------------------------------------------------------------------------
             |              Corrected
         nim |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      Lagnim |   .7520719   .0717721    10.48   0.000     .6114011    .8927427
     h_stat1 |  -.0326195   .0193024    -1.69   0.091    -.0704515    .0052124
   equity_ta |   .0449562   .0175698     2.56   0.011     .0105201    .0793923
nonintinc_ta |  -.2720017    .114066    -2.38   0.017    -.4955669   -.0484364
loggross_l~s |   .2065882   .1080373     1.91   0.056     -.005161    .4183375
  prov_loans |  -.0128563   .0606415    -0.21   0.832    -.1317115     .105999
lqdassets_~g |  -.0007852   .0021062    -0.37   0.709    -.0049133     .003343
nonintexp_ta |   .2300394    .082592     2.79   0.005      .068162    .3919168
earningsas~a |  -.0233106   .0062032    -3.76   0.000    -.0354685   -.0111526
bankdep_cu~4 |   .0005649   .0026278     0.21   0.830    -.0045855    .0057153
ebrd_bankr~1 |   .4579809    .278792     1.64   0.100    -.0884413    1.004403
economic_f~t |  -.0139011   .0204435    -0.68   0.497    -.0539696    .0261673
  rgdpgrowth |   .0375442   .0156329     2.40   0.016     .0069043     .068184
  gdp_percap |   .0000392   .0000241     1.63   0.104    -8.04e-06    .0000864
    cpi_ebrd |  -.0005027   .0145042    -0.03   0.972    -.0289304    .0279251
stdev_inte~k |  -.0372319   .0719479    -0.52   0.605    -.1782472    .1037834
  dv_foreign |  -.2020926   .1217812    -1.66   0.097    -.4407794    .0365943
   dv_origin |    .023403    .115209     0.20   0.839    -.2024025    .2492086
     dv_2002 |    .228104   .3202534     0.71   0.476    -.3995811    .8557891
     dv_2003 |   .2752902   .2981141     0.92   0.356    -.3090027    .8595831
     dv_2004 |   .3058311   .2658293     1.15   0.250    -.2151848    .8268471
     dv_2005 |  -.0327624   .2463803    -0.13   0.894    -.5156589    .4501342
     dv_2006 |  -.1682161   .2285058    -0.74   0.462    -.6160793     .279647
     dv_2007 |  -.1791602   .2092385    -0.86   0.392    -.5892602    .2309398
     dv_2008 |  -.2553675   .1840601    -1.39   0.165    -.6161186    .1053837
      dv_bul |  -.9628803   .4108931    -2.34   0.019    -1.768216   -.1575446
      dv_cro |  -1.794978   .5348301    -3.36   0.001    -2.843226   -.7467303
      dv_cze |  -1.768692   .6520402    -2.71   0.007    -3.046667   -.4907166
      dv_est |  -1.747654   .6878404    -2.54   0.011    -3.095796   -.3995112
      dv_hun |  -1.466197   .6310149    -2.32   0.020    -2.702964   -.2294308
      dv_lat |  -1.180882   .5258258    -2.25   0.025    -2.211481    -.150282
      dv_lit |    -1.5556   .4727379    -3.29   0.001    -2.482149   -.6290505
      dv_mac |  -.3254057   .3865554    -0.84   0.400     -1.08304     .432229
      dv_pol |  -1.465318   .5356567    -2.74   0.006    -2.515186   -.4154501
      dv_rom |  -1.289718   .4146005    -3.11   0.002     -2.10232   -.4771164
      dv_ser |  -2.021559   .6155219    -3.28   0.001     -3.22796   -.8151582
      dv_svk |  -1.608799   .5313391    -3.03   0.002    -2.650205   -.5673937
      dv_slo |  -1.744795   .6700601    -2.60   0.009    -3.058089   -.4315016
       _cons |  -.3326899   1.981117    -0.17   0.867    -4.215608    3.550228
------------------------------------------------------------------------------
```

```
Instruments for first differences equation
  Standard
    D.(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin stdev_interbank)
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    L.Lagnim
    L2.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    L(2/3).prov_loans
Instruments for levels equation
  Standard
    _cons
    h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4
    ebrd_bankref1 economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000
    dv_2001 dv_2002 dv_2003 dv_2004 dv_2005 dv_2006 dv_2007 dv_2008 dv_2009
    dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat dv_lit dv_mac dv_pol
    dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin stdev_interbank
  GMM-type (missing=0, separate instruments for each period unless collapsed)
    D.Lagnim
    DL.(equity_ta nonintexp_ta nonintinc_ta loggross_loans)
    DL.prov_loans
------------------------------------------------------------------------------
Arellano-Bond test for AR(1) in first differences: z =  -5.03  Pr > z =  0.000
Arellano-Bond test for AR(2) in first differences: z =  -0.69  Pr > z =  0.491
------------------------------------------------------------------------------
Sargan test of overid. restrictions: chi2(91)   = 344.70  Prob > chi2 =  0.000
  (Not robust, but not weakened by many instruments.)
Hansen test of overid. restrictions: chi2(91)   =  97.19  Prob > chi2 =  0.309
  (Robust, but can be weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
  GMM instruments for levels
    Hansen test excluding group:     chi2(43)   =  49.39  Prob > chi2 =  0.233
    Difference (null H = exogenous): chi2(48)   =  47.80  Prob > chi2 =  0.481
  gmm(Lagnim, lag(1 1))
    Hansen test excluding group:     chi2(78)   =  85.99  Prob > chi2 =  0.251
    Difference (null H = exogenous): chi2(13)   =  11.20  Prob > chi2 =  0.594
  gmm(equity_ta nonintexp_ta nonintinc_ta loggross_loans, lag(2 2))
    Hansen test excluding group:     chi2(29)   =  33.43  Prob > chi2 =  0.261
    Difference (null H = exogenous): chi2(62)   =  63.76  Prob > chi2 =  0.414
  gmm(prov_loans, lag(2 3))
    Hansen test excluding group:     chi2(69)   =  80.76  Prob > chi2 =  0.157
    Difference (null H = exogenous): chi2(22)   =  16.43  Prob > chi2 =  0.794
  iv(h_stat1 lqdassets_custstfunding earningsassets_ta bankdep_custdep_c4 ebrd_bankref1
economic_freedom_hrt rgdpgrowth gdp_percap cpi_ebrd dv_2000 dv_2001 dv_2002 dv_2003 dv_2004
dv_2005 dv_2006 dv_2007 dv_2008 dv_2009 dv_bos dv_bul dv_cro dv_cze dv_est dv_hun dv_lat
dv_lit dv_mac dv_pol dv_rom dv_ser dv_svk dv_slo dv_foreign dv_origin stdev_interbank)
    Hansen test excluding group:     chi2(59)   =  70.06  Prob > chi2 =  0.154

    Difference (null H = exogenous): chi2(32)   =  27.14  Prob > chi2 =  0.711
```