STAFFORDSHIRE UNIVERSITY

Ownership transformation and firm performance in the successor states of the former Yugoslavia

HASHANI, Alban

May 2016

A thesis submitted in partial fulfilment of the requirements of Staffordshire University for the Degree of Doctor of Philosophy

Abstract

Privatization became a major component of economic policy around the world since the mid-1980s despite the conflicting theoretical arguments and empirical evidence for this policy. The inconclusive evidence, apart from reflecting genuine differences among countries and industries under investigation, is also the result of methodological and empirical problems this literature is beset with. This provides the motivation for this research project which intends to contribute to the literature by addressing some of these problems and also by applying it to a particular set of countries, the successor states of the former Yugoslavia, that have been either not studied at all or not studied as a group despite the fact that they share the same history and the same economic, political and social background which are distinct from other transition economies. As with the established empirical literature in the field, the research focuses on the impact of privatization on the performance of firms in the broad context of the neoclassical theory and its extensions.

The thesis aims at investigating the impact of privatization on companies' performance in Bosnia and Herzegovina, Croatia, Kosovo, Macedonia, Montenegro, Serbia and Slovenia, independent countries that emerged from the disintegration of the former Yugoslavia. In doing so, this thesis initially embarks on a critical review of theoretical and empirical literature, identifying their theoretical predictions and assessing their empirical validity, highlighting a variety of methodological problems from which the previous studies have suffered. The empirical investigation of this thesis uses Stochastic Frontier Analysis to estimate the efficiency of companies with different ownership structures. It also addressed the issue of missing data by employing a multiple imputation procedure. In addition, policy evaluation econometrics using matched difference-in-difference estimators is employed for estimating the causal relationship between ownership transformation and companies' performance. Special attention is paid to addressing the issue of selection bias which is the main challenge in evaluating the effect of privatization.

The empirical results suggest that privatization is associated with improvement in companies' performance in terms of technical efficiency and sales levels, while it is associated with a significant drop in employment levels. Also, privatization is associated with improvement in performance over time. The results suggest that there is some heterogeneity across countries, industries and ownership types. In particular, they show that the average efficiency scores of companies in the successor states vary systematically across these countries with Slovenian companies being the most efficient, followed by those in Croatia, Montenegro, Bosnia, Serbia and Macedonia i.e., in some order of institutional and economic development in the region.

Table of Content

List of Table

List of Figures

Abbreviations

2SLS	-	Two Stage Least Square
ANOVA	-	Analysis of variance
BEEPS	-	Business Environment and Enterprise Performance Survey
CFR	-	Common Factor Restrictions
CG	-	Corporate Governance
COLS	-	Corrected Ordinary Least Squares
CRS DEA	-	Constant Returns to Scale Data Envelopment Analysis
DA	-	Data Augmentation process
DEA	-	Data Envelopment Analysis
DFA	-	Distribution Free Approach
DID	-	Difference-in-Difference
DM	-	Deutsche Mark
DTI	-	Department of Trade and Industry
EBRD	-	European Bank for Reconstruction and Development
EM	-	Expectation–Maximization algorithm
EU	-	European Union
FC	-	Fixed Costs
FDI	-	Foreign Direct Investment
GDP	-	Gross domestic product
GMM	-	Generalised Method of Moments
IMF	-	International Monetary Fund
IMR	-	Invers Mill's Ratio
IQR	-	Interquartile Range
IV	-	Instrumental Variable
KAS	-	Kosovo Agency for Statistics
KTA	-	Kosovo Trust Agency
LCY	-	League of Communists of Yugoslavia
LR	-	Likelihood Ratio
MAR	-	Missing at Random
MCAR	-	Missing Completely at Random
MCMC	-	Markov Chain Monte Carlo
MEBO	-	Management and Employee Buyout
MI	-	Multiple Imputation
MLE	-	Maximum Likelihood Estimation
MOLS	-	Modified Ordinary Least Squares
NMAR	-	Not Missing at Random
OECD	-	Organisation for Economic Co-operation and Development
OLS	-	Ordinary Least Squares
PAK	-	Privatization Agency of Kosovo

POE	-	Publicly Owned Enterprise
PSM	-	Propensity Score Matching
SFA	-	Stochastic Frontier Analysis
SFRJ	-	Socialist Federal Republic of Yugoslavia
SOE	-	State Owned Enterprise
SUTVA	-	Stable Unit Treatment Value Assumption
TE	-	Transition Economy
TFA	-	Thick Frontier Approach
UN	-	United Nations
UNMIK	-	United Nations Mission in Kosovo
USD	-	United States Dollar
VRS DEA	-	Variable Returns to Scale Data Envelopment Analysis
WWII	-	World War II

Acknowledgement

First and foremost, I would like to thank my supervisor, Professor Iraj Hashi, for his continuous support, dedication and encouragement since this endeavour started. His observations and comments and many motivating discussions have been invaluable. My sincere appreciation is extended to Professor Geoffrey Pugh for his very useful input on my empirical research. I also owe my gratitude to other professors and staff at Staffordshire University.

I am forever indebted to my parents and family for their understanding, endless patience and encouragement during these years.

Last but not least, I gratefully acknowledge the generous financial support from the Open Society Foundation and Staffordshire University.

This thesis is dedicated to the memory of my late parents!

Preface

Privatization has been a major component of economic policy around the world during the last four decades. It was part of a reconsideration of the role of the state in the economy, both in developed and developing countries, which was settled in favour of the view that state involvement had been excessive, and that the private ownership would raise both allocative and technical efficiency (defined in the context of the neoclassical theory and the assumption of optimising firms), leading to greater economic well-being. While over half a century ago, there was general support for public ownership in a variety of the so-called 'strategic' industries, the following decades witnessed a shift towards the support for the return of these industries to private ownership. This was primarily encouraged by well-documented poor performance of State Owned Enterprises (SOEs) as well as by the return to prominence of theoretical propositions that support private ownership over public ownership. The theoretical arguments, however, do not seem to have provided a definitive prediction on the relation between ownership and performance. A large body of empirical literature on the subject also failed to provide conclusive evidence on the relationship between the ownership form and performance of companies.

In spite of inconclusive theoretical and empirical arguments, the privatization policy has been embraced by governments around the globe soon after Mrs Thatcher's Conservative government embarked on its privatization programme in the UK. The last major region to embrace the privatization policy was Central and Eastern Europe. Privatization in this region was part of the broader effort to transform the countries of the region from command to market economies. As the scope and size of the state sector in these economies was much wider and larger than in Western countries, the scale and scope of privatization in the former was much greater and more diverse than in the latter.

The impact of ownership transformation on companies' performance has been the subject of extensive research. However the evidence is still somewhat mixed. While differences in results can reflect genuine heterogeneity among countries and industries under investigation, they may also be due to a variety of empirical problems that have been largely overlooked in the current literature. This provides the motivation for this research project which intends to contribute in filling a gap in the literature by remedying some of these problems. Also, this thesis covers a particular set of countries that have not been investigated jointly, and some of them not individually, despite the fact that they were part of the same country and under the same economic system for nearly half a century.

The aim of this thesis is to investigate the impact of privatization on companies' performance in successor states of former Yugoslavia (Bosnia and Herzegovina, Croatia, Kosovo, Macedonia, Montenegro, Serbia and Slovenia). This thesis addresses the following specific research questions: does ownership matter, in theory and practise; weather private companies perform better then SOEs; whether foreign companies display better performance compared to domestic de-novo private companies and SOEs; whether following privatization, firms improve their performance measured in terms of selected performance indicators; and whether there is any difference in performance of companies across the six countries under consideration?

As this list indicates, the thesis is a purely microeconomic study within the framework of the neoclassical theory and its extensions and the assumption of optimising firms. As with the established empirical literature on privatisation (such as Megginson and Netter, 2001; Djankov and Murrell, 2002; Estrin et al., 2009), it focuses on the impact of this policy the performance of the firm measured by productivity or efficiency as defined in the broad framework of neoclassical theory and its extensions. The thesis does not investigate the macroeconomic implications of the privatization policy such as the potential increase in unemployment in the aftermath of large scale privatisation – issues which are beyond the scope of this study.

The main motivation and the importance of this thesis is in its contribution to current literature on privatization, especially in the context of successor states of former Yugoslavia. The novelty of the research in this thesis is that it uses up-to-date econometric techniques that have not been previously applied in the context of the countries that are in the focus of this thesis. These approaches try to remedy some of the problems that are often overlooked in the current literature on the impact of privatization. Another novelty of this research is that it addresses the missing data problem, which again is largely overlooked in existing studies.

The research questions are investigated by initially embarking on a critical review of theoretical and empirical literature. This is done in order to identify theoretical predictions and assess their empirical validity as well as guide our own empirical research in later Chapters. The empirical methodology relies on cross-sectional and panel data analyses employing Stochastic Frontier Analysis (SFA) as well as policy evaluation econometric techniques combining matching methods with difference-in-difference estimators. The empirical methodology takes into account the potential problems that have been largely ignored in the current literature. The data used for the empirical part include survey data from the World Bank and the European Bank for Reconstruction and Development (EBRD) which cover six successor states of former Yugoslavia (Bosnia, Croatia, Macedonia, Montenegro, Serbia and Slovenia); as well as survey data from the Riinvest Institute for Development Research, which covers Kosovo.

This thesis is structured as follows: Chapter 1 covers two dimensions. First, it outlines the major theoretical framework behind the ownership debate. Here special attention is paid to theoretical foundations on which privatization rests, including key elements of property rights theory, public choice theory, and principal agent theory among others. However, a theoretical case for state ownership is also presented. Secondly, it reviews privatization as a policy, with the focus in the context of Transition Economies (TEs). The privatization process in this region was part of a broader effort to transform the countries of the region from command to market economies. Therefore it highlights an important point: the empirical analysis must distinguish the effects of privatization from that of other reforms carried out around the same time. This Chapter maintains the idea that theoretical predictions are not self-evident propositions and that one has to necessarily turn to empirical evidence for more conclusive understanding.

Chapter 2 provides a critical review of the empirical literature on the impact of privatization on companies' performance particularly in the context of TEs. The empirical literature on this topic is vast and the number of relevant studies in TEs' contexts is far beyond a hundred. Thus, this chapter was selective rather than exhaustive, focusing on the studies that were published after the year 2000. Special attention was paid to the performance measures used; the methodological issues and strategies; and the sample coverage of individual studies. This Chapter complements the theoretical discussion in Chapter 1 in establishing the analytical framework for the impact of ownership on companies' performance in Chapters 4 and 6.

Chapter 3 discusses the nature of social ownership in former Yugoslavia as a form of ownership distinct from other TEs. It also summarises the ownership transformation before and after the break-up of the Yugoslav Federation by reviewing common and distinctive features of privatization methods employed in the successor states. This Chapter also reviews the limited empirical evidence on the impact of privatization on the performance of emerging private companies in these countries, pointing out their shortcomings. The Chapter examines the main aspects of ownership and performance in this specific context and, as such, informs the investigation that is undertaken in Chapter 4.

Chapter 4 embarks on an empirical investigation of the efficiency of companies in the successor states of the former Yugoslavia, focusing on the effect of ownership. From policy perspective, the measurement of efficiency and the analysis of the gap between efficient and inefficient companies is of particular importance. This Chapter starts by discussing the concept of efficiency, in particular Technical Efficiency, which is the measure of interest in this Chapter. After an extensive and detailed discussion of alternative methods of estimation of efficiency, the Chapter explains the choice of SFA as the preferred method of estimation. Issues such as functional form of the production function and distributional assumptions about the efficiency term and the error term are subject to an exhaustive discussion. This Chapter also employs a simulation based extension of the Heckman selection model for nonlinear models (as proposed by Greene, 2006) in order to control for selection bias problem, which is largely ignored in the literature. The missing data problem, which is another endemic problem in studies using survey data, is often overlooked in the literature. Ignoring the missing data might introduce bias of unknown size and direction in the estimation process. It also involves implicitly making a more restrictive assumption that data is the missing 'completely at random'. This Chapter deals with this problem by using the 'Multiple Imputation' procedure after a careful consideration of different approaches. A step-by-step presentation of this process in presented along with detailed discussion of each step. This process has increased the sample size by around 44 percent.

Chapter 5 provides an analysis of the privatization process in Kosovo. Privatization in Kosovo was distinct from other successor states of former Yugoslavia as well as from other TEs due to its political and economic specificities. Here, these specificities are discussed in details, including a background of Kosovo's economy within former Yugoslavia till now. Chapter 5 presents the relevant background information on the privatization process in Kosovo and provides the context of empirical investigation which is conducted in the following Chapter.

Chapter 6 provides an empirical analysis of privatization induced performance improvements in Kosovo companies. A novelty of this chapter is the use of policy evaluation econometrics in assessing the impact of privatization on companies' performance. Methods like Propensity Score Matching (PSM) and Difference-in-Difference (DiD) are discussed in details. Here a combination of the matching estimators with difference-in-difference is employed, which is expected to deal with various methodological problems and improve the precision of estimates significantly. The choice of the method is preceded by careful consideration of its relative merits compared to other estimation strategies. This methodology is especially capable in addressing the selection bias problem which is endemic in the existing literature. Using matched difference in difference estimators, in a balanced panel dataset, changes in two performance measures, sales (measured by real sales) and the number of employees, are estimated. By using a control group of companies that were subject to similar business environment, and benefiting from longitudinal data, the effect of aggregate shocks are stripped off from the effects of ownership transformation. This allowed us to isolate the impact of privatization on companies' performance. This is particularly important in the context of the massive systemic change in Kosovo where privatization, as argued, was part of larger reforms which can confound the estimates if not accounted for.

Chapter 7 summarises the main findings of the thesis as well as its contributions to the current literature. This Chapter also points out the limitations of this research and suggestions on the avenues along which this research can be further extended. Finally, some policy implications are also presented.

Chapter 1

Theory of privatization: does ownership matter?

Contents

Introduction

The aim of this chapter is twofold. First, it seeks to outline the main conceptual framework and theoretical foundations underpinning the ownership debate.[1] Secondly, it reviews privatization as a policy; especially in the context of Transition Economies (TEs).[2] The debate about the size and scope of the government in the economy has been a part of the economics discipline since its inception and it is still on-going. The answers given to the fundamental questions arising from this debate, and the underlying reasons for these answers, have been constantly changing. While in the period after WWII, there was a large tendency to support government ownership, the following decades witnessed the rise of strands of literature that made a case against the state ownership.[3] The latter were primarily fuelled by dissatisfaction with the actual performance of State Owned Enterprises (SOEs) as well as by the return to prominence of theoretical prepositions supporting private ownership.[4]

There are several distinct conceptual frameworks which underpin the privatization debate. They range from those that fall in the area of economics to those that contemplate the privatization process as a political mechanism which allows the government to advance noneconomic goals (Hodge, 2000). Both will be given sufficient attention in this Chapter.

---

[1] It is largely accepted that the term privatization was coined by Drucker (1969). See for instance: Hodge (2000, p. 13), Savas (2000, p. 15), Johnson and Walzer (2000, p. 3), Greene (2002, p. 27), Megginson and Netter (2003, p. 31), and Megginson (2005, p. 15). Bel (2006) suggests that the term privatization has appeared much earlier in literature; citing the 1961 Webster Dictionary of English language as the first source.
[2] Privatization is spelled with "z" or "s". While British spelling is used throughout this thesis, still privatization is spelled with "z" in line with dominant use in current literature. Megginson and Netter (2001) find that the vast majority of papers they surveyed use "z" spelling.
[3] A concise survey of this debate is provided by Vickers and Yarrow (1991) and Shleifer (1998).
[4] In Yugoslavia and its successor states, the concept of State Owned Enterprise was replaced by Socially Owned Enterprise (the abbreviation remaining the same, SOE). The differences will be discussed in greater details in Chapter 3.

Governments embarking on the privatization process have articulated, both explicitly and implicitly, different objectives for the reform. Most of the cited reasons underline that SOEs are inherently less efficient. This premise seems less ambiguous in cases where companies operate in competitive markets, which are largely immune from substantial market failures and there is no goal ambiguity. However, as soon as any market imperfections are present, or even suspected, the theory becomes less conclusive. It becomes especially controversial when companies are thought to pursue some social objectives as opposed to simply maximize profits.

Despite the inconclusiveness of the ownership debate, privatization of SOEs became a major economic policy of many countries during the last several decades leading to thousands of state owned firms becoming private during this period. Soon after Mrs Thatcher's Conservative government came to power in the UK, the privatization agenda started to evolve globally and this period is considered by many as the beginning of the dominance of modern privatization paradigm (Megginson and Netter, 2001). Shortly after the UK, privatization programmes spread rapidly among both developed and developing countries around the world. The last major region to embark on privatization was Central and Eastern Europe in the aftermath of the dissolution of the socialist system. The privatization process in this region was part of broader effort to transform themselves from command to market economies (Estrin, 1994; Estrin et al., 2009). As the scope of the state sector in former socialist countries was more wide spread and different in nature than in Western countries, the scope of privatization was much greater and more diverse.

This chapter intends to set the scene for the theoretical and empirical findings presented in the latter part of this thesis. Given the large range of discussions on privatization, this chapter had to be selective rather than exhaustive, focusing on the main strands of literature on the ownership debate and privatization.[5] The rest of this chapter is organized as follows. Section 1.1 presents the main strands of the ownership debate. It starts from the neoclassical point of view which largely overlooks the importance of ownership and rather focuses on the importance of market structures in generating efficient outcomes. It then relaxes some of the assumptions to emphasize the importance of ownership. Here, the theoretical case for state ownership as well as the theoretical case for private ownership are presented. At this point, particular attention is paid to theories supporting privatization (such as property rights theory, public choice theory and principal agent theory) while also highlighting their shortcomings. Section 1.2 presents privatization as a policy. Here the emphasis is on TEs given that the focus of this thesis is on that context. Several elements required some explanation when analysing the privatization process in TEs. This section therefore analyses elements related to: sequencing of privatization; privatization vs. de novo private sector development and the importance of competition; restructuring and privatization; methods of privatization used in TEs as well as the size of privatization proceeds in TEs relative to their GDP. Section 1.3 concludes.

1.1 The ownership debate

The ownership debate has been part of the economic discourse for a long time; however, it peaked in the 1980s and 1990s as the privatization reforms spread out in both developing and developed countries. This debate has shifted from one largely favouring government ownership over half a century ago, to one largely supporting private ownership in subsequent decades (Shleifer, 1998). From the

[5] A more extensive survey of this literature is provided Megginson and Netter (2001) and Megginson (2005).

neoclassical point of view, a perfectly competitive market, free of externalities with perfect information flow can lead to a Pareto optimal equilibrium solution (no redistribution of goods or productive resources can improve the position of one individual without making at least one other individual worse off). In these instances, the ownership per se is rendered unimportant. This neutrality outcome serves as a suitable benchmark which is valid only under very restrictive assumptions. However, when these assumptions do not hold or are relaxed, then ownership is expected to matter. This section reviews the ownership debate by comparatively analysing the theoretical case for state ownership and private ownership. Here, a summary of main results in the economic theory of privatization is provided which are needed to guide the review of the empirical evidence in Chapter 2 and to channel our own empirical research in Chapter 4 and Chapter 6.

1.1.1 Theoretical case for state ownership

State ownership enjoyed popularity for decades, especially during the post–Second World War period (Shirley and Walsh, 2001). The fundamental reasons for state ownership broadly fall under two categories. First, state ownership is justified by the shortcomings of the market outcomes and is hence viewed as a remedy for many market failures. Secondly, state ownership has been regarded as an instrument for the attainment of non-economic goals (Grout and Stevens, 2003). Both of these reasons need further attention.

The theoretical case for public ownership, according to neo-classical economic theory, rests on the perceived solution to market failures. This case has tended to focus mainly on market failures associated with, among others, public goods and imperfect competition. Neoclassical economics was used to support the idea that public goods should be produced by companies owned by the government. These goods have the following distinguishing features. First, there is a non-excludability from consuming the good (i.e. it is difficult, if not impossible, to exclude those who do not want to pay for the goods from consuming them). Second, the collective consumption feature which states that additional consumers of the goods do not deplete the quantity of the goods. The problems with provision of these goods are both from demand and supply sides. On the demand side, markets fail to produce sufficient level of public goods because consumers tend to free ride on others; hence no consumer is willing to pay for the full cost of the public good. On the supply side, companies are reluctant to produce a good for which they cannot recoup the marginal value of their investment. Therefore, public ownership is viewed as a solution to this market failure situation.

Market failures due to imperfect competition, which appear mainly in the presence of natural monopolies, enjoying large economies of scale, are another example providing some justification for public ownership.[6] Proponents of public ownership argue that private ownership of natural monopolies will lead to output levels below the optimum level and prices above the marginal cost (Megginson, 2005). Given that government is not constrained to profit-maximising objective, publicly-owned natural monopoly can increase output to optimal level and reduce prices to the marginal cost level (though at such levels they may suffer losses) (Shleifer, 1998).

The opponents argue that pubic ownership is not the only solution to natural monopolies and that regulation of these monopolies can be considered as an alternative.[7] In this type of market failure, the focus of the literature turns

[6] Similar argument is used also for other monopoly distortions, where the price/marginal cost equality is disturbed, leading to allocative inefficiency.

[7] An excellent summary of the regulatory literature is provided by Laffont and Tirole (1993) and Laffont (1994).

towards whether state ownership or regulation of private monopoly yields more optimal results. According to Laffont and Tirole (1993), this largely depends on the ability to design complete contracts. If contracts are complete, the result would be the same between regulation of private monopoly and public ownership. In case when contracts are incomplete, the results will be different. Similarly, Adam, Cavendish and Mistry (1992) suggest that the results would depend on regulatory capacities. Regulation of private natural monopolies as a second-best alternative is viewed as ineffective and inefficient by supporters of public ownership. This is due to several reasons, including information asymmetries which put private owners in a better bargaining position over regulators; the complexity of regulating multiproduct companies; the risk of regulatory capture and overcapitalisation (the so-called Averch - Johnson effect') (Vickers and Yarrow, 1989).[8,9] Also, Sappington and Stiglitz (1987) make a case for public ownership in the view that this lowers transactions costs faced by the government when attempting to intervene in economic affairs.

Methods to address regulatory failure are also part of this discussion. Demsetz (1968), Kay and Thompson (1986) and Bishop and Kay (1989) suggest that competition at entry level could mimic competitive behaviour in non-competitive markets. Similarly, Nalebuff and Stiglitz (1983) propose a system which would allow regulators to reward companies' efforts to enhance efficiency. However, it is suggested that in reality these solutions are hardly

[8] The Averch–Johnson effect is the tendency of regulated companies to engage in excessive amounts of capital accumulation in order to expand the volume of their profits. If companies' profits to capital ratio is regulated at a certain percentage then there is a strong incentive for companies to over-invest in order to increase profits overall. This investment goes beyond any optimal efficiency point for capital that the company may have calculated as higher profit is almost always desired over and above efficiency. For details, see (Averch and Johnson, 1962).
[9] It is important to point out that these four problems could also be faced by managers of SOEs (Shirley and Walsh, 2001).

attainable (Shirley and Walsh, 2001).[10] Moreover, the success of such methods largely depends on the institutional environment (Shapiro and Willing, 1990; Vickers and Yarrow, 1991; Shirley, Kikeri and Nellis, 1992). Despite potential problems, countries with more developed regulatory infrastructure are expected to be more capable of privatizing and regulating firms operating in non-competitive markets. The regulation is expected to be even more problematic in less-developed countries (Cook and Kirkpatrick, 1988). So state ownership is cited as a potential remedy for this type of market failure, primarily in the absence of strong regulators (Shirley and Walsh, 2001).

Another reason for public ownership relates to the ability of government to pursue non-economic objectives seeking to maximise social welfare, even at a tolerable loss of economic efficiency (Vickers and Yarrow, 1989; Yarrow, 1986; Willner, 1996). This assumes that government has the appropriate social welfare function as an objective. Such function may include policies that facilitate regional development, reduce inequality, paying above-equilibrium wages and increasing employment, among others (Choksi, 1979; Megginson, 2005). In other words, policies that otherwise would not necessarily be pursued by the private sector. This framework assumes that political markets (the competition between politicians) are efficient. In case that political markets work efficiently, public ownership – in theory – has the right potential to maximise social welfare, i.e. the sum of producer and consumer surplus. However, in case of failures in political markets, the appropriateness of the set social objective cannot be tested nor challenged. Shirley and Walsh (2001) suggest that studies advocating a social welfare maximising paradigm fail to provide any evidence that social benefits can offset efficiency loss. As such,

[10] As far as competition at entry level is concerned, Williamson (1976) and Goldberg (1976) suggest that this condition is improbable due to incumbent advantages, information asymmetries or collusion.

according to these author, the comparisons are arbitrary. Moreover, other ways of attaining social objectives are not discussed. Also, the theoretical case for public ownership rests on the assumption that the behaviour of the government is benevolent. This assumption has been challenged by opponents of public ownership to which we turn in the next section.

1.1.2 Theoretical case for privatization

As argued in the previous section, the case for state ownership, as far as efficiency is concerned, rests on the argument that, in cases of market failure, public ownership can serve as a remedy. It also assumes that governments act benevolently. In contrast, privatization rests on perception that state ownership has failed (i.e., there is ‘government failure’) either due to vaguely defined property rights or due to the behaviour of the government and its agents. There are several theoretical foundations on which privatization is based, including key elements of property rights theory, public choice theory, and principal agent theory among others. Each of these concepts support the view that privatization improves efficiency through better incentives, organizational performance and control. These theories basically argue that SOEs’ relative inefficiency is primarily a function of ownership, and also a function of the behaviour of government and its agents. However, there is another strand of literature that argues that competition is more important than merely ownership. This line of thought maintains that SOEs largely operate in non-competitive environment (primarily because of restrictions on competition imposed by governments) and that the relative inefficiency of SOEs is also a function of lack of competition. This section will initially discusses theories that support private ownership, including property rights theory; public choice theory and principal agent theory. The last part of this section will briefly discuss the effects of competition.

Property rights theory

The issue of property rights was largely overlooked in economics until the late 1960s; the use and allocation of property rights were generally taken as given. The subsequent years saw the rise to prominence of the idea that property rights are important and that their arrangement cannot be taken for granted. Property rights theory argues that the discrepancy in performance between state- and private- owned firms is a function of their ownership arrangement (Alchian, 1965; Demsetz, 1967; Furubotn and Pejovich 1972; De Alessi, 1987). According to the property rights school, private ownership is believed to improve corporate performance through incentives, with the market system as disciplinary mechanisms for allocating resources efficiently. Also, it is argued that property rights provide an incentive to pursue long-term rather than short term economic goals (Soto, 1996). In cases when the property rights are not defined clearly and when the decision makers do not bear the cost nor enjoy the benefits of their decisions, they put the assets to inefficient use (Boycko, Shleifer and Vishny, 1996). Similar outcomes are expected even in cases when property rights exist, but are loosely or poorly defined. The important implication of well-defined property rights is that it generates strong incentives for economic agents which in turn lead to better performance.

Property rights, in a narrow sense, cover the control rights over assets and rights over cash flows generated by putting the assets to use. In case of an SOE, property rights are divided among various actors, including managers and politicians (who collectively split control rights) as well as the state treasury (who controls cash flow rights). According to property rights theory, privatization should serve as a mean of unifying property rights in the hands of a single owner.[11]

According to property rights theory, there are two important factors that lead to better performance of private companies compared to their public counterparts: first is the transferability of ownership; and the second, there is a risk-bearing associated with decision-making process under private ownership (Alchian, 1977). These factors are expected to have a significant impact on the monitoring system within the firms and incentives leading to greater efficiency and productivity in private companies. As far as the transferability of ownership is concerned, there is an important distinction between private and public ownership. While in former, the owner has the right to transfer property rights, in the latter, the owner (public at large) cannot transfer these rights. In the words of Alchian (1977, p. 139):

"Public ownership must be borne by all members of the public, and no member can divest himself of that ownership. Ownership of public property is not voluntary; it is compulsory as long as one is a member of the public."

This implies that owners of public property cannot transfer property rights even if they are not satisfied with the performance of an SOE. The proportion of ownership that each member of the public holds is negligible, therefore they have insufficient incentives to monitor the performance of an SOE and its managers.[12] Consequently, managers of SOEs have greater opportunity for shirking than their counterparts in private sector (Zeckhauser and Horn, 1989).

[11] Property rights in private ownership setup are not necessarily concentrated on a single owner. They may be shared among more individual owners but they are clearly defined. In spite of this, concentration of property rights in smaller number of owners permits easier response to any agency problem (Aghion and Bolton, 1992).

[12] Davis (1971) argues that even in cases when ownership is equally dispersed in a private company, the monitoring is more efficient than in a case of an SOE. This is primarily because public at large essentially does not think of itself as being effective owners of SOEs.

Also, it is very costly for an individual owner to detect poor performance of the company. Even if poor performance is detected, the benefit from engagement in improvement of the performance is divided among all members of the public, lowering the incentives for monitoring and exercising ownership rights in the first place. In turn, the inability of owners to react is internalised by managers of SOEs who consequently are not compelled to improve performance (Jensen and Meckling, 1976). Another reason for weak incentives is that SOEs are generally not subject to a bankruptcy constraint.

Conversely, in a private company, the ownership rights are transferable. Under private ownership, poor performance is detected easier and owners can react by either selling their shares or engaging in better monitoring – or by dismissing the managers (the so-called 'exit' and 'voice' mechanisms). This puts pressure on managers who subsequently improve the performance of the company. As a result of transferability, it is expected that detection and disciplining of poor management is less costly. Also, the ability to transfer property rights allows owners to acquire shares of companies that are compatible with their skills based on comparative advantage principle. The resulting specialisation of ownership is expected to have efficiency-enhancing consequences by improving monitoring and decision-making process (Davis, 1971).

Another important factor discussed by the property rights theory is risk-bearing. Given that property rights, in the case of public ownership, are divided among various parties, the risks and/or rewards are not borne by the decision makers. Lack of risk-bearing creates disincentives for SOE managers to seek the best use for assets. On the other hand, in the case of private ownership, the risk is borne by individual owners as property rights are concentrated and because they participate in the decision-making process by choice. Liability towards risk increases the incentives of individual owners to actively participate in decision-making process and in monitoring. This also encourages managers to improve performance.

Property rights arrangements in private companies provide strong incentives for managers to pursue policies and decisions that maximise companies' value (Pejovich, 1990). In De Alessi's words (1980, p. 27-28):

> *"The crucial difference between private and publicly owned firms is that ownership in the latter effectively is non-transferable. Since this rules out specialization in their ownership, it inhibits the capitalization of future consequences into current transfer prices and reduces owners' incentives to monitor managerial behaviour."*

To summarise broadly, the property rights theory argues that ownership structure has a significant impact on companies' productive efficiency and that ownership effects dominate other sources of performance variation between an SOE and a private company. However, according to Starr (1989), property rights theory fails to recognise other sources of discrepancy in performance which can be related to other factors (including, among others, size of the company, information asymmetry, ambiguity of goals or other incentives that are not related to property rights, such as contract incentives). Despite its shortcomings, property rights theory has served as the main theoretical rationale for privatization. This theory views privatization as a suitable reassignment of property rights.

Public choice theory

The public choice theory has also been very influential in providing a supporting framework to justify privatization as a political reform.[13] It focuses on the comparative efficiency of private and public sector (Parker, 1998). The public choice theory postulates that public sector is comparatively less efficient because of the idea that government agents maximise their own utility function rather than pursuing public goals, or the interest of the company (Buchanan, 1972; Tullock, 1976; Boycko, Shleifer and Vishny, 1996). Thus, the role of the public sector, the argument goes, should be limited. In fact, the advocates of the public choice theory counsel the reliance on private ownership which they expect to increase competition and improve efficiency. Downs (1967, p. 257) argues that:

"We can intuitively postulate that the total amount of waste and inefficiency in society is likely to rise as bureaucracy becomes more prominent. This seems probable because true waste is so much harder to define and detect in bureaus than in private firms. Also, there are no automatic mechanisms for limiting it in the former as in the latter. This admittedly untestable conclusion implies that society should arrange to have services produced by market-oriented firms rather than bureaus, when possible, other things being equal."

The public choice theory rests on two basic arguments: (i) that individual preferences cannot be aggregated into coherent social ordering and (ii) that individuals are rational own utility-maximisers. Both of these arguments deserve some explanation. The first problem that this theory addresses is the difficulty of coordinating multiple actors and aggregating preferences in collective decision-making. As every agent pursues own utility maximisation,

[13] Linowes (1990) suggests that teachings of the public choice theory were the main arguments that motivated contemporary privatisation movement in the United States.

hardly any integrated goal can be designed. One way to surpass this problem is to use unanimity as a decision-making rule in setting an optimal collective choice. However, even if only one individual is worse off from the collective choice, the decision will not be made. Therefore the unanimity hardly seems practical. Instead, a majority voting rule can be considered as an alternative decision-making rule. Even though the latter avoids problems arising from unanimity, still it cannot provide a definite and stable choice. Instead, the result will be 'cycling' since each choice produces different majority with no non-arbitrary stopping point.[14] Multiple and frequently changing objectives of these enterprises arising from government's attempts to accommodate diverse interest groups also exacerbates agency problems since outcomes of managerial decisions become more difficult to measure and monitor (Estrin and Perotin, 1991).

The second argument focuses on the behaviour of economic agents which is considered to be rational utility-maximising. In the words of one of the leading authors of the public choice theory, Buchanan (1978, pp. 17): *'People should be treated as rational utility maximisers in all their behavioural capacity'*. Centred on the rational choice model, the public choice theory does not justify the reliance on public ownership as a solution to market failures and increasing economic efficiency. The public choice theory holds that self-maximizing behaviour in a private market setting leads to benevolent outcome while in public decision making process the effects are detrimental (Buchanan and Tullock, 1962; Niskanen, 1971; Borcherding, 1977).

The public choice theory maintains that government agents are inclined to pursue their own interests, or that of interest groups, rather than the interests

[14] This is known as Kenneth Arrow's 'impossibility theorem' which shows that, if certain conditions hold, no decision-making rule can translate the individual preferences into a well-behaved social utility function.

of the public at large (Buchanan, 1978; Mueller, 1984; Boycko, Shleifer and Vishny, 1996). Moreover, the gain that may be achieved by utility maximising agents is positively correlated with the size of an SOE under their supervision (Niskanen, 1971; Buchanan, 1977; Boycko, Shleifer and Vishny, 1996). In turn, this prompts government agents to seek to increase the size of an SOE rather than focusing on improving its performance.[15] This is primarily present in cases of ambiguity of goals and policies that government agents pursue (Niskanen, 1971). Moreover, given that SOE managers are subject to soft budget constraints and have access to finance at discounted interest rates, they are encouraged to use more capital (Niskanen, 1968; De Alessi, 1969). In turn, this leads to another major distortion as government agents – who are in office for a limited period – will concentrate on short-term rather than long-terms plans concerning the SOE.

SOEs are viewed by many as a way for government to advance social goals at a tolerable expense in terms of economic efficiency (Vickers and Yarrow, 1989; Willner, 1996). Along those lines, Okun (1975) argues that governments use SOEs to pursue equality in income distribution. However, the transferring mechanism by which this (re)distribution is conducted can lead to waste of public resources and inefficiency in resource allocation. Also, following the rational choice assumption, the major beneficiaries will be the government agents in charge of the process, i.e. the benefits are concentrated with SOEs' managers and politicians while costs are dispersed among the public at large. Other interest groups, such as unions, can also benefit by using their bargaining power through rent-seeking. In this context, according to Sunstein (1990, p. 70), rent-seeking is defined as a waste of wealth through (re)distribution efforts by politicians rather than production of wealth through markets. In cases when

[15] Buchanan (1977) points out that this explains the spreading out of public sector and excess labour in SOEs.

managers of SOEs and politicians try to maximize their own benefits or electoral interests, the outcome is expected to be inconsistent with efficiency. The company managers under public ownership are not exposed to disciplining effect of the market; they expect to be bailed out when in trouble with the excuse of serving public or social goals. The public choice theory also puts emphasis on competition against ownership. This feature of public choice theory distinguishes it from property rights theory which suggests that it is ownership per se that affects performance and efficiency (Vining and Boardman, 1992; Miranda, 1994).

The public choice theory has faced important criticisms related to its underlying assumptions. Firstly, it is argued the assumption that agents are self-interested utility maximisers is a simplistic assumption. While it is agreed that self-interest is an important element of agents' behaviour, it is not the only motivation (Boston, 1991; Self, 1993). Similarly, in cases when political markets work efficiently, self-interest is slightly mitigated. Secondly, the public choice theory has been criticized on the grounds that its predictions lack empirical validation.[16] Despite its shortcomings, public choice theory has provided a crucial supporting framework for privatization.

Principal-agent theory

The principal-agent theory relies on the assumption that control and ownership in a company (be that public or private) are separated. Therefore, the principal and the agent enter into a contracting arrangement. Given that these parties may not share the same set of interests (i.e. they have diverging interests), the agency problem arises. The agency problem also arises due to the inability of the principle to monitor and control the agent due to asymmetry of information

[16] This issues is further elaborated in Chapter 2.

(Jensen and Meckling, 1976; Holmstrom and Milgrom, 1987; Walker and Vasconcellos, 1997). The principal-agent theory has attracted significant interest in the privatization literature as it can explain differences in the agency problem in public and private sector.

According to Vickers and Yarrow (1989), the principal-agent relation in private companies is different from that in SOEs. In the case of private companies, the manager (the agent) is responsible to the owners (the principals) while in case of an SOE, the manager (the agent) is responsible to the government (the principle) who is not the ultimate owner (that being the 'public' or the 'society'). Moreover, in case of an SOE, there is another principal-agent relation between the government (as an agent) and the general public (as a principal). This dual principal-agent relationship is expected to aggravate the agency problem. The managers of SOEs will seek to advance their own interests while also satisfying the objectives of the government through attainment of often political and social objectives. Reconciling these multiple diverging objectives is expected to increase costs and negatively impacting efficiency. Conversely, in the case of private companies, where the objective is clearer, the management will have to satisfy only the goals set by the owner(s) (Magginson and Netter, 2003).

If a private company performs poorly, it is easier for the principle to observe the performance and efficiency of the agents. The principle of a private company can take measures to force the agent to improve performance or can decide to sell off her shares in the company. This in turn, triggers the threat of bankruptcy and takeover which can induce more efforts from the agent in the first place (Singh, 1971). These disciplining effects are absent in case of an SOE as there is no easy (costless) way to determine bad performance; no easy way to push agents to improve efficiency; and ultimately there is no credible threat of bankruptcy and takeover.[17] Therefore, the principal-agent theory suggests that SOEs will not be compelled to strive efficiency (Yarrow, 1986).

The principal-agent theory suggests that privatization can lead to more efficient outcome as it breaks the dual principal-agent relationship inherent in SOEs. Also, through privatization, ambiguous and conflicting objectives set for SOEs, which are an important source of the pronounced agency problem under public ownership, can be eliminated.[18]

The Effects of Competition

Apart from offering superior incentives for improved monitoring and efficiency, private ownership also encourages competition. Conversely, state ownership promotes a non-competitive environment and this may be one of the sources of its relative inefficiency (Smith and Trebilcock, 2001). Theoretically, a competitive market setting allows free entry of new firms to the market leading to optimal levels of output and marginal cost pricing. Competition therefore increases production efficiency as it creates the right incentives for businesses to do so.

On the other hand, non-competitive environments, which are more pronounced in under extensive state ownership, lead to welfare losses by restricting output and charging prices higher than marginal cost. In the absence

---

[17] This is also augmented by arguments made by public choice theory which assumes that governments do not strive for maximum efficiency because of other, mainly electoral, motivations.

[18] Private companies also suffer from this problem but the ability to monitor the actions of the agent is easier and there are simpler ways to devise appropriate incentive schemes in absence of ambiguous objectives. Still, individual small shareholders in private companies face similar problems to monitor managers and exercise property rights as the individual shareholders in case of an SOE. The only difference remains the transferability of property rights which was discussed earlier in this sections.

of competitive pressure, SOEs are not incentivised to strive for higher efficiency. This is more noticeable in the case of natural monopolies where state ownership can be viewed as a remedy in the absence of a proper regulatory framework as discussed in Section 1.1.1. In industries where government ownership is large, generally competition is discouraged or reduced (Shirley, 1994). Of course, in TEs, the scope of state ownership is not limited to natural monopolies. Indeed, during the early phases of transition, these countries were dominated by state ownership in all economic sectors. To sum up, the transformation of ownership from the state to the private sector is expected to promote the development of a competitive environment as it will diminish the role of the state in the economy. This in turn would lead to improved performance and higher efficiency.

1.2 Privatization as a policy framework

Over the last three decades, both developed and developing countries have embarked on ambitious privatization programmes. The privatization process was part of a reconsideration of the role of the state in the economy, which was largely resolved in favour of the perception that state involvement had been excessive and that the private ownership would raise enterprise efficiency.[19] This was also encouraged by the development of economic theories that supported private over state ownership. Soon after Mrs Thatcher's conservative government came into power, the privatization agenda started to evolve. The privatization process in the UK had an influence on economic

[19] This was an important change in course by most countries which until then had employed extensive state ownership in a wide range of sectors in the economy. Until the late 1970s, state ownership had been embraced for various reasons, but primarily because it was perceived as necessary to promote growth (by controlling the so-called 'commanding heights' of the economy) and respond to market failures and shocks. Some of these reasons were also ideologically motivated.

policy throughout the world and this period is associated by many as the beginning of the general acceptance of privatization as an effective policy by economists and policy makers around the world (Bishop and Kay, 1989; Megginson and Netter, 2001).[20]

Privatization served as a mean to expanding state revenues by either generating revenues via asset sales or by reducing the cost of subsidies to inefficient SOEs (Lopez de-Silanes, 1997). It was also viewed as a way to limit the state intervention in the economy while also promoting wider share ownership.[21] However, the most important reason for divesting state owned companies was the well documented poor performance of SOEs. Privatization in turn was seen as a key element in improving economic efficiency of those firms (Frydman, et.al. 1999). Given that the focus of this thesis is on TEs, the following section discusses the privatization process in that context.

1.2.1 Privatization in Transition Economies

Following the developed and developing countries, the Central and Eastern Europe was the last major region to embrace privatization wholeheartedly. The extent of privatization that has taken place in TEs is unprecedented (Nellis, 2001) and was part of a broader effort to transform these countries from command to market economies (Estrin, 1994). As such SOEs' privatization in TEs cannot be seen in isolation as a simple transfer of ownership. The scope for

[20] Privatization initiatives can be traced even earlier, such as the privatization programmes in West Germany in 1960s for instance (Esser, 1998). Also, other countries have divested state owned companies from time to time prior to 1980s. However, these initiatives did not feature as core component of public policies in these countries.

[21] Broadening share ownership was also viewed through political lenses, primarily because it was viewed as a way to increase the support for privatization and other market-oriented reforms and also for making it hard for succeeding governments to reverse the already undertaken reforms (Megginson, 2005).

privatization in TEs was much greater and more diverse in nature than in Western countries as the scope of the state sector in the former was more widespread. According to Estrin (1994), at the beginning of transition, the state sector was producing the bulk of national output in all TEs. Such a huge scale of privatization would be a daunting task even for mature market economies with sound institutions and legal infrastructure. In TEs, however, neither academics nor policy makers were certain how to design and implement privatization schemes on such a massive scale (Jelic, Briston and Aussenegg, 2003).

Unlike developed countries, where the debate was focused on the objectives of privatization, the debate in TEs centred around alternative methods of privatization rather than the privatization itself as the 'reasons for privatization were clear; a political symbol of reform and addressing inefficiencies of the state sector' (Estrin, 1994 p.20). The announcement of privatization programmes was a clear political statement to express governments' intentions to creating a well-functioning market economy. Moreover, international financial institutions backed by Western governments insisted on including privatization in the transformation package as a condition for financial and technical support (Batt, 1994 p.89).[22]

The necessity to embark on privatization in TEs was largely influenced by well documented inefficiencies of SOEs and the evidence was by far stronger than in Western economies (Estrin, 1994; Boycko, Shleifer and Vishny, 1996). Privatization was also viewed as a way of limiting state involvement in economic affairs as well as a means to balance the books. Having operated in

[22] A policy package approved by the international financial institutions to support developing countries in crisis, commonly referred to as The Washington Consensus, included privatization as one of the three main policies for transition economies (alongside liberalisation and stabilisation) (Irdam, Scheiring and King, 2016).

centrally planned economies, state firms were too large, vertically integrated, producing poor quality goods (Blanchard, 1997). They produced goods to serve their internal markets and to trade within the socialist trading block without being subject to international competition (Ellman, 1989). A large public sector was often used by the government to achieve non-commercial objectives, such as employment, or other protectionist policies. Generally, the public sector lacked monitoring and incentives, and managers did not perform as effectively as in the private sector (Boycko, Shleifer and Vishny, 1996). Another reason for weak incentives is that SOEs were not subject to a bankruptcy constraint or take-over threats which would discipline inefficient managers. They rather expected to get 'soft budgets' from the state and be bailed out when in trouble (Kornai, 1980). There were several elements that require attention when analysing the privatization process in TEs. This includes elements related to: sequencing of privatization reforms, privatization vs. de novo private sector and the importance of competition, restructuring and privatization, and the method of privatization. The rest of this section briefly discusses these points in the given order.

The privatization process was one of the most important aspects of the transition to a market economy, yet none of TEs could privatize all of its SOEs at once. This raises the issue of the sequencing the privatization process and whether governments privatize strategically (Gupta, Ham and Svejnar, 2001). Several authors such as Husain and Sahay (1992), Glaeser and Scheinkman (1996), Gupta, Ham and Svejnar (2001) have investigated this issue closely and modelled the question of sequencing the divestment of SOEs. They generally argue that the sequence of SOEs' sale was determined by the governments rather than being a random selection. They further argue that the sequencing and staging of sales was developed based on governments' conflicting objectives which might have been to maximize Pareto efficiency, maximize public support and goodwill, minimizing political cost, maximizing economic efficiency through informational gains of privatization, and maximizing privatization revenues (Gupta, Ham and Svejnar, 2001 p. 34). In addition to its theoretical importance, this issue also has important implications for empirical studies that evaluate the impact of privatization on companies' performance. The selection bias in privatization, despite being largely ignored in empirical work, has been considered by a few studies to which we will return in Chapter 2.

Another important issue is whether there is a trade-off between privatization and the development of the de novo private sector, or these are complementary. The complementarities between the privatized and de novo private sector can be argued for in terms of the competitive environment that the latter generates and the competitive pressure it puts on the privatized firms (Havrylyshyn and McGettigan, 1999). Privatization also is also intertwined with restructuring which leads to the freeing of assets locked in SOEs with positive effects on the private sector. In practice, most countries have concluded that the existing state sector cannot be left to survive or 'wither away' on its own; hence have embarked on some form of privatization (Hare, 1994 p.31). Privatization in this context was viewed as an opportunity to increase competition. Moreover, it was coupled with facilitating the entry conditions for de novo private companies. Along these lines, equally important is the question of whether there is any effective alternative policy to privatization. In the case of TEs, privatization was not the only component of microeconomic adjustment or the transformation programme (Estrin, 1994). There is a strand of literature which argues that competition and deregulation are more important for improving performance of firms than privatization alone (Yarrow, 1986; Kay and Thompson, 1986; Bishop and Kay, 1989; Vickers and Yarrow, 1991; Pinto, Belka and Krajewski, 1993; Nickell, 1996; Allen and Gale, 1999; Angelucci et al., 2002;

Zhang, Fitzpatrick and Parker, 2002). Studies examining both competition and privatization found that the latter had higher impact on company performance than competition alone. Similarly, the imposition of hard budget constrains was considered by many TEs as a way of improving company performance. Nonetheless, Frydman et al. (1999) suggest that the financial discipline is not sufficient to improve corporate performance i.e. there are clear limits to what the imposition of hard budget constrains can accomplish if not coupled with ownership transformation. According to Nellis (1994) and Shirley and Walsh (2001), improvement in companies' performance is attained only when the full package of reform, including the ultimate threat of privatization, is employed.

An important decision that governments have to make is whether SOEs should be restructured before the sale or the restructuring should be left to the private owner afterwards. Comprehensive restructuring before divestiture aims at attracting effective owners, but this is usually done at the expense of privatization speed (EBRD, 1994). Restructuring SOEs may involve financial restructuring or operational restructuring where the former is considered less difficult (Megginson, 2005). In centrally planned economies the majority of enterprises, including banks, were owned by the state, therefore writing off enterprise and inter-enterprise debt i.e. financial restructuring, represents a simple accounting exercise (EBRD, 1994). In turn, operational restructuring which would involve reorganization of production processes, splitting up SOEs, selling off or closing down non-core activities, and compulsory redundancies is much more difficult (Carlin and Mayer, 1992). In the early stages of transition, the World Bank advised that governments should restructure SOEs comprehensively before divestiture (Nellis and Kikeri, 1989). Later on the same World Bank experts (Shirley, Kikeri and Nellis, 1992 p.60) suggested that small and medium-sized SOEs "should be sold 'as is' at the best price possible, as quickly as possible." This was backed by the fact that most

SOEs were not very profitable, were overstaffed and employed obsolete equipment; some even incurring significant loses (Perroti, 1994 p. 55). The state would be under great political pressure to subsidise such companies while on the other hand runs the risk of fiscal collapse. Therefore a more rapid privatization process would lead to macroeconomic stabilisation and greater confidence in the reform itself. Moreover, the predominant Western recommendation was to consider privatization while focusing firstly on macroeconomic stabilisation (Boycko, Shleifer and Vishny, 1995). This is in line with the neoclassical view of transition which pays attention to market liberalization before addressing property rights issues. Yet, the Austrian School considers that macroeconomic stabilization can be achieved only under a private property rights order (Calcagno, Hefner and Dan, 2006 p.42).

Restructuring before divestiture was used in some of TEs like Hungary, Estonia, Poland, Slovenia, Rumania (EBRD, 1994) and for some of the larger companies. Some countries, like East Germany, managed successfully to restructure some companies before privatization, however this road was unattainable for other TEs. It is widely agreed in the literature that restructuring would be virtually impossible in the absence of privatization in TEs. Moreover, the empirical evidence suggests that restructuring before privatization does not pay off (see for example Lopez de-Silanes, 1997; Chong and Lopez de-Silanes, 2002; Chong and Galdo, 2002). Generally, these authors suggest that the government should not intervene to restructure SOEs prior to divestiture. Instead, government should focus on creating social safety net for redundant workers rather than invest in these SOEs. Delays in privatization will only decrease the confidence in the reform itself and give more space to the parties that oppose privatization, including SOEs' managers for whom privatization acted as a direct threat to their privileged position (Blanchard, 1997).

The question regarding the different methods of privatization employed in TEs has attracted widespread discussion in economic literature (Schüsselbauer, 1999). Since state property was created in different ways, there was no best single way of privatizing them. This is especially true in the context of TEs where countries had different levels of institutional and economic development. TEs have employed different techniques and combination of them to privatize their SOEs which in turn resulted in different ownership structures and overall efficiency gains (Havrylyshyn and McGettigan, 1999). As Earl and Estrin (1997) have suggested, the share ownership structure and the pattern of dominant ownership in different countries vary significantly according to the method of privatization used.

As discussed earlier the main focus of the debate in TEs was on the method of privatization unlike in western countries. The problem of 'method' arises primarily due to the absence of a capital market, where company valuation is a difficult task and information provided by companies is unreliable (Estrin, 1994; Brada, 1996). There was a huge mismatch between the domestic supply of savings and potential market value of firms to be privatized (Estrin, 1994). Also, in the early phases of transition, these countries were not an attractive destination for foreign investors. Moreover, due to the widespread asset stripping, governments had to act promptly (Canning and Hare, 1994). Consequently, a majority of these countries launched some form of "mass privatization" or "voucher privatization", distributing shares of a large number of companies for free or at low nominal prices (Megginson, 2005). There were of course other methods that TEs used for divestment of SOEs too (see Table 1 for details on different methods of privatization used in TEs),[23] but mass

[23] For instance, selected number of TEs used privatization through restitution. This method featured in all those countries where the government embarked seriously on privatization, as it demonstrates the commitment of the new political system to righting the wrongs of the past (Batt, 1994). This divestment method was appropriate only when dealing with privatization of

privatization was the "primary" method of privatization in 10 TEs, and a secondary method in another 9 TEs (EBRD, 2004). According Boycko, Shleifer and Vishny (1994) and Nellis (2001) many TEs had no real alternative to the mass privatization method. Mass privatization is understood as offering the free or very highly subsidized transfer of a large proportion of state assets to the whole population. It was assumed that give-away schemes met both efficiency and distribution goals as a "second-best solution' (Schüsselbauer, 1999 p.67). Other benefits of mass privatisation were that it partially overcame the constraint of an underdeveloped capital market, it enjoyed public support as it eliminated the concern of the public that privatization is benefited only a small number of individuals. Mass privatization led to diffused ownership which raised the concern that the new owners will not be effective owners as they would lack the knowledge and the incentive to undertake deep restructuring (EBRD, 1997). However the resulting ownership structures proved to be only transitional as, in most countries, a gradual concentration of ownership emerged through the process of 'secondary privatization' (Grosfeld and Hashi, 2001).[24]

easily identifiable property that have been expropriated during the past government by returning to the original owner or their inheritors. This method of privatization was not dominant given that the property that was subject to restitution was limited.

[24] This issue was more difficult in cases when managers and employees were effective owners and where restructuring involved large redundancies. However, Blanchard (1997) argues that even in such cases, and when insiders cannot restructure the company themselves, they are still incentivised to sell their shares to outsiders as they are aware that status quo will only reduce the value of the company in the future.

Table 1.1. Privatization methods in TEs

Country	Primary method	Secondary method
Albania	MEBO	vouchers
Armenia	direct sales (since 1999) vouchers (pre 1999)	MEBO
Azerbaijan	cash auctions	vouchers
Belarus	MEBO	vouchers
Bosnia and Herzegovina	vouchers	direct sales
Bulgaria	direct sales	vouchers
Croatia	MEBO	vouchers
Czech Republic	vouchers	direct sales
Estonia	direct sales	vouchers
Macedonia	MEBO	direct sales
Georgia	vouchers	direct sales
Hungary	direct sales	MEBO
Kazakhstan	direct sales	vouchers
Kyrgyzstan	vouchers	MEBO
Latvia	direct sales	vouchers
Lithuania	vouchers	direct sales
Moldova	vouchers	direct sales
Poland	direct sales	MEBO
Romania	MEBO	direct sales
Russia	vouchers	direct sales
Serbia and Montenegro	auctions (Serbia) vouchers (Montenegro)	direct sales
Slovak Republic	direct sales	vouchers
Slovenia	MEBO	vouchers
Tajikistan	direct sales	MEBO
Turkmenistan	MEBO	direct sales
Ukraine	vouchers	MEBO
Uzbekistan	MEBO	direct sales

Source: Transition Report (EBRD, 2004)

Other forms of privatization included Management and Employee Buyout (MEBO) which was primary method in 8 transition countries. This was also a way for governments to avoid clashes with the entrenched managers and employees who were strong opponents of the reforms. Direct sale of companies to the public was another method of privatisation though only 7 out of 27 TEs used this method as their primary method of divesting SOEs and these were among the most successful TEs (Estrin, 2007).While the economic arguments for privatizing state assets through direct sale are convincing, it faced practical difficulties given the short domestic supply of savings as discussed earlier. Privatisation has progressed differently in different countries depending on the speed of the implementation of the policy, the strength of supporting institutions and other factors. Privatisation revenue as share of GDP is a good indication of what different countries have achieved (Table 1.2).

Table 1.2. Privatization revenues as share of GDP in TEs (%) **2**

Country	2004	2005	2006	2007	2008	2009	2010
Albania	11.4	11.5	11.7	13.1	13.6	16.0	na*
Armenia	10.2	na	na	na	na	na	na
Azerbaijan	3.0	3.2	na	na	na	na	na
Belarus	3.0	3.1	2.9	5.5	6.3	na	na
Bosnia and Herzegovina	2.6	na	na	na	na	na	na
Bulgaria	18.0	21.2	22.5	23.5	24.3	24.3	na
Croatia	14.6	14.7	15.7	16.7	17.0	17.4	na
Estonia	7.2	na	na	na	na	na	na
Macedonia	13.8	14.3	20.0	20.2	20.6	21.2	na
Georgia	24.5	28.1	32.9	38.1	41.8	na	na
Hungary	31.0	31.6	32.8	33.1	33.1	na	na
Kazakhstan	29.0	29.2	29.7	30.1	30.3	30.5	30.6
Kyrgyzstan	7.2	7.4	7.4	7.6	7.4	7.5	7.5
Latvia	9.5	9.6	10.5	10.6	10.8	na	na
Lithuania	13.3	13.7	16.5	16.6	16.6	na	na
Moldova	0.0	0.0	0.0	0.0	0.0	na	na
Montenegro	na	na	na	na	na	na	na
Poland	13.5	13.9	14.0	14.2	na	na	na
Rumania	na	na	na	na	na	na	na
Romania	6.2	6.3	6.4	6.5	6.5	6.5	na
Serbia	7.7	10.2	17.4	20.2	21.4	23.1	na
Slovak Republic	35.1	35.2	35.2	35.2	na	na	na
Slovenia	4.7	4.8	4.9	6.4	6.5	6.5	na
Tajikistan	6.8	7.3	7.9	8.0	8.6	na	na
Turkmenistan	0.6	0.6	na	na	na	na	na
Ukraine	10.1	15.1	15.2	15.5	15.5	na	na
Uzbekistan	4.7	5.2	5.5	5.9	6.3	na	na

Source: Transition Indicators (http://www.ebrd.com); * - data not available

1.3 Conclusions

A range of theories and issues concerning ownership and privatization policy were considered in this chapter. The aim was to investigate as broadly as possible relevant theories related to the role of ownership in the performance of companies as well as the privatization process in TEs. This is done in order to better understand the background and better direct both the review of the empirical literature on the subject (in Chapter 2) as well as our own empirical investigation in the following chapters (Chapters 4 and 6).[25] Given the large range of discussions on privatization, this chapter had to be selective rather than exhaustive, focusing on the main strands of literature on privatization.

This chapter started by analysing the ownership debate focusing on the main arguments in favour and against state ownership. The theoretical literature reviewed here seems to suggest that ownership does matter apart from certain situations such as perfectly competitive markets and in the absence of any market failure. The underlying reasons for state ownership were that it was a remedy for market failures and an instrument for the attainment of non-economic goals. Both of these reasons implicitly assumed that government is benevolent and that political markets are efficient. Both of these assumptions were challenged by opponents of public ownership. On the other hand, a range of theories including property rights theory, public choice theory, and principal agent theory were used to demonstrate that private ownership is expected to yield more efficient results compared to public ownership. This is especially the case in competitive markets which are more immune from substantial market failures. Property rights theory maintains that it is the ownership arrangements that explain the discrepancy between the performance state- and

[25] Chapter 4 analyses the effect of ownership on technical efficiency in successor states of former Yugoslavia. Chapter 5 analyses the privatization induced performance changes of companies in Kosovo.

private-owned firms. According to this theory properly defined property rights provide an incentive to enhance efficiency. This is also due to market discipline to which private owned companies are subject. Public choice theory emphasises that government agents maximise their own utility function rather than pursuing public goals, and highlights the fact that, unlike private-owned companies, they are not subject to market discipline. Different from property rights theory, the public choice theory puts greater emphasis on competition rather than on ownership as the only factor affects performance and efficiency. Finally, the principal agent theory shows that the principal-agent relation in private companies is different from that in SOEs and that the agent can be made to work more efficiently (through monitoring and incentives) in private companies than in SOEs. Although these theories have been subject to a range of criticisms, they still provided a crucial supporting framework for privatization.

This chapter also examined the privatization policy and the debates surrounding it, particularly in the context of TEs. Over the last three decades, thousands of companies have been transferred to private ownership around the world. The most important motive for divesting state owned companies was the well documented poor performance of former SOEs. Privatization in turn was seen as a key element in improving economic efficiency of these firms. In transition countries, privatization was part of the broader reform or transformation of these countries from centralised to market economies. This is especially important from the perspective of empirical analysis. Given that privatization was part of larger structural reforms, the empirical analysis must distinguish the effects of privatization from that of other simultaneous reforms which took place in these countries. Because of attribution problems, this is largely overlooked in the literature. Also, the type of owners that emerged after privatization is important in determining the overall result of ownership transformation.

The review of the literature in this chapter provides some insight into the theoretical framework for analysing the differences in the performance of state and private-owned companies. However, the major inference from this chapter is that theory alone is unlikely to provide conclusive answers about advantages and drawbacks of privatization. Therefore a review of the empirical work is of essential importance. Moreover, since most of the arguments are based on empirical observations, it is necessary to review this literature systematically. This is done in the next chapter.

Chapter 2

Privatization: review of the empirical evidence

Contents

Introduction

As argued in Chapter 1, the theory underlying privatization debate is unlikely to produce a conclusive narrative about the impact of ownership transformation on companies' performance. Therefore researchers have had to concentrate on empirical evidence in order to obtain more definitive conclusions. There is a large body of empirical literature analysing the impact of privatization on companies' performance, especially in the context of TEs. Reviews of this literature report that the number of relevant studies in the TE context goes far beyond a hundred. Therefore, this Chapter does not intend to provide an all-inclusive coverage of this literature. Instead, the focus of this Chapter is on a selection of studies in order to analyse different types of empirical strategies; methodological issues; performance measures used; as well as sample coverage.

By doing so, it will try to establish the analytical framework for estimating the impact of ownership in companies' performance. The empirical strategy used in individual studies reviewed in this Chapter provide useful insights for the context that we intend to investigate in Chapter 4 (focusing on successor states of former Yugoslavia: Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia) and Chapter 6 (focusing on Kosovo alone). Reviewing the empirical literature on privatization enables us to set the relevant hypotheses and expectations in these Chapters.

Based on the research design, the empirical evidence on privatization can be broadly clustered into two major groups: longitudinal analyses of ownership transformation effects (comparison of performance indicators before and after privatization) and cross-sectional analyses of ownership effects (comparison of performance of companies with different ownership structures). There are also variants of these methods depending on the context of investigation and the data at hand. The results reported in various studies employing different methodologies, are not uniform. They range from insignificant results to significant positive and significant negative results on the impact of ownership on companies' performance. Heterogeneous results are found across countries, measures of performance, specifications, estimation methodologies, and types of new owners.

The empirical work in this field also faces a number of potential problems which can be broadly narrowed down into three types. First, in relation to time periods covered, initial studies on privatization used very short time frame with most of the observations clustered immediately after divestiture. Secondly, in relation to quality of data, some studies have used small, often non-representative, samples of companies, with no clear distinction of types of owners and with data produced following different accounting standards. Thirdly, many studies have failed to control adequately for the selection bias problem, i.e. companies not being selected for privatization at random. These problems could have resulted in many studies suffering from biased results and can partly explain the reason for great variation in the reported results about the effect of ownership transformation on companies' performance.[26] However, despite the fact that empirical work in this field is beset with problems, many authors have managed to compare the performance of SOEs and privately-owned firms quite successfully.

The rest of this chapter is organised as follows. Section 2.1 provides a broad summary of extensive surveys of this literature and points out the main methodological challenges. Section 2.2 reviews the studies that estimate the relationship between privatization and companies' performance in single countries, while section 2.3 reviews studies concerned with more than one country. Section 2.4 concludes by also considering the implications of this review for the empirical analyses undertaken in the following chapters.

[26] Different results could also reflect genuine differences between countries and industries under investigation (Megginson and Netter, 2001).

2.1 The effect of ownership on companies' performance: a review of the literature

There is a large number of studies that analyse the impact of privatization on companies' performance, especially in the context of TEs. There are also several extensive surveys of firm-level evidence on privatization.[27] The overall results of these surveys range from those that do not find any significant effect of privatization on companies' performance to ones that suggest that privatization improves companies' performance. Also, in some limited cases, privatization is found to have negative effects on performance (see for instance Estrin et al., 2009).

As indicated, studies looking at this relationship suffer from many problems, including: short time span of available data; small often non-representatives samples of companies with no clear distinction of types of owners and with data produced following different accounting standards; and finally most of the studies on this topic failed to correctly account selection bias problem. Given that the companies in the privatization programme were privatised in sequence (and not at once), there is a selection process involved which may or may not be significant, i.e. the selection may or may not be random. Governments are usually tempted to privatize the best (or the easiest) firms first in an attempt to portray the process as successful. Also, foreign companies participating in the process are expected to cherry-pick and try to obtain shares of the best companies. Finally, if possible, companies might self-select if they want to go through privatization process or not (Megginson, 2005). Sample selection bias can also exist between alternative forms of privatization (EBRD, 1997). If this selection process is unaccounted for, then the estimates might be biased (Estrin et al., 2009). Selection bias of ownership is usually overlooked in the research related to the effects of ownership on companies' performance (Megginson and Netter, 2001; Kikeri

[27] See for instance: Galal et al. (1994); Bevan, Estrin and Schaffer (1999); Sheshinski and López-Calva (1999); Shirley and Walsh (2001); Megginson and Netter (2001); Kikeri and Nellis (2002); Djankov and Murrell (2002); Megginson (2005); Estrin et al. (2009).

and Nellis, 2002; Djankov and Murrell, 2002; Megginson, 2005; Estrin et al., 2009). Djankov and Murrel (2002)[28], in their meta-regression analysis, note that the biggest methodological problem in estimating the effect of ownership on performance is the selection bias. They find that only one-third of the reviewed papers make some efforts to control for this problem.

From an empirical point of view, there are broadly two approaches to analyse the effects of ownership transformation. The first approach, and by far more frequently used, is to compare performance indicators of companies under different ownership forms. If companies that are subject of comparison are not drawn randomly, then the results may be biased. The second, employing longitudinal data compares performance measures before and after ownership transformation. In particular, studies that analyse the impact of privatization on companies' performance by comparing pre- and post-privatization indicators without controlling for aggregate fluctuations and regulatory reforms, despite their relative merits, are afflicted by biases of unknown direction and size (Megginson, 2005; Brown, Earle and Telegdy, 2006).[29,30] Besides, aggregate fluctuations and regulatory reforms may be specific for a particular group of companies (in a particular region or sector for instance) and in the absence of sufficient observations, such specific shocks will not be accounted for,

[28] The authors use meta-regression analysis to synthesise the empirical literature on privatization, including 125 empirical studies.

[29] Initially used by Megginson, Nash and Randenborgh (1994), this methodology has been extensively employed to analyse this relationship in both transition and non-transition countries. For instance: Green and Vogelsang, 1994.

[30] In fact, some of the reforms associated with the transition process (such as price liberalisation and deregulation) are at times considered to be more important than privatization itself (see for instance, Yarrow, 1986; Kay and Thompson, 1986; Bishop and Kay, 1989; Vickers and Yarrow, 1991; Allen and Gale, 1999). Others however, hold the contention that privatization is necessary for significant improvements in companies' performance (see for instance, Vining and Boardman, 1992; Boycko, Shleifer and Vishny, 1996; Nellis, 1994; Brada, 1996; Shleifer, 1998). However, in any case, there is a general agreement that these reforms are important and failing to disentangle their effect from that of privatization process, might introduce bias in inference.

hence leading to biased estimates. Therefore, it is important to have adequate data in order to be able to employ econometric techniques that control for such problems.

Before turning to the in-depth analysis of individual studies we briefly summarise the main findings of the most extensive surveys of this empirical literature. Following Djankov and Murrell (2002) and Estrin et al. (2009), while there are some disparities in the reported results, there seem to be a general agreement that foreign ownership is associated with the highest performance improvement in most TEs. Domestic owners and insider owners (management or employee) have been reported to induce less performance enhancement. Domestic owners and insider owners are also associated with insignificant or even negative results compared to SOEs. Competitive pressure has also been reported to have a complementarity effect with ownership. Furthermore, these surveys suggest that results are not uniform and there is significant heterogeneity between regions and countries.

The impact of ownership is expected to vary depending on, among others, institutional and economic development of individual countries. Seeking to identify any such patterns that may exist, empirical evidence on the relationship between privatization and companies' performance is analysed separately depending on the country, or sample of countries, that this evidence comes from. This is also done in order to follow the empirical strategy we use in following Chapters.[31] Accordingly, evidence from single country studies is first reviewed, followed by that of mixed sample of countries. The focus is on TEs and in non-regulated industries. Also, this Chapter only reviews relevant empirical studies that were published after the year 2000, that could have be identified by the author. Earlier studies have been extensively reviewed in surveys mentioned earlier. Moreover, they generally used shorter time

[31] In Chapter 4 the impact of privatization on firm performance is measured jointly for 6 countries. In Chapter 5 only one country is analysed.

period of data and were beset with more methodological shortcomings. For a review of earlier studies, see surveys cited at the beginning of this section.

2.2 Evidence from single country studies

The empirical evidence on the impact of privatization on companies' performance in TEs based on studies that focus on single countries does not appear to be conclusive. The results vary from country to country for many reasons, including the methodology employed, output measures used, differences between countries and industries under investigation. Details about methodology (including their efforts to control for selection bias problem), time period covered, sample size and results are presented in Table 2.1. For convenience, throughout this Chapter, asterisk (*) is added do denote studies that do not account for the selection bias problem.

In a panel analysis with Slovenian firms, Orazem and Vodopivec (2004) find that that ownership has no impact on performance expressed in terms of productivity. Similarly, Bakanova et al. (2006)*, looking at Belarusian companies do not find any support that private ownership will enhance company performance and that newly created firms will perform better than privatised firms or SOEs. Along the same lines, in a recent paper, Hagemejer, Tyrowicz and Svejnar (2014), using panel data from Poland, employing before-and-after framework with matched counterfactual, find that once controlling for selection bias, there is no significant impact of ownership on companies' performance expressed in terms of improvement in value added. Their results seem to be robust across different specifications. Another study that controls for selection bias and finds similar results is that of Hanousek, Kocenda, and Svejnar (2007). Using a large unbalanced panel dataset, this study finds that the effect of privatization is limited and that many privatized firms do not display a performance that is different from that of SOEs, apart from companies that are privatized by foreign owners. In fact, the same study, in some specifications, finds that SOEs have also displayed small positive effects in cases when the state retained control through the golden share mechanism. Cull, Matesova and Shirley (2002)* also find negative effects associated with private domestic ownership. Simoneti et al. (2005) analysing Slovenian firms, found no significant difference in productivity growth between not-listed private companies and companies controlled by the state. Simiarly, Domadenik, Prasnikar and Svejnar (2003) analysing Slovenian firms, using an instrumental variable approach, to control for selection bias, found that the impact of privatization on labour adjustment are insignificant. Warzynski (2003)* studying 300 Ukrainian companies, found that privatization has only a marginally significant positive effect on profitability but its effect on productivity change is not significant.

On the other hand, in a panel analysis, Perevalov, Gimadii, and Dobrodey (2000), looking at Russian firms, find that privatization produced some improvement in the performance of companies expressed in terms of labour productivity and sales growth. Earle and Telegdy (2002) also find positive and significant improvement in labour productivity associated with privatization. Grigorian (2000) using two stage least square (2SLS) with instrumental variables (IV) regression on 5,300 Lithuanian enterprises finds significant positive impact of private ownership on labour productivity measures. Similarly, Dobrinsky at al. (2001)* using Cobb-Douglas and translog production functions find that private ownership is always associated with higher productive efficiency (expressed in terms of value added). Also, Jones and Mygind (2002) looking at Estonian firms, find that, relative to SOEs, private ownership is by 13–22% more efficient. They also find higher positive effect of insiders' ownership (management ownership) on sales growth compared to domestic outsiders, though both groups display better performance than SOEs. Brown and Earle (2002), looking at Russian manufacturing firms find that privatization and competition do not increase job creation.

Salis (2006) takes a different approach from the conventional method by using matched difference-in-difference estimators. This method takes a group of privatized firms and compares their performance with a group of similar non-privatized firms (similar in terms of observable characteristics) to identify the difference in their impact.[32] He finds that productivity of SOEs acquired by foreign companies improves. His study finds similar results when looking at employment growth figures. Foreign ownership is found to outperform other types of companies in terms of all indicators by all but one of the reviewed studies. Hanousek, Kocenda, and Svejnar (2007) suggest that foreign owners display superior performance in terms of sales growth compared to all other types of owners. Pivovarsky (2001) and Cull, Matesova and Shirley (2002)* find that foreign ownership is associated with positive effects on productivity growth. Mickiewicz (2005) reports that foreign ownership also displays the best results in terms of employment increase. Konings and Xavier (2003) however report that foreign-owned companies had lower employment growth rates compared to domestic private and SOEs. Also, Maurel (2001) drawing on a large sample of Hungarian firms suggests that both foreign and private Hungarian firms are more efficient and invest more than state-owned firms.

Looking at the method of privatization and the ownership that comes out of privatization, Miller (2006) suggests that mass privatization has resulted in lowest performance improvements compared to other methods. Mass privatization leads dispersed ownership which leaves companies with poor corporate governance mechanism. Thus ownership concentration becomes important as a mechanism of owners exercising control over their company. Perevalov, Gimadii, and Dobrodey (2000) also find that methods of privatisation do influence performance and the direction of impact is heterogeneous. In spite of this, firms with higher levels of ownership concentration, regardless of type of ownership, performed better than firms with dispersed ownership. Similarly, Andreyeva (2003), using a panel analysis of large sample of Ukrainian companies, found that the effects of performance

[32] The method will be discussed in detail in Chapter 6.

improvement associated with privatization were higher when ownership was concentrated by several private owners indicating that privatization to dominant outsider leads to more efficient results. Again, the highest positive effect is attained under foreign ownership.

Also, several reviewed studies find that competition has a positive and significant effect on performance indicating complementarity between competitive pressure and ownership Grosfeld and Tressel (2002). This is also supported by the findings of Djankov and Murrell's (2002) meta-regression analysis. There are also country level studies that compare the relative performance of SOEs with that of de novo private companies. Warzynski (2003)* and Mickiewicz (2005) suggest that de novo firms perform better than state firms. The list of identified studies that have estimated the effect ownership on companies' performance, and a summary of various features of these studies and their results, is presented below in Table 2.1. The fifth column of the table also comments on the efforts made by the authors for dealing with the selection bias problem. The period covered by these studies is not very long. Out of 25 reviewed studies only two of them cover a period of more than ten years. Three of them are cross-sectional studies, while 12 others cover less than five year (of which eight cover three or less than three years). Also, out of 25 reviewed studies five of them do not account for the selection bias problem and five of them make some limited efforts to control for it. Only five of the studies that cover more than 5 years make limited or no efforts to control for selection bias problem.

Generally, single country studies find mixed results, ranging from negative, to insignificant and positive results. However, foreign ownership is almost always associated with improvement in performance. Also, methods of privatization that lead to higher concentration seem to be associated with better performance.

Table 2.1. List of studies that analyse single countries (in chronological order)

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Hagemejer, Tyrowicz and Svejnar (2014)	*Poland*	*1995-2009*	*Using 15 years of firm-level data for Poland, authors use before-and-after framework with matched counterfactual. They find that once the selection bias is accounted for, the productivity improvement becomes uncommon. Their results seem to be robust across different specifications.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*Value added*
Hanousek, Kocenda, and Svejnar (2007)	*Czech Republic*	*1996-1999*	*The study uses large unbalanced panel dataset of 2,529-2,949 observations. It uses fixed effect estimation employing Heckman selection model to control for selection bias problem. The study finds that the effect of privatization is limited and that many private owners do not display a performance that is different from that of SOEs. However, concentrated foreign owners display superior performance compared to all other types of owners. Also, in some specification, the study finds that state has displayed positive performance when it retained control through golden share.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*Percentage change in sales* *Percentage change in profit over sales* *Percentage change in labour*
Salis (2006)	*Slovenia*	*1996-1999*	*Using matched difference-in-difference estimators, the study finds that productivity of SOEs acquired by foreign companies improves. Similar results are observed when looking at employment growth figures.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*-Productivity* *-Output* *-Employment*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Bakanova et al. (2006)	*Belarus*	*2004*	*The study employs OLS and probit regressions using survey data which were collected in 2004 covering 402 enterprises. The authors do not find any support for the hypotheses that (i) private ownership will enhance company performance and that (ii) newly created firms will perform better than privatised or state-owned ones.*	*The selection bias problem is not accounted for.*	*-Employment growth* *-Sales per worker* *-Profit over sales*
Miller (2006)	*Bulgaria*	*1996-2003*	*Using data from various sources, the authors compiled a list of balance sheet data of 2,515 enterprises. The study finds that mass privatization firms have performed less well than firms privatized by other means. Comparing firms within the mass privatization programme by ownership type, the study finds that firms with higher levels of ownership concentration, regardless of type of ownership performed better than firms with dispersed ownership.*	*Limited efforts to account for selection bias problem.*	*-Return on assets*
Mickiewicz (2005)	*Poland*	*1996-2002*	*Using panel data on large Polish firms, author finds that privatised and de novo firms are the main drivers of employment growth and that, in the case of de novo firms, it is foreign ownership which display the best results. Author uses generalised method of moments techniques (GMM) which allows controlling for selection bias by using predetermined variables as instruments.*	*The selection bias problem is accounted for.*	*-Change in employment*

Study	**Country**	**Period covered**	**Methodology and results**	**Efforts to deal with selection bias**	**Dependent variable(s)**
Simoneti et al. (2005)	*Slovenia*	*1994-2001*	*Using a sample of 479 Slovenian firms the study tests the effect of a company being listed or not listed in comparison to being controlled by the government. The study employs Heckman two-stage selection model to address the selection bias issue. The study finds that listed companies display higher productivity compared to government controlled companies. The results for non-listed companies are insignificant.*	*The selection bias problem is accounted for and the sample size is relatively large*	*-Growth in productivity*
Orazem and Vodopivec (2004)	*Slovenia*	*1994-2001*	*Using fixed- and random-effect estimators on unbalanced panel data of all manufacturing firms in Slovenia over the period 1994–2001, the study finds that ownership has no impact on performance.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*-Productivity*
Akimova and Schwödiauer (2004)	*Ukraine*	*1998-2000*	*Using survey data of 202 enterprises conducted in 2001 which covered the period between 1998 and 2000. The study finds that insider ownership has significant inverted U shape non-linear effect on performance. Outside ownership is found to have insignificant effect on performance while foreign ownership is also found to have inverted U shape non-linear effect on performance.*	*The selection bias problem is not accounted for.*	*-Sales per worker*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Andreyeva (2003)	*Ukraine*	*1996-2000*	*Using a sample of over three thousand enterprises, the study estimates a production function using random-effects and instrumental variable estimators. The study finds that firm performance improves significantly with privatization. The effects are found to be higher when ownership is concentrated by several private owners indicating that privatization to dominant outsider leads to more efficient results.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*-Productivity* *-Sales*
Domadenik, Prasnikar and Svejnar (2003)	*Slovenia*	*1996-1998*	*The study uses a sample of 130 privatized firms during the period between 1996 and 1998. It uses IV regression models. The results about the impact of privatization on labour adjustment found to be insignificant.*	*Limited efforts to account for selection bias problem.*	*-Labour adjustment*
Konings and Xavier (2003)	*Slovenia*	*1994-1998*	*Using unique firm level data, covering virtually the whole population of Slovenian manufacturing firms the study uses Heckman sample selection model. The study finds that privately owned firms had higher growth rates of labour than did state and foreign owned firms.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*-Percentage change in labour*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Earle and Estrin (2003)	*Russia*	*1994*	*The empirical work is based on survey data from privatized and state-owned Russian firms. The authors found robust evidence of a positive impact of privatization on labour productivity.*	*Limited efforts to control for selection bias.*	*-Labour productivity*
Pivovarsky (2001)	*Ukraine*	*1998*	*Using IV method, the authors find that ownership concentration by foreign firms and banks is associated with better performance of companies.*	*The selection bias problem is accounted for.*	*-Productivity*
Warzynski (2003)	*Ukraine;*	*1989-1997*	*Using survey data from 300 Ukrainian companies, the study finds that privatization has a marginally significant positive effect on profitability but its effect on productivity change is not significant. Study also finds that De novo firms perform better than state firm.*	*The selection bias problem is not accounted for.*	*-Percentage change in profitability* *-Percentage change in productivity*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Grosfeld and Tressel (2002)	*Poland;*	*1991-1998*	*The study uses all listed firms in Warsaw Stock Exchange (about 200 non-financial companies). Using GMM estimation authors were able to account for selection bias problem. They found that ownership concentration has non-linear relationship with performance. Similarly, they found that competition has positive and significant effects on productivity growth.*	*The selection bias problem is accounted for.*	*-Percentage change in productivity*
Cull, Matesova and Shirley (2002)	*Czech Republic*	*1993-1996*	*Using 1017 observations from 392 firms, this study employs fixed effects estimators. The study found that foreign ownership is associated with positive effects on productivity growth. However, once this ownership becomes dominant, the results seem to become negative. Negative results are also found in case of dominant domestic owner and in case of private ownership.*	*The selection bias problem is not accounted for.*	*-Percentage change in productivity*
Earle and Telegdy (2002)	*Romania*	*1992-1997*	*Using fixed effect estimation in 2,354 cases, the study finds that private ownership has positive and highly significant effect on labour productivity. The highest positive impact is found when controlling for outside ownership. Insiders and mass privatization are found to have small but positive impact on performance.*	*The selection bias problem is accounted for.*	*-Sales per worker*

Study	**Country**	**Period covered**	**Methodology and results**	**Efforts to deal with selection bias**	**Dependent variable(s)**
Konings and Lehmann (2002)	*Russia*	*1996-1997*	*The study uses fixed-effects specifications of static labour demand equations. Results show that SOEs exhibit weaker wage employment trade-off than do privatized and partially privatized firms.*	*The selection bias problem is accounted for.*	*-Labour demand*
Brown and Earle (2002)	*Russia*	*1985-1999*	*The study uses census data for Russian manufacturing firms covering periods before and after privatization. They find that privatization and competition did not increase job flows, but they are associated with significantly higher covariance of employment growth with relative productivity.*	*Limited efforts to control for selection bias*	*-Growth of employment* *-Job reallocation*
Jones and Mygind (2002)	*Estonia*	*1993-1997*	*The study uses large randomly selected sample of companies. Employing fixed-effects production function models, the authors found that depending on the particular specification (and relative to state ownership), (i) private ownership is 13–22% more efficient; and (ii) all types of private ownership are more productive, though managerial ownership has the biggest effects (21–32%) and ownership by domestic outsiders has the smallest impact (0–15%).*	*The selection bias problem is accounted for.*	*-Sales*

Study	**Country**	**Period covered**	**Methodology and results**	**Efforts to deal with selection bias**	**Dependent variable(s)**
Dobrinsky et al. (2001)	*Bulgaria*	*1994-1996*	*Using Cobb-Douglas and translog production function, the study finds that private ownership is always associated with higher productive efficiency.*	*No efforts are made to control for selection bias.*	*-Value added*
Maurel (2001)	*Hungary*	*1992-1998*	*Using a large sample of Hungarian firms over 7 years, the study employs fixed effects to estimate performance, while controlling, among others, for ownership. Reported results suggest that both foreign and private Hungarian firms are more efficient and invest more than state-owned firms.*	*Limited efforts to control for selection bias*	*-Sales*
Grigorian (2000)	*Lithuania*	*1995-1997*	*Using 2SLS IV regression on 5,300 enterprises, the study finds significant positive impact of private ownership on labour productivity measures.*	*The selection bias problem is accounted for.*	*-Sales per worker*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Perevalov, Gimadii, and Dobrodey (2000)	*Russia*	*1992-1996*	*The study is based on 189 enterprises and uses conditional fixed effects logistic regression to control for selection bias. The results show that privatization produced little improvement in the performance of companies. When disaggregating the data, the study reveals that methods of privatisation do influence performance but the impact is not always positive.*	*The selection bias problem is accounted for.*	*-Sales per worker* *-Percentage change in sales*

Source: Author's own compilation

2.3 Evidence from mixed samples

The empirical evidence on the impact of privatization on companies' performance using mixed sample of countries is numerous. These studies use different output measures, different countries and time-spans as well as different methodologies. Similar to the previous section, this evidence is also not conclusive. Carlin et al. (2001) in a panel analysis using data from 3,300 firms in 25 TEs find that privatization does not have any significant impact on performance expressed in terms of growth in sales and labour productivity. They maintain that sales or productivity growth of SOEs is statistically not different from that of privatized companies. Brown, Earle and Telegdy (2006) on the other hand find that results vary across different countries. Using the data for nearly the whole universe of former SOEs from Hungary, Romania, Russia and Ukraine, they find that privatization is associated with high significant positive effects in Rumania, while in Hungary and Ukraine the results are much lower, though still positive. In the case of Ukraine they become insignificant in some specifications, and in Russia the results range from negative to positive depending on the specification used.

The reviewed papers also indicate that resulting ownership after privatization seems to explain some variation in performance. For instance, Sabirianova, Svejnar, and Terrell (2005), using a panel of large firms in the Czech Republic and Russia find that privatization to domestic owners did not substantially improve companies' performance expressed in terms of value added. Companies privatized by domestic owners are found not to be able to catch up with global efficiency standards as proxied by foreign-owned firms. Similarly, Commander and Svejnar (2007) find that domestic private ownership does not have a significant effect on performance expressed in terms of value added. Also, Frydman, Hessel, and Rapaczynski (2000) using fixed effects panel estimation, find that companies owned by outsiders are more effective in terms of revenue growth compared to companies owned by insiders or SOEs.

Insider ownership is found to have the least performance improvement effects (Jones and Mygind, 2000)*.

Most of the studies that control for foreign ownership find that the effect of privatization in case of foreign ownership is associated with higher performance improvements expressed by various indicators, including value added, sales and productivity (Angelucci et al., 2002*; Commander and Svejnar, 2007; Sabirianova, Svejnar, and Terrell, 2005; Jones and Mygind, 2000*). Faggio and Konings (2003) find that foreign ownership is also associated with improvement in terms of employment.

Jones and Mygind (2000)* using large sample of companies in Lithuania, Latvia and Estonia suggest that, the effects of private ownership on productivity vary considerably over time and across countries and are always either zero or positive. Similarly, Claessens and Djankov (2002) analysing privatized and state-owned enterprises in seven TEs find that privatization is associated with significant improvement in sales and labour productivity and, to a lesser extent, with fewer job losses. Moreover, they find that the effect of privatization seems to increase in magnitude and significance over time. For instance, companies privatised for less than two years are found to have similar labour productivity to that of SOEs. However, companies privatised for more than three years clearly outperform SOEs. Their results are robust to different specifications. Frydman, Hessel, and Rapaczynski (2000) find that privatization increases the revenue of firms privatized to outsiders by almost ten percentage points. They also examine the effect of the imposition of hard budget constraints and find that hard budget constraints alone are incapable of inducing performance improvements given that there is a lack of credible commitment by governments to properly impose such constraints to underperforming SOEs.

Some of these papers try to control for selection bias problem by using various techniques however most of them are constrained by the availability good instruments that would allow them to control for this problem. Some of the studies in fact fail to control for it while some, after identifying the selection bias, and in absence of proper instruments to deal with it, report only inconclusive results (see for instance Goud, 2003)*.

Most of these studies report the importance of competition. For instance, Angelucci et al. (2002)* using Cobb-Douglas production function find that there is some complementarity between competitive pressure and ownership, and that competitive market structures are equally associated with better performance. Commander and Svejnar (2007) and Carlin et al. (2001) also report that competition in the product market has important effects on companies' performance.

The list of reviewed studies covering more than one country and a summary of the features and results of these studies is presented below in Table 2.2. Again, the fifth column of the table also comments the efforts made by the authors for dealing with selection bias problem. Similar to single country studies, the period covered by these studies is not very long. Out of 12 reviewed studies three are cross sectional studies (either one year of data or pooled cross section). Six studies cover a period of less than five years and the remaining ones cover a period between six to eight years. No study covers a period of more than ten years. Also, out of 12 reviewed studies three of them do not account for selection bias problem. Another five make some limited efforts to control for it. The narrow time span covered by the data and the limited efforts to deal with selection bias remain prevalent in empirical studies in this field. However, there is some improvement in recent studies compared to the ones produced before 2000.

Similarly, multi country studies also find mixed results. This also reflects particularities of those countries (most probably the institutional framework at a particular time). The results also depend on whether the authors take various problems into consideration or not, as well kind of ownership (and corporate governance structure) comes out of privatisation.

Table 2.2. List of studies that analyse more than one country (in chronological order)

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Commander and Svejnar (2007)	*26 TEs*	*2002 and 2005*	*The study uses large randomly stratified sample of firms in 26 TEs. The data come from Business Environment and Enterprise Performance Survey (BEEPS); 2002 and 2005 rounds. The study uses augmented Cobb Douglas revenue function also employing instrumental variable approach to account for selection bias. The results of the study show that foreign (but not domestic private) ownership and competition have an impact on performance – measured as the level of sales controlling for inputs.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*-Value added*
Brown, Earle and Telegdy (2006)	*Hungary, Romania, Russia and Ukraine*	*1994-2002*	*The study uses panel data of nearly the whole universe of former SOEs (23,884 in all four countries) from both before and after privatization periods. It uses OLS; fixed effects; as well as fixed effect and firm-specific trends estimators. Pre-privatization data are used to control for selection bias. The results show significant positive effect of privatization on productivity in Romania, ranging from 15 to 50 percent. Positive and significant results are also estimated in Hungary however the range is lower than that of Romania. In Ukraine, the estimated results are positive but lower than in the other two countries. Moreover, results in Ukraine are sensitive to model specifications and in some cases*	*The selection bias problem is accounted for and the sample size is relatively large.*	*-Productivity*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
			become insignificant. Lastly, estimated results from Russia range from negative to positive.		
Sabirianova, Svejnar, and Terrell (2005)	*Czech Republic and Russia*	*1992-2000*	*The study uses panel data on almost all industrial firms in each country, employing translog production function. Authors find that privatization to domestic owners did not substantially improved companies' performance; domestic firms are not catching up to the (world) efficiency standard given by foreign-owned firms; and the distance of the Russian firms to the efficiency frontier is much larger than that of the Czech firms and continued to grow for most firms beyond 1997 while remaining constant in the Czech Republic. Data from initial periods are used to control for selection bias.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*-Value added*
Goud (2003)	*25 TEs*	*1999*	*The study uses BEEPS 1999 data covering 4,104 firms in the sample from 25 TEs. Using a binomial logic regression model the author checks for selection bias. After finding the presence of selection bias, and in absence of proper instruments to deal with it, the study provides only inconclusive results about the direction of effect of ownership on companies' performance.*	*The selection bias problem is not accounted for.*	*-Change in sales* *-Change in labour*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Faggio and Konings (2003)	*Poland, Estonia, Slovenia, Bulgaria, and Romania*	*1993-1997*	*The study uses data from 6,884 companies from five TEs. However, the ownership effects are not estimated for Estonia and Slovenia in absence of ownership information. The results are based on 6,144 observations and find that foreign-owned companies in Romania, Poland and Bulgaria have higher job creation and excess job reallocation rates compared to SOEs. Also, job destruction rates among these companies are lower.*	*Limited efforts to account for selection bias problem.*	*-Percentage change in labour*
Angelucci et al. (2002)	*Bulgaria, Poland and Rumania*	*1997-1998*	*The study uses data from around 22,500 companies (around 2000 in Bulgaria, around 3000 in Rumania and the rest from Poland). It employs Cobb-Douglas production function using OLS as well as fixed- and random-effects estimators. The study indicates that there is some complementarity between competitive pressure and ownership. On the one hand, import penetration is found to be associated with better performance in Poland regardless on the ownership structure of the company. This effect is strengthened in case of foreign owned firms. On the other hand, in Bulgaria and Romania import penetration is associated with lower performance of domestic companies while competitive market structures are equally associated with better performance.*	*The selection bias problem is not accounted for.*	*-Sales* *-Value added*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Claessens and Djankov (2002)	*Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia and Slovenia*	*1992-1995*	*The study uses data from 6,000 privatized and state-owned enterprises in seven TEs over the initial transition period. Using fixed effects, cluster effects, and random effects, the study finds that privatization is associated with significant improvement in sales and labour productivity and, to a lesser extent, with fewer job losses. The effect of privatization seems to increase in magnitude and significance as the time since privatization passes. For instance, privatised companies for less than two years have similar labour productivity to that of SOEs. However, privatised companies for more than years clearly outperform SOEs. The results are robust to different specifications.*	*The selection bias problem is accounted for and the sample size is relatively large.*	*-Percentage change in labour productivity -Sales -Employment*
Carlin et al. (2001)	*25 TEs*	*1996-1998*	*The study uses data from 3,300 firms in 25 TEs looking at growth in sales and in sales per employee over a three-year period. Fixed and random effects estimators are used. The study results show that, controlling for other factor, privatization does not have any significant impact on performance. Sales or productivity growth of privatized companies is statistically not different from that of SOEs. However, de novo private companies have significantly higher sales growth but lower productivity growth. The study also finds that competition in*	*Limited efforts to account for selection bias problem.*	*-Percentage change in sales per worker -Sales*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
			product market also has important effects on companies' performance.		
Walsh and Whelan (2001)	*Bulgaria, Hungary, Slovakia and Slovenia*	*1990-1996*	*The study uses data from 220 firm from four TEs. The authors control for pre-and post – privatisation effects on companies' growth using group effects. Authors' use pre-privatization data to control for selection bias. They find that majority outside ownership outperforms majority insider/state ownership, but only when controlling for EU export orientation of companies. In cases when EU export orientation is similar to both groups of companies, the results are significantly not different.*	*Limited efforts to account for selection bias problem.*	*-Percentage change in labour*
Jones and Mygind (2000)	*Lithuania, Latvia and Estonia*	*1994 and 1995*	*The study uses large sample of companies in Lithuania, Latvia and Estonia employing generalized Cobb Douglas and translog production functions. Cross-sectional and fixed and random effects methods are used in different specifications. Results suggest that even though effects of private ownership on productivity vary considerably over time and across countries, still productivity effects are always found to be either zero or positive. Results about specific ownership structures are mixed. For instance, in Lithuania all forms of private ownership have zero productivity effects. However,*	*The selection bias problem is not accounted for.*	*-Value added*

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
			estimates for Estonia indicate that outside and foreign ownership is preferred to insider ownership. In regards to insider ownership alone, in Estonia, results show that majority ownership of employees yield better performance than majority ownership by managers.		
Frydman, Hessel, and Rapaczynski (2000)	*Hungary, Poland and Czech Republic*	*1990-1993*	*The study uses data from 215 firms (90 of them state and 125 privatized) from the Czech Republic, Hungary, and Poland (the initial sample size is larger but many companies were dropped). These are survey data collected in 1994. Using fixed effects panel estimation, the study finds that companies owned by outsiders are more effective in terms of revenue growth compared to companies owned by insiders or SOEs.*	*Limited efforts to account for selection bias problem.*	*-Percentage change in sales*
Frydman et al. (2000)	*Hungary, Poland and Czech Republic*	*1994-1995*	*The study uses data from 216 firms from the Czech Republic, Hungary, and Poland. It examines whether the imposition of budget constraints alone are sufficient to improve companies' performance in these countries. The study finds that the threat of hard budget constraints is weak in absence of credible commitment from the government to enforce them for SOEs with weak performance. The study finds that privatization alone increases the revenue of firms privatized to outsiders by almost ten percentage points.*	*Limited efforts to account for selection bias problem.*	*-Percentage change in sales*

Source: Author's own compilation

2.4 Conclusions

This chapter has reviewed the empirical studies estimating the effect of ownership on companies' performance. As indicated, empirical research on the relationship between privatization and companies' performance is very broad. Especially in the context of TEs, there is a vast number of empirical studies that try to determine the direction and importance of this relationship. Given that the privatization process in TEs was extensive, it provided an excellent laboratory for empirical research. This Chapter finds that there is a wide range of results arising from the fact that the studies are different in respect to their measures of ownership and performance, estimation techniques, the identity of the buyer, the extent of competition in the product market, institutional framework and time periods covered. The reviewed literature showed that privatization and companies' performance are related; however, their relationship is not straight forward. So far, neither the theory nor the empirical literature were able to provide conclusive evidence about the direction and magnitude of the effect of privatization on companies' performance.

In general, studies reviewed in this Chapter suffer from many problems, primarily the selection bias problem. Early empirical studies tended to ignore this problem which might explain some of the variation in results reported in this literature. Estrin et al. (2009) expanding the survey by Djankov and Murrell (2002) find that when focusing only on the empirical research that tries to deal with the selection bias problem, the results become less diverse and privatization effects, in more cases, are found to have positive impact on performance. However, as indicated in this Chapter there is still significant variation across the relevant studies.

The review of the recent studies suggests that there is heterogeneity in results which can be partially explained by different characteristics of the original studies. It has been argued that the lack of a conclusive evidence in the literature can partly be attributed to the lack of attention to selection bias. Similarly, small, non-representative and barely comparable data, may also explain some of the heterogeneity of results in the existing literature.

In order to deal with these problems, Chapter 4 will examine the relationship between ownership and performance at the micro level, using data collected for statistically representative samples using the same methodology, and data which allows us to control for selection bias.

Studies that analyse the impact of privatization on companies' performance by comparing indicators before and after privatization that do not control aggregate fluctuations and regulatory reforms are especially susceptible to estimation problems. Studies that focus on TEs have to make additional efforts to try and disentangle the effect of ownership transformation from the effect of other reforms that were typically carried around the same period. Also, the transition process is afflicted with aggregate shocks which, if are not accounted for properly, may erroneously be attributed to ownership transformation. The direction and size of the bias that may be introduced in such cases is unknown. Accordingly, unlike most of the previous studies, the analysis in Chapter 6 uses a large representative sample of companies with observations over a seven year period which also include companies that did not go through the privatization process hence providing a good benchmark to isolate the effects of aggregate shocks and regulatory reforms. The key proposition of the empirical models in the following Chapters is that ownership matters and it does account for differences in companies' performance. This hypothesis will be further developed and empirically investigated in Chapter 4 and Chapter 6.

Chapter 3

Privatization in former Yugoslavia: from social to private ownership

Contents

Introduction

The aim of this Chapter is to analyse the nature of ownership and its transformation in former Yugoslavia and its successor states.[33] It starts by analysing social ownership, as a form of ownership very distinct from that in the rest of the communist bloc. It brings together different theories to analyse the model of the Yugoslav firm and the underlying ownership structures. This Chapter focuses only on the post-1952 period, as from this date, former Yugoslavia had completed her departure from the centralized system and begun to develop the decentralised market socialism model.[34] During this period, the management and decision-making rights over the companies' affairs were largely transferred to employees and these competences were further increased in the following decades.[35,36] The increased autonomy of companies had an impact on their decision-making and the goals they perused.[37] The emergence of this type of economic organisation was soon accompanied by theoretical models hich aimed at the explanation and interpretation of the behaviour of Yugoslav firms and their performance (see for instance: Ward, 1958; Vanek, 1970; Horvat, 1982).

[33] The Socialist Federal Republic of Yugoslavia (SFRJ, hereafter referred to as former Yugoslavia) was formally a decentralized federation, consisting of six republics (Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia) and two autonomous provinces (Kosovo and Vojvodina). As of 2014, there are 7 independent states formed after the break-up of the federation: Bosnia and Herzegovina, Croatia, Kosovo, Macedonia, Montenegro, Serbia and Slovenia. This chapter does not include Kosovo as it will be discussed separately in Chapters 5 and 6.

[34] From the end of the Second World War until 1952 Yugoslavia had a soviet-type system of socialism with strong emphasis on central planning and industrialisation.

[35] During this period it was recognized that the allocation and ownership of resources by state and central planning was inefficient. This was especially reinforced because of the severe crises experienced by the Federation after the break from the Soviet Union. Hence it started a process of diminishing excessive centralization of state functions and devolving some of those functions to the lower levels of the federation (republican or provincial). This also ensured the needed support and legitimacy from the federal units (Gligorov, 2004).

[36] By mid-1960s, workers' council had substantially increased their competences, especially in controlling the distribution of profits between wage and internal funds (Furubotn, 1971).

[37] It should be emphasised that, despite the massive decentralisation of power, the Centre (the federal government and the League of Communists of Yugoslavia, LCY) retained important competences to satisfy broader economic, political and social goals and to maintain the power of LCY.

This Chapter also surveys the ownership transformation processes in the successor states of former Yugoslavia. The privatization process in the former federation based on the Act on Social Capital of 1989 started before that other transition economies. The extent of the ownership reform based on this legislation, however, was limited as the reforms were cut short by the breakup of the Federation. Despite their similar initial ownership structures, the successor states followed different paths in transforming social ownership, with some relying heavily on the previous federal legislation; some modified the legislation to allow for other methods, while the rest undertook heavy changes in privatization legislation. Further, this Chapter, using the limited existing literature, will investigate how the transformation of ownership has impacted the performance of emerging private companies.

Since the aim of this Chapter is to provide a context for the empirical analysis of the following Chapter, the investigation is focused on the issues relevant to privatisation and firm performance only. As such, this Chapter does not seek to provide comprehensive discussions of the social ownership and its transformation. These aspects have been extensively analysed in the previous literature on the Yugoslav economy.[38] Rather, this Chapter seeks to identify and analyse the key aspects of ownership and performance in this specific context and, as such, will inform the investigation that is undertaken in the following Chapter.

The rest of this Chapter is organised as follows. Section 3.1 will provide the context of the ownership structure in former Yugoslavia. The main form of ownership in this country was social ownership; hence, this section starts by first exploring the Yugoslav firms in the self-management/social ownership setting. Concepts such as property rights and workers' self-management, and issues such as saving and investment decisions, wage setting, maximization of income per worker or profit maximization, among others, will be discussed in this section. Section 3.2 explains the initial

[38] For a comprehensive survey see Prout (1985), Lydall (1984), Estrin, (1991).

ownership transformation initiatives in the late 1980s based on the 1989 Act on Social Capital. Here the favoured position of the 'insiders' and the progress of this method of privatization until the beginning of the break-up of the federation are discussed. Section 3.3 analyses the process of privatization and ownership transformation in successor states of former Yugoslavia. It will focus on the common and distinctive features in transforming social ownership and legacies of privatization plans based on pre-1990 legislation. It will also present short analyses of the privatization process in each of the successor states, including some remarks on the resulting ownership structures after privatization. Section 3.4 reviews the limited empirical evidence on the impact of privatization on companies' performance in these countries. Section 3.5 concludes.

3.1 Yugoslavia's market socialism: social ownership and workers' self-management

The economic system of former Yugoslavia was distinct from that of other socialist countries and this distinction is rooted in her departure from the centralized model of socialism in early-1950s (Lydall, 1984). This departure gave enterprises higher degree of autonomy and, together with other novel features, became known as the self-managed or the socialist market economy (Prout, 1985). The model of social ownership promoted the concept of industrial democracy through increasing the involvement of workers in all matters related to the operation of their enterprises. It was instituted by law as a top-down process rather than as a voluntarily or entrepreneurially driven phenomenon. In turn, it led to a lot of inconsistencies as the competences and relations of numerous agents were only loosely defined (Pejovich, 1992). In an effort to channel these problems into formal structures, it was necessary to embark on numerous reforms from 1952 to the late 1970s. In some cases, when economic agents took advantage of increased freedom and behaved in an unexpected manner (not deemed appropriate by the authorities), rigid regulations were imposed which allowed only for anticipated actions which in turn reduced the incentives for participation in autonomous decision-making (Horvat, 1982).

The most fundamental reform of the soviet type system in Yugoslavia was the introduction of 'social ownership'. Enterprises did not belong to either shareholders (as in market economies) or the state (as in the soviet system). They belonged to the 'society' and left in trust with their employees. Employees were expected to look after the enterprise assets, maintain them and increase their value over time. They also became the main beneficiaries of enterprises – though not their owners. In practice, and over time, it became clear that while enterprises and their assets were the property of the society and everyone was an owner, in reality no one in particular was the owner, discharging the full functions of ownership.[39] Of course, in extreme cases (such as the bankruptcy of an enterprise) the state became interested and involved in resolving the problems faced by enterprises (in the case of bankruptcy, for instance, by merging it with another enterprise and writing its debts off). In some sense, as it has been argued by Vanek (1970), social ownership was an extension or a variant of state ownership.

The level of employees' decision making rights and obligations evolved over time. Workers' Councils of each firm were empowered to formulate annual plans, set production targets, levels of investment, most prices and wages, and were allowed to enter in contractual relations. Apart from prices of a narrow range of commodities which were kept controlled, the rest were gradually liberalized from the mid-1960s, increasing further the decision making power of enterprises and the scope for the operation of markets (Flaherty, 1988). At the same time limited trade liberalization reforms were enacted to abandon the state monopoly of foreign trade (common under

[39] The functions of ownership include the right to possession (jus possidendi), the right to use (jus utendi), the right to benefit (jus fruendi) and the right to dispose (jus abutendi) property.

the Soviet system) and allow for more foreign competition, exposing the economy to the disciplining effects of competition. On the other hand, the means of production retained their public ownership (Furubotn, 1971). The greater autonomy of enterprises meant that the behavioural objectives of companies became an issue of central importance.

Due to its specific features, a great deal of research was conducted to analyse the socialist market economy in general, and the specific Yugoslav variant in particular.[40] At firm level, different theories emerged explaining the behaviour of the labour-managed firms. Ward in his seminal 1958 paper put forth a theoretical model based on the assumption that a labour-managed firm tends to maximise income per worker, and compares the operation of such an enterprise with that of a capitalist firm.[41] The comparison between the labour-managed firm and the capitalist firm was done while implicitly assuming that the two have the same production function and that the supply of factors is the same in both settings (Milanovic, 1983). This framework was used in much of investigations that followed.[42]

Ward's model can be summarised as follows. Consider a firm with one variable input with its production function q(L, K), where L is the number of workers and K the capital input which is assumed to be fixed.[43] The firm operates in a competitive market, selling its product at price p and incurs some non-labour related fixed costs (C). A labour managed firm is then assumed to maximise per worker income (i):

$$i = \frac{pq(L) - C}{L} \tag{3.1}$$

[40] See for instance Vanek (1970); Horvat (1982); Estrin and Bartlett (1982); Estrin and Svejnar (1985); Liotta (2001).

[41] Ward named this kind of enterprise the 'Illyrian Firm', clearly alluding to Yugoslavia. In subsequent literature this term was used to describe self-managed firm.

[42] For illustration, see Domar (1966), Bonin and Fukuda (1986), Vanek (1970), Estrin and Svejnar (1985), Ireland (1987).

[43] The production function y=f (L, K) is assumed to have positive but declining marginal product, i.e., $y'(L)>0$ and $y''(L)<0$

A company pursuing a profit maximising objective would, of course, maximize its profit:

$$\pi = pq(L) - WL - C \tag{3.2}$$

Where W is the level of wages and L the level of employment. Expressions (3.1) and (3.2) show that wages can be greater or less than per worker income (w > or < i) depending on the level of profit (profit < or > zero). The Ward model assumes that all profit is appropriated by workers with each member taking an equal share. The level of employment is set so that the per worker income is maximized.

Expression (3.1) can be rewritten as:

$$i = \frac{pq(L)}{L} - \frac{C}{L} \tag{3.3}$$

Where $\frac{pq(L)}{L}$ is revenue per worker and $\frac{C}{L}$ is cost per worker. In Figure 3.1 (Panel A), revenue and costs per worker are plotted against the number of employees. $\frac{pq(L)}{L}$ (for simplicity written as $\frac{R}{L}$ in the following diagrams) is the average revenue product of labour and has an inverted u-shape reflecting the fact that the law of diminishing return will set in at some point as employment increases. $\frac{C}{L}$, representing average costs per worker is a rectangular hyperbola asymptotic to its axes. Income per worker reaches the maximum when the difference between $\frac{R}{L}$ and $\frac{C}{L}$ is the greatest, which is the value of L_1 for which the slopes of $\frac{R}{L}$ and $\frac{C}{L}$ are equal.

Income per worker (i) is the vertical difference between $\frac{R}{L}$ and $\frac{C}{L}$ curves and is presented in Panel B of Figure 1. On this panel, we have also shown the marginal value product of labour curve ($p.MP_L$). On the basis of the usual relationship between the average and marginal product curves, this curve passes through the maximum point of the i curve (which is actually the average value product of labour). The labour managed firm is expected to operate at point A where income per worker is maximised, employing L_1 workers and paying the maximum per worker income. A profit maximizing firm, on the other hand, would operate somewhere to the right of point L_1, employing a higher level of workers and paying only the wage level.

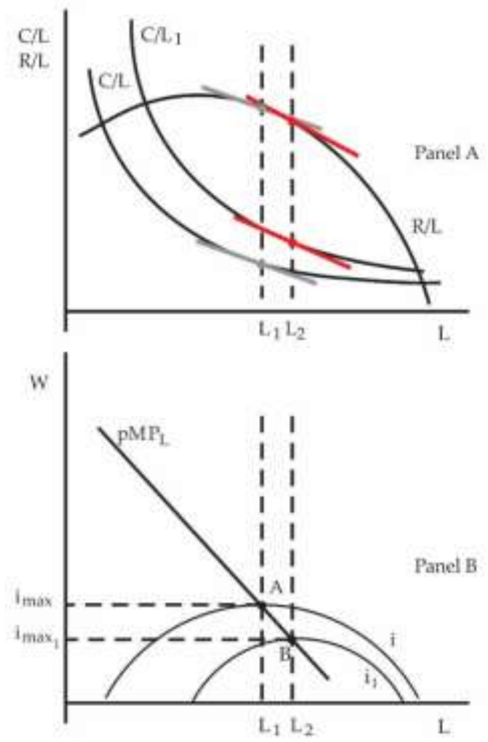


Figure 3.1.Behaviour of the Labour Managed firm (change in costs)
Source: Author drawing from various sources

The comparative static analysis of the labour managed firm produces some strange results, known as 'perverse results'. For example, if fixed costs increase, the $\frac{C}{L}$ schedule in Panel A of Figure 3.1 will shifts upwards to $\frac{C}{L_1}$. At the former optimum level of employment L_1, the $\frac{C}{L_1}$ curve will be steeper than the $\frac{R}{L}$ curve. Consequently, the labour managed firm will increase the number of workers (and output) until the slope of $\frac{C}{L_1}$ equals the slope of $\frac{R}{L}$. This is also presented in Panel B of Figure 3.1. As a result of the change in $\frac{C}{L}$ curve, there will be a new schedule of income per worker (i_1). The new optimum position is at point B where the i_1 curve reaches its maximum (and also where it is intersected by the marginal value product of labour curve (pMP_L), somewhere to the right of the original level (point A). Thus an increase in fixed costs will motivate the firm to employ more workers. A profit maximising firm would not have changed its employment level as a result of this change.

The effect of an increase in the output price is also unusual. This is presented in Figure 3.2. Panel A of Figure 3.2 is very similar to Panel A in Figure 3.1 with $\frac{R}{L}$ and $\frac{C}{L}$ and the income per working maximising level of employment of L_1 as in Figure 1. Suppose that an increase in demand leads to an increase in the market price p. The $\frac{R}{L}$ schedule in Panel A of Figure 3.2 shifts upwards to $\frac{R}{L_1}$. At the old optimum employment level of L_1, the $\frac{R}{L_1}$ curve will be steeper than the $\frac{C}{L}$ curve. Consequently, the labour managed firm will decrease the number of workers (and consequently output) until the slope of $\frac{R}{L_1}$ equals the slope of $\frac{C}{L}$, i.e., to L_2. In Panel B, the increase in p results in an upward shift of the marginal value product of labour curve (pMP_L) to pMP_{L1}.

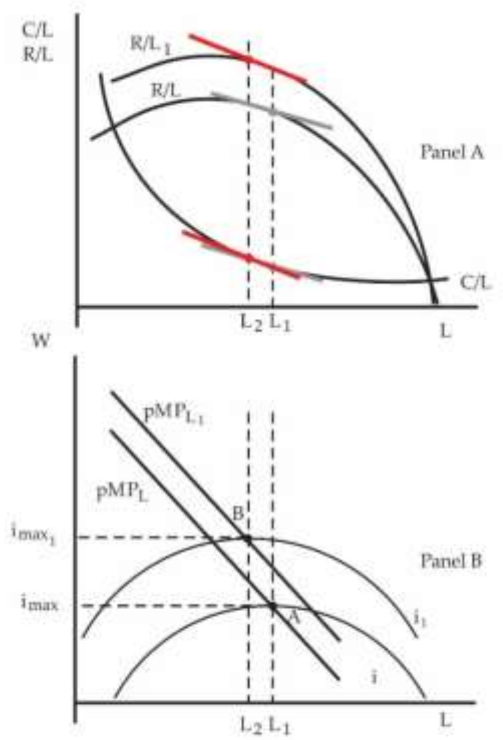


Figure 3.2 Behaviour of the Labour Managed firm (change in price)
Source: Author drawing from various sources

The new schedule of income per worker (*i_1*) has its maximum somewhere to the left of the initial maximum. There is of course a new marginal value product of labour curve ($pMPL_1$) which passes through the maximum of the *i_1* curve (at point B), slightly to the left of the optimum position (point A). Thus an increase in output price leads to a decrease in employment and output. A profit maximising firm would have increased its output and employment in response to a price rise. The behaviour of the labour managed firm is often referred to as 'perverse'. As Ireland (1987) points out, this behaviour is the result of the distorted incentives (income per head maximisation).[44]

This basic model has been reinforced by many authors in subsequent literature (see for instance Domar, 1966 and Vanek 1970. Also, other extensions have been developed to include less restrictive assumptions, for instance multiple variable inputs and substitutability of inputs. Milenkovitch (1984) finds that the inclusion of these assumptions seems to decrease the 'perverse' behaviour of the labour managed firm, though it will still retain its sub-optimal output and employment levels compared to its profit maximizing counterpart.

However, another group of authors have refuted this model on the grounds of underlying assumptions about the firm's objectives. This strand of literature argued that maximizing income per worker does not reflect the objective of the Yugoslav labour managed firm (see for instance Horvat, 1972, 1976; Prasnikar et al., 1991). Horvat (1984; 1986) suggests that some of the behaviours predicted by the Ward model were never observed in Yugoslav economy. Also, Prasnikar and Svejnar (1991) asserted that labour managed firm can produce efficient results while at the same time

[44] At macroeconomic level, this implies that there is no mechanism for clearing labour markets as no market wage exists, hence creating unemployment in the long run equilibrium. Unemployed workers cannot make themselves more attractive by lowering their supply price as if hired they receive proportionate share of firms net revenue. Meade (1972, 1974) proposes a way to remedy this by allowing firms to hire new workers on discriminatory terms. Another mechanism is the entry of new firms.

have more equitable allocative efficiency. The latter group of authors have also refuted the Ward's model on the basis of the level of efforts that self-managed workers put into their jobs. Horvat (1986), Jones and Svejnar (1982) and Vanek (1970) ague that workers who are involved in decision making and manage themselves, are more productive and put greater efforts in their work due to the increased utility from self-management. Horvat suggests that the workers council is in better position than the board of directors in a capitalist firm to monitor the affairs of the firm and the behaviour of the management. The council has the necessary information and has a strong motivation for correct decision making (Horvat, 1982; p. 251).

Property rights theorists have also analysed the behaviour of the labour-managed firm. They assert that because of unclear property rights, the allocation of resources by labour managed firms is sub-optimal (Pejovich, 1992). This line of thought maintains that prevailing property rights arrangement in former Yugoslavia distorted the investment decisions given that the workers were not permitted to own capital. As the workers have only the right to use the firms' assets while they are in employment, they have more incentive to increase current consumption rather than investments (or future consumption). Due to these ambiguous property rights, employees have the incentive to transfer future cash flows of the company to present, leading to sub-optimal level of investment. This, single period model, was extended to a multi-period model which assumes that workers' objective is wealth rather than income maximization (Furubotn and Pejovich, 1970).

Given this objective, if the workers recognize that an increase in capital will improve productivity and higher income in the future, they will support diverting some of the present income to investment. In this case, the Ward hypothesis would be a special case of the basic wealth maximizing model. Assuming that the workers are rational, they will choose to invest in non-owned assets only if they have permanent working relations with their firm. However, when workers are laid off or leave the firm, they lose all claims on the future returns from the capital for which they have sacrificed income in previous periods. As they cannot capture the benefit from investment, they choose to invest less than their capitalist profit maximizing counterparts. Property rights theorists also assert that the labour managed firm is expected to take greater risks as the failure is shared with the society at large, while the benefits are captured only by the firm. This type of moral hazard cannot be easily disciplined by a socialist state with soft-budget constraint in pursuit of higher employment and equity.[45]

Several interventions to restore these perverse incentives have been put forward since the 1960s in successive liberalization packages.[46] These reforms, apart from introducing markets at local/national level, also exposed the economy to foreign goods and services. Additionally, these reforms aimed at introducing harder budget constraints by allowing the banking sector to allocate investment funds based on market principles.[47] Faced with foreign competitive pressure and with harder budget constraints, it was expected that companies would be forced to restructure and modernize in order to ensure their survival. Harder budget constraints in a bank lending relationship could induce investment in non-owned assets; however these constraints were never seriously imposed. Instead, the soft budget constraint regime was retained in order to maintain employment levels consistent with social goals despite inflationary consequences (Milenkovitch, 1984). The interventions of the

[45] Some of the arguments of property rights theory about state ownership are also relevant here. For details see section 1.1.2 in Chapter 1.

[46] By then one of the ideas that became widely accepted was to speed up the entry of new firms, to boost the number of entrepreneurs in order to improve the dynamism of the highly concentrated and stagnant industrial structure. A further theoretical impetus came from the economics of self-management (Vanek, 1970), where entry was crucial for ensuring allocative efficiency.

[47] In this regard, there was a perverse relationship between macro and micro level decision-making in former Yugoslavia. While the macroeconomic decision-making was administratively imposed, the microeconomic level was largely left to the market mechanism. The government decided the level of money to be spent in each sector and used the banking sector to allocate the money based on market principles (Pejovich, 1966). While the market based distribution of funds aims to minimize the distortions caused by administrative decisions at the macro level, it proved unable to eliminate them. Moreover, as long as the banks were to be socially owned, there was a problem in bank lending relationship as both borrowers and lenders were the same agents (Gligorov, 2004).

government distorted the disciplining effect of the market and, at the same time, restricted the autonomy of self-managed enterprises.

In cases when investment was financed by bank loans, companies tended to over-invest and over-consume accumulating large debts. When debt levels became unsustainable, companies were rescued by local governments or through mergers with companies in the same sector. While companies were not allowed to sell off their assets, they were not prevented from devaluating social capital by either (i) borrowing money that they could not repay or (ii) exhaust the machinery without accumulating depreciation funds. This allowed enterprises, and their employees, to pursue their own individual interests further at the expense of the society.

Richer and better performing regions were dissatisfied as they were paying proportionately higher taxes to support poorer regions which were plagued with systematic inefficiency (Flaherty, 1982; Milenkovitch 1971). Moreover, during the 1980s the economy of former Yugoslavia was in the midst of an economic crisis which resulted, amongst other things, in cutting back inter-regional support to poorer regions at a time when more resources were needed (Hashi, 1992).[48]. Moreover, the economic decision-making was subordinated to political objectives which limited the level of democratic decision-making. High level of decentralisation of authorities to constituent units weakened the ability of the federal government to develop proper regional policy instruments aiming at reducing inter-regional difference. Moreover, the increasing autonomy resulting from decentralisation and reliance on market mechanism even expanded these difference (Hashi, 1992). Given the high levels of diversity, the disintegration of the country, was almost inevitable, and would emerge as a Pareto-improving option (Bolton and Roland, 1997). The liberalization of trade and globalization renders the size of the country (single market) as unimportant as the

[48] The following section provides some insights about the economic crisis that former Yugoslavia faced during this period.

advantages of closed markets disappear. Also due to high diversity, the incentives to disintegrate gradually emerged (Gligorov, 2004). These outcomes together with the absence of democratic decision-making and unresolved ethnic tensions, led to the ultimate dissolution of the federation and the 'Yugoslav wars' of the 1990s.

3.2 The privatization process before the break-up of former Yugoslavia

During the 1980s, former Yugoslavia faced major economic crises, with high unemployment, hyperinflation, huge trade imbalance and unable to service its large foreign debt. The unemployment levels reached 14 percent in 1989 with a few million additional people working abroad. At the same time, by then the surplus personnel had reached 20 percent of the labour force (Coricelli and Rocha, 1991).[49] During this decade, the output barely grew; GDP of 1989 stood at essentially the same level as that of 1979 (Gligorov, 2004).[50] It was accompanied by a substantial increase in poverty rates (Milanovic, 1991).[51] The enterprises were experiencing huge losses accounting for over 15 percent of GDP.[52]

The experience of this decade showed that successive reforms of the system had not been able to deliver the necessary changes to put the economy on the right track. It was recognized that the expansion of the social ownership has reached its limitation and further economic development had to be based on the expansion of the private

[49] The surplus personnel resulted from the SOEs' attempt to avoid bankruptcy through the non-payment of salaries.
[50] As predicted by most of the theories discussed above, there was a constant pressure to increase wages while investment was relegated to the background. The necessary investment was largely financed by external borrowing, resulting in higher and higher inflation. Once the external sources were dried out, investment dropped significantly, plunging the economy in a prolonged stagnation (Gligorov, 2004).
[51] Compared to agricultural and mixed households, the urban population experienced the effects of increased poverty more due to greater deterioration of living conditions among SOE workers (Milanovic, 1991).
[52] During the 1980s, the average enterprise losses were around 3 percent of GDP, starting as low as 1.6 percent in 1980 (Coricelli and Rocha, 1991).While these numbers are affected by many accounting issues, still they indicate a highly deteriorating trend.

sector. In an attempt to overturn this situation, the government of Prime Minister Ante Markovic initiated a series of radical economic reforms at the end of 1989, with the support of the International Monetary Fund (IMF).[53] These reforms required the implementation of an austerity package aiming to bring hyper-inflation under control, freezing wages, substantial reductions in government spending as well as divestiture of SOEs (Spencer, 2000).

The credit to the industrial sector was frozen, facilitating the bankruptcy process. Through the so-called 'exit-mechanism', established under the provisions of the newly enacted legislation, the government would initiate bankruptcy proceedings if the company failed to meet the creditors' claims.[54] Also the creditors could convert their credits into controlling equity of the insolvent enterprise, while the government was prevented from stepping in. Within one year, the implementation of the reform brought the inflation down to virtually zero (Crnobrnja, 1994). However, the reforms also had negative consequences. The level of unemployment increased, output plummeted and bankruptcies rose.

Privatization was a fundamental part of the reform package, which also included hard budget constraints aiming at limiting financial indiscipline of SOEs. The most significant step towards privatization was taken with the enactment of the Enterprise Law in 1988 which limited workers self-management, allowed the entry of private capital and the establishment of joint-stock companies. Also, all forms of property were to be treated equally in legal terms, and the establishment of all forms of companies was constitutionally allowed (including the establishment of an SOE). The

[53] The arrangements with the IMF increased the role of the federal government as the main authority over economic affairs. This was also supported by the IMF who needed a central authority to implement reforms. However, as the role of the government in Belgrade increased, so did the national intolerance agenda (Magaš, 1993).

[54] If an enterprise was unable to pay its bills for 30 days running, or for 30 days within a 45-day period, the government would launch bankruptcy proceedings within the next 15 days (Kiss, 1994). During this period, also state property started to grow through debt-equity swaps exercised on insolvent social debtors.

privatization process *per se* was formalized on the basis of the Act on Social Capital of 1989. This law attempted to define property rights and create a framework that allowed for privatization of assets. It favoured insiders by offering them shares at large discounts and long payment periods. Former and current employees were entitled to buy shares at 30 percent discount on the nominal share values, subject to a maximum value of DM20,000. Each year of employment with the company gave the worker an additional one percent discount up to ceiling level of 70 percent. Employees were entitled to pay for their shares in instalments, provided that they complete their payments within ten years. The remaining (unsold) shares of each enterprise were to be sold in public auctions to domestic and foreign enterprises or individuals (Franičević, 1999); though the continued existence of SOEs was not prohibited (Uvalic 1997, p. 269).

The Act on Social Capital declared the Development Funds as the owners of SOEs. As a consequence, any proceeds resulting from sale of shares could not be used for capital investments in the companies. Consequently, the initial results of the privatization were not satisfactory as companies continued to be critically undercapitalized and the resulting dispersed insider ownership structures made it difficult to embark on the badly needed restructuring process (Hillman and Milanovic, 1992).

The continued economic crisis exacerbated the political stability of the country and threatened to aggravate the simmering ethnic tensions (Spencer, 2000). The privatization process based on the Act on Social Capital had barely taken off when the deteriorating political situation turned into armed conflict. It is estimated that less than 10 percent of SOEs underwent the privatization process while the rest retained their former status (i.e., socially owned) at the time of the dissolution of former Yugoslavia (Vujacic and Vujacic, 2011).

3.3 Privatization and ownership transformation in successor states of former Yugoslavia

At the time of independence, the number of SOEs in the successor states of Former Yugoslavia was 14,682. There was a similar distribution of companies among republics apart from Montenegro and Macedonia, where the number of enterprises was significantly lower (Table 3.1).

Table 3.1. Number of socially owned enterprises (at the time of independence) in successor states of former Yugoslavia

Country	Number of SOEs and date
Bosnia and Herzegovina	3000 (in 1995 - Dayton Agreement)
Croatia	3619 (in 1992)
Macedonia	1288 (in 1993)
Serbia and Montenegro*	3878 (in 1992)
Slovenia	2897 (in 1992)

Note: *Only around 10 percent were in Montenegro.
Source: Countries' Privatization Agencies

After the break-up of Yugoslavia, successor states enacted new legislation in order to expedite the privatization process. However the process itself was slow due to the absence of relevant institutions to implement the process. In Slovenia, socially owned firms were privatized in a way that preserved the continuity of ownership and the survival of existing firms (Gligorov, 2004). An interesting approach for transforming social ownership was to sell or distribute a proportion of the companies' shares to their employees, allowing the capital markets to determine the eventual ownership structure. A sizeable portion of the economy remained in direct ownership of Funds for many years. Only after the start of break-up of the Federation, the privatization process in successor states created space for international participation (Mencinger, 1996).

In Croatia, SOEs were initially nationalized and then sold to private owners (Gligorov, 2004). This gave great discretionary power to the government and privatization agencies. The insiders continued to be favoured while outside investors were discriminated against, thus the inflow of foreign capital was deterred (Hiller and Drezga, 1996). By 1996 selective voucher privatization was also introduced which benefited only selected groups, mainly those affected by the war (Franicevic, 1999). Subsequent legal amendments created space for new methods of privatization extending to strategic selling and outsider ownership (Ostovic, 1996).

In Bosnia and Herzegovina, the privatization process was put on hold until the end of the war in 1995. By then the only privatization that had been carried out was that based on former federal legislation. Based on this, only around 5 percent of SOEs had been privatized (Bayliss, 2005).The actual privatization process did not restart until 1997, after the Government nationalised all the remaining enterprises and their unsold shares. The method adopted was voucher privatization. By early 2001, less than 10 percent of large-scale enterprises within the Federation had been privatised, while in Republika Srpska the figure was less than 5 percent (Donais, 2002). However, the majority of small-scale enterprises were privatized between 1989 and early 2000 (see Figure 3.3 for details). The privatisation process in Bosnia and Herzegovina faced a number of uncertainties, including information problems and a highly decentralised implementation process. There were further problems regarding the ownership status of enterprises, given unclear documentation of minority “internal” shares issued to employees under the pre-war privatisation legislation (EBRD, various years).

In Serbia, the privatization process went through several phases after the break-up of the federation. The first phase was based on previous legislation. Insiders were very interested in purchasing shares as the instalments to be paid were not indexed for accelerating inflation (Milovanovic, 2007). Unlike all the other successor states of former Yugoslavia, Serbia retained ‘social property’ as one of the main property forms, implying that privatization was in no way imposed on enterprises as obligatory (Uvalic, 2010). Still, by 1994, almost 43 percent of social ownership had been transferred to private owners. However, the revised legislation reversed the process renationalizing almost all previously privatized assets. This brought down the share of private owners to 1-2 percent (Vujacic, 1996, pp 398-9). In 1997 new legislation was passed which introduced free distribution of shares to employees (Hadzic, 2002). By 2000, less than ten percent of social capital had been privatized (Begovic et al., 2000). The process intensified after 2001 along with the implementation of other transition reforms after the democratic revolution of October 2000 (Vujacic and Vujacic, 2011).

In Montenegro, while part of the Serbia-Montenegro state, the new law passed in 1992 which nationalized the social owned enterprises, was also applied in this country. Government controlled Funds became owners of the majority of shares with the workers retaining minority ownership in these companies (Cerovic, 2010). The model defined by the law was mass voucher privatization (distribution of shares to all adult citizens for free) (EBRD, 2001). By the end of the decade, when Montenegro had become an independent country, new legislation was passed which allowed for other forms of ownership transformation.

In Macedonia, the law was passed in 1993 which allowed for revising the process based on former Yugoslav legislation. As a result only about 10 percent of previously privatizations were approved. The new legislation projected that 30 percent of shares were to be offered to employees on favourable terms, 15 percent were to be transferred to state pension funds and remaining 55 percent were available for sale to any investor on equal terms (foreign and domestic). The law was based on case-by-case selling and the methods to be used were different depending on the size of the company (Slaveski, 1997; Suklev, 1996).

To sum up, in all successor states, though to varying degrees, similarities with previous legislation were kept, showing path dependency from divestiture method before the break-up of the federation which favoured workers and managers. Table 3.2 summarises the privatization methods used in these countries.

Table 3.2 Methods of privatization in successor states of former Yugoslavia

Country	Primary Method	Secondary Method
Bosnia	Voucher	Direct sale
Croatia	MEBO	Voucher
Macedonia	MEBO	Direct sale
Montenegro	Vouchers	Direct sale
Serbia	Auctions	Direct sale
Slovenia	MEBO	Voucher

Source: EBRD (various years)

Management and Employee Buyout (MEBO) was the primary method in Croatia, Macedonia and Slovenia while their adopted legislation allowed for other methods of privatization. Voucher privatization was an important method in Bosnia and Montenegro (as a primary method) and the secondary method in Slovenia and Croatia. Only in Serbia the primary method of privatization was through auctions; however the process was very slow, and accelerated only after the end of the Kosovo war in 1999.

These privatisation methods, on the whole, resulted in dispersed ownership structures where no efficient corporate governance (CG) framework could be established. The bearers of the vouchers had no incentives in enforcing good GG on companies; nor had they the know-how or the capital to initiate the restructuring process by themselves. In the case of MEBO privatisation, insiders paid for the shares from company profits, using up investment resources. The resulting ownership structures, with little ownership control and little financial resources delayed the restructuring process and most of the companies, as in other transition countries, lost their competitiveness (EBRD, 1997).

Subsequently a process of concentration of ownership started to emerge through secondary privatization.[55] Secondary privatization was also important for the entry of strategic investors given that the first stage of privatization, to a large extent, excluded the outsiders. In later stages of transition, ownership concentration was strengthened mainly by some incumbent owners increasing their shares. Incumbent owners were reluctant to seek equity financing from outsiders fearing the loss of control (Simoneti and Jamnik, 2000). Reliance on internal sources constrained companies from effective restructuring.

By the end of the 1990s, countries had recognized that not only privatization was important, but that the resulting ownership structures also mattered. By then it was recognized that for companies to survive in a competitive setting, restructuring and establishment of the sound corporate governance are more important than mere ownership transformation. Empirical studies, almost unanimously suggest that companies privatized by foreign investors have been the best performers (for details see Chapter 2). To this end, governments engaged in facilitating increased foreign ownership while shifting the motivation of privatization away from social concerns towards improvements in corporate governance (EBRD, 1998). This is especially true for countries that started the process later (like Serbia) and tried to simultaneously divest SOEs and attract FDI, but also in countries where the privatization process was progressing slowly.

The privatization process was an important instrument of attracting FDI into different sectors in transition countries (Hunya and Kalotay, 2000).[56] With the liberalization of FDI increased in all successor states of former Yugoslavia- between 1998 and 2008, on average, the levels of FDI increased almost 14 times (EBRD, various years). This increase was triggered significantly by privatization related investment inflows, and

[55] Secondary privatization refers to the evolution and changes of ownership structures in privatized companies after the initial privatization.
[56] Fore greater details on the relationship between FDI and privatization, see Chapter 2.

the dynamics of FDI was seriously affected by acceleration and deceleration of the privatization process (EBRD, 1998). However, while privatization has dominated FDI inflows, FDI has not been the dominant form of privatization.

Using EBRD and World Bank data (various years), a significant positive relationship between level of privatization revenues and FDI inflows in successor states of former Yugoslavia is found. Figure 3.3 shows that in all countries, an increase in the level of privatization proceeds (expressed as percent of GDP), has been associated with an increase in FDI inflow.[57] The figures also point out the positive trend of FDI inflow during the last decade. In Slovenia and Croatia, a flatter growth of the level of privatization revenues is observed in later stages of transition. This is mainly because these countries are entering the final stages of divesting SOEs. However, despite the small increase in the level of privatization revenues as percentage of GDP, the levels of FDI has continued to increase. This signals the increasing role of non-privatization related foreign investment inflow, which is found also in other advanced transition countries.

[57] Lower correlation coefficient is obtained in case of Croatia.

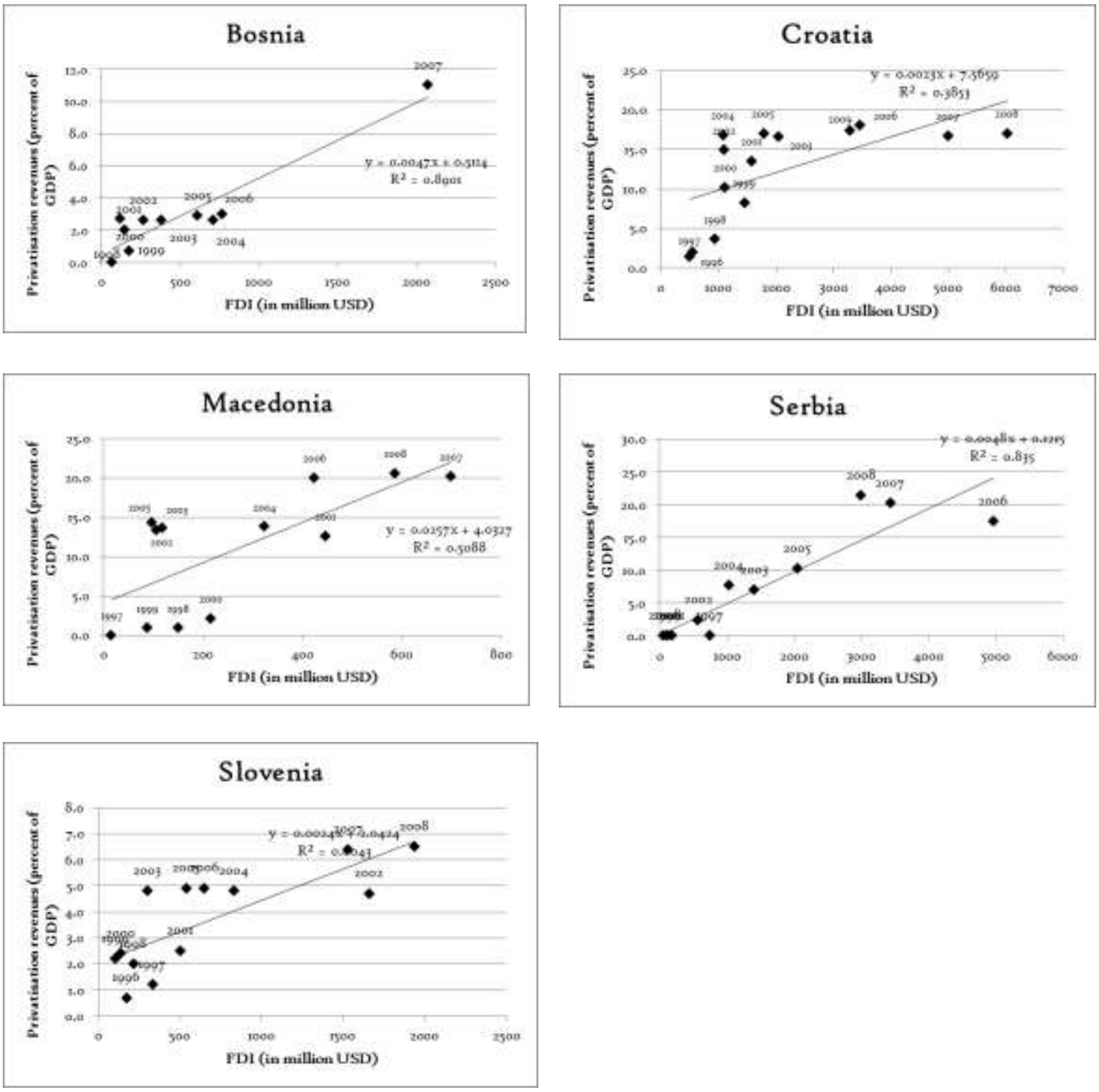


Figure 3.3. Privatization and FDI
Source: Author's calculations using EBRD and World Bank Data

As for the scale of divestments achieved by successor states of former Yugoslavia, Figure 3.4 shows that while all countries succeeded in transferring the majority of small-scale enterprises to private owners between 1989 and early 2000, the large-scale privatization lagged behind.

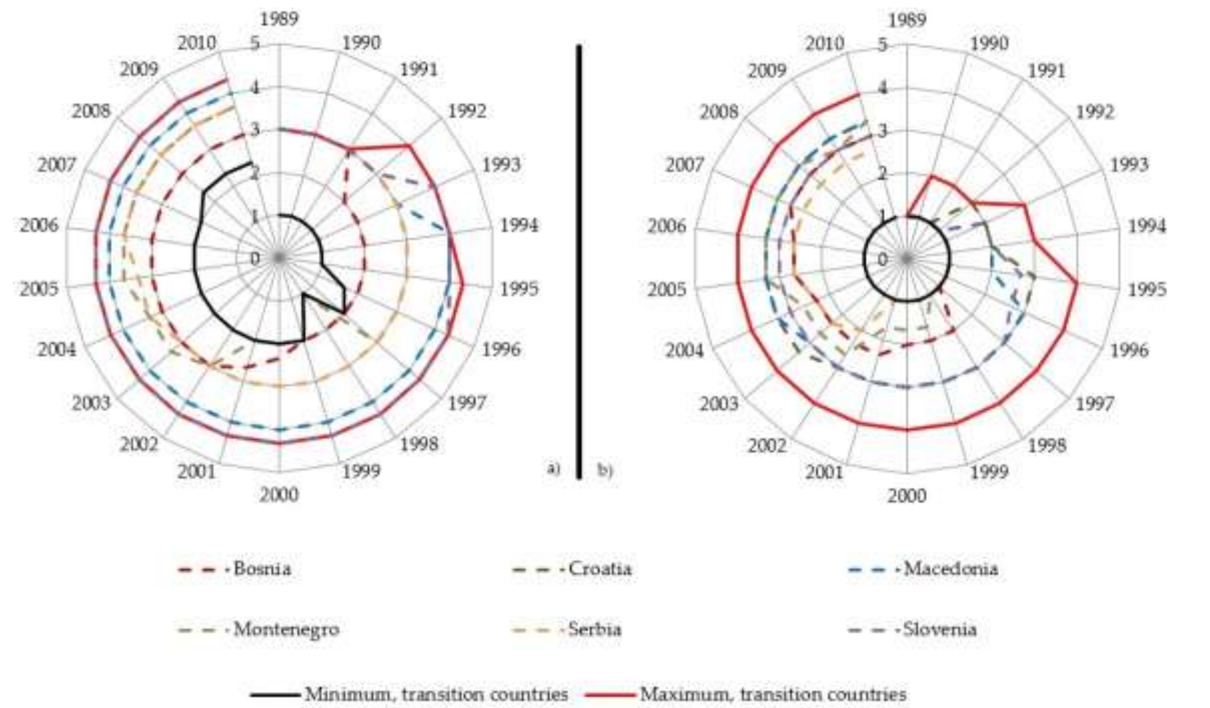


Figure 3.4. Scale of progress in a) small- and b) large-scale privatisation 4

Note: The 1-4 score is the ranking of the EBRD. The classification system for assessing progress in large-scale privatization is: 1–minimal progress; 2–scheme ready for implementation; some firms divested; 3–more than 25% of assets privatized; 4–more than 50% of assets privatized, and substantial progress on corporate governance; 4+ –more than 75% of assets in private hands; standards and performance comparable to advanced industrial countries. The classification system for small-scale privatization: 1-minimal progress; 2-substantial shares privatized; 3-scheme ready for implementation; 4- Complete privatisation of small companies with tradable ownership rights; 4+- Standards and performance typical of advanced industrial economies: no state ownership of small enterprises; effective tradability of land.

Source: Author's calculation based on EBRD data

In 1989 all countries started from the same social-ownership setting but the dynamics of the process did not follow the same path in all countries as shown in Figure 3.3. In Slovenia and Croatia, small-scale privatization reached levels of typical advanced industrial economy as early as 1996. In Macedonia, small-scale privatization was completed even earlier but was limited to companies with tradable ownership rights (short of tradability of land). In Montenegro, the scheme for small-scale privatization was ready for implementation as early at the initial stage of transition, but the progress has been sluggish with significant backslide in 1998 and 2001. During this period, Montenegro, together with some other transition countries scored the lowest score, marking minimal progress. Similarly Serbia did not make significant progress in small-scale privatization and until 2002 it had a same level of progress it achieved in the beginning of the 1990s. Currently Serbia and Montenegro have a score of 3.67 which is close to completely privatizing small companies with tradable ownership rights. The small scale privatization primarily focuses on companies largely operating in competitive non-regulated sectors.

The large-scale privatization (privatisation through public offering of shares) continues to lag behind in all these countries. Slovenia, Croatia and Macedonia were the first to achieve considerable progress and by mid 1990s they managed to privatize over 25 percent of assets. Since then, little progress was achieved- in Slovenia the same level of privatization was recorded even in 2010 while in Croatia and Macedonia over 1/3 of assets were privatized by 2010. In other countries, and during the early years of transition, the extent of large-scale privatization was the lowest among all transition countries. The major steps were taken only after the year 2000. Montenegro and Bosnia managed to pick up in the following years privatizing over one third and over 25 percent of assets respectively. In general, despite the acceleration of large-scale privatization in recent years, the successor states of former Yugoslavia still lag behind the best performers among transition countries.

Despite delays in privatization, companies operating in non-regulated sectors were exposed to the disciplining effects of, both internal and external, competition since the beginning of transition. During this period, state control over companies' affairs started to fade away, the soft-budget constraints were lifted and the threat of ultimate bankruptcy became credible. Under such circumstances, companies had to adjust their behaviour, by pursuing profit maximization, in order to be able to survive the new market conditions.

Even some two decades after the beginning of transition, privatization in successor states of former Yugoslavia remained incomplete, despite the fact that the issue of social property was mostly resolved and, if it still exists (e.g., in Serbia), it is present to a much lesser extent (EBRD, various years). Markovic reforms provided an interpretation of the concept of 'social ownership'. That the society, represented in this case by Funds, owned the assets and workers had a major stake. In order words, unlike the popular belief in many successor states, enterprises did not belong to workers (they were declared the property of Development Funds which were under the government control); but with employees having a major claim to the socially owned assets (potentially up to 70% discount and up to DM 20,000). In recent years the share of private sector in employment and output has increased considerably in all countries. By 2010, the share of private sector employment ranged from 60 percent in Macedonia to 70 percent in Slovenia and Croatia (see Figure 3.5). In terms of output, the private sector accounted for a higher share in Slovenia, Croatia and Macedonia (84 percent), which is similar to OECD countries, compared to Montenegro (65 percent) and Bosnia and Serbia (60 percent). While state involvement in economies of these countries is still through ownership links and its regulatory role, the main source of economic growth is the genuine private sector (EBRD, various years).

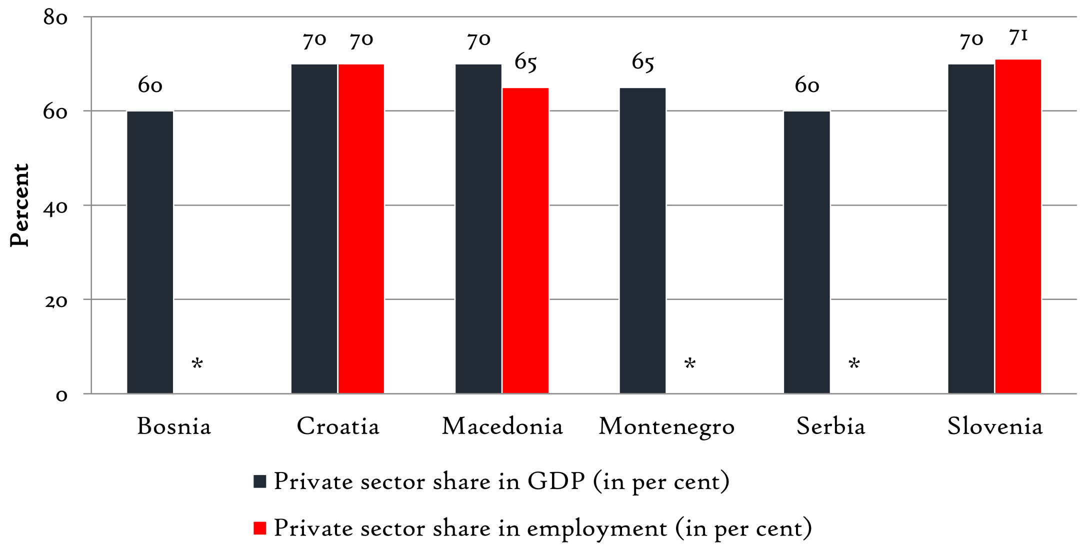


Figure 3.5. Share of private sector in employment and output (2010)
* Data for the shares of privates sector in employment for Bosnia, Montenegro and Serbia were not available.
Source: EBRD data; www.ebrd.com

3.4 Empirical evidence from privatization process in successor states of former Yugoslavia

The empirical evidence on the effect of privatization on companies' performance in the successor states of the former Yugoslavia is very limited and far from conclusive. The following section aims at reviewing selected empirical works that investigate the privatization induced performance changes in these countries as well as differences in performance among companies under different types of ownership resulting from privatization. This short review is limited only to companies operating in non-regulated sectors.[58] There are several empirical papers looking at the impact of privatization in Slovenia, Macedonia, Serbia, Croatia and Montenegro. However, to our best knowledge no rigorous empirical research has been conducted to date analysing the impact of privatization in Bosnian enterprises. Also, there is no empirical evidence that jointly analyses the impact of privatization across these countries. Moreover, there is no empirical evidence focusing on the impact of ownership on the technical efficiency of companies.[59]

The studies considered here have reported mixed results.[60] Similarly to Chapter 2, for convenience, an asterisk (*) is added do denote studies that do not account for selection bias problem. Glennerster (2003), finds weak evidence of privatization-induced performance improvements in Macedonia. Most of the studies cited here show that insider-controlled companies perform relatively poorly compared to companies owned by outside investors (Prašnikar , Svejnar and Domadenik, 2000*; Glennerster, 2003; Zalduendo, 2003*; Zelic, 2005*). Prašnikar et al. (2002)* finds no significant differences in total factor productivity between different groups of firms in

[58] It should be noted that there are some studies analysing the impact of privatization on the performance of companies in regulated sectors; especially in the banking sector. These studies are not included as they are not in the focus of this thesis.
[59] The following chapter will fill this gap by analysing the impact of ownership on company performance in successor states of former Yugoslavia and contribute to better understanding the impact of ownership on companies' efficiency.
[60] The main characteristics of these studies will be shown below, in Table 3.3.

Slovenia and Macedonia. Simoneti and Gregoric (2004) analyse the effect of the increasing managerial control on Slovenian firms' performance. They find the evidence of positive effect only for companies with dominant ownership and companies which are listed.

Studies that analyse the impact of foreign ownership provide consistent findings. Pervan, Pervan and Todoric (2012) find that, in Croatia, foreign controlled listed firms perform better than domestically controlled firms while Smith, Cin and Vodopivec (1997) find that, in Slovenia, a one percentage point increase in foreign ownership is associated with a 3.9 percent increase in value added. Similarly, Bliss, Polutnik and Pahar (2007)* looking at Slovenian companies and Zelic (2005)* looking at Serbian companies, maintain that de-novo private companies outperform both SOEs and privatized companies. Zalduendo (2003)* argues that apart from private ownership, market-based economic institutions and elimination of hard-budget constraints have served to strengthen corporate performance. Table 3.3 recapitulates the main features of these studies presenting the country of analysis, sample description, study period, methodology as well as a summary of empirical findings. The fifth column of the table also comments the efforts made by the authors for dealing with selection bias problem. Out of 9 reviewed studies six of them do not account for endogeneity problem. The rest make only some limited efforts to control for it. This might have introduced bias in their estimates so their results should be interpreted with caution.

Table 3.3. Selected studies on the impact of ownership on performance (in chronological order)

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Pervan, Pervan and Todoric (2012)	Croatia	2003-2010	Using 1,430 observations of listed Croatian firms from the Zagreb Stock Exchange drawn from the period 2003-2010, the paper analyses the relationship between firm ownership (ownership concentration and type) and performance expressed in terms of return on assets. Authors employ dynamic panel analysis. The study finds that (i) ownership concentration is negatively related to performance, i.e. listed firms with dispersed ownership perform better than firms with concentrated ownership; (ii) foreign controlled listed firms perform better than domestically controlled firms; (iii) majority of state owned firms perform worse than privately held firms.	Limited efforts to account for selection bias problem.	-Return on assets
Knezevic Cvelbar, Domadenik and Prasnikar (2008)	Slovenia	1998-2002	Using a panel data analysis, the study analyses the performance of companies with different ownership. The study finds that outsiders do not appear to be more efficient owners than insiders, whereas the state is identified as an inefficient owner, especially in the case of direct state ownership.	The selection bias problem is not accounted for.	-Sales growth
Bliss, Polutnik and Pahar (2007)	Slovenia	1995 to 2004	Using 30,000 Slovenian firms drawn from the period 1995 to 2004, the study analyses the performance differences between privatized enterprises and newly-established firms. The study	The selection bias problem is not accounted for.	-Total factor productivity growth

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
			finds that de novo private firms perform better than privatized firms.		
Zelic (2005)	Serbia	2002-2003	Using a sample of over 15,000 enterprises, the paper examines the effect of various privatization methods on performance of Serbian enterprises. Using cross-sectional analysis, the study finds that (i) private ownership yields higher investment levels than social ownership; (ii) voucher privatization, leading to inside ownership, provides worse results in terms of investment compared to privatization by sale. Sill, these companies perform better than those that did not go through privatization; (iii) de novo private firms outperform all other forms of ownership.	The selection bias problem is not accounted for.	-Level of investment
Simoneti and Gregoric (2004)	Slovenia	1995 to 1999	Using a panel of 182 Slovenian firms drawn from the period 1995 to 1999, the study looks at the performance effect of companies privatized by managers. The study finds no insignificant evidence of any positive effects of the managerial control on Slovenian firms' performance. Some positive effects are found in terms of firms' financial performance (but not total factor productivity) in cases of listed companies.	Limited efforts to account for selection bias problem.	-Total factor productivity -Financial performance

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
Glennerster (2003)	Macedonia	1996 to 1999	Using fixed-effects panel data regression, the study finds weak but significant evidence that privatization improves performance in terms of sales, employment and profits even in cases of predominant insider ownership. Companies sold to outsiders perform better than firms privatized by employees.	Limited efforts to account for selection bias problem.	-Sales -Employment -Profits
Zalduendo (2003)	Macedonia	1994 to 2000	Using OLS estimates, the study finds that private ownership is associated with improvement in companies' performance expressed in terms of profits as share of sales. Also, high concentration of ownership improves corporate performance.	The selection bias problem is not accounted for.	-Profits as share of sales
Prasnikar et al. (2002)	Slovenia and Macedonia	1996-1998	The study analyses the difference in productivity between with dominant internal or external ownership after privatization. The study finds that in case of Macedonia the differences between firms that chose internal or external privatisation method became smaller while in case of Slovenia the difference is insignificant.	The selection bias problem is not accounted for.	-Total factor productivity
Prasnikar, Svejnar and Domadenik (2000)	Slovenia	1996 to 1998	Using firm-level panel data of 127 large- and medium-size firms drawn from the period 1996 to 1998, the study examines the difference between insider and outsider ownership in the post-privatisation restructuring. The study finds that (i) firms where outside investors have had the predominant influence on the decision-making	The selection bias problem is not accounted for.	-Restructuring

Study	Country	Period covered	Methodology and results	Efforts to deal with selection bias	Dependent variable(s)
			process have entered the process of restructuring earlier.		
Smith, Cin and Vodopivec (1997)	Slovenia	1989 to 1992	Using a sample of 22,735 Slovenian firms drawn from period of 1989 to 1992, the paper examines the impact of foreign and employee ownership on (a) performance and (b) likelihood that a former SOE is acquired by foreign company or insider employees. Using two-stage Tobit least-squares procedure, the study finds that (i) a 1 percentage point increase in foreign ownership is associated with a 3.9 percent increase in value added, and for employee ownership with a 1.4 percent increase; (ii) firms with higher revenues, profits, and exports are more likely to be acquired by foreign investors and insider employees.	The selection bias problem is accounted for and the sample size is relatively large.	-Value added

Source: Author's own compilation

3.5 Conclusions

This Chapter highlighted the major features of the social ownership in former Yugoslavia and its transformation in her successor states. The Chapter explained that social ownership as a form of ownership distinct from that in the rest of the socialist bloc attracted great attention from researchers. This gave rise to an interesting and long running debate on whether such a system can allocate resources efficiently. Two important lines of arguments dominated the discussions in opposing social ownership. The first represented by Ward who asserts that, in terms of technical efficiency, labour managed firm is sub-optimal as it will employ and produce less compared to a profit maximizing firm. The second line is that of property right theorists who argue that because of unclear property arrangements, consumption will be preferred to investment leading to sub-optimal levels of investment. Despite the fact that these two lines of arguments were disputed, they clearly make a case that in absence of disciplining effect of the market, the labour managed firm is bound to be technically and allocativelly inefficient. However, another line of arguments supporting social ownership was also present. This strand of literature argued that the underlying assumptions of the Ward model and those of the property rights theory did not reflect the case of the Yugoslav labour managed firm.

This Chapter has argued that, despite many attempts, reforming the socialist system in former Yugoslavia proved impossible. Radical reforms (similar to those that were successfully employed in transition economies) were undertaken during the end of 1980s. However, the developing political situation particularly the rise of Milosevic in Serbia and the growing nationalist tendencies in Croatia and Slovenia, interrupted and undermined these reforms. The disciplining measures were not credibly upheld and were traded off for social considerations. Also, the continued economic crisis aggravated political stability and intensified ethnic tensions. This ultimately led to decades of armed conflicts in the region and the disintegration of the federation.

Further, this Chapter showed that despite their similar pattern of social ownership, the successor states followed different paths in transforming social ownership, with some relying heavily on the previous federal legislation; some modifying the legislation to allow for other methods, while the rest undertaking heavy changes in privatization legislation. The state and employees were recognised as stakeholders or beneficiaries in almost everywhere though the share of each varies in different countries. The theoretical background of social ownership largely leans towards the idea that companies in former Yugoslavia pursued non-profit maximising objectives. However, in all the successor states, after the start of the transition process (primarily due to the disciplining effect of competition, depleted state control, imposition of hard budget constraints and the credible threat of bankruptcy) companies had to adjust by pursuing profit maximization in order to be able to survive the new market conditions.

This Chapter has also reviewed the limited empirical literature that investigate how the transformation of ownership impacted the performance of emerging private companies. The studies discussed provide mixed evidence about the impact of privatization on companies' performance. However, those that control for foreign ownership maintain that companies privatized to foreign owners perform better. Also, de-novo private companies are found to outperform both SOEs and privatized companies. The empirical evidence related to effects of privatization on companies' performance is beset with estimation problems.. In all reviewed studies, limited or no effort was made to address the endogeneity (selection) problem. Overlooking the endogeneity problem might have introduced bias in estimates. The data used in these studies are clustered around the time of divestiture which limits the analysis. There is also no empirical evidence that jointly analyses the impact of privatization across these countries. Moreover, there is no empirical evidence focusing on the impact of ownership on technical efficiency of companies. The following Chapter will fill this gap by analysing jointly the impact of ownership on company performance in successor states of former Yugoslavia and by contributing to better understanding the impact of ownership on companies' efficiency employing Stochastic Frontier Analysis while controlling for selection bias.

Chapter 4

The impact of ownership on Efficiency of companies in successor states of former Yugoslavia

Contents

Introduction

The aim of this Chapter is to measure the efficiency of companies in successor states of former Yugoslavia focusing on the effect of ownership.[61] As argued in Chapter 3, the successor states of former Yugoslavia, despite their similar patterns of ownership, followed different paths of transforming their SOEs and the transition reforms progressed at varying speeds. However by early 2000, these countries, by and large, had managed to transform their economies and institutions to match those of other TEs. By then the main source of economic growth was the genuine private sector. Also, the remaining SOEs, particularly those in competitive non-regulated industries, had to operate under similar conditions as the de-novo private companies and subject to hard budget constraints, largely pursuing profit maximizing objectives. Centred on this premise, this Chapter will compare the efficiency of companies with different ownership structures operating in reasonably similar conditions.

The measurement of efficiency has been a topic of considerable interest in economics but the empirical measurement of efficiency is rather recent (Kumbhakar and Lovell, 2000). This is mainly because of the dominance of neoclassical economics where the inefficient behaviour is ruled out and companies are considered to be fully optimizing agents. However, inefficiency does exist in the real world and most companies, even though they try, are not fully efficient. Therefore the measurement of efficiency and

[61] The study includes: Bosnia and Herzegovina, Croatia, Macedonia, Montenegro, Serbia and Slovenia. Kosovo was not part of the analysis as it was not covered by the previous rounds of the Business Environment and Enterprise Performance Survey (BEEPS) conducted by World Bank and EBRD, which constitutes the main source of data for this Chapter. Chapters 5 and 6 will try to fill the gap for Kosovo by testing some of the theoretical propositions related to ownership which are also highlighted here. Unfortunately, the results are not directly comparable due to the fact that the Kosovo data include only private companies (de-novo and privatized), whereas the data for other successor states of former Yugoslavia include both private companies (de-novo and privatized) and SOEs. As a result, Chapter 6 examines whether there are any differences in performance related to ownership transformation, whereas this Chapter tests for differences between mean efficiency scores among companies with different ownership structures. It also accounts for differences in performance of companies privatized by different types of owners, specifically domestic private investors and foreign investors. It is expected that the ownership should account for differences in performance of companies.

the analysis of the gap between efficient and inefficient companies has become an important area of research for both economists and policy makers.

As discussed in Chapter 2, the dominant methodology used in the existing empirical literature on the impact of ownership on companies' performance compares either pre- and post-privatization performance of selected privatized firms, or the performance of state firms with either de novo private or privatized firms operating under reasonably similar conditions (for more details, see Chapter 2).[62] These approaches usually consider performance measures such as turnover, employment and labour productivity. Recently, other approaches have been introduced in empirical literature which analyse the efficiency of companies with different ownership structures applying more advanced econometric techniques.[63] Utilising a production function, these studies estimate the efficiency (or inefficiency) of companies compared to a suitable benchmark, or frontier. In this Chapter, the Stochastic Frontier Analysis is used to investigate the impact of ownership on the efficiency of companies in successor states of former Yugoslavia. The Chapter also employs a Heckman selection model in an attempt to address the selection bias problem, which is endemic in the research related to privatization and has been largely overlooked as argued in Chapter 2.

There are only few studies that compare the efficiency of firms with different ownership structures by employing Stochastic Frontier Analysis and, to our knowledge, only one of them deals with TEs.[64] Moreover, there is no empirical

---

[62] Chapter 6 will combine these two approaches by using policy evaluation econometrics.

[63] These approaches focusing on efficiency estimation include both parametric and non-parametric methods. The most used technique of the former approach is Stochastic Frontier Analysis (SFA) while of the latter the Data Envelopment Analysis (DEA).

[64] Kocenda, Hanousek and Masika (2011) use SFA to assess the financial efficiency and the ownership of Czech firms. However, even this study is limited in terms of justifying the choice of appropriate functional form and distributional assumptions that this methodology requires. Also, it does not properly control for selection bias. There are some studies analysing the efficiency of companies in transition countries but they focus on regulated markets, primarily in banking sector. See for instance, Staikouras, Mamatzakis, and Koutsomanoli (2008) focusing on the banking sector of 6 TEs;

evidence that evaluates the impact of ownership on companies' performance in all successor states of former Yugoslavia. Therefore this Chapter contributes to the existing empirical literature by analysing the impact of ownership on the efficiency of firms across these countries using SFA, while controlling for factors that influence efficiency and for selection bias.

In this Chapter, efficiency refers to technical efficiency and is measured at a specific point in time. The dataset consists of cross sectional pooled data on private enterprises (owned by either foreign or domestic investors) and SOEs from six countries of former Yugoslavia. It is based on three waves of BEEP survey, in 2002, 2005 and 2009 covering over 3,800 observations. BEEPS is a firm-level survey of a representative sample of enterprises conducted by the World Bank and EBRD in a large number of countries (More detailed explanation about BEEPS is provided in Section 4.3.1). As in most cases of using survey data, there are missing observations in the dataset. Missing data are dealt with using the 'Multiple Imputation procedure'. This is another important contribution to the existing empirical investigations using BEEPS data. So far, to the best knowledge of the author, papers analysing the impact of ownership on companies' performance have ignored the missing observations without any discussion of the rationale for this action.[65] The maximum likelihood estimates (MLE) method was used to estimate the parameters of the stochastic frontier function, employing the Limdep 9.0 software for the estimation procedure. The stand-alone software NORM was used for the imputation procedure.

The rest of this Chapter is organised as follows. Section 4.1 briefly presents the concept of efficiency. Here the analytical framework and basic terminology of the efficiency literature, upon which the empirical model is built, is introduced. Section 4.2 discusses

Mamatzakis, Staikouras Koutsomanoli (2008) focusing on banking system of 10 TEs and Kosak and Zoric (2011) focusing on 8 TEs.

[65] The author has also contributed towards improving the BEEPS datasets by identifying errors in the data which were reported to the World Bank and were subsequently corrected by the latter.

the estimation of the stochastic frontier model. Here particular attention is paid to methods of measuring efficiency focusing on differences between deterministic and stochastic techniques, deciding on distributional assumptions and choosing the functional form. Section 4.3 discusses data and procedures carried out to handle missing data. Section 4.4 discusses the model, presents some empirical considerations and results. Section 4.5 presents the limitations of the model and Section 4.6 concludes.

4.1 The concept of efficiency

This section briefly summarises the influential theoretical and empirical contributions that led to the expansion of the empirical measurement of efficiency. The concept of efficiency has been discussed for a long time, however its empirical measurement is fairly recent in economic literature. This is mainly because of the dominance of neoclassical economics which considers producers as full optimisers (Kumbhakar and Lovell, 2000). The starting point in the discussion of efficiency is the very definition of the production function which began with the work of Cobb and Douglass (1928). Imposing limits on output and inputs leaves open the possibility for some producers to be more or less efficient than others. Hicks (1935) analysing the behaviour of monopolies argued that these firms do not attempt to be fully efficient as they do not face the pressure of competition; he labelled it the 'quiet life' of monopolies. In other words, the non-competitive setting allows monopolies not to strive for full optimization.[66] Also, Leibenstein (1966) argued that there is some inefficiency built in

[66] Also, the property rights literature (among others, Alchian, 1965) argued that state owned companies are inherently less efficient than private counterparts. See Chapter 1 for details. Alchain and Kessel (1962) offer a different explanation for the apparent superior efficiency of companies in competitive markets. They maintain that since monopolies operate in either regulated settings or unregulated but threatened by regulation or antitrust actions, they are constrained not to strive for full efficiency. If these companies earn profits in excess of regulated ones or if their profits are offset by the regulatory or antitrust environment, then they simply tolerate some level of inefficiency.

the production process arising from agency and related incentive problems.[67] Koopmans (1951, p.50) introduced the modern definition of technical efficiency:

> *"[A] producer is technically efficient if an increase in any output requires a reduction in at least one other output, or an increase in at least one input, and if a reduction in any input requires an increase in at least one other input or a reduction in at least one output."*

Following this definition, Debreu (1951) and Shepherd (1953) were the first to introduce the distance functions as a way of measuring the distance between the current position of a company and a frontier. Before that the empirical analysis of efficiency had been based on least squares methodology which allowed points to be above and below the fitted function, thus estimating the mean efficiency. This literature raised theoretical issues which paved the way for the development of the research on empirical measurements of efficiency.

The modifications suggested by frontier models fostered the use of different techniques which allowed all points to be on one side of the fitted function by enveloping the data. The introduction of the distance functions in the context of efficiency was a crucial development in the literature of the efficiency measurement (Kumbhakar and Lovell, 2000). Farrell (1957) is considered to be the first to have treated the production function as a frontier. Also, Farrell is considered as the first to have distinguished two basic forms of efficiency: technical efficiency and allocative efficiency. While the former reflects the ability of the company to obtain maximal output given a set of inputs (i.e. avoiding waste), the latter reflects the optimal mix of

[67] He argued that two otherwise identical firms rarely produce the same output levels given the same set of inputs. He identified a range of factors that influence this inefficiency, including among others, the asymmetric information, incomplete contracts, agency problems, monitoring difficulties and motivation. He labelled it 'x-inefficiency'. This concept was criticized on the grounds that it reflected an incompletely specified model rather than a failure to optimize (see for instance, Stigler, 1976; de Alessi, 1983). Nevertheless, Libenstein's arguments are largely considered valid and fit neatly into the agency literature (Greene, 2008). Moreover, it is almost impossible to construct a model as suggested by his critics.

inputs or outputs, given their respective prices.[68] Economic efficiency is a product of these two types of efficiency (Fried, Lovell and Schmidt, 2008) (see Figure 4.1). The theory of efficiency postulates that the best performing company operates on the frontier that is specified by the behavioural goal (as cost minimization, revenue or profit maximization).

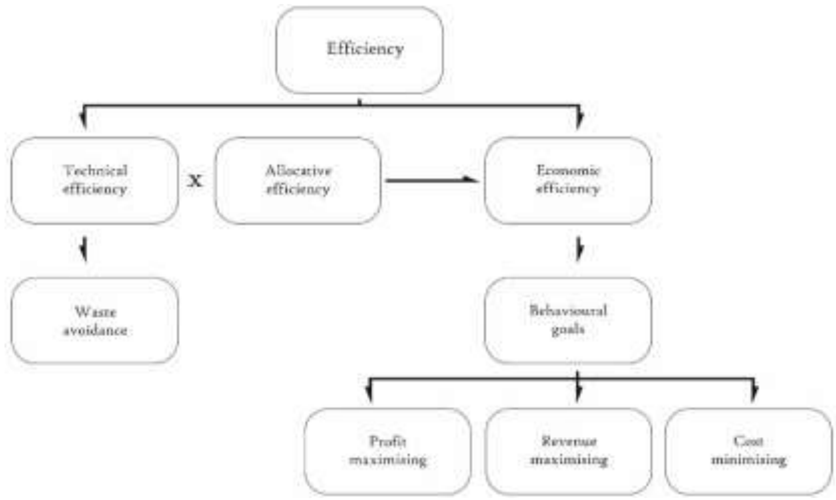


Figure 4.1. Decomposition of economic efficiency
Source: Author's own drawing

While this Chapter is concerned only with measures of technical efficiency (due to data limitations on prices of inputs and outputs), still we briefly summarise the concept of economic efficiency, of which the technical efficiency is a part. Figure 4.2 illustrates the concept of economic efficiency using input oriented measure of technical and allocative efficiency. Economic efficiency is calculated as a ratio of potential to actual performance. Consider a company producing a single output using inputs X_1 and X_2. The QQ curve represents an isoquant, i.e. the combination of inputs to produce a certain level of output. The CC curve represents an isocost, and the ratio of factor prices. A company operating at point A is inefficient as it uses more inputs

[68] Influential authors in the efficiency literature, including Kumbhakar and Lovell (2000), Coelli, et al. (2005) and Greene (2008) among others, refer to the decomposition of economic efficiency into two components as the Farrell decomposition, introduced in Farrell (1957).

to produce a unit of output. This company would have been technically efficient if it were to operate at point Q′. Its technical efficiency is measured by OQ′/OA, which is the radial distance of the company from the isoquant. Given factor prices, represented by the slope of the CC line, Q′ is not the best position for a company to operate at (point A* represents such position). The radial distance from the isocost, OC′/OQ′, represents the allocative efficiency. Both ratios are less than unity, representing some degree of inefficiency. The overall economic efficiency is the product of technical and allocative efficiency and is given by the following ratio:

$$\text{Econ Efficiency} = OQ'/OA \times OC'/OQ' = OC'/OA \qquad (4.1)$$

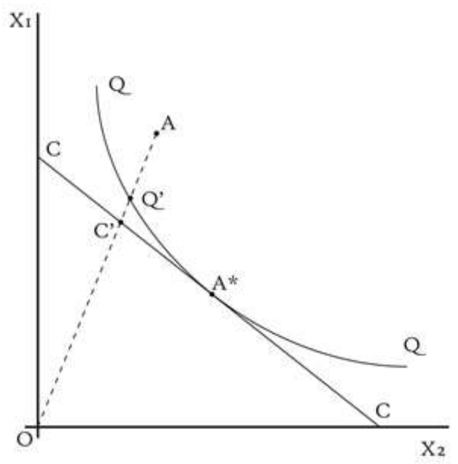


Figure 4.2. The measurement and decomposition of economic efficiency
Source: Author's own drawing based on multiple sources

In terms of its measurement, the technical inefficiency of company A is measured as (1-OQ′/OA) which measures the proportion of inputs that could be reduced without reducing the output level. The further a company gets from the isoquant, its technical efficiency becomes smaller and smaller. Conversely, the closer it gets to the isoquant, its technical efficiency approaches unity. Therefore the technical efficiency ratio will fall between zero and one. Similarly the allocative inefficiency of company A is measured as (1- OC′/OQ′) and ranges between 0 and one.

In line with the notion of frontier, developed by Debreu (1951) and Farrell (1957), a series of empirical work, including Aigner and Chu (1968), Seitz (1971), Timmer (1971), Afriat (1972) and Richmond (1974) appeared in the literature. While all these papers contributed to the development of the field, the contemporary research on econometric estimation of efficiency started with the seminal papers simultaneously published by Meeusen and van den Broeck (1977) and Aigner, Lovell and Schmidt (1977) who proposed the stochastic frontier model as a practical framework for testing theoretical propositions set forth previously.

4.2 Estimation of efficiency

The estimation of the efficiency involves the comparison of a company's performance relative to the optimal performance located on the frontier (Fried, Lovell and Schmidt, 2008). Since it is impossible to observe directly the optimal position of each company, in a deterministic setting, the best performer in the industry is used as a proxy for the optimal output level (Kumbhakar and Lovell, 2000; Greene, 2008; Fried, Lovell and Schmidt, 2008).[69] The distance from the frontier specifies the level of inefficiency of a firm. The basic principle of the frontier analysis is therefore a more sophisticated form of benchmarking a sample of companies against a 'best practice'. The main aim of the recent research has been to identify the sources of inefficiency and to separate their effect from the environmental factors which are not in companies' control (Fried, Lovell and Schmidt, 2008).

4.2.1 Estimation approaches

In with the context of the frontier analysis, two methodological approaches to estimating efficiency have appeared in the literature: parametric and non-

[69] The frontier in deterministic approaches is determined by analysing the position of the best performer in the industry while in stochastic approaches, the frontier is randomly placed by the whole collection of stochastic elements which might enter the model outside the control of the firm (discussed in greater details later in this section).

parametric.[70] Both approaches are rigorous benchmarking applications that use distance functions to measure efficiency (Fried, Lovell and Schmidt, 2008). The pioneering work in both areas appeared in the late seventies (Aigner, Lovell and Schmidt, 1977 and Charnes et al., 1978). Even though both techniques were originally developed to study technical efficiency, today they are also widely used for the estimation of economic efficiency.

Parametric techniques are generally built upon the stochastic character of the data employed. The predefined functional form does always incorporate a disturbance term that is composed of two parts: the inefficiency component and the random error. The random error component accounts for the measurement errors or other external events. Omitting the random error term would implicitly misidentify the random shocks and leads to wrong measurements as inefficiencies. Due to the twofoldness of the error term, the parametric techniques have been referred to as the 'composite error term' models in the efficiency literature. In practice, several parametric techniques

[70] Parametric approaches are sometimes referred to as econometric techniques; the non-parametric approaches are based upon mathematical programming. Some early parametric techniques include deterministic methods such as Corrected Ordinary Least Squares (COLS) and Modified Ordinary Least Squares (MOLS which are modifications of OLS. COLS, introduced by Winsten (1957), is a frontier version of OLS as it bounds the data from above. As a two-step procedure it initially uses OLS regression to obtain consistent and unbiased estimates of the slope parameters and the constant term but biased estimate of the intercept parameter. In the second step, the biased intercept parameter is shifted up by adding to the intercept term the largest negative OLS residual so that the frontier is defined by the best performing company. Since only the intercept is changed, the frontier is a parallel shift of the OLS regression. As such it does not necessarily envelope the data as closely as possible (Kumbhakar and Lovell, 2000). MOLS, suggested by Afriat (1972) and Richmond (1974), is also a two-step procedure with the first step being similar to COLS. In the second step, the estimated intercept parameter is shifted up by adding the mean of the assumed one-sided distribution. The OLS residuals can then be used to provide consistent estimates of the technical efficiency of each producer as in the case of the COLS model. However, in MOLS, some companies might be above the estimated production function creating problems of interpretation; i.e. some of the resulting efficiency scores might be greater than unity. In both COLS and MOLS the deviation of the estimated efficiency from the theoretical maximum is attributed solely to the inefficiency (i.e. ignoring random shocks). That is contrary to OLS that attributes the whole deviation to the random shock. These parametric techniques are largely considered as not appropriate for measuring inefficiencies, and as such they will not be discussed any further in this Chapter. Therefore, the parametric techniques discussed later in this Chapter refer only to stochastic techniques.

have been developed, the Stochastic Frontier Approach (SFA) being the most widely used.

Other parametric techniques include Thick Frontier Approach (TFA) and Distribution Free Approach (DFA). TFA, developed by Berger and Humphrey (1991), is less restrictive than SFA but provides less information. The approach specifies the functional form but does not require distributional assumption for the error components. This approach identifies companies in the top and the bottom quartile of the distribution. Companies located in the top quartile are assumed to be relatively efficient and jointly form the thick frontier. Companies in the bottom quartile are relatively inefficient compared to this frontier. TFA assumes that variations in residuals within each quartile represent the random error whereas the distance between the quartiles represents the average inefficiency score. As such, TFA does not allow for estimation of inefficiency scores for each company. However, Bauer et al. (1998) suggest a model adjustment so that company specific efficiency scores can be calculated. Kumbhakar and Lovell (2000) suggest that TFA does not yield precise estimates; however, it does provide an insight into the probable magnitude of inefficiencies.

On the other hand, DFA, introduced by Berger (1993), assumes that the random component of the composed error term averages out to zero over time in the context of panel data. A production function is estimated for each period of the panel data sample with the residuals of each regression consisting of the inefficiency component and the random error term. Since the random error is assumed to average out over time, the average of the residuals for each firm is therefore assumed to represent the average inefficiency term. Berger (1993) suggests that a five year period is typically needed to estimate DFA. Due to their limitations, TFA and DFA approaches are ruled out in this Chapter. While the former is found to lack econometric rigour and unable to yield precise estimates, the latter requires panel data which is not available for our analysis. Therefore, in the remainder of this Chapter, the term parametric technique i refers exclusively to SFA.

Non-parametric techniques, which by construction are deterministic, use mathematical programming to observe the best practice frontier. The most frequently employed method is the Data Envelopment Analysis (DEA) (Stavarek, 2006; Coelli, 1996; Barr and Siems, 1994). In DEA mathematical linear programming is used to construct the best practice frontier against which the inefficiencies of particular firms are measured. This is done without parameterizing the technology but by making comparisons of companies' efficiency with the observed best practice (Greene, 2008). Two widely used types of DEA models are with constant returns to scale (CRS DEA) and with variable returns to scale (VRS DEA).

The essential difference between non-parametric and parametric techniques is the very small restriction imposed on the specification of the form of the frontier. Technically, the main difference between the non-parametric and parametric frontiers is the issue of the random error. Non-parametric techniques do not allow for the random errors (like errors in measurement or accounting). However, it is more than probable that in reality these errors do occur. Non-parametric techniques do not take special account of these errors and they are simply treated as inefficiencies. As the estimated frontier encompasses all obtained observations including outliers, random shocks and firm-specific effects are grouped together and are jointly interpreted as the level of inefficiency. As Kaparakis, Miller and Noulas (1994) note, due to extensive omission of the stochastic properties of the data, the application and interpretation of the deterministic frontiers of non-parametric approaches remains questionable. In non-parametric approaches, the frontier is rather a surface, formed by a piecewise linear combination of 'best practice observations' thus leading to a convex production possibilities set (Coelli, 1996). Due to the specification of the frontier there are no a priori assumptions about the functional form.

In both approaches, the models include measures of output and inputs for each company – and these have to be specified at the start. Starting from a non-parametric deterministic approach, the production frontier can be written as:

$$Y_i = f(x_i, \beta)xTE \tag{4.2}$$

Where Y_i is the quantity of actual output of company $i = 1, \dots, I$; x_i is the vector of inputs used by company i; $f(x_i, \beta)$ is the production frontier and β representing the vector of technology parameters to be estimated. Therefore the technical efficiency TE_i of company i can be written as:

$$TE_i = \frac{y_i}{f(x_i, \beta)} \tag{4.3}$$

where TE is defined as a ratio of observed output to maximum feasible output. A particular company (y_i) therefore would have achieved its maximum feasible output $f(x_i, \beta)$ if, and only if, TE equals to unity. Alternatively, if the efficiency coefficient falls short of unity, the company is technically inefficient. The closer the company is to unity, it is considered to be more efficient. This equation represents a deterministic output frontier. In other words, the whole deviation from the maximum feasible output is attributed to inefficiency. As discussed earlier, this ignores the fact that output can be affected by random shocks, which are out of the company's control, and data errors. In order to account for random shocks and data errors, a stochastic production frontier needs to be introduced. As a starting point, the output frontier is specified as a stochastic frontier following Aigner, Lovell and Schmidt (1977). The idea is to decompose the residual term of the parametric frontier production function into two components: a symmetric random error and an inefficiency term, thus:

$$Y_i = f(x_i, \beta) + \varepsilon_i \tag{4.4}$$

$$\varepsilon_i = v_i + u_i \tag{4.5}$$

Where v_i is the random shock and u_i is the company specific inefficiency. In a stochastic frontier model technical efficiency TE of company i can be defined as:

$$TE = \frac{y_i}{f(x_i,\beta)+v_i} \tag{4.6}$$

Which defines efficiency as the ratio of the observed output of each company to the maximum feasible output in an environment accounting for v_i. Similarly, a company is considered as technically efficient if the efficiency score equals one; that is no reductions in inputs can be made to produce the same level of output. Maximum likelihood techniques and the method of moments can be used to estimate stochastic frontiers. Then, using the Jondrow et al. (1982) technique, the inefficiency term can be separated from the residuals. Technical inefficiency is therefore defined in an output-expanding fashion indicating the maximum amount by which output can be increased given the production technology and observed inputs. The estimated inefficiency component can then be used to obtain producer-specific estimates of efficiency. A measure of producer-specific efficiency is therefore provided by:

$$TE_i = \exp\{-u_i\} \tag{4.7}$$

The estimation of efficiency using a stochastic production frontier requires an assumption regarding the distribution of the error term. Distributional assumptions are essential in decomposing the error term into two components, i.e. the statistical noise and the genuine inefficiency (Kumbhakar and Lovell, 2000). The independent distribution of these two components of the error term makes it possible to capture firm-specific inefficiency scores. Different distributional assumptions and their importance are discussed in greater detail in sub-section 4.2.2.

In this Chapter, the estimation of deviations between actual (estimated) and target (optimal) output will be carried out by employing Stochastic Frontier Analysis. As discussed, this technique, simultaneously developed by Aigner, Lovell and Schmidt

(1977) and Meeusen and van den Broeck (1977), decomposes the error term in the regression model into a two-sided random error which captures the random events outside the control of the firm and the one-sided inefficiency component. There are two main reasons why the stochastic frontier approach is chosen over other non-parametric approaches to perform the estimation of the efficiency scores. First of all, since large data sets are employed in this Chapter, some statistical noise is expected. Secondly, the data used are survey data which carries with it the risk of inaccuracies. This method would enable us to avoid measurement errors, appearing possibly due to the above mentioned factors, being assigned as inefficiency of a particular company in the dataset.

Following the aim of this Chapter, and in order to have efficiency estimates which are comparable across the countries under investigation, a single frontier approach is employed. This technique permits the comparison of efficiency scores in different countries measured against a common frontier. This method requires additional efforts to control for different economic environments in which firms operate (Green, 2008). Failing to account for heterogeneity is likely to affect the stability of efficiency results (Bos et al., 2005; El-Gamal and Inanoglu 2005; Mester, 1997; and Berger and Mester, 1997). In this regard, country dummies are included to control for the countries' heterogeneity. Consequently, the estimated efficiency scores can be compared, and conclusions can be drawn as to whether companies in one country are more efficient than companies in others.

Since it is very likely that efficiency varies across companies or time, one must ascertain the determinants of this variation by either including other explanatory variables in the model or by adopting a two stage approach. In the latter setting, efficiency measures are obtained in the first stage which are further regressed against a vector of explanatory variables in the second stage (Kumbhakar and Lovell 2003). Many authors argue that using a two-step procedure will introduce an estimation bias in the second step given that in the first step exogenous influences are not accounted for (for details see: Caudill and Ford, 1993; Caudill, Ford and Gropper, 1995; Wang and Schmidt, 2002 and Greene, 2008). Wang and Shmidt (2002) argue that this is a similar issue to the omitted variable problem in linear regression models. In general, it is argued that when heterogeneity in the model is parameterized in terms of observables, then those features should be included in the model at the first step. In other words, a single step procedure is largely preferred. In this investigation, a one-step procedure is used in which other firm-specific covariates are included right from the start.

4.2.2 Functional form and Distributional assumption

Even though parametric techniques have often been praised for their ability to separate the random error component, they are built upon the concept of an a priori specification of the functional form of the frontier and assumptions about the distribution of the inefficiency component of the error term.

Functional form: As with the choice of the estimation method, there is no consensus in the efficiency literature on which functional form to employ when estimating the frontier. In order to estimate the stochastic frontier model a functional form needs to be pre-specified for the shape of the frontier function. Recent literature on efficiency modelling is characterized by a variety of functional forms of the stochastic frontier. The functional forms range from the most simple Cobb-Douglas Functions (Coelli, 1996) to adjusted Cobb-Douglas forms (Schure and Wagenvoort, 1999) and more complex Translog Functions (Podpiera and Podpiera, 2005; Bonin, Hasan, Wachtel, 2004; Kaparakis, Miller and Noulas, 1994). As Greene (2008) has noted, the Cobb-Douglas and Translog models significantly dominate the literature on stochastic frontier and the econometric estimation of inefficiency.

The major advantage of the Cobb-Douglas functional form is its simplicity, however, at the same time that feature causes two problems. Hasenkamp (1976) argued that Cobb-Douglas form cannot accommodate multiple outputs without some difficulties. In addition, if the true structure of (single-output) production technology is more complex than its Cobb-Douglas representation, the unmodelled complexity will show up in the error term, perhaps leading to biased estimates of the inefficiency term. On the other hand, Translog functional form, firstly introduced by Christensen, Jorgensen and Lau (1971), is a more flexible specification. The restrictions on the stochastic frontier function are relaxed with the application of a Translog production function compared to the Cobb-Douglas (Coelli et al., 2005). The Translog form does not impose assumptions about constant elasticities of production nor elasticities of substitution between inputs. From the production point of view companies can be seen as institution transforming multiple inputs into multiple outputs. The first consideration while choosing the appropriate functional form is therefore its ability to accommodate this multi-production nature of the company. Given that Cobb-Douglas and Translog specifications are nested models, the likelihood-ratio (LR) test can be conducted to select the best specification for the production function for a given data set.

Distributional assumption: To estimate the production frontier, additional assumptions regarding the distribution of the error term are required. Distributional assumptions are essential in decomposing the error term into the two components (Kumbhakar and Lovell, 2000). There is no consensus in the literature regarding the choice of the distributional assumption for the u_i component, though there is an agreement that it is one-sided and positively skewed as $u_i > 0$. The most commonly used distributional assumptions for u_i include:

1. The half normal distribution: $u_i \sim \text{iid } N^+(0, \sigma_u^2)$ first introduced by (Aigner, Lovell and Schmidt, 1977);
2. The exponential distribution: $u_i \sim \text{iid } G(\lambda, 0)$ exponential with mean λ (Aigner, Lovell and Schmidt, 1977 and Meeusen and van den Broeck, 1977)
3. The truncated distribution: $u_i \sim \text{iid } N^+(\mu, \sigma_u^2)$ truncated normal (Stevenson 1980)
4. The Gamma distribution: $u_i \sim \text{iid } G(\lambda, m)$ gamma with mean λ and degrees of freedom m (Greene, 1980 and Stevenson, 1980).

Earlier works mostly used half normal and exponential distributions, later studies began using other distributions such as truncated normal and gamma. Coelli et al., (2005) argue that half-normal and exponential distribution yield inefficiency scores clustered around zero and efficiency scores clustered around 1, given that the mode of these distributions is zero. Unlike the half-normal and exponential distributions, the truncated normal and the gamma models are flexible and allow for a wider range of distributional shapes even though they have computational complexities. The truncated normal distribution allows the mode of u_i to take either positive or negative values. Stevenson (1980) proposed two-parameter truncated normal distribution in order to generalize half-normal distribution. Greene (1990) generalizes the one-parameter exponential distribution, by including an additional parameter to be estimated, thus providing a more flexible distributional shape.[71]

While the choice of the distributional assumption is still an on-going debate, most of the results suggest that the estimates of inefficiency are reasonably robust to functional form and choice of distributional assumption (Greene, 2008). Based on Greene (1990), and using the Christensen and Greene (1976) electricity data, Kumbhakar and Lovell (2000) find that rank correlations for estimates of inefficiencies scores from the four distributions is in the range from 0.75 (exponential and gamma) to 0.98 (half normal

[71] For more details on the properties of these distributions see: Kumbhakar and Lovel (2000) and Greene (2008).

and truncated normal). Similarly, Greene (2008) compares the results for the four distributions and, with respect to efficiency estimates, finds that exponential and half-normal distributions are virtually identical, with correlation coefficients reaching up to 0.99. Some empirical studies find that under different distributional assumptions similar efficiency scores and rankings are obtained (for details see Greene, 1990; Kumbhakar and Lovell, 2000 and Kumbhakar and Lovell 2003). If the results are similar then the potential bias arising from improper distributional assumption diminishes significantly. Coelli et al. (2005) argue that the choice of the distributional assumption is influenced by theoretical considerations related to the research at hand. Similarly, Ritter and Simar (1997) argue in favour of using simple distribution, such as normal or exponential, in cases where the efficiency ranking and scores are similar across different distributional assumptions.

4.3 Data (handling missing data)

The following section presents the data used in this analysis and the procedures to handle the missing data. The basic analytical framework and terminology of data imputation and methods of replacing missing data including multiple imputation are discussed. The Section also presents the source of data, description of variables and summary statistics. It also provides a discussion on the multiple imputation procedure by presenting a non-technical summary of the procedure in the NORM software used in this Chapter and the diagnostics of multiple imputation runs.

4.3.1 Data

The dataset used in this Chapter is based on the Business Environment and Enterprise Performance Survey (BEEPS), a joint initiative of the European Bank for Reconstruction and Development (EBRD) and the World Bank (WB). The surveys were conducted in three rounds, in 2002, 2005 and 2009. In the first two rounds of the

BEEPS the sample was structured to be representative in each country with specific quotas in terms of size, sector, ownership, export orientation or years in operation i.e. non-random sampling. In 2009 a stratified random representative sampling method was used, with three levels of stratification: industry, establishment size and region. Enterprises that operate in sectors subject to government regulation and supervision, that receive subsidies, firms operating in primary industries, or those that employ over 10,000 employees were excluded from the survey in all three rounds. The sub-sample used in this Chapter cover the six successor countries of Former Yugoslav Federation, namely, Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro and Macedonia.[72] The distribution of the sample between manufacturing and service sectors, in all three rounds of the survey, was determined according to sectors' relative contribution to GDP in each country.

As with most survey data, the BEEPS dataset contains many missing observations, and until recently, this issue was largely ignored. Even when it was not overlooked, insufficient attention was paid to the problem (Peugh and Enders, 2004). Analysts mainly used ad hoc practices without sound theoretical grounding to handle the missing data (Schafer and Olsen, 1998). The use of 'complete cases only' was the main method of handling missing data, sometimes justified by the fact that the dataset is large and that the results will not be affected by dropping the missing observations and losing some of the data. Since in most situations the missing observations are spread throughout the dataset (missing data on different variables in different years), the proportion of missing data usually becomes very significant when several variables were used in a regression. Dropping observations with missing values involves making a strong implicit assumption about the missingness mechanism and if this assumption does not hold, the estimation bias might be introduced.[73] Even when this assumption holds, while the results will be unbiased, they will still be inefficient

[72] Until 2005, the data for Serbia included that of Montenegro as well.

[73] The assumption related to the missing data mechanism is explained in the following sub-section.

as some of the already available information is discarded (Baltagi, 2001). Other simple methods of handling the missing data used in empirical research include substitution of missing observations with plausible values (for instance by means or regression predictions). These methods, despite their simple computational attractiveness, are beset with well documented, weaknesses.[74]

Recently, other approaches to address the missing data issue have been developed and this topic is now an active area of continuous research.[75] These approaches range from simple deterministic single imputation to more advanced stochastic multiple imputation methods. Durrant (2005) argues that the choice of the appropriate technique depends on the data available, the application and the purpose of the analysis. In general, the Multiple Imputation (MI) method is largely favoured to other techniques and is considered as the most convenient and flexible method for analysing data with missing values (Schafer, 1999). In this chapter, Multiple Imputation has been used as the technique for handling missing data. For the application of the MI technique the stand-alone software NORM developed by Schafer (1999) was employed.[76]

4.3.2 Data Imputation

Researchers working with the BEEPS dataset (or indeed other large datasets) have usually ignored the problem of missing data (also referred to as missing values), citing as the reason the computational complexity of advanced techniques for handling this problem (Little and Rubin, 1987; Wayman, 2003). As a consequence, a substantial amount of information is lost which can possibly introduce bias in estimation results.

---

[74] For details see: Little and Rubin (1987) and Schafer (1999). Other methods for handling missing data are discussed in subsequent sections.
[75] For details see: Rubin, 1976; Little and Rubin, 1987; Little, 1992; and Horton and Laird, 1999 among others.
[76] We used NORM because the empirical work of this Chapter (for which the dataset is imputed) is carried out in Limdep which cannot compute multiple imputations and run SFA at the same time.

Bernard and Meng (1999) suggest that, in general, there are three types of concerns that arise with missing data: (i) loss of efficiency; (ii) complication in data handling and analysis; and (iii) bias due to differences between the observed and unobserved data. Different approaches and methods for handling missing data have been proposed (explained later in this section) to address these concerns.

Irrespective of the methods used to handle the missing data, initially it is important to understand why the data are missing. Determining the reasons for missingness is crucial in deciding how to deal with the missing data. The distribution of missing values, or data mechanism as it is termed in statistical literature, is usually distinguished according to the probability of responses and fall into three standard categories:

- Missing completely at random (MCAR) when the probability of an observation missing is unrelated to both observable and unobservable data. In this case missing observations are not different from non-missing observations and the only drawback in using complete cases is the reduction in the inference power resulting from discarding important information (Collins, Schafer and Kam, 2001; Baltagi, 2001).
- Missing at Random (MAR) when the probability of an observation being missing is related to observable data but unrelated to unobservable data. For instance, if the probability of answering a particular question is related to another observable variable. This assumption is less restrictive and more common in empirical research than that underlying MCAR (Azar, 2002; Royston 2005).
- Not missing at random (NMAR) when the non-response process is related to unobservable variables.

For instance, consider a dataset with a number of variables (a_1,...., a_n, X). The data for the variable X are said to be MCAR if the probability that a value of X is missing is not related to the value of X itself or to any other variables in the dataset. The data are said to be MAR if the probability that a value of X is missing is not related to the X itself but is related to the values of other variables (a_1,....a_n). For example, if larger companies do not report their level of revenues, we can say that size of the company is a good predictor of the missingness; in this case it can be assumed that data are MAR. Finally, the data are said to be NMAR if the probability that a value of X is missing is related to the value of X itself, i.e. to unobservable variables. For example, if companies with higher level of revenues do not report their revenues.

Generally if the missing data depend on observable variables (MCAR and MAR), the process is termed 'ignorable' and if the missing data depend of the on unobservable variables (NMAR) the process is termed 'unignorable'. In former cases, the missingness is observable and the mechanism leading to missingness does not need to be modelled. In the latter case, the missingness is unobservable and, therefore, the mechanism leading to missing data cannot be ignored and the missingness property should be modelled (Little and Rubin, 2002).[77]

Schafer (1997) suggests that examining the ignorability assumption and its appropriateness, especially MAR, is of crucial importance. However, in most cases, the assumption that data are MAR cannot be tested.[78] Van Buuren, Boshuizen and Knook (1999, p. 686) explain that the verification of the MAR assumption requires external information about the distribution of missing values; for instance, as Schafer and Graham (2002) suggest, by obtaining follow-up data from non-respondents. However, these authors argue that small departures from MAR are inevitable. Recent research shows that small violations of MAR usually have only a minor impact on estimates and standard errors (Schafer and Graham, 2002). Schafer (1997) suggests

[77] For a more detailed approach to modelling NMAR, see Little and Rubin, 2002.
[78] On occasion, the MAR condition is known to hold exactly. When missing data are *missing by design* (when the intention of the investigator is not to record all potential variables for all subjects), they tend also to be MAR. For details, see Schafer (1997).

that even when the missing data are not precisely MAR, still ignorable procedures tend to be better than ad hoc procedures such as case deletion as the former approaches remove all of the nonresponse bias explained by observable data whereas ad hoc procedures may not. All approaches that deal with missing data (including complete case analysis) assume, at least implicitly, the ignorability process. Given that ignorability (MCAR and MAR) holds, multiple imputation procedure is recommended. Alternatively, ignoring missing data might yield biased estimates if the MCAR assumption does not hold. The latter assumption is frequently not met in practice (Muthén, Kaplan and Hollis, 1987). In contrast, multiple imputation should yield unbiased estimates also under MAR assumptions, which holds more commonly.

Broadly speaking, there are several methods of dealing with missing data ranging from (i) complete case analysis, i.e. methods that ignore the missing observations, (ii) single imputation methods, and (iii) the more advanced multiple imputation methods.

Methods that ignore missing values use only complete cases and if there is any missing observation for one variable of a particular unit of analysis, the entire unit is omitted (commonly known as “listwise deletion” or “complete case analysis”). This approach is the simplest and yields reasonable results in cases when a small amount of data is missing. However, if the remaining cases are not representative of the entire sample the results will be biased (Wayman, 2003). Especially in cases with higher number of variables, and because the missing observations are usually spread throughout the dataset, a great share of information is lost. Moreover, if the data are not MCAR, complete case analysis might introduce bias into inferences.

Single imputation methods are widely used in research primarily due to their computational simplicity. These methods include, among others, deterministic single imputation mean substitution, hot-deck imputation, nearest-neighbour imputation, and predictive mean matching imputation (for discussion see Schafer and Graham, 2002; Durrant, 2005). These methods generally use regression analysis in complete cases and internalise these regression equations to predict the values of missing cases. Empirical evidence that utilizes different imputation techniques suggests that single imputation methods can yield unpredictable results and are not based on strong theoretical grounds (see for details Little and Rubin, 1987; Schafer, 1997). However, in cases where the number of missing observations is small and the missing mechanism is 'ignorable', single imputation methods perform reasonably well. Shafer (1997) regards the use of these methods in cases when the percentage of missing observations does not exceed ten percent as acceptable. In cases when this percentage is higher, more advanced methods are suggested (Little and Rubin, 2002).

The multiple imputation approach is an increasingly popular strategy for analysing data with missing values (Rubin, 1987; Allison, 2002). It has a strong theoretical grounding and superior ability to address the uncertainty dimension of the imputed values. It can be described as a three step procedure: imputation, analysis and combination steps (Figure 4.3). The key idea behind the multiple imputation is that it creates *m* different completed datasets replacing missing values with plausible random values, or imputations (von Hippel, 2003). Then, *m* completed datasets are analysed separately and finally the results from *m* datasets are combined using Rubin's (1987) formula.

Within the Multiple Imputation framework, both dependent and independent variables can be treated, despite the fact that researchers are often reluctant to impute values on the dependent variable. However, Schafer and Graham (2002) suggest that missing values on independent variables (predictors) and missing values on dependent variables (outcomes) do not fundamentally differ. Schafer and Graham (2002, p. 148) even caution their readers:

"Not to believe general statements such as, 'missing values on a dependent variable can be safely ignored,' because such statements are imprecise and generally false."

Young and Johnson (2011) suggest that all variables in the imputation model should be treated as a multivariate response. An imputation model does not represent structural or causal relationships among variables. The imputation model is merely a device to preserve important features of the joint distribution (means, variance and correlations) in the imputed values (Schafer and Graham, 2002). If the dependent variable is omitted from the imputation model, then the correlation between the dependent variable and any of the independent variables is assumed to be zero (Graham 2009). This assumption will systematically bias coefficients downward (Little and Rubin 2002; Graham 2009). One of the important standards of Multiple Imputation, therefore, is that every variable to be included in the analysis model should also be included in the imputation model, including the dependent variable (Schafer and Graham 2002). In addition, in a subsequent analysis of the imputed data, some variables may be treated as dependent in one equation and as independent in another (Schafer and Graham, 2002; Young and Johnson, 2011).

Imputation		**Analysis**		**Combination**
Creating *m* datasets using data augmentation iterative process	⇨	Estimating *m* datasets (estimation method specified by the researcher)	⇨	Combining results using Rubin's (1987) formula

Figure 4.3. MI as a three step procedure
Source: Author's own drawing based on multiple sources

In the imputation step, the number of repeated imputations m is a matter of choice between efficiency and practicality. Rubin (1987) suggest that *two* to *ten* imputations suffice under most realistic circumstances. Shafer (1997) finds that after first few imputations the marginal gains rapidly diminishes. Rubin (1987) shows that the efficiency of estimates based on m imputations is approximately $(1 + \frac{\gamma}{m})^{-1}$, where γ represents the rate of missing information. Table 4.1 shows the percentage of efficiency achieved for different rates of missing information and number of new imputed datasets (m).

Table 4.1. Percentage of multiple imputation efficiency based on the number of imputations (m) and fraction of missing data (γ)

m	γ=0.1	γ =0.3	γ =0.5	γ =0.7	γ =0.9
3	97	91	86	81	77
5	98	94	91	88	85
10	99	97	95	93	91
20	100	99	98	97	96

Source: Schafer and Olsen, 1998

As can be seen from Table 4.1, the efficiency improvements of MI increasingly diminishes after the first few datasets (m). In cases where the percentage of missing information is very high, the improvements of efficiency diminish more slowly. Schafer and Olsen (1998) suggest that three to five imputations are generally sufficient to obtain efficient results.

The analysis step is subject to research at hand and the estimation method is specified by the researcher. This step is described in Section 4.5 of this Chapter. In the combination step, the average of the squared standard errors of the m estimates and the calculated variance of the m parameter estimates across the generated imputations is combined (for a formal discussion of these issues see Rubin, 1987). After estimating regressions with each imputed datasets, estimates and standard errors are saved. Suppose that $\hat{Q}_j$ represents the estimated coefficients from dataset j (j=1,2,…m), and U_j represents the standard errors accompanying $\hat{Q}_j$, then the overall estimate is the average of the individual estimates (4.8):

$$\bar{Q} = \frac{1}{m}\sum_{j=1}^{m} \hat{Q}_j \tag{4.8}$$

For calculating overall standard errors first the (4.9) within- and (4.10) between-imputation variance (B) is obtained in order to be able to calculate the (4.11) total variance.

$$\bar{U} = \frac{1}{m}\sum_{j=1}^{m} U_j \tag{4.9}$$

$$B = \frac{1}{m-1}\sum_{j=1}^{m}(\hat{Q}_j - \bar{Q})^2 \tag{4.10}$$

$$T = \bar{U} + \left(1 + \frac{1}{m}\right) B \tag{4.11}$$

Then, the overall standard error is the square root of total variance (T). Confidence intervals are obtained by taking the overall estimate plus or minus a number of standard errors, where that number is a quantile of Student's t-distribution with degrees of freedom (4.12):

$$df = (m-1)\left(1 + \frac{m\bar{U}}{(m+1)B}\right)^2 \tag{4.12}$$

A significance test of the null hypothesis Q=0 is performed by comparing the ratio $t = \bar{Q}/\sqrt{T}$ to the same t-distribution.

As mentioned earlier, empirical evidence suggests that in cases when the MAR mechanism is a plausible assumption, the use of multiple imputation is recommended (Schafer and Olsen, 1998). Multiple imputation using Markov Chain Monte Carlo (MCMC) technique is found to yield good results even in cases where the percentage of missingness reaches 50 percent. We return to MI procedure of our own example in Section 4.3.4, after describing the variables and providing a summary statistics of the data to which MI is applied.

4.3.3 Description of variables and summary statistics

Following the MI procedure and the reconstruction of the full dataset, the next stage of the estimation process is the identification of the inputs and outputs of the production process. However, there is no consensus in the empirical research on the choice of inputs and outputs which the specific production functions incorporate

(Coelli et al., 2005). The measurement of output and inputs is straightforward in cases when physical output and input quantities are available. However, usually these data are not directly observable, especially in cases when companies operate in service sectors and produce multiple products or services. Consequently, different proxies are used as measures of inputs and output. In this analysis, following the methodology employed in most of the relevant works on the subject, value-added is used as a proxy for output (see Coelli et al., 2005 for a discussion on output measures). It is a measure of the total value of deflated sales less the value of all the intermediate inputs (non-labour and non-capital inputs). Added value data are more commonly used when sectoral analysis is undertaken (Coelli et al., 2005). Other inputs are measured in physical or monetary values, according to the availability of the data. Correspondingly, capital input is measured by the deflated book values of a firm's capital. Labour input is measured by the total number of employees. Monetary values are deflated using appropriate Producers Price Index at a two digit level of industry disaggregation. The model specification includes also squared and cross-product terms of capital and labour. These measures are included to accommodate the requirements of the Translog specification (Specification 4.15).

Country dummies are included to adjust the frontier against which the efficiency scores are estimated. A set of control variables are included to isolate the effect of ownership, including variables controlling for SOEs, private companies controlled by foreign owners and private companies controlled by domestic owners. Also, two interaction dummies are included to control for privatized companies to foreign owners and to domestic owners. Sector dummy and two year dummies are also included. Additional dummy variable (Urban) is included as an instrument in the selection model (specification 4.13). The definition and notation used for variables are provided in Table 4.2. Output and input variables are transformed into natural logarithm form. The dependent variable is the natural logarithm of value added. Five imputed datasets were created which were then used for the estimation of stochastic frontier analysis. All model specifications were run with the five imputed datasets and the results are combined using Rubin's formula (see Section 4.3.2 for details of combining results using this formula).

Table 4.2. Variable description for the stochastic frontier (and selection) models

Name of the variable	Description	Notation
Dependent variable/s		
Value Added	Continuous variable calculated as difference between deflated sales and non-labour and non-capital inputs. Transformed into natural logarithms.	lnOut
Independent variables		
Capital Input	Continuous variable measured by the deflated book values of capital. Transformed into natural logarithms.	lnCap
Labour Input	Continuous variable measured by total number of employees. Transformed into natural logarithms.	lnLab
Squared term of capital	Measured by the following expression 0.5 *(lnCap*lnCap)	1/2 $(\text{lnCap})^2$
Squared term of labour	Measured by the following expression 0.5 * (lnLab*lnLab)	1/2 $(\text{lnLab})^2$
Cross-product term of capital and labour	Measured by the following expression (lnCap*lnLab)	lnCaplnLab
Bosnia	1 if a company is from Bosnia and 0 otherwise	BiH
Croatia	1 if a company is from Croatia and 0 otherwise	Cro
Macedonia	1 if a company is from Macedonia and 0 otherwise	Mac
Montenegro	1 if a company is from Montenegro and 0 otherwise	Mng
Serbia	1 if a company is from Serbia and 0 otherwise	Ser
Slovenia	1 if a company is from Slovenia and 0 otherwise	Slo (base category)
Manufacturing	1 if the company operates in the particular sector and 0 otherwise	Man
Construction	1 if the company operates in the particular sector and 0 otherwise	Cons

Wholesale and retail	1 if the company operates in the particular sector and 0 otherwise	Whol
Transport	1 if the company operates in the particular sector and 0 otherwise	Trans
Hotel and Restaurants	1 if the company operates in the particular sector and 0 otherwise	Hot
Other Services	1 if the company operates in the particular sector and 0 otherwise	Other services (base category)
Years	Year dummies controlling for years 2002, 2005 and 2009 (2002 is the base year)	2002, 2005, 2009
State owned	State ownership (state holding controlling stakes – over 50%)	SOE (base category)
Private foreign owned	Private and privatized companies (foreign owner holding controlling stakes – over 50%)	PriFo
Private domestic owned	Private and privatized (domestic private sector holding controlling stakes – over 50%)	PriDo
Privatized to foreign company**	Privatized companies only (the new owner is foreign private company)	PrivatizedF
Privatized to domestic company **	Privatized company only (the new owner is domestic private company)	PrivatizedD
Urban***	1 if company operates in a large city (over 50,000 inhabitants) and 0 otherwise	Urban

* Continuous variables. All accounting data is converted into U.S. dollars using period average exchange rates, based on monthly series from the International Monetary Fund, nearest to the end date of each respective financial account to allow for comparison across countries.
** Used for specification 4.16 to depict the impact of different new owners on companies' efficiency.
*** Used as an instrument in the selection model (specification 4.13).
Source: Author's own compilation

Initially, the data were examined for severe outliers using interquartile range (IQR) test. Only the severe outliers with values more than three times the interquartile range of a quartile were excluded. More precisely, if A_1 and A_3 denote the first and the third quartiles (approximate 25th and 75th percentile), the observation x was considered an outlier to be excluded if the value of $x < A_1 - 3IQR$ or $x > A_3 + 3IQR$. Summary statistics of the original data is provided in Table 4.3.

Table 4.3. Summary statistics of the data

Variable	Fraction (%)		Mean	Std. Dev.	Min	Max	% of missing (# of missing)
	1	0					
Value added	-	-	3,390,022	13,800,000	1,213	285,000,000	26.85 (1021)
Capital	-	-	2,046,563	9,237,346	366	154,000,000	34.48 (1311)
Labour	-	-	122	361	1	10,000	0.37 (14)
Bosnia	19.56	80.44	0.20	0.40	0.00	1.00	0 (0)
Croatia	15.29	84.71	0.15	0.36	0.00	1.00	0 (0)
Macedonia	19.35	80.65	0.19	0.40	0.00	1.00	0 (0)
Montenegro	3.05	96.95	0.03	0.17	0.00	1.00	0 (0)
Serbia	24.66	75.34	0.25	0.43	0.00	1.00	0 (0)
Slovenia	18.08	81.92	0.18	0.38	0.00	1.00	0 (0)
Manufacturing	27.24	72.76	0.27	0.45	0.00	1.00	0 (0)
Construction	10.37	89.63	0.10	0.30	0.00	1.00	0 (0)
Wholesale and retail	34.75	65.25	0.35	0.48	0.00	1.00	0 (0)
Transport	6.87	93.13	0.07	0.25	0.00	1.00	0 (0)
Hotel and Restaurants	6.11	93.89	0.06	0.24	0.00	1.00	0 (0)
Other Services	14.66	85.34	0.15	0.35	0.00	1.00	0 (0)
Year 2002	25.69	74.31	0.26	0.44	0.00	1.00	0 (0)
Year 2005	30.46	69.54	0.30	0.46	0.00	1.00	0 (0)
Year 2009	43.85	56.15	0.44	0.50	0.00	1.00	0 (0)

State owned	11.98	88.02	0.11	0.31	0.00	1.00	0 (0)
All private foreign	10.13	89.87	0.10	0.30	0.00	1.00	0 (0)
All private domestic	77.89	22.11	0.78	0.42	0.00	1.00	0 (0)
Privatized to foreign company	6.29	93.71	0.10	0.42	0.00	1.00	0 (0)
Privatized to domestic company	42.64	57.36	0.57	0.76	0.00	1.00	0 (0)
Urban	35.69	64.31	0.36	0.48	0.00	1.00	0 (0)

Source: Author's own compilation based on STATA printouts

The summary statistics show that the output of companies ranges from just over 1,200 USD to 285 million USD. Companies in the sample are dominated by small firms.[79] Around 44 percent of observations are from the year 2009 while in 2005 and 2002 the proportion of observations is 30 and 26 percent respectively. Companies from Serbia represent around 25 percent of the whole sample though it should be noted that for the first two waves of the survey, data from Serbia includes Montenegro as well. Companies mainly engage in trade and services, with the share of manufacturing and construction activities being just over 37 percent. They are mainly private, domestically owned. Just over 10 percent of companies are state owned companies.

The rate of missing values is fairly low; however the largest number of missing values occur for the most important variables for the estimation of the production function: output, capital and labour. The rate of missingness in these variables is around 27 percent for output, around 34 percent for capital and around 0.4 percent for labour. We treat our missing data as item non-response which occurs when, for some reason, the respondent participating in the survey does not respond or has no valid answer

[79] See Figure 4.4, panel c for the distribution of companies according to size.

for some of the questions.[80] Since we lack knowledge of the missing values themselves, the MAR assumption is not testable. However, further investigation of the missingness pattern shows item nonresponse is higher the larger the companies are. Therefore the size of the company (expressed in terms of number of employees) seems to predict the missingness. Therefore we assume that the missing data are MAR. The size of the company, as a covariate that predicts the missingness, is also included in the analysis.

Since in most cases the missing observations are spread throughout the dataset (missing data on different variables in different cases), the proportion of missing data usually becomes very significant. Table 4.4 summarises the matrix of missingness pattern. It shows that if a complete case analysis had been employed, a significant fraction of observations would have been lost (around 44 percent). There are 2,128 complete case observations or 55.97 percent of possible 3802 observations. Other columns in Table 4.4 show the pattern of missingness for each variable and the number of cases with particular number of missing observations. Number 1 means that the data is observable, while number 0 means that the data is missing.

[80] Other types of nonresponses include unit non-response and wave non-response. The former arises when a selected respondent refuses or is unable to participate in the survey while the latter, which is related to longitudinal data, arises when one or more waves of data are missing for a respondent that has provided data for at least one wave (for more see Schafer and Graham, 2002; Durrant, 2005).

Table 4.4. Matrix of missingness pattern

	Count of observations with specified pattern?							
	2128	359	2	2	650	651	1	9
Variable	*comple-te cases*	*with missing value added*	*with missing labour*	*with missing value added and labour*	*with missing capital*	*with missing value added and capital*	*with missing labour and capital*	*with missing value added, labour and capital*
Value added	1	0	1	0	1	0	1	0
Labour	1	1	0	0	1	1	0	0
Capital	1	1	1	1	0	0	0	0
Bosnia	1	1	1	1	1	1	1	1
Croatia	1	1	1	1	1	1	1	1
Macedonia	1	1	1	1	1	1	1	1
Montenegro	1	1	1	1	1	1	1	1
Serbia	1	1	1	1	1	1	1	1
Slovenia	1	1	1	1	1	1	1	1
Manufacturing	1	1	1	1	1	1	1	1
Construction	1	1	1	1	1	1	1	1
Wholesale and Retail	1	1	1	1	1	1	1	1
Transport	1	1	1	1	1	1	1	1
Hotel and Restaurants	1	1	1	1	1	1	1	1
Other Services	1	1	1	1	1	1	1	1
2002	1	1	1	1	1	1	1	1
2005	1	1	1	1	1	1	1	1
2009	1	1	1	1	1	1	1	1
State owned	1	1	1	1	1	1	1	1
All private foreign	1	1	1	1	1	1	1	1
All private domestic	1	1	1	1	1	1	1	1
Privatized to foreign company	1	1	1	1	1	1	1	1
Privatized to domestic company	1	1	1	1	1	1	1	1
Urban	1	1	1	1	1	1	1	1

Source: Author's own compilation based on the NORM software printouts

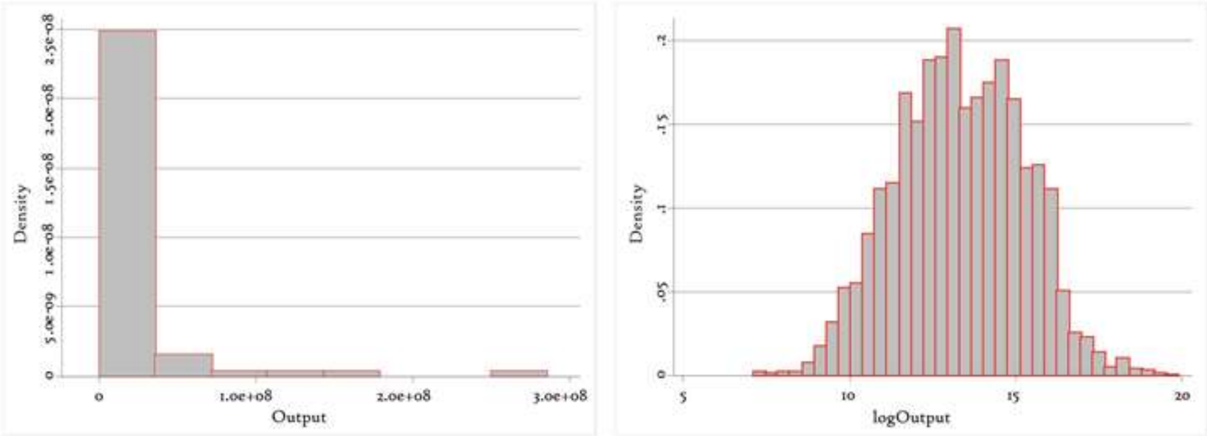
As discussed earlier, ignoring missing values is based on a stronger assumptions about the missing data mechanism. However, even if the assumption holds, due to the missingness pattern, a great proportion of data can be lost. The use of MI is justified as, on the one hand, the variables with missing data are important to the subsequent analysis and, on the other hand, the missing values have serious potential biasing effects.

4.3.4 Imputation procedure

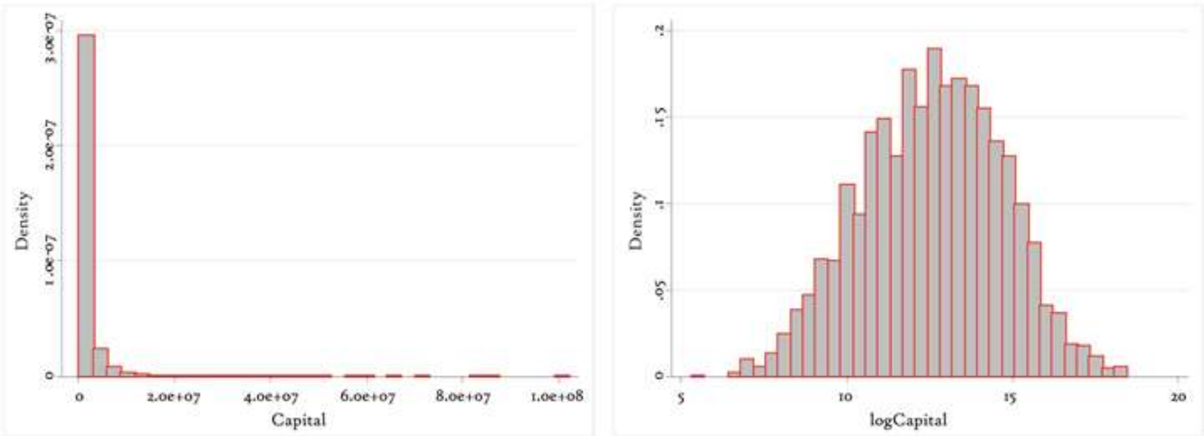
The specification used for MI (i.e. variables and observations) is exactly the same as the specification for the main research question (i.e. Equation 4.16) in order to preserve the associations among variables and also avoid problems of misspecification.[81] . In the normal model, a multivariate normal distribution for the data is assumed. Therefore the first step before imputation procedure was to approximate the normality of the data to be imputed by transforming them into natural logarithms. The survey data used are not normally distributed: some are bounded between zero and one, others are skewed. In this case, discrete variables were completely observed and only continuous variables which are heavily skewed to the right should be imputed. Non-normality of the data is handled through transforming the variables with missing observations by taking natural logarithms is recommended when data are skewed to the right (Graham, Cumsille and Elek-Fisk, 2003).

[81] For details on missingness specification see Meng (1995) or Schafer (2001).

a) Output



b) Capital



c) Labour

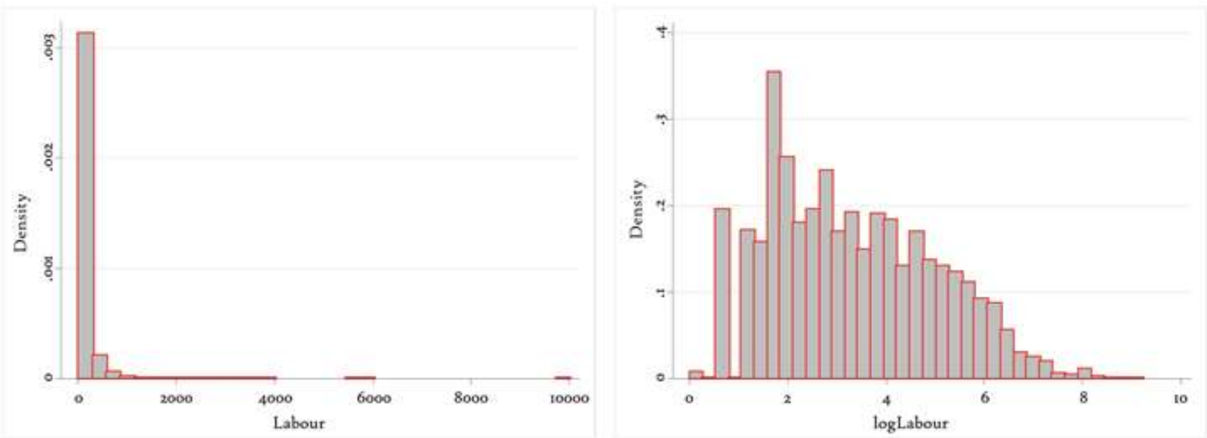


Figure 4.4. Histogram of variables before and after transformation
Source: Author's own drawing based on LIMDEP outputs

As Figure 4.4 shows, the transformation to natural logarithms was found to give good approximation of variables to normality. Moreover, any deviation from normality y (for the variables to be imputed) should not harm the imputation process too much (see Schafer, 1997 and Gelman et al., 2005).

For the application of the multiple imputation technique we rely on the stand-alone software NORM developed by Schafer (1999a). A detailed description of software and its computational routines can be found in Schafer and Olsen (1998) and Graham and Hofer (2000). However, we summarise the imputation procedure carried out in NORM in non-technical language. In brief, data imputation in NORM is a two-step procedure, (i) the Expectation–Maximization (EM) algorithm and (ii) Data Augmentation (DA) procedure.[82]

Running the Expectation–Maximization algorithm obtains maximum-likelihood estimates of parameters from incomplete data.[83] EM uses the relationship between data parameters and the missing values. If the parameters of the data are known, then predicting unbiased missing values is simple. Likewise, estimating the model parameters would be simple if the missing values are known (Schafer and Olsen, 1998). The EM algorithm takes advantage of this interdependency by iterating between the following two steps: (i) predicting the missing values based on estimated values for the parameters and (ii) use these predictions to update the parameter estimates. These steps are repeated in an iterative fashion until the sequence of parameters converges, i.e. the difference in covariance matrix from one iteration to the next becomes insignificant (Dempster et al., 1977). The speed of convergence is related to the rate of missing information. If the level of information about the parameters in the missing observations is high relative to the observed observations, then the

[82] The formal definition and key properties of EM are reviewed by Little and Rubin (1987) and Schafer (1997).

[83] EM introduced by Dempster, Laird and Rubin, (1977) has been updated and extended in recent years improving the convergence of these algorithms (van Dyk and Meng, 1997).

convergence is slow and vice-versa. In our case EM algorithm converged after 79 iterations.

The second step is the Data Augmentation (DA) process. It is a special type of Markov chain Monte Carlo (MCMC) iterative simulation procedure that fills the missing observations and estimates the unknown parameters. Unlike EM, the iterative process in DA is stochastic. However, as with EM, DA randomly imputes the missing data based on the assumed values of the parameters and the parameters are updated from a Bayesian posterior distribution based on the observed and imputed data (Schafer and Olsen, 1998). Again, the speed of convergence is related to the rate of missing information but the convergence in the case of DA is different. Since DA is a stochastic procedure, it converges in distribution rather than in a single set of values as it does in EM. In case of DA, the convergence can be interpreted as a lack of serial dependence, i.e. the simulated missing data and parameters at convergence are statistically independent of those at the initial step. It is important to determine the sufficient number of cycles between imputations to ensure that they simulate two random draws from the population. Schafer and Olsen (1998) suggest that DA nearly always converges in fewer cycles than EM, therefore the running the EM algorithm prior to running DA is recommended as it gives some idea as to how many cycles are necessary.[84]

As shown in Figure 4.5 (panels a and b), the investigation of time-series and autocorrelation plots did not suggest any convergence problems. Figure 4.5 shows the diagnostic plots for the worst linear function from 1,000 steps of data augmentation for the sample data used in this Chapter. The upper plot in panel a) is simply a plot of the value of the worst linear function at each step of data augmentation. Ideally, one

[84] Running EM algorithm before DA is recommended also because the resulting parameter estimates provide good starting values for the DA procedure.

would see a pattern in this upper plot that looks something like a rectangle (Schafer and Olsen, 1998). The plot shown in this panel (panel a) is reasonably good.

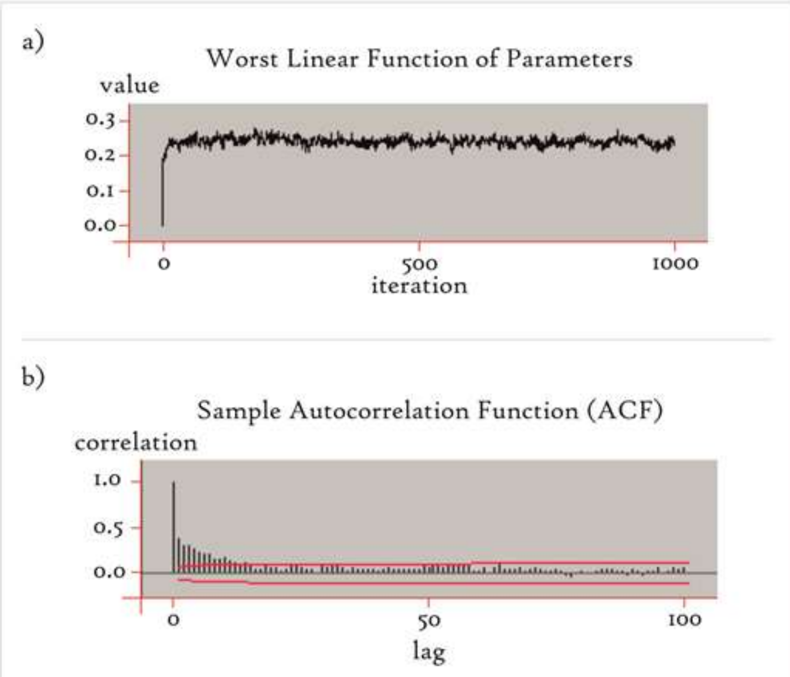


Figure 4.5. Diagnostic plots from a data augmentation run
Source: Author's own drawing based on NORM outputs

The lower plot (panel b) is the plot of the autocorrelation of a parameter estimate (in this case the worst linear combination). When the autocorrelation dips below the red line (and stays there), there is evidence that this value of the number of steps of data augmentation between imputed data sets is sufficient to produce a non-significant autocorrelation between estimates. That is, setting *the number of cycles* to this value will be sufficient for multiple imputation. We use 200 cycles even though the convergence is achieved earlier (For EM it is achieved at 79 iterations). Schafer and Olsen (1998) suggest that allowing large number of cycles does not cause any problem as the simulated values are stationary after convergence. In fact they recommend larger number of cycles, as a safety margin, to ensure complete independence of the imputed values. Finally, following these steps, 5 new complete datasets with 3802 observations each were created. The multiple imputation procedure enabled us to increase the sample size by around 44 percent.

4.4 Empirical considerations and results

4.4.1 Discussion of the model

As mentioned earlier, the aim of this Chapter is to measure the mean efficiency of companies in successor states of former Yugoslavia capturing the effect of ownership. It intends to answer the following questions:

- Whether domestic de-novo private companies perform better then SOEs;
- Whether privatized companies (to foreign or domestic companies) perform better than SOEs;
- Whether foreign companies have higher mean efficiency scores compared to domestic de-novo private companies and SOEs;
- Does the sector of operation explains any of the differences in output performance of companies with different ownership structures;
- Whether there are any differences in output performance of companies across successor states of former Yugoslavia;
- Whether there was an improvement of output performance across years.

There are several strands of literature related to ownership-efficiency nexus including, among others, property rights theory, public choice theory and parts of the agency theory. These theories have been extensively reviewed in Chapter 1, and therefore will not be repeated here. Yet, despite their shortcomings, all of these theories support the hypothesis that private ownership improves efficiency through better incentives and more effective disciplining mechanisms. As discussed in Chapter 2, although empirical research mainly finds that better performance is associated with private ownership, it is by no means conclusive as the resulting performance may vary across countries, measures, specifications, and new types of owners.

This Chapter therefore seeks to explore the impact of the ownership status on efficiency using the stochastic frontier analysis and estimating firm-specific efficiency scores for companies in the six countries under consideration. The key proposition of the empirical models in this Chapter is that the ownership and other firm and country specific characteristics explain differences in output performance and mean efficiency scores.

4.4.2 Addressing selection bias

Before progressing any further, it is important to discuss the issue of selection bias which is usually overlooked in the research related to the effects of ownership on company performance (see Chapter 2 for more detailed discussion on this topic). Attempts to control for selection bias in applied research in social sciences have become extensive in the last three decades; largely employing Heckman (1979) sample selection models. Sample selection models are a well-developed class of econometric models that have been widely employed especially in estimating linear regression models.[85] Yet, the extension of these methods to non-linear models is more recent (Greene, 2008a). The basic structure of a selection model assumes that the observed data are not drawn randomly from the population. Instead, the data are assumed to be drawn only when a related companies' characteristic has a certain value/threshold. If this systematic relation is not accounted for, then bias is introduced in the estimates. A general solution to the selectivity problem relies upon an auxiliary model of the process of selection (Greene, 2006).

Heckman's (1979) selection model is a two stage model in which the first stage is the selection equation and second stage is the substantive equation of interest. The first stage in this case assesses the probability of being selected into privatization by using predictors to determine the selection. The second stage then examines the effects of the independent variables on the outcomes of interest. The most widely used

[85] A selected sample is a general term that describes a non-random sample (Wooldridge, 2002).

approach is to add the inverse Mill's ratio (IMR), obtained from the selection equation, into the second stage to correct for selection problem.[86] Greene (2008a), however, argues that such an approach is inappropriate for non-linear models such as stochastic frontier.[87] He proposes an alternative approach for a class of nonlinear models in Greene (2006) that relies on a simulation based estimator. This Chapter uses these estimators to account for sample selection in the stochastic frontier model. The sample selection estimator for SFA was only made available in Limdep 9.0 (Greene, 2007).

Initially we test for selection bias using Heckman selection model for a class of nonlinear models as proposed by Greene (2006) to note if there are systematic differences between companies that were not privatized and those that were. Here the selection into privatization is estimated in the selection model using maximum-likelihood probit model employing exogenous variable that effect the decision to be selected for privatization. The main assumption required to guarantee reliable estimates of selection for privatization is the existence of at least one additional regressor in the decision equation. This regressor is required to be independent of the error term (Wooldridge, 2002). The challenge here is to find strong instruments that can explain selection for privatization, but not be a determinant of firm performance except through its impact on ownership. The problem with our dataset is that such instruments are not easily available by design. Also, some potential instruments were not available in all three rounds of surveys. However, we managed to find an instrument that proxies the extent of competition in product market where companies

[86] Mill's ratio is the ratio of the probability density function to the standard normal cumulative distribution function. In the first stage (selection equation), the inverse Mill's ratio is computed for each observation. For details see (Wooldridge, 2002).

[87] Greene (2008a) points out that none of the authors that used Heckman selection model in the context of Stochastic Frontier Analysis formally modified their stochastic frontier models to accommodate the results. He argues that sample selection bias arises as a consequence of the correlation between the unobservables in the main equation and those in the sample selection equation - thus, the ambiguity in adding an IMR to a model that contains no such unobservables. A study analysing the Slovenian context (Simoneti et al., 2005) also uses Heckman selection model in non-linear setting by adding the IMR to the second stage equation but it does not use Stochastic Frontier Analysis.

operate. Governments are expected to sell companies that operate in more competitive markets before going to companies in less competitive industries. To measure product market competition, a dummy variable is used which takes the value of 1 if company operates in large cities (with 50,000 or more inhabitants) and zero if it operates in small cities. The idea is that, ceteris paribus, the more competitive a market in which the company operates (proxied by the number of inhabitants), the more likely it will be that government will be induced to privatize the firm. Moreover, more competitive markets reduce the advantages of retained state ownership by the government.

The selection model is given by the following specification:

$$P(y = 1|x) = \beta_0 + \tau_1 Urban + \beta_l lnlab + \beta_K lncap +$$

$$+\beta_O lnout + \delta_1 Man + \delta_2 Const + \delta_3 Whol + \delta_4 Trans + \delta_5 Hot + \rho_1 Cro + \rho_2 BiH +$$
$$\rho_3 Ser + \rho_4 Mng + \rho_5 Mac + \varphi_1 2005 + \varphi_2 2009 \qquad (4.13)$$

Where response probability P is the selection status, i.e. the probability of being selected for privatization, taking the value of 1 that company is privatized and zero otherwise, conditional on the set of explanatory variables. These variables include *Urban,* as a proxy of market competition as well as other covariates that are also included in the second step, or main, equation (specification 4.15). These variables include inputs, labour (lnlab) and capital (lncap), and output measure (lnout) as well as time-invariant factors such as sector, country and year dummies. The correlation between the error terms of the two equations (4.13 above and the second stage model 4.15), i.e., the coefficient rho produced by the software, provides a method of testing the specification of the selectivity model against the simpler model (Greene, 2008a).[88]

[88] The Limdep printouts of the selection model, assuming normal distribution, are presented in Appendix 1. The selection model is run in all five imputed datasets (M1, M2, M3, M4, M5) and are

The results of the selection model are very similar to the results of the frontier regression without correcting for selection, specification 4.15 on its own (respectively Column 3 and Column 1 in Table 4.9).[89] The absence of selection bias is further confirmed as the correlation between the error terms of the two equations, as indicated by rho, is not statistically significant (shown at the bottom of Column 3 in Table 4.9). Rho has a potential range between -1 and +1 and can give some indication of the likely range of selection bias. A correlation with an absolute value of 1 would occur if the regression coefficients of the selection model and the regression coefficients of the substantive model were estimated by identical processes (i.e., potential selection bias). Conversely, a value of rho closer to zero would suggest that data are missing randomly or the regression coefficients of the selection model and the regression coefficients of the substantive model were estimated by unrelated processes (i.e., less evidence of selection bias). The results show that Rho coefficient is close to zero (0.001) with a p value close to one (0.97). We can hence reject the hypothesis that there is sample selection problem and interpret the SFA specification number 4.15 independently.

4.4.3 Functional form and distributional assumption

As already established, the estimation of the stochastic frontier requires pre-specified functional form of the production function. As argued in section 4.2.2, there are different functional forms used in the literature to model production functions starting from a simple Cobb-Douglas formulation progressing to a more complex Translog form. Since Cobb-Douglas specification is nested in the Translog form the choice of the most appropriate functional form between the two can be tested using the generalized likelihood-ratio (LR) statistic as suggested by Battese and Coelli (1993). LR test is defined by:

---

correspondingly presented in Appendices 1.1 – 1.5. The overall results are combined using Rubin's formula.

[89] The choice of the functional form and distributional assumptions is justified later in the chapter.

$$LR = -2[lnL_r - lnL_u] \quad \dots \dots \dots \dots \dots \dots \dots \quad (4.14)$$

where lnL stands for likelihood ratio of restricted (r) and unrestricted (u) model respectively. The null hypothesis states that there is no significant difference between the two specifications. LR test has an approximate chi-square distribution with degrees of freedom equal to the difference in the number of degrees of freedom between the two models (i.e., the number of variables added to the model).

The following specification (4.15) is used as the model to be estimated but several tests were conducted to consider the restrictions on the parameters:

$$lnOut = \alpha_0 + \beta_K lncap + \beta_L lnlab + \frac{1}{2}\beta_{kk} lncap^2 + \frac{1}{2}\beta_{LL} lnlab^2 + \beta_{KL} lncaplnlab + \delta_1 Man + \delta_2 Const + \delta_3 Whol + \delta_4 Trans + \delta_5 Hot + \rho_1 Cro + \rho_2 BiH + \rho_3 Ser + \rho_4 Mng + \rho_5 Mac + \varphi_1 2005 + \varphi_2 2009 + \theta_1 PriFo + \theta_2 PriDo + (v_i + u_i) \quad (4.15)$$

Where:

- $lnOut$ represents the output expressed in terms of Value Added
- β_K and β_L are the estimated coefficients of Capital and Labour input
- β_{KK} and β_{LL} are the estimated coefficients of squared terms of the inputs and β_{KL} is the estimated coefficient of cross-product of inputs
- $\varepsilon_i = (v_i + u_i)$ is a vector of composed error term consisting of two independent elements
  - v_i is the independently distributed error term that represents random variation in output due to factors not under companies' control as well as the effects of omitted explanatory variables, measurement errors, and statistical noise.
  - u_i is non-negative firm-specific technical inefficiency representing the stochastic shortfall of companies' output from the production frontier due to inefficiency.
- δi, ρi, φi and θi denote estimated coefficients of a set of dummy variables controlling for industries, countries, years and ownership respectively.

Initially, simple Cobb-Douglass frontier function (including only logs of capital and labour inputs) was fitted in five imputed datasets (M1, M2, M3, M4, M5) followed by a Translog formulation (including Cob-Douglass elements, squared and cross-product terms of the inputs).[90] The LR test was conducted to test for the most appropriate formulation. The results of the LR test are presented in Table 4.5.[91] The LR test in all datasets suggests that the use of Translog function is preferable to a simple Cobb-Douglas specification.

Table 4.5. Generalized likelihood Ratio Test for functional form of the stochastic frontier model

Database	Null hypothesis	LR Test	Chi square value***	Result
M1	$\beta_{KK} = \beta_{LL} = \beta_{KL} = 0$	19.76	16.27	Reject H0
M2	$\beta_{KK} = \beta_{LL} = \beta_{KL} = 0$	16.51	16.27	Reject H0
M3	$\beta_{KK} = \beta_{LL} = \beta_{KL} = 0$	32.16	16.27	Reject H0
M4	$\beta_{KK} = \beta_{LL} = \beta_{KL} = 0$	25.88	16.27	Reject H0
M5	$\beta_{KK} = \beta_{LL} = \beta_{KL} = 0$	31.23	16.27	Reject H0

***Chi square values at 0.1 percent level.
Source: Author’s own compilation based on LIMDEP outputs

Other LR tests were conducted to consider the restrictions on the parameters in the model specification 4.15. Table 4.6 presents the LR test for joint significance of other explanatory variables: dummies controlling for Sector, Country, Time and Ownership. In all five imputed datasets the H0 was strongly rejected favouring the unrestricted model which includes time, environmental and firms-specific covariates.

[90] The Limdep printouts of the Cobb-Douglas and Translog specifications are presented in Appendix 2. The Cobb-Douglas and Translog specifications are run in all five imputed datasets (M1, M2, M3, M4, M5), and are correspondingly presented in Appendices 2.1 – 2.5. In all cases the Cobb-Douglas specification is presented first followed by the Translog specification. In all these specifications, normal distribution is assumed. Specifications with other distributional assumptions are presented in Appendix 4. The discussion about the distributional assumptions is presented in the following sections.
[91] The LR tests presented in Table 5 are based on the frontier functions assuming normal distribution of the u_i. Frontiers were also fitted assuming other distributional assumption (truncated, exponential and Gamma) and the results were similar.

Table 4.6. Generalized likelihood Ratio Test for the significance of other variables

	Null hypothesis	LR Test	Chi square value***	Test statistic
M1	δi=ϱi=φi=θi=0	928.682	36.12	Reject H0
M2	δi=ϱi=φi=θi=0	939.37	36.12	Reject H0
M3	δi=ϱi=φi=θi=0	986.89	36.12	Reject H0
M4	δi=ϱi=φi=θi=0	1073.12	36.12	Reject H0
M5	δi=ϱi=φi=θi=0	958.33	36.12	Reject H0

****Chi square values at 0.1 percent level.*
Source: *Author's own compilation based on LIMDEP outputs*

Finally, a single restriction on ownership parameters was imposed as these covariates are the focus of this research. The LR test, presented in Table 4.7, for no effect of ownership was strongly rejected in all five imputed datasets indicating that the ownership explains some the variation of companies' performance.

Table 4.7. Generalized likelihood Ratio Test for the significance of ownership

	Null hypothesis	LR Test	Chi square value***	Test statistic
M1	θi=0	53.65	13.82	Reject H0
M2	θi=0	66.19	13.82	Reject H0
M3	θi=0	35.90	13.82	Reject H0
M4	θi=0	65.31	13.82	Reject H0
M5	θi=0	57.02	13.82	Reject H0

****Chi square values at 0.1 percent level.*
Source: *Author's own compilation based on LIMDEP outputs*

An alternative specification (4.16) was also run to include an interaction term to jointly depict the effect of privatization and the type of new owner. The interaction term analysed the effect of privatization on companies privatized to a foreign owner and to a domestic owner. The results are presented in Table 4.9 (Column 2). Limdep printouts of this specification are presented in Appendix 3. This specification is run in all five imputed datasets (M1, M2, M3, M4, M5), and are correspondingly presented in Appendices 3.1 – 3.5.

$$lnOut = \alpha_0 + \beta_K lncap + \beta_L lnlab + \frac{1}{2}\beta_{kk} lncap^2 + \frac{1}{2}\beta_{LL} lnlab^2 + \beta_{KL} lncaplnlab + \delta_1 Man + \delta_2 Const + \delta_3 Whol + \delta_4 Trans + \delta_5 Hot + \rho_1 Cro + \rho_2 BiH + \rho_3 Ser + \rho_4 Mng + \rho_5 Mac + \varphi_1 2005 + \varphi_2 2009 + \zeta_1 PrivatizedF + \zeta_2 PrivatizedD + (v_i + u_i) \quad (4.16)$$

Following the discussion in section 4.2.2, another matter to be considered before fitting the frontier functions is the distributional assumption about the u_i. In order to avoid misspecification, Translog frontier function (in five imputed datasets) was fitted with all four distributional assumptions (normal, truncated, exponential and gamma).[92] The estimated efficiency scores were then compared to identify eventual differences. Following Kumbhakar and Lovell (2000) and Greene (2008), rank correlations for estimates of inefficiencies from the four distributions can be used to compare the estimated results. Also, the use of scatter diagram gives a graphical insight to the eventual differences.

Along these lines, Pearson and Spearman rank correlations for estimates of efficiency were calculated. These correlations were calculated for all five imputed datasets. As the results presented in Table 4.8 show, both Pearson and Spearman rank correlation coefficients indicate that the efficiency scores are highly correlated with correlation coefficients averaging around unity. The results are consistent across five imputed datasets and all correlation coefficients are significant at conventional levels of significance.

[92] The Limdep printouts of Cobb-Douglas and Translog specifications with truncated, exponential and gamma distributions are presented in Appendix 4 (Results with normal distributional assumption were presented in Appendix 2). These specifications with all distributional assumptions are run in all five imputed datasets (M1, M2, M3, M4, M5), and are correspondingly presented in Appendices 4.1 – 4.5. In all cases the Cobb-Douglas specification is presented first followed by the Translog specification with the following order of the distributional assumptions: truncated, exponential and gamma.

Table 4.8. Pearson and Spearman rank correlations for estimates of efficiency with different distributional assumptions for ui*

M1	Normal	Truncated	Exponential	Gamma
Normal	1.0000	0.9795 (0.000)	0.9791 (0.000)	0.9623 (0.000)
Truncated	0.9999	1.0000	1.0000 (0.000)	0.9829 (0.000)
Exponential	0.9999	1.0000	1.0000	0.9829 (0.000)
Gamma	0.9711	0.9713	0.9713	1.0000
M2	**Normal**	**Truncated**	**Exponential**	**Gamma**
Normal	1.0000	0.9810 (0.000)	0.9805 (0.000)	0.9615 (0.000)
Truncated	0.9999	1.0000	1.0000 (0.000)	0.9807 (0.000)
Exponential	0.9999	1.0000	1.0000	0.9807 (0.000)
Gamma	0.9675	0.9677	0.9677	1.0000
M3	**Normal**	**Truncated**	**Exponential**	**Gamma**
Normal	1.0000	0.9818 (0.000)	0.9814 (0.000)	0.9599 (0.000)
Truncated	0.9999	1.0000	1.0000 (0.000)	0.9783 (0.000)
Exponential	0.9999	1.0000	1.0000	0.9783 (0.000)
Gamma	0.9643	0.9646	0.9646	1.0000
M4	**Normal**	**Truncated**	**Exponential**	**Gamma**
Normal	1.0000	0.9789 (0.000)	0.9785 (0.000)	0.9613 (0.000)
Truncated	0.9999	1.0000	1.0000 (0.000)	0.9829 (0.000)
Exponential	0.9999	1.0000	1.0000	0.9829 (0.000)
Gamma	0.9717	0.9718	0.9718	1.0000
M5	**Normal**	**Truncated**	**Exponential**	**Gamma**
Normal	1.0000	0.9812 (0.000)	0.9809 (0.000)	0.9606 (0.000)
Truncated	0.9999	1.0000	1.0000 (0.000)	0.9792 (0.000)
Exponential	0.9999	1.0000	1.0000	0.9792 (0.000)
Gamma	0.9662	0.9663	0.9663	1.0000

*Note: Pearson correlations are presented above diagonal. Spearman rank correlations are presented below diagonal; p-values in brackets.
Source: Author's own compilation based on STATA outputs

Equally, the scatter diagrams of efficiency scores across imputations and across distributional assumptions, presented in Figure 4.6, depict similar pattern of relationships.

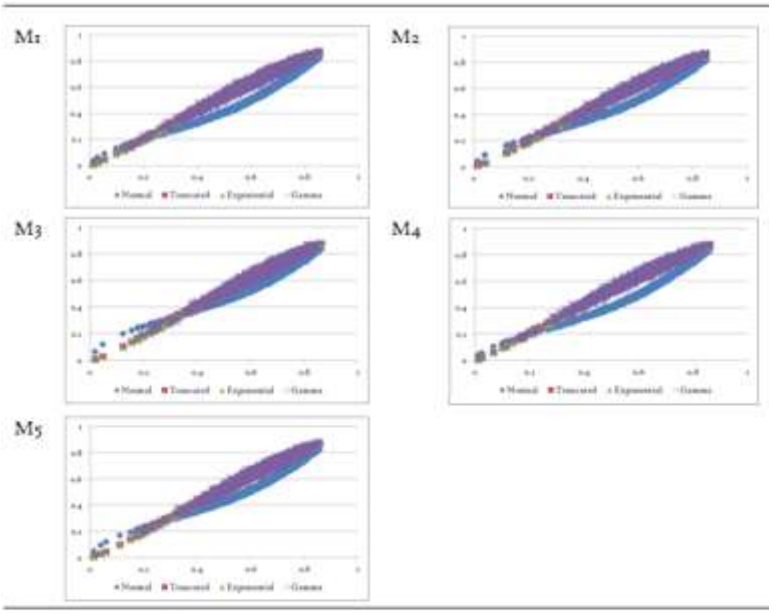


Figure 4.6. Scatter diagrams of efficiency scores across different distributional assumptions
Source: Author's own compilation based on LIMDEP output

Ritter and Simar (1997) argue in favour of using simple distribution, such as normal or exponential, in cases when the efficiency ranking and scores are similar across different distributional assumptions. Given these similar efficiency scores and rankings, established by Pearson and Spearman rank correlations as well as graphical representation, we use the normal distribution for inefficiency scores. Hereafter, all regression results presented in this Chapter are estimated assuming normal distribution of inefficiencies.

4.4.4 Results

The parameters of stochastic model and the inefficiency scores are estimated using maximum likelihood estimators. The software package Limdep 9.0 was used as the econometric software to carry out the estimations.[93] The estimated parameters include βs, σ_v^2, σ_u^2, σ^2, λ and γ. The variances of parameters of symmetric v_i and one-sided u_i are denoted σ_v^2 and σ_u^2 respectively. The overall model variance is given by $\sigma^2 = \sigma_u^2 +$

[93] For obtaining descriptive statistics, Spearman rank correlations, Pearson correlations and Kernel density distribution graphs STATA 11 was used. Other graphs were produced using Microsoft Excel 2010.

σ_v^2. The λ parameter denotes the deviation from the optimal frontier and is given by $= \frac{\sigma_u}{\sigma_v}$. The measure of total variation of output from the frontier that can be attributed to the inefficiency is given by parameter $\gamma = \frac{\sigma_u^2}{\sigma^2}$.

The results from five imputed datasets in all three specifications were combined using Rubin's formula (Rubin, 1987). The process for combining the results is described in detail in section 4.4.2. Combined results are presented in Table 4.9.[94] The dependent variable is lnOutput in specifications presented in Column 1 and 2 of Table 4.9 and in the second stage of specification presented in Column 3. Most of the signs of the coefficients are as expected and statistically significant, including the variance parameters. We start by analysing the variance parameters (last four rows of Panel A of Table 4.9) which are the most important elements in testing the appropriateness of the stochastic frontier model.

The estimated Lambda (λ) coefficient is statistically significant implying that there is inefficiency in the data and that the output variation is not purely random (Greene, 2007). It demonstrates that the deviation from the frontier is significantly influenced by inefficiency. Lambda is a measure of the amount of variation stemming from inefficiency relative to noise for the sample. If significant, it suggests that the use of the Stochastic Frontier model is appropriate given that it shows the existence of the two error components. If Lambda is not statistically different from zero, it implies that the variance in production relative to the frontier is solely attributed to the random error, i.e. there is no inefficiency component in the disturbance term. In that case the model can be estimated efficiently by ordinary least square. In other words, firms operating on the frontier are accepted to be technically efficient and except for random disturbances, are receiving maximum output for the combinations of the inputs used.

[94] The Limdep printouts of Translog specifications with normal distribution are presented in Appendix 1.

The estimated variance parameter Gamma (γ), which should take values between 0 and 1, is statistically significant and averages (across all imputed datasets) at 0.45. This suggests that 45 percent of the difference between observed output and the corresponding frontier is due to inefficiency. This reveals the importance of incorporating technical inefficiency in the production function. The statistically significant parameter Gamma confirms that that the systematic technical inefficiency effects are not zero and consequently not all firms operate on the frontier.

Table 4.9. Combined results from stochastic frontier estimation

PANEL A
dependent variable: lnOut

	Column 1		Column 2		Column 3	
	Specification 4.15		Specification 4.16		Specification 4.13	
	SFA		SFA		SFA with selection	
	Coefficients	P, 2-tailed	Coefficients	P, 2-tailed	Coefficients	P, 2-tailed
lnCap	0.019	0.86	0.012	0.92	0.067	0.250
lnLab	1.133***	0.00	1.133***	0.00	1.492***	0.000
1/2 $lnCap^2$	0.019	0.14	0.020	0.15	0.037	0.128
1/2 $lnLab^2$	-0.028***	0.05	-0.032***	0.02	-0.015**	0.048
lnCaplnLab	-0.019	0.16	-0.018	0.19	-0.051	0.121
_2005	0.422***	0.00	0.412***	0.00	0.564***	0.000
_2009	0.258***	0.00	0.241***	0.00	0.351***	0.000
Man	-0.251***	0.00	-0.242***	0.00	-0.270***	0.000
Cons	0.028	0.81	0.008	0.95	0.027	0.772
Hot	-0.289***	0.00	-0.286***	0.00	-0.367***	0.000
Whol	0.278***	0.00	0.304***	0.00	0.311***	0.000
Mng	-0.694***	0.00	-0.710***	0.00	-0.937***	0.000
Bos	-0.788***	0.00	-0.798***	0.00	-1.014***	0.000
Cro	-0.402***	0.00	-0.393***	0.00	-0.532***	0.000
Ser	-1.038***	0.00	-1.038***	0.00	-1.320***	0.000
Mac	-1.191***	0.00	-1.190***	0.00	-1.498***	0.000
PriFo	0.413***	0.00	-	-	0.682***	0.000
PriDo	0.053	0.45	-	-	0.253	0.382
PrivatizedF	-	-	0.093***	0.01	-	-
PrivatizedD	-	-	0.009	0.72	-	-
Lambda (λ)	0.904***	0.00	0.887***	0.00	-	-
Sigma	0.973***	0.00	0.967***	0.01	-	-
Intercept	9.776***	0.00	9.868***	0.00	13.208***	0.000

Gamma (γ)	0.448***					
PANEL B.						
					Probit selection model	
Constant	-	-	-	-	-0.393***	0.000
lnCap	-	-	-	-	0.118***	0.000
lnLab	-	-	-	-	0.305**	0.010
lnOut	-	-	-	-	0.514***	0.000
Man					0.093***	0.000
Con					0.508	0.388
Hot	-	-	-	-	0.856***	0.000
Whol	-	-	-	-	-0.164*	0.062
Mon	-	-	-	-	0.200	0.211
Bos	-	-	-	-	0.094	0.112
Cro	-	-	-	-	0.838***	0.000
Ser	-	-	-	-	1.057*	0.078
Mac	-	-	-	-	0.972	0.128
Urban	-	-	-	-	0.105	0.160
Rho(w,v)	-	-	-	-	0.001	0.970

PANEL C: Summary statistics of efficiency scores

	Number of observations	Mean	Standard Deviation	Minimum	Maximum
Normal distribution	3,802	.5716547	.0903016	.1680576	.8231664

*** Significant at 1 percent level; **significant at 5 percent level; *significant at 10 percent level of significance. ▲ This panel includes the estimated results of the first stage PROBIT selection model.

Source: Author's own compilation based on LIMDEP outputs

Given that the Translog functional form is used, the interpretation of the technology parameters is complicated, because of the squared and cross-product terms of the inputs, and because the effect is "spread" among the cross products as well (Greene, 2008). Also, the coefficients of these parameters are of secondary importance in efficiency analysis as the focus is on efficiency scores. Therefore for the sake of brevity detailed interpretation of technology terms is not presented.

When looking at the evolution of output performance over time, an improvement pattern can be noticed in both Specification 4.15 and 4.16 (Column 1 and Column 2 of Table 4.9). The coefficients of variables 2005 and 2009 are positive and significant indicating that there was an increase in output compared to 2002 which is the base year. In terms of sector of operation, in both Specification 4.15 and 4.16, the estimated results suggest that manufacturing, and hotel and restaurants display lower output compared to 'other services' which is the base category. Conversely, wholesale sector has higher output compared to the base category. The coefficient for construction sectors is statistically insignificant. Specification 4.16, includes the interaction terms to depict the joint effect of privatization and the type of new owner. The interaction terms analysed the effect of privatization on companies privatized to a foreign owner and to a domestic owner. The results seem to suggest that a company privatized to a foreign owner outperforms SOEs and displays better output performance than companies privatized to domestic owners. However, even though the coefficient of the companies privatized to domestic owners is positive (compared to the SOEs), it is still statistically insignificant. Specification 4.15, excludes these interaction terms and presents only the coefficients of both private foreign and private domestic companies (comparing them with SOEs as base category). Coefficient of foreign owner companies is positive and significant indicating that private foreign companies have better performance compared to SOEs, while the coefficient of domestic private companies is statistically insignificant. In relation to the dummy variables controlling for countries, they are all statistically significant at one percent level of significance. By having Slovenian companies as reference, the results seem to suggest that companies from all the other countries have lower output performance compared to Slovenian companies.

As mentioned before, however, the focus of the analysis here is the firm-specific efficiency scores. We further analyse the efficiency score of the main equation (Specification 4.15). The SFA produces efficiency estimates or efficiency scores of individual companies. In panel C of Table 4.9, a summary of efficiency scores is presented. It shows that mean efficiency score is 0.57 and it ranges from around 0.17 to 0.82 with a standard deviation of 0.1. Figure 4.7 presents the frequency distributions and Kernel density estimator of efficiency scores. Graphical presentation suggests that there is a tendency for companies towards technically efficient operation (since efficiency scores are more clustered around 1); with a majority of them clustered around 0.6. Over 90 percent of companies fall in the range from 0.45 to 0.75. Only around 2 percent of companies have efficiency scores greater than 0.75 while over 8 percent of companies have efficiency scores less than 0.45.

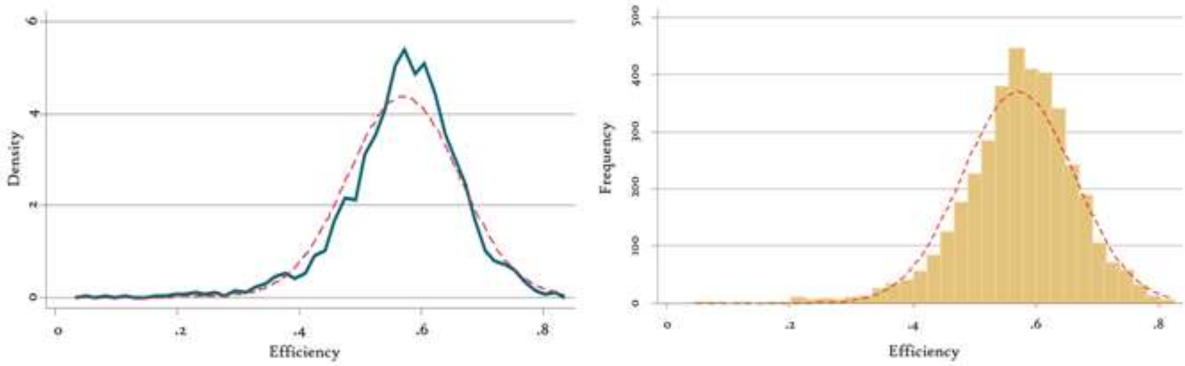


Figure 4.7. Kernel density estimate and frequency distribution of efficiency scores (red dotted lines represent normal distribution)
Source: Author’s own drawing based on LIMDEP outputs

Before analysing firm specific scores of efficiency and inefficiency, it is important to note their properties by examining whether they lie within the confidence intervals. Horrace and Schmidt (1996) suggest that estimated inefficiencies can be used to obtain the conditional mean and variance of u_i given ε_i. Given the distributional assumptions for the error components $u_i \sim iid\ N^+(0, \sigma_u^2)$ and $v_i \sim iid\ N(0, \sigma_v^2)$, the conditional distribution of u_i given ε_i is truncated with normal mean μ_i^* and variance σ^*. With that the conditional mean and variance of the inefficiency and efficiency terms are available, following Bera and Sharma (1999) the conditional confidence intervals for firm-specific technical efficiency and inefficiencies given ε_i can be constructed using the following system of equations:

$$\mu_i^* = -\frac{\varepsilon_i \sigma_u^2}{\sigma^2} = -\frac{\varepsilon_i \lambda^2}{(1+\lambda^2)} \dots \dots \dots \dots \dots \dots \dots \dots \quad (4.17)$$

$$\sigma^* = \frac{\sigma_u \sigma_v}{\sigma} = \frac{\sigma \lambda}{(1+\lambda^2)} \dots \dots \dots \dots \dots \dots \dots \dots \quad (4.18)$$

Then the lower confidence bound (LCB) and the upper confidence bound (UCB) are defined as:

$$LCB_i = \mu_i^* + \sigma^* \varphi^{-1}[1 - \left(1 - \frac{\alpha}{2}\right) \varphi\left(\frac{\mu_i^*}{\sigma^*}\right)] \dots \dots \dots \dots \dots \dots \dots \dots \quad (4.19)$$

$$UCB_i = \mu_i^* + \sigma^* \varphi^{-1}[1 - \frac{\alpha}{2} \varphi\left(\frac{\mu_i^*}{\sigma^*}\right)] \dots \dots \dots \dots \dots \dots \dots \dots \quad (4.20)$$

Where $\varphi\ (\cdot)$ is the distribution function of the standard normal distribution. Greene (2008) suggests that the constructed confidence intervals are not of u_i as they are termed in many papers. The confidence inteval does not bracket a particular u_i, it is in fact characterising the conditional distribution of u_i given ε_i. Following these arguments and the set of equations discussed, we have been able to construct two types of confidence intervals (one for efficiency and one for inefficiency scores). For brevity, here we present only confidence intervals for technical efficiencies.[95] These plots are also more insightful in terms of the size of the intervals.

Figure 4.8 depicts the confidence interval for technical efficiency from five imputed datasets (the vertical axis shows values of efficiency scores, ranging from 0 to 1; the horizontal axis shows the number of companies from 1 to 3,802). The diagram show that the efficiency estimates are within the confidence intervals and that the most efficient firms yield the shortest confidence interval. This confirms the proposition put forth by Bera and Sharma (1999) that when companies move towards the frontier, they not only increase technical efficiency but also reduce the production uncertainty, which is defined by var(ui|ei). As companies' efficiency gets closer to 1, the confidence interval gets narrower (note the upper left hand corner of each diagram).

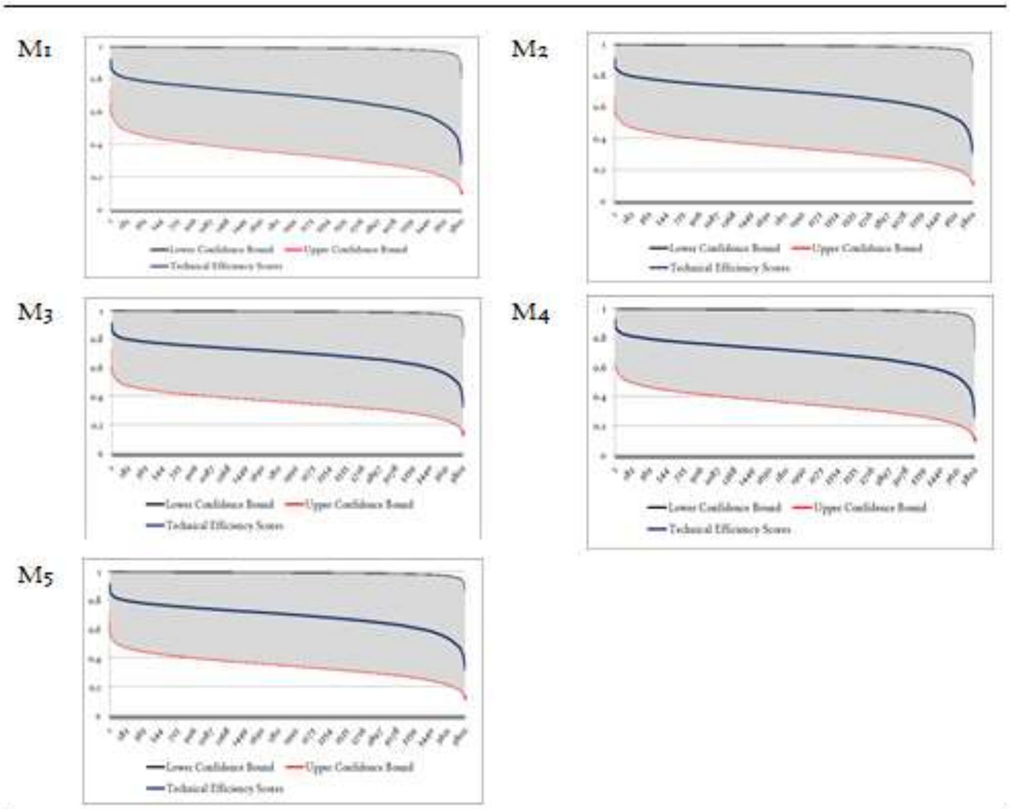


Figure 4.8. Confidence interval for technical efficiency
Source: Author's own drawing based on LIMDEP outputs

[95] Confidence interval for technical inefficiencies in all five imputed datasets are presented in Appendix 5. Similarly, the figures show that the inefficiency scores are within the confidence intervals.

Since efficiency scores vary across companies, they can be related to companies' characteristics, thus one can identify sources of inefficiency. Given that the impact of ownership on companies' performance is the focus of this thesis, the following paragraphs focus on this relationship.

To investigate the effects of the ownership on efficiency, the one-way ANOVA analyses are conducted. The null hypothesis of these tests is that the means of efficiency scores are equal across groups of companies with different ownership structures. This exercise uncovers the impact of ownership which was identified as having a major influence on efficiency. Here the theoretical proposition as to whether ownership accounts for differences in the mean efficiency scores according to different ownership structures are compared and tested. Table 4.10 summarises the ANOVA results of efficiency difference by three factors in all 6 countries included in this analysis. The results indicate that the mean efficiency score of SOEs is lower than that of private companies owned by either domestic or foreign investors. The mean efficiency score of SOEs ranges from 0.53 in Macedonia to 0.65 in Slovenia. The differences in mean efficiency scores between SOEs and private companies owned by domestic investors are very small. The range of the mean efficiency score of private companies owned by domestic investors is higher by only 0.01 or one percent compared to that of SOEs. On the other hand, the mean efficiency scores of private companies owned by foreign investors are higher ranging from 0.58 in Macedonia to 0.7 in Slovenia. A similar pattern is observed in all countries. The positive difference in the mean efficiency scores of private companies owned by foreign investors compared to SOEs is significant at one percent level in all countries. Similarly, the mean efficiency scores of private companies owned by foreign investors compared to private companies owned by domestic investors are higher and statistically significant everywhere apart from Montenegro. On the other hand private companies owned by domestic investors have higher, but statistically insignificant, mean efficiency score compared to SOEs.

Table 4.10. Summary of ANOVA results for differences in mean efficiency scores of firms with different types of ownership

	Bosnia		**Croatia**		**Macedonia**		**Montenegro**		**Serbia**		**Slovenia**	
Ownership type	**Mean efficiencies**		**Mean efficiencies**		**Mean efficiencies**		**Mean efficiencies**		**Mean efficiencies**		**Mean efficiencies**	
State Owned Companies	0.574		0.613		0.534		0.584		0.549		0.653	
Private (Owned by domestic investors)	0.580		0.618		0.539		0.589		0.555		0.659	
Foreign (Owned by foreign investors)	0.616		0.654		0.575		0.625		0.591		0.695	
One-way ANOVA	**F value**	**P value**	**F value**	**P value**	**F value**	**P value**	**F value**	**P value**	**F value**	**P value**	**F value**	**P value**
Private foreign company compared to state owned company	3.12***	0.000	5.12***	0.000	6.27***	0.000	4.89***	0.067	4.66***	0.000	4.49***	0.000
Private domestic compared to state owned company	5.19	0.422	4.22	0.388	2.38	0.298	5.31	0.832	4.79	0.349	2.56	0.783
Private foreign company compared to private domestic company	3.78***	0.002	4.78***	0.002	4.42**	0.039	4.55	0.266	5.16**	0.045	3.96***	0.000

*** Significant at 1 percent level; ** significant ant 5 percent level

Source: Author's own compilation based on ANOVA outputs

4.5 Limitations of the model

Although this chapter has offered several important contributions to the existing literature, the limitations of the model presented here need to be acknowledged and discussed. Firstly, as the analysis has to rely on cross-section samples, by necessity it misses the dynamic assessment of the relationship between variables and, therefore, the results should be considered as indicative. Also, in absence of data on the pre-privatization period, it was not possible to have a selection model which takes into account that period. Secondly, as the data for prices of inputs and outputs were not available, the model accounts only for technical efficiency. The availability of these data would have allowed analysing economic efficiency (technical and allocative efficiency). Decomposing the inefficiency component into technical and allocative inefficiency allows the identification of the type of inefficiency which is the main source of departure from the frontier (cost minimizing, revenue or profit maximizing). This would have been particularly important for policy recommendations. Finally, the BEEPS dataset was not available for Kosovo therefore the results are not directly comparable with those presented in Chapter 6 (which covers the situation in Kosovo).

4.6 Conclusions

Until recently, the economic literature largely ignored the concept of efficiency due to the dominance of the neoclassical economics in which companies are considered to be full optimisers, operating on their production possibility frontier (and thus efficient) because of competitive pressure. However, in recent decades the measurement of efficiency and the analysis of the gap between the actual and potential levels of output has become an important area of research for both economists and policy makers. The primary reason is to identify the sources of inefficiency and separate their effect from the environmental factors which are not in companies' control.

This Chapter summarised influential theoretical and empirical contributions that led to the development and expansion of efficiency analysis. It presented the concept of economic efficiency and its decomposition into technical and allocative efficiency. Estimation methods, including parametric and non-parametric techniques, were discussed in order to provide a rationale for the choice of SFA as the appropriate method of estimation used in this Chapter. This method enables the estimation of firm-specific inefficiency scores in an environment allowing for external shocks and influences. Due to data limitations, the analysis of this Chapter was limited to technical efficiency. Using a Translog production function with inefficiency effects, the technical efficiency scores of companies in the successor states of former Yugoslavia were estimated. Also, variations in efficiency scores based on a range of environmental and firm-specific factors were explained. The results indicate that inefficiency was present in the surveyed companies, therefore, SFA proved to be an appropriate method for this exercise. Variance indicators suggest that almost 45 percent of difference between observed output and the corresponding frontier is due to inefficiency. This reveals the importance of incorporating technical inefficiency in the production function.

As the data are country representative and the estimation is conducted using a single frontier, the results can be compared across different countries. By classifying according to the degree of mean efficiency score, Slovenian companies appear to be the most efficient followed by companies from Croatia, Montenegro, Bosnia, Serbia and Macedonia. In terms of the sector of operation, companies from the wholesale sector seem to have display better output performance followed by companies in construction, other services, manufacturing and hotels and restaurants. The coefficient for the construction sector is statistically insignificant.

Having separate observations for several types of ownership (state, domestic private and foreign private), allows us to derive conclusions regarding the impact of each ownership type on companies' efficiency. The results, in terms of the significance and sign of the variables, are overwhelmingly consistent with the theoretical expectation cited earlier and they are mostly significant. In all countries foreign owned companies outperform other companies (domestic private and state owned companies) and the results are highly significant. Similarly, privatized companies by foreign owners outperform SOEs and privatized companies by domestic owners. SOEs seem to have the lowest mean efficiency score although the difference with domestic private companies (de novo or privatized) is not statistically significant. The results also indicate that output performance has increased over the years compared to 2002.

This chapter has also analysed the issue of incomplete data, employing a multiple imputation procedure for handling missing data. The multiple imputation procedure enabled us to increase the sample size by around 44 percent and avoid the restrictive assumption of missing completely at random, made in most similar studies, though generally not acknowledged. We expect that handling missing data has improved the precision of estimates.

Chapter 5

Privatization in Kosovo: the context and the progress

Contents

Introduction

The aim of this Chapter is to analyse the privatization process in Kosovo. The discussion concentrates on the post-war period when the large-scale privatization process was initiated. But it also provides a brief background to ownership transformation that started in the late 1980s based on the Act on Social Capital in former Yugoslavia. In Kosovo, as in other parts of former Yugoslavia, the dominant form of ownership of companies was 'social ownership'. Formally, enterprises belonged to the society and left in trust with the employees to operate them, look after and maintain the society's assets, and benefit from them. This had created the de facto impression that enterprises belong to their employees, which of course was not the case in legal terms.

The privatization process in Kosovo was distinct from that in other successor states of former Yugoslavia as well as from other TEs, at least in two ways. First, it was designed and largely implemented under the auspices of the United Nations interim administration without any significant involvement of a democratically elected national government.[96] Secondly, the method of privatization after the 1999 war did not follow the legacies of Markovic's reform in particular in terms of providing significant preference to workers or managers. The only method of privatization has been 'sale to the highest bidder' in an attempt to attract outside strategic investors, preferably foreign investors. Therefore, the ownership transformation process in Kosovo did not result in significant insiders' ownership nor in dispersed ownership which was common in cases of mass distribution of shares.

Kosovo was the last of the successor states of former Yugoslavia to embark on lar-scale privatization, even though the privatization process was introduced in 1989.

[96] United Nations Mission in Kosovo (UNMIK), governed Kosovo according to the Security Council Resolution 1244 until the declaration of independence in February 2008. Security Council Resolution 1244 vested UNMIK with authority over the territory and people of Kosovo, including all legislative and executive powers and administration of the judiciary.

However, the number of companies in Kosovo that went through the privatization process in that period was very small and the process was soon brought to an end as the emergency measures of the Serbian Government were imposed from March 1989 onwards. Although the privatization process in Kosovo started much later than in other successor states of former Yugoslavia, it progressed relatively fast so that it was almost completed at the same time as in most of these countries.

This Chapter starts by analysing the state of Kosovo's economy within the former Yugoslav federation until now. Also, this Chapter provides relevant background information on the privatization process in Kosovo and sets up the context of empirical investigation which is conducted in Chapter 6.

5.1 Background of the Kosovo economy

The economy of Kosovo as part of former Yugoslavia

Kosovo was the poorest region of former Yugoslavia. In 1988, the per capita output in Kosovo stood at 28 percent of that of former Yugoslavia as a whole (Mitra, 2001). From a mainly agricultural economy after the Second World War, Kosovo started to transform its economic profile in early 1970s mainly due to significant industrialisation programmes supported by the federal government's investment funds. As a result, between 1970s and 1990s, Kosovo's economic activity was dominated by extractive industry and production of raw material and semi-finished products. However, most of the processing was conducted in other regions of former Yugoslavia (Riinvest Institute, 1998). During this period, as presented in Table 5.1, the share of industry rose to almost one half of Kosovo's output while the share of agriculture fell from almost one third to one fifth of the output.

Table 5.1: Structure of Kosovo's output (figures in percentages)

Sector Year:	**1971**	**1988**	**1996**
Industry	33.3	47.4	33.8
Agriculture	28.2	20.4	28.8
Other	38.5	32.2	37.4

Source: Riinvest Institute, 1998 (based on official statistics of former Yugoslavia)

Following the abolition of Kosovo's autonomy and the imposition of the so-called 'emergency measures' by the Serbian Government in 1989, [97] Kosovo experienced a decade of significant de-industrialization. During the 1990s, the economy suffered many years of poor, and sometimes destructive, policies, lack of effective domestic institutions, broken external trade and financial links, international sanctions and underinvestment (UNDP, 2012). During the first half of the 1990s, this resulted in a sharp decline in per capita income, which fell by an annual average of 13.4 percent, while GDP contracted by 50 percent (Mitra, 2001). The most severely hit sectors were industry and mining (Riinvest Institute, 2000). As a consequence of the fall in output, external trade links could not be maintained. During 1990s, over 150,000 Albanian workers were expelled from their jobs in public administration. This ignited a massive wave of migration which depleted the human capital of the country (Riinvest Institute, 1998).

The economy of Kosovo after the war

After the war, the UN Security Council assigned the mandate to form a transitional government in Kosovo to UNMIK. Since then, and in joint efforts with the international community, Kosovo has made significant progress in the reconstruction

[97] These measures included the suspension of Kosovar institutions (such as the Assembly, government, courts, Albanian speaking educational institutions, etc.), the dismissal of a large number of Kosovar employees (especially all the managerial personnel) and their replacement by Serbian employees brought from other parts of Yugoslavia – especially the Serbian refugees from the Wars in Croatia and Bosnia, dismissal of university professors and high school teachers who refused to refrain from teaching in Albanian, and the imposition of military control over Kosovo. The economic situation declined drastically during this decade because of mismanagement, lack of investment, and even the transfer of assets from Kosovo to Serbia. For more details, see Riinvest Institute (2001).

of the war-damaged economy and in establishing the legal and institutional framework that would facilitate a functioning market economy.

The growth rates in the post-war period reached double digit levels mainly driven by international aid and remittances. However, following a decade of neglect many SOEs were no longer viable, and the industrial base of the country had been severely damaged. Many other SOEs downsized by significantly reducing their labour force. The resulting narrow production base is still reflected in high trade and current account deficit which are financed primarily through foreign aid and remittances.

By 2005 growth rates though steady, became more sluggish, averaging at around three percent until now. This level of growth is not transformational, i.e. it is unable to address the pressing issue of unemployment which according to a recent labour force survey by the Kosovo Agency for Statistics (KAS, 2013), stands at 30 percent. The estimates of the World Bank (2010) indicate that Kosovo needs to double its recent years' growth rates to be able to address the unemployment issue and start to catch-up with other countries in the region. Currently, Kosovo's per-capita income stands at around two thirds of that of regional countries and at around one tenth of that of EU countries.

The business environment in Kosovo has not been conducive. World Bank (2015) ranks Kosovo as 66th out of 189 economies in terms of the ease of doing business. Riinvest Institute (2013) finds that unfair competition, which is primarily a consequence of high informality and tax evasion, is ranked as the major impediment to doing businesses. This is followed by institutional barriers related to contract enforcement and access to finance. Unfavourable business environment impedes local businesses and also discourages foreign investors.

Kosovo's economy has maintained a positive growth and was largely immune from the first wave of the European financial crisis (2008-2010). This was primarily due to her low level of integration in the world financial system. This limited exposure provided a buffer against the crisis. However, indirectly, some effects were felt in the real economy through the drop in remittances, exports and FDI. Kosovo has a very prudent fiscal policy and a stable budget performance. It runs a very low level of public debt and budget deficit.

On the whole, the major concern for the Kosovo economy remains the reliance on unsustainable sources of growth which included foreign development aid, consumption, remittances and governance spending. Kosovo faces tough transition agenda as a result of its weak institutional structure and years of poor economic policies. However some progress has been made, especially in terms of trade and price liberalisation and some considerable progress in terms of privatization, to which we turn in the following section.

The business environment in any country is an essential determinant of the success of privatization and of private sector development, strongly influencing economic growth, job creation and standard of living. Several studies based on annual surveys by the World Bank and Riinvest Institute have demonstrated that, during the post war period, the business environment has not been conducive to the private sector growth. The World Bank (2015) ranks Kosovo as 66th out of 189 economies in terms of the ease of doing business, below its neighbouring countries.[98] Riinvest Institute (2013), using a large representative sample of Kosovo companies, finds that unfair competition is the main obstacle in doing business in Kosovo, followed by corruption. Similar findings are confirmed by Riinvest (2013a) in a study focusing on informality and tax evasion in Kosovo. This report finds that around 40 percent of sales is not reported for tax purposes while the number of employees is underreported by around 36 percent.

[98] The overall 'Doing Business' ranking is based on the average ranking of a large number individual indicators on which countries are assessed.

Corruption, mentioned earlier, is an important element of the poor business environment and a major barrier to private sector development. Various international organizations reporting on corruption suggest that corruption is rife in Kosovo. Transparency International (2015) ranks 168 countries around the world, using a scale from 0 (highly corrupt) to 100 (very clean). Kosovo scored 33 points on this scale and was ranked as 103rd based on the level of corruption (Denmark with the lowest level of corruption is ranked as the 1st). The perceived level of corruption in Kosovo based on Transparency International's Corruption Perception Index (CPI) is the highest amongst Western Balkan Countries.

In the context of the privatization process, however, the level of corruption was expected to be relatively low primarily due to the method of privatization used (for details see the next section). By using the highest price as the only criteria to determine the winner, the discretion of the institutions and officials involved in the process was significantly reduced. This largely eliminated the subjective assessment of bids which gave officials some discretion over the choice of the winners in privatisation bids. The role of officials in the process has been recognized as a major problem in privatization methods used in other countries. However, despite the fact that the privatization method in Kosovo left less room for corrupt behaviour, Riinvest (2009) found that businesses perceive that the process was not immune from corruption.

The obstacles to private sector development reflect the level of institutional development, primarily in relation to contract enforcement which is also ranked as a major impediment to doing business. The cost of finance, which also reflects the risks associated with a poor business environment and weak contract enforcement and investor protection, is also found to be a major obstacle to the growth of enterprises in Kosovo. Riinvest (2013) reports that the cost of finance is regarded as a serious obstacle to their growth by Kosovo businesses. Also of significant concern is the low level of credit in the Kosovo economy. According to CBK (2015), the level of domestic credit provided by the financial sector as a percentage of GDP stands at around 36 percent, significantly lower than that of countries in the region. The significantly lower level of credit to the private sector may of course be the due to a combination of factors such as high interest rates; the perceived high level of contract enforcement risk; a highly concentrated banking industry; the prudential credit policy of the banks; and an undeveloped business sector that faces difficulties in accessing the formal banking sector.

Another element of the business environment is the availability and quality of the public infrastructure in a country. Riinvest (2009; 2013; 2013a) find that Kosovo also faces significant infrastructural barriers with great impact on the companies' performance, especially in the manufacturing sector. These problems lower the competitiveness of firms through increasing their cost of production and transportation. Similarly, there are other barriers that firms face related to the quality of training and education of the labour force.

Although the institutions of a market economy in Kosovo have all been built from scratch under the guidance of the European Union and the international community, the business environment has remained poor and in need of rapid improvement. Needless to say that there has been some good progress in selected aspects of the business environment (such as macroeconomic stability and low inflation) but these have been rather exceptional.

Unfavourable business environment, apart from impeding local businesses, also discourages foreign investors. The level of FDI in Kosovo remains modest, but declining, averaging around €313 million during the last eight years (see Figure 5.1).

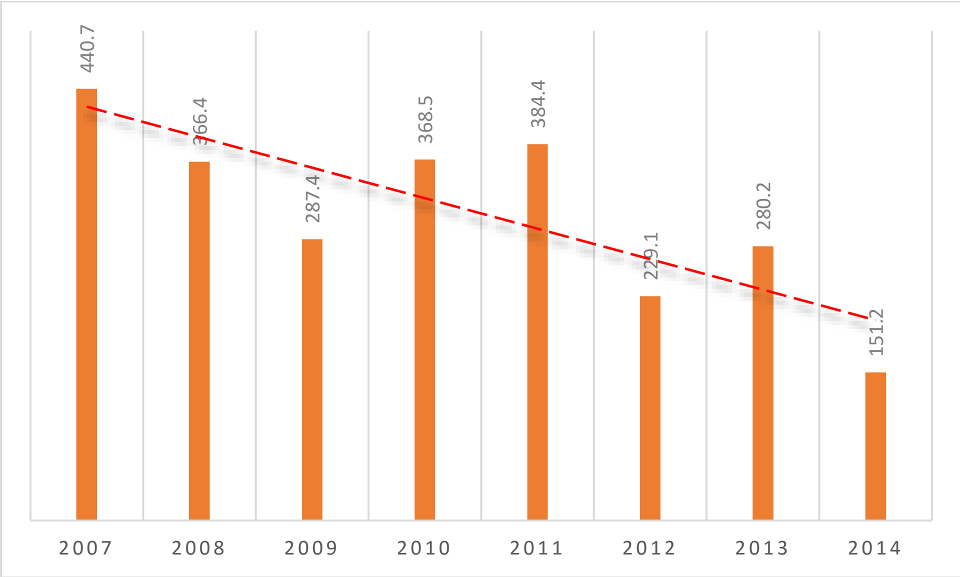


Figure 5.1. Levels of FDI in Kosovo (in million €)
Source: Author's own drawing based on data from the Central Bank of Kosovo (2015)

The process of privatization of SOEs in Kosovo showed a similar correlation with FDI as in other TEs, i.e. FDI was predominantly related to the privatization process (although in Kosovo foreign investors were not the main group of investors in the privatization process). Approximately one in eleven privatized enterprises was privatized through FDI, either partially or completely. Of course it should be noted that one in three enterprises privatized through FDI involved the Kosovo diaspora (Riinvest, 2008). During its height, the privatisation process was accompanied by the accelerated growth of the level of FDI inflow. During 2005, 2006 and 2007, when the privatization process was at its peak, there was a significant inflow of FDI, reaching its peak in 2007 (CBK, 2015). The proportion of privatization proceeds from FDI stands at around 13 percent of total revenues (AKP, 2015).

The structure of FDI in the privatization process shows that a large share (around one-fifth) of FDI went into the manufacturing sector (CBK, various years). This reflects the relative concentration of social enterprises in the industrial sector. In particular, the privatization in mining and metal processing attracted more FDI. The level of FDI started to decrease with the slowdown of the privatisation process, especially after

2007 when the biggest companies were already privatized. The origin of FDI in Kosovo, including privatization-related FDI, is mainly from the European Union member countries, but there were also investors from the United States and to a lesser extent from other countries. This also reflects the geographical spread of countries with Kosovo diaspora. However, there have also been rare investors from Asian countries (Riinvest, 2008).

The privatization method used in Kosovo did not discriminate against foreign investors and did not offer preferential treatment to insiders (which was common in other TEs). However, despite the fact that the privatization method in Kosovo created a level playing field for foreign investors, the process has attracted modest levels of FDI. This primarily reflects the conditions of the business environment of a post-war country. Moreover, as a result of the global financial crisis of 2008, the level of FDI was reduced across the region, and similar pattern was observed in Kosovo as well.

The low and falling level of FDI in Kosovo is also related to the political status of Kosovo as an independent country and the perceived political risk arising from the fact that Serbia and a number of other countries (including Russia with a veto power in the UN Security Council) have still not recognised the independence of Kosovo.

5.2 Privatization in Kosovo

Privatization process based on Act on Social Capital

The privatization process in Kosovo started in 1989 on the basis of the Act on Social Capital (the so-called Markovic Law, named after the last Prime Minister of former Yugoslavia) while Kosovo was still in the Yugoslav Federation. This method of privatization favoured insiders by offering them shares at large discounts and long payment periods.[99] Contrary to other successor states of former Yugoslavia, the number of companies that went through this process of privatization in Kosovo was very small (around 20) and the process was soon brought to a halt by the imposition of emergency measures by the Serbian Government in 1989. Moreover, in most of these companies, the process was not properly completed. While all of the 20 companies had changed their legal status from an SOE to a Joint Stock Company (which was the first step to full privatization as anticipated by the Act on Social Capital), in most cases, the shares were not distributed nor paid for by employees and managers. In the following decade, the Serbian regime privatized some of the Kosovo companies to the newly arrived Serbian employees as well as to banks and development funds in Serbia – an action which had no basis in the Yugoslav laws and were deemed illegal after the war by the UN Administration.

Privatization process after the war

After the war, SOEs were de facto operating without any proper control. UNMIK made its first attempts to re-establish controlling mechanisms similar to ones of pre-1989.[100] SOEs were supposed to regular financial reports Municipal councils. These reports were subject to Municipal councils' approval. These councils were also in entitled to exercise controlling rights in case that SOEs violated the law. The exercise of controlling rights by the Municipal councils was poor, however they still maintained some authority over SOEs (KIPRED, 2005). In early 2000, the controlling rights were soon transferred at a central level, to the newly established Department of Trade and Industry (DTI). DTI did not have the required capacities to exercise proper control over SOEs. In an attempt to re-establish the controlling mechanisms, DTI initiated a process of re-establishing the workers' councils as an instrument of resolving conflicts in SOE's. The workers' councils were supposed to fulfil their

[99] For more details on the privatization process based on Act on Social Capital, see Chapter 3, section 3.2.
[100] The legislation of pre-1989 was considered as the 'applicable law' by UNMIK.

function as they did in the pre-1989 period. However, before long it became clear that instruments that were prerequisites for efficient operation of workers' councils were dissolved. Transferring controlling rights to workers' councils, in effect, left SOEs without any legal nor administrative control. As a consequence, SOEs started to rent out their assets coupled with asset stripping by insiders. From the legal point of view, this was also a violation of applicable law as defined by UNMIK. In absence of credible threat, SOEs continued this practice without fearing sanction for using social property for other than production purpose (Riinvest Institute, 2004; KIPRED, 2005).

In the second half of 2000, UNMIK produced a proposal known as 'The White Paper'. This document projected the establishment of a privatization agency and selling the enterprises to outside investors, with a possibility for employees to participate in the process by obtaining up to 30-40 percent of shares, as a complementary method in order to satisfy trade unions. The 'White Paper' also proposed the commercialization of SOEs (leasing of SOEs for a period of 10 years). The UN legal department did not support the idea of privatization on the grounds that UNMIK did not have a mandate to embark on ownership transformation. However, commercialization process was approved. The commercialization process was an attempt to foster private sector development and prevent further asset stripping in SOEs. It also avoided the issue of ownership. A number of companies[101] were transferred to private sector investors on the basis of a 10-year lease in return for an annual fee (Riinvest Institute, 2002).[102] But the policy was controversial and its scale remained limited.

By the end of 2000, the DTI proposed a transformation of SOEs into Joint Stock Companies, based on the Act on Social Capital of 1989. This proposal anticipated that

[101] This was a very simple process and did not involve converting the company to a joint stock company as a first step for privatization – unlike other transition economies where commercialization was the initial step to full scale privatization.

[102] Only 13 companies went through the commercialization process. Between them they committed nearly DM 83 million (€42 million) in investment. Annual concession fees, which are retained in trust for the eventual owners, totalled DM 1.8 million (€920,000).

majority of shares (60-70 percent) would go to employees on preferential terms while the remaining shares would be sold to outside investors. DTI expected that this method may be acceptable to the UN legal department as it was in line with the 'applicable law'. Also, the proceeds from selling shares to outsiders could serve as a capital inflow to these companies (Riinvest Institute, 2005). However, many concerns were raised by local and international experts about this method on the grounds that it would not be effective especially in attracting outside investors. Also, it was not supported by the UN legal department on the same grounds as was the ownership transformation based on the 'White paper'.

After a prolonged debate on the need for privatization and the choice of the suitable method, which had started immediately after the war, UNMIK assumed responsibility for the privatization process by passing a law on the creation of the Kosovo Trust Agency (KTA) as well as the method of privatization in 2002. KTA became the agency responsible for the privatization of SOEs.[103] The legislation foresaw that KTA would hold and administer SOEs in trust for the benefit of the legitimate creditors and owners. Serious privatization started in 2003 under the auspices of the Kosovo Trust Agency (KTA), and continued after independence under the new Privatization Agency of Kosovo (PAK). The privatization process in Kosovo enjoyed popular support when it was initiated. As in other TEs, the process was seen as a political symbol of reform and addressing the inefficiencies of state sector. Riinvest Institute (2002) reports that 87 percent of SOEs' managers supported privatization.

The Kosovo Trust Agency inherited around 600 Socially Owned Enterprises and had to arrange for their privatization. The exact number of SOEs was not easy to determine

---

[103] This law also established that a group of companies known as 'Publicly Owned Enterprises' (POEs), which included utilities, the airport and railways, would not be privatized until later. KTA also became responsible for the reform and restructuring of these companies in order to prepare them for later privatization. After independence, the government decided that, in principle, these companies would be privatized but the actual method and a timetable for their privatization are yet to be decided. In 2010, Prishtina Airport was transferred to the private sector through a concession agreement. In 2012, Kosovo Energy Distribution and Supply company was also privatized.

because of the unclear definition of 'social ownership' and missing or destroyed official documentation (which was either destroyed during the war or removed by the Serbian government employees when they left Kosovo). While in most cases the records clearly indicated SOEs' status, in some cases it was indicated that former SOEs were partially converted to Joint Stock Company status through share sales to employees or transferred to Serbian institutions (banks and funds) during the late 1980s and early 1990s based on Act on Social Capital. For another group of companies, the records were unclear as to whether they are fully or partially socially or privately owned (KTA, 2002). SOEs employed an estimated 60,000 people, of which only about a third were active. Around 40,000 employees were inactive on unpaid leave (PAK, 2015). SOEs in Kosovo operated in variety of sectors including: agriculture; manufacturing (including manufacturing of food; textile; leather; wood; basic metals and fabricated metal products); construction; trade and retail; tourism, among others. Figure 5.1 presents SOEs' disaggregation by sector of operation.

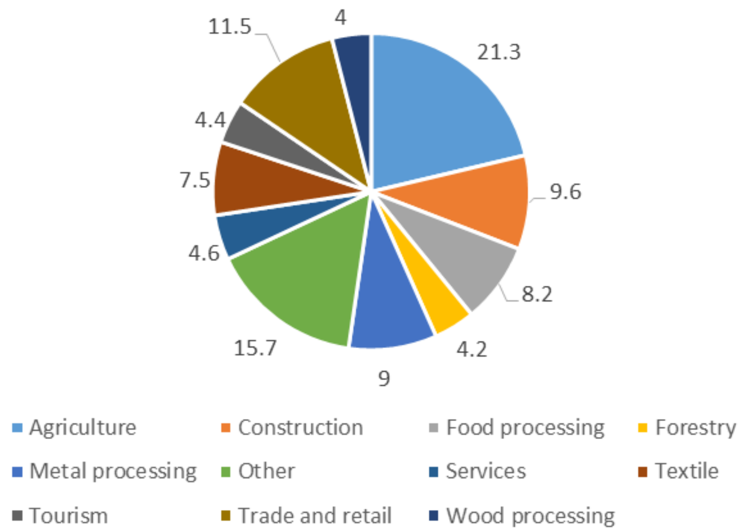


Figure 5.2. SOEs' disaggregation by sector of operation (in percent)
Source: Author's drawing based on KTA data

It is estimated that SOEs represented around 90 percent of Kosovo's industrial and mining assets, around 50 percent of commercial retail space, and less than 20 percent of agricultural land. Important technological and human assets were concentrated in these enterprises during the 1970s and 1980s but due to the events in the 1990s, the depreciation of assets and technologies, and changes in regional and international business environment, most of these enterprises were operating ineffectively and below their capacities and some ceased operations altogether (Riinvest Institute, 2008).

The sole method of privatization used in Kosovo has been "sale to the highest bidder", which was not used as the only method of privatization in any other TEs nor in the successor states of former Yugoslavia (Riinvest Institute, 2004).[104] The use of highest price as the only criterion intended to lower the discretion of implementing agency and avoid some of the problems that arise in case of other methods.

The method is also referred to as 'Spin-Off' and was designed to circumvent the problem of disputed ownership and claims against companies (coming largely from Serbia and the former Serbian employees who left Kosovo after the war) by creating a new company (known as 'NewCo') to which the assets and current liabilities (defined generally as the last three months of unpaid accounts payable and the last year of unpaid taxes) of the old company, but not its long term liabilities, were transferred and then put up for sale. Long term liabilities remained with the old SOE and were to be dealt with by the privatization proceeds which are held in an escrow account outside Kosovo. The old SOEs will be ultimately liquidated. Old employees (including Serb employees and those who had worked for the company before 1980s) have claims on the proceeds of privatisation. Also, various Serbian banks and funds had claims against the companies because of the illegal privatisations undertaken during the Emergency Measure (also explaining why they were deemed illegal by UNMIK – being discriminatory). These claims were an important barrier to privatisation until the idea of 'spin off' was put forward, together with the money being kept in an

[104] However, direct sale methods were used as primary or secondary method in different TEs (see for details, Table 1.1 in Chapter 1).

escrow account abroad until the claims were dealt with. A special Chamber of the Supreme Court was set up with international judges to look into the legitimacy of these claims. According to PAK (2015), there are 88,851 claims put forward by creditors, employees and Serbian banks and funds. While over 90 percent of these claims were reviewed by PAK, only 19 claims in total have been finally resolved.

Table 5.2 presents the process of transferring SOEs to NewCos. New owners did not have any responsibility towards current employees of the company, except in cases when companies were privatized through 'Special Spin-Off' which is next discussed.[105] An old SOE could be transferred into more than one NewCos. SOEs were large, vertically integrated, companies and the process of privatization of these companies as they were seemed impractical. Therefore, some SOEs were split up in order to expedite the privatization process. Out of around 600 SOEs, 769 NewCos were established.

Table 5.2. Spin-off process of transferring SOEs to NewCos.

SOE		NewCo
Assets		**Assets**
Land	transferred →	Land
Buildings	transferred →	Buildings
Machinery	transferred →	Machinery
Licences	transferred →	Licences (renewed)
Leases	transferred →	Leases
Liabilities		**Liabilities**
Current liabilities	transferred →	Current liabilities
Long term liabilities	not transferred	-
Employees	not transferred	-

Source: Author's own compilation

[105] KTA and later PAK also used liquidation process as a method of privatization. In effect, companies were span-off in similar fashion and were put up for sale to the highest bidder. The only difference was that companies that went through liquidation process were largely agricultural land and buildings with limited or no business activity attached to them.

In the case of a small number of large and important companies, referred to as 'Special Spin-Offs', the sale required the bidder to undertake certain employment and investment commitments. In many of these cases, the new owners did not honour their investment undertaking resulting in further negotiations with PAK and, in some cases, the reversal of privatization contract. PAK (2015) reports that on average 54 percent of investment commitments and 85 percent of employment commitments were honoured.

The privatization process in Kosovo did not discriminate between foreign and domestic owners. However, as in other TEs, in the early phases of transition, Kosovo was not an attractive destination for foreign investors. While FDI was dominated by privatization-related investment in early stage of transition, it was not the dominant type of resulting ownership. According to KTA official data, only one in eight SOEs were privatized by foreign investors, either completely or partially. However, almost one in three companies that were privatized through FDI were in fact privatized by members of the Kosovo diaspora.

To date, over 90 percent of all SOEs have been privatized. Although the process was brought to a halt twice[106], it made significant progress during 2005, 2006 and 2007, and after independence in 2009 and 2010, and was slowed downed in the later years, as the process was coming to an end. The acceleration of the privatization process coincided with improvements in exports, FDI and GDP growth rates. Privatization proceeds peaked in 2006 when they reached almost €160 million (Figure 5.1). In total,

[106] First in late 2003 and 2004 by the intervention of then Director of KTA (who was eventually removed by the Special Representative of the Secretary General of the UN for having obstructed this process), and later in 2008 in the preparation for, and the euphoria after, the independence. The suspension of the privatization process in 2003 had sent negative signals to potential investors by increasing uncertainty. In particular, provided that the suspension of the process had retroactive effects by impacting previous tenders that were published and carried out according to the rules and regulations that were in place until the suspension of the process came into effect.

privatization proceeds are over €643 million. They represent over 12 percent of Kosovo's GDP (KAS, 2015).

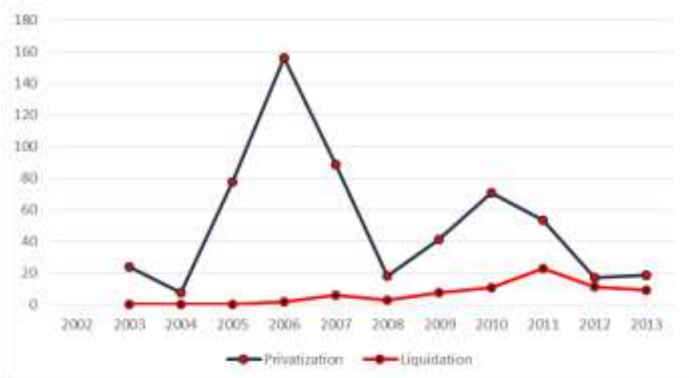


Figure 5.3. Level of privatization proceeds from privatization through spin-off and liquidation process
Source: Author based on data from KTA.

The proceeds from privatization have been kept in an escrow account, held abroad, pending the resolution of ownership claims against the privatized companies, an issue which was not resolved at the time of privatization – and has still not been resolved despite Kosovo's independence. Former employees of privatized SOEs were entitled on a priority basis to a 20 percent share of the proceeds from privatization (PAK, 2015). Employees were eligible to participate in the 20 percent share only if they were registered as an employee with the SOE at the time of privatization, and have been employed for more than three years during any period of time (Riinvest Institute, 2008). This process was coordinated with unions and has been very slow. PAK (2015) reports that only about 15 percent of the 20 percent share of proceeds has been paid out to eligible beneficiaries. The issue of social ownership was thus resolved by the proceeds being divided by the 'society' (represented by PAK) and the employees – very much in the same way as in other successor states. However, unlike the successor states, ownership of privatized firms was not transferred to interest groups close to parties in power or to the former elite.

After privatization, a considerable number of companies remained inactive. Riinvest Institute (2008) finds that the proportion of inactive companies after privatization stood at around 30 percent. However, when filtering out companies that went through the liquidation process (which were initially included in the sample), the percentage of inactive companies after privatization drops by almost two thirds to about 10 percent. Of those, the majority were in the wholesale and retail trade sector (around 43 percent), while the rest were in manufacturing sector (around 40 percent) and hotels and restaurants (around 17 percent). Further investigation of companies that were inactive after privatization was impossible due to data limitations. However, Riinvest Institute (2008) finds that in some cases, new owners treated these companies as a real estate investment and were kept inactive awaiting better market conditions for their property.

The data gathered for the purpose of the empirical investigation of the following Chapter shows that the average capacity utilization in privatized companies was around 55 percent.[107] However, over 40 percent have undertaken some form of restructuring. Companies that were privatized through special spin-off and those privatized by foreign owners were associated with faster restructuring. These data confirm the findings from a similar survey conducted in 2008 (for details see Riinvest Institute, 2008).[108] The number of employees has shrunk by an average of 45 percent while the turnover of employees is reported to be very high. The data suggests that only one in three employees in the current workforce were part of the company prior to privatization.

Despite the fact that the privatization process in Kosovo is almost completed, there has been no comprehensive empirical analysis of the privatization process. The data gathered for the purpose of the empirical investigation of the following Chapter also included a representative sample of de-novo private companies. The data suggests that impediments in the business environment have similar impact across all businesses, privatised and de-novo private. Therefore, the analysis of the impact of

[107] The survey was conducted in 2012 by Riinvest Institute for Development Research. For further details, see Chapter 6, section 6.2.2.
[108] The author has been part of the research team that produced the report in 2008.

privatization on companies' performance in Kosovo has to take into account aggregate shocks of the business environment to be able to isolate the effect of ownership transformation. The fallowing Chapter addresses this issue by using a control group and employing methods of policy evaluation econometrics.

5.3 Conclusion

This Chapter highlighted the privatization process in Kosovo. This process was distinct from that in other TEs and in successor states of former Yugoslavia, due to its economic and political specificities. As a policy, it enjoyed popular support when it was initiated. Also, as in other TEs, the process was seen as a political symbol of reform and addressing inefficiencies of state sector. While the privatization method promoted foreign investors, the results in attracting FDI were modest. However, this also mirrors the conditions of the business environment in general in Kosovo.

This Chapter also provided the context of the empirical investigation which is undertaken in the following Chapter. As mentioned earlier, even though the privatization process, there has been almost completed, there is still no empirical evidence focusing on the impact of ownership transformation on companies' performance. This gap is filled in the following Chapter by employing policy evaluation econometric techniques, a combination of matching technique with difference-in-difference estimators, which arguably best addresses the selection issue and is able to disentangle the impact of external factors and shock from the impact of privatization.

Chapter 6

Privatization in Kosovo: impact evaluation

Contents

Introduction

The main objective of this Chapter is to analyse the changes in firm performance induced by the privatization process in Kosovo. It draws upon the theoretical propositions set forth in Chapters 1 and 2 as well as upon the context of investigation presented in Chapter 5. This Chapter analyses the relationship between ownership transformation and performance of firms using policy evaluation econometrics. As discussed in greater detail in Chapter 2, the empirical literature on the topic of privatization broadly includes comparisons of performance indicators of companies before and after privatization or comparisons of the performance of privatized companies with either SOEs or de-novo private companies operating under roughly similar conditions. But if these two methods are combined, that is comparing 'before-and-after' changes in the performance of companies that went through privatization with the 'before-and-after changes' in the performance of companies that did not, the results would be significantly improved. This is because the time-varying factors are also captured by the group of companies that did not go through privatization, since both groups are assumed to have been exposed to the approximately similar environment.

The majority of papers using 'before-and-after' approach attribute the whole observed change in performance to the divestiture. In a stationary environment one would expect that this approach would yield reasonably good estimates. But in fact, the economic environment undergoes constant changes and therefore observed changes in companies' performance could be driven by changes in the operating environment rather than mere ownership transformation. This methodology is especially weak in transition economies where the privatization process is part of wider systemic reforms. Changes might be a result of other reforms such as price and trade liberalization, among others, which are typical in countries in transition. To overcome this problem, this Chapter uses de-novo private companies matched with companies gone through the privatization process in order to observe the difference in their performance as they are both subjected to similar business environment and systemic shocks.

In the context of impact evaluation, it is challenging to know what would have been the performance of companies in the absence of privatization. Isolating the effects of privatization is especially very hard in TEs where the privatization process is part of wider reforms. Therefore, in order to be able to attribute the observed differences in performance to the policy itself, additional efforts are required. The majority of studies, especially for TEs, do not account for counterfactuals (what would have happened over time to mean outcomes for companies in the absence of privatisation). In order to address this issue, we use a technique which is a combination of Propensity Score Matching (PSM) and Difference-in-Difference (DID) in order to identify the impact of privatization on performance measures. Here the privatization process is considered as 'treatment'.[109] This study compares the pre- and post-privatization performance of treated group (privatized companies) with the performance of non-treated group (de-novo private firms) during the same time period. Using PSM the latter group of companies are matched so that they can be comparable with the former (explained in details later in the Chapter). Given that we use fixed effect estimation (which are by design within unit estimator), each treated company serves as a comparison point for itself. Non-treated companies in this case serve merely to capture the aggregate shocks and changes in the environment to which both sets of companies have been exposed to. For that purpose, PSM allows us to match non-treated companies that are exposed to similar environmental conditions and have similar features with treated companies.

[109] The term 'treatment' came from the medical sciences (Cameron and Trivedi, 2005), and makes more sense when used in that context. However, in conformity with the bulk of the literature on the subject, the term is also used in this Chapter.

Using this econometric framework (matched difference in difference), changes in two performance measures, sales (measured by real sales) and the number of employees, are estimated. This Chapter uses a balanced panel firm level data from 600 de-novo private and over 133 privatized SOEs in Kosovo (over the 2005-2011 period). The Chapter contributes to the existing empirical literature in at least two ways. First there is no comprehensive analysis of the impact of ownership transformation in Kosovo's privatized SOEs. Secondly, the matched difference-in-difference technique, has not been widely used in studies on privatisation in TEs as a remedy to estimation problems that are endemic in existing literature.[110]

The remainder of this Chapter is organized as follows. Section 6.1 discusses, in general terms, the methodology used in this Chapter. Here the analytical framework and basic terminology of the policy evaluation econometrics is introduced. Section 6.2 discusses the model, the data and the modelling procedure, including the improvements in modelling to overcome diagnosed problems. Section 6.3 presents the estimated effects of ownership transformation on companies' performance (sales and employment). Section 6.4 presents some limitations of this Chapter while section 6.5 concludes with a summary of findings.

6.1 Impact evaluation

This section offers an introductory overview of quantitative methods of impact evaluation. Here the analytical framework and basic terminology of the impact evaluation econometrics, employed in the empirical part of this Chapter, is introduced. Privatization of SOEs in TEs has dominated the economic and policy agenda of these countries since its inception in early 1990s. Policies, such as privatization, are designed and carried out to achieve an objective or change an

[110] In fact, to the best of our knowledge, there is only one study (Salis, 2006) that uses matched difference-in-difference in similar context.

outcome, for instance the performance of privatized companies. The majority of countries justified this policy by the anticipated improvement in performance after ownership transformation (for details see Chapter 1). As argued in pervious Chapters, theoretical literature and empirical evidence is not conclusive about the privatization process on performance. Indeed, there are many studies that find mixed results (for details, see Chapter 2). Evaluating the impact of privatization process in TEs is especially important because of the relative size and scope of the state sector at the onset of transition in these countries. Furthermore, given the absence of a consensus on the impact of privatisation, methods of evaluation of the level and nature of the impact of privatization on privatised firms remains the main concern of researchers and policymakers.

6.1.1 The evaluation problem

Impact evaluation, in the current context, aims to identify and determine the change in the outcome of a policy measure or a 'treatment' (performance of privatized companies) that can be attributed to that policy alone (privatization). The causal relationship between the policy and the outcome under investigation is considered as the most important feature and the biggest challenge of impact evaluations (Gertler et al., 2010). Analysing the impact of a particular policy requires making inference about the outcome that would have been observed in absence of the policy (Holland, 1986). If we denote with Y_0 the outcome of the firm had it not gone through the treatment and with Y_1 the outcome of the firm had it gone through the treatment, then the impact of the policy would be:

$$\Delta = Y_1 - Y_0 \tag{6.1}$$

If these data were available, then one could conclude that the relationship between the policy and the variable under consideration is causal. Since for any firm only one of the Ys is observed (either Y_1 or Y_0), the difference or the policy impact (Δ) is not observed for any of the firms. This missing data problem is the core of the policy impact evaluation, and approaches that try to overcome this problem attempt to estimate these missing data. In the absence of such information (or the counterfactual), one might alternatively compare the outcome of units that were subject to policy with a suitable comparison group or benchmark. The choice of the comparison group therefore is very important. Generally there are two types of comparison benchmarks (surrogate counterfactuals): (1) the comparison of the outcome of companies that went through privatization with the outcome of those that did not; and (2) the comparison in outcome of companies that went through privatization 'before and after' the intervention.

Comparing companies that went through the treatment and those that did not is usually known as 'with-and-without' comparison.[111] This technique requires additional effort to ensure that the companies being compared are not systematically different from each other. If it fails to ensure this, the estimates are likely to be biased. For instance, due to selection bias in the privatization process, companies that went through the treatment might have had a better performance even before the treatment. Companies might have been selected for privatization because they would have found willing buyers more quickly and therefore were better to start the process with. Comparing this group of firms with a group that has not gone through the treatment would produce biased estimates.[112] This is because differences in performance might not be a result of the policy itself; they rather represent the underlying differences that exist between the two sets of firms.

Comparison in outcome of companies that went through privatization 'before and after' the intervention is another counterfactual. It is commonly referred to as 'before-

[111] This method is largely used in the evaluation of privatization policy. For details see Megginson (2005).

[112] In this case, if privatized companies would have had better performance regardless of the policy, the selection bias will be positive, overestimating the impact of the privatization process on performance.

and-after' comparison. It attempts to evaluate the impact of a programme by tracking changes in performance indicators over time. The counterfactual is estimated using the pre-intervention (pre-policy) outcome. It assumes that had the firm not gone through the treatment, its outcome would have been the same as the pre-intervention outcome. This simple difference method is unlikely to yield reasonable evaluation of the policy since there are many factors, apart from policy itself, which might change over time. Ignoring other factors could lead to biased estimates by falsely attributing differences in outcomes solely to the treatment. Consequently this comparison might yield under- or over-estimation of policy's impact. However, one might combine these approaches to improve the estimation process. A combination of 'with and without' with 'before and after' arguably best improves the accuracy of an evaluation study (Blundell and Costa Dias, 2000). This combined technique is described later in the Chapter and used thereafter.

There are different approaches to policy evaluation. Depending on the data used for evaluation, they broadly fall into two categories: (i) experimental and (ii) non-experimental. Before discussing these approaches, it is important to note that both assume that the impact of the policy on one unit does not affect other units, or the impact of the policy on participants does not affect non-participants (known as non-interaction assumption).[113] The non-interaction assumption is referred to as Stable Unit Treatment Value Assumption (SUTVA) (Rubin, 1978). In cases when the scope of the policy or treatment is limited, SUTVA usually holds. However, even in cases when the policy is more widespread (like in case of privatization in TEs), Imbens and Wooldridge (2009) suggest that the indirect effects of a policy on one unit are likely to

[113] The interacting effects, i.e. the effects of treated companies on non-treated companies are known as general equilibrium (or spill-over) effects.

be much smaller than the direct effects of the exposure of the unit itself. As a result, the general equilibrium effects can probably be ignored for most purposes.[114]

Experimental methods are generally viewed as the most robust evaluation approaches (Burtless, 1995; Nichols, 2007). They are usually considered as the gold standard of impact evaluation (Gertler et al., 2010). Ideal experimental data provide the best counterfactual and eliminate the evaluation problem (Blundell and Dias, 2002). They are based on constructing a comparison group that is a random subset of the population. If carried out properly, this approach constructs a control group with identical distributions of observable and unobservable characteristics to those in the treatment group (within sampling variation). The only difference is the participation in the programme that is being evaluated. Hence, the selection problem is overcome because participation is randomly determined (Bryson, Dorsett and Purdon, 2002). Given that the number of potential participants to which we apply the randomized assignment process is sufficiently large, the resulting groups of treated and non-treated units will have a high probability of being statistically identical (Gertler et al., 2010). In turn, randomized experiments have high internal and external validity.[115] In a randomized experiment isolating the effect of the treatment is straightforward. Regressing the outcome on the intercept and a treatment indicator yields unbiased estimator of average treatment effect. It also allows adding other control variables to the regression function to increase precision without jeopardising consistency since randomization implies that in large samples the treatment indicator and the covariates are independent (Imbens and Wooldridge, 2009).

[114] There is a noteworthy literature that deals with the problems arising with cases when SUTVA does not hold. This involves modelling the interactions by specifying which units interact with each other and possibly the relative magnitude of these interactions. Most of this literature treats the interactions not as nuisance; it rather deals with this problem as the primary object of interest while still many of the issues remain unresolved. For further discussion, see Smith (2000), Manski (2000), Brock and Durlauf (2000), Kling, Jeffrey and Lawrence (2007), and Graham (2008).

[115] Internal validity indicates that the estimated impact is clear of other confounding factors and that it represents the true effect of the policy. External validity on the other hand means that the estimated impact can be generalized to accurately represent the population from which the sample is drawn.

However, experimental data are usually rare in economics mainly due to ethical considerations and high costs. Allowing a particular set of units to undergo the treatment and deny it to others is often politically unfeasible as the justification of such a policy to units that are left out is difficult (Khandker, Koolwal and Samad, 2010). As a result, most of the research in the evaluation literature is based on observational data (nonrandomized experiments). Studies based on observational data try to mimic the natural experiment as much as possible. In the absence of a controlled randomised experiment, the primary task therefore is to use estimation to create the counterfactual or control units under most reasonable conditions. These methods among others include: instrumental variable (IV) estimators, two-step Heckman selection estimators, propensity score matching estimators and difference in difference estimators. The appropriate methodology for non-experimental data largely depends on the information available to the researcher. Panel data or repeated cross sections support less restrictive estimators because they draw from both cross-sectional and time dimension. In any case, there is a clear trade-off between the available information and the restrictions needed to guarantee a reliable estimator.

Blundell and Dias (2009) suggest the use of IV estimators and two-step Heckman selection estimators when only a single cross-sectional data are available. Similarly, propensity score matching can be used in both cases when cross-sectional and panel data are available. If one has access to baseline data, then the use of difference in difference provides more robust estimates of the impact of the policy. Finally, a combination of the last two methods (i.e. propensity score matching with difference in difference) is expected to improve the quality of non-experimental evaluation significantly (Blundell and Dias, 2000; Imbens and Wooldridge, 2009; Khandker, Koolwal and Samad, 2010). Since the data used in this Chapter are longitudinal (with information on both treated and non-treated), the use of a combined method is decided as the preferred empirical strategy. The following subsections discuss the propensity score matching, difference in difference and the combined method. Here the necessary conditions of these techniques for reliable estimation of policy evaluation are also discussed.

6.1.2 Propensity score matching

The following section describes the propensity score matching methodology. Matching can be applied in almost any policy evaluation context as long as there is a group of treated units and a group of non-treated units that can serve as a suitable benchmark. It relies on observed characteristics to construct a comparison group, hence relying on the strong assumption of no unobserved differences among the two groups. Because of this strong assumption, matching methods are more reliable when combined with other policy evaluation techniques (primarily with difference-in-difference estimators). Finding an appropriate match from non-treated group for each unit that went through the treatment requires approximating characteristics or determinants as closely as possible between the two groups of units. As the list of characteristics or the dimensions against which one wants to find the match increases, the likelihood of finding a match diminishes. This is commonly referred to as the 'curse of dimensionality' and its effect increases exponentially with the increase in dimensions. The curse of dimensionality is present in any dataset with high dimensionality (many characteristics). As the number of characteristics increases, the data are scattered far apart from each other. Thus the number of matched data points available can be very small which can yield erroneous estimates because sample selection bias may be introduced. For instance, if one tries to find a match of non-participants based on two characteristics, say, sector of operation and size of the company, it is likely that many matches can be found from the pool of the comparison group. However, if the vector of characteristics, for which one tries to find matches, increases to include, say, location of operation, export activity, then the chances of finding an exact match diminishes significantly. Table 6.1 illustrates the problem. It contains two groups of seven firms (treated and non-treated) with data on four characteristics (location, export, sector and size). It attempts to find a match for each of the treated firms in the comparison group based on the four characteristics. As shown in the table, it is clear that there is no exact match for four of the treated firms and only three of them could be matched against the comparison group (the rows with same colour shading represent the exact match between the treated and the comparison groups). If number of known characteristics of the treated group were higher, the chance of finding exact match for them would diminish. In cases of high dimensional data, fewer companies can be matched. Therefore, in the absence of enough matched observations, it is hard to get good estimates. However, if the number of units in the comparison groups is large, then it would be more likely to find matches. Matching requires abundant high quality data (Blundell and Dias, 2002).

Table 6.1. Matching on different characteristics

Treatment group				Comparison group			
Location (1–large city; 0–other)	Export (range from 1–5)	Sector (NACE)	Size (Small – S; Medium – M; Large – L)	Location (1–large city; 0–other)	Export (range from 1–5)	Sector (NACE)	Size (Small – S; Medium – M; Large – L)
1	3	B	L	1	2	H	L
0	2	C	M	0	1	L	S
0	5	D	L	0	4	F	M
0	1	D	S	0	3	N	M
1	4	D	M	0	5	D	L
1	2	H	L	0	1	E	S
0	1	L	S	0	1	L	S

Source: Author's own compilation
Note: the same colour shading of cells represents the exact match between units in the treated group and units in the comparison group.

The curse of dimensionality can be avoided by using propensity score matching (PSM) proposed by Rosenbaum and Rubin (1983). A propensity score is a conditional probability of participation in a treatment. This approach does not try to match two groups of units with exactly the same values for all observable control characteristics. Instead, for each participating and non-participating unit it estimates a probability that a unit will participate in a treatment. For companies that, for whatever reason, have not participated in a treatment, a propensity score provides a measure of how likely they were to have participated, had they been eligible for the programme based on the characteristics of those who were selected to participate (Wilde and Hollister, 2007). In this way, non-participants and participants with similar characteristics, summarized by their propensity scores, can be matched. The non-participants with similar propensity scores to participants are the comparison group.

The probability estimation, the so-called propensity score, is based on the observed control characteristics. In effect, propensity scores primarily simplify matching by reducing the dimensionality of the matching problem and summarizing the pre-treatment characteristics of units in each groups to a single variable. Consequently, if each unit undergoing the treatment can be matched with a unit with the same matching variables (score) that has not undergone the treatment, then the impact of the treatment on that unit can be measured (Blundell and Dias, 2002).

PSM is based on two assumptions (i) the conditional independence assumption, and (ii) the assumption of common support. The conditional independence assumption, also called un-confoundedness, implies that the selection into the programme (or the take-up of the programme) is based on observed characteristics (Rosenbaum and Rubin, 1983; Imbens and Wooldridge, 2009). If the selection criteria of the programme are not straightforward or if it allows for self-selection[116], then selection bias is

[116] The self-selection problem is not present in our case as the decision to select for treatment is external to the firm and not in its control.

introduced in the estimates. The un-confoundedness assumption cannot be tested. If unobserved characteristics determine the selection, PSM is not the appropriate method. If unobserved characteristics affect both participation and outcome, this situation yields what is called a 'hidden bias' (Rosenbaum, 2002). However, when combined with other techniques, the hidden bias problem is largely alleviated.[117]

The second assumption, the common support or overlap condition, maintains that treated companies have comparison observations 'nearby' in the propensity score distribution (Heckman et al., 1999; Blundell and Dias, 2002). In order for PSM to ensure valid estimates, all treated companies have to be matched successfully with non-treated companies. The biggest concern in applying matching method is the lack of common support (Imbens and Wooldridge, 2009). Finding a substantial region of common support requires a large set of data. Treated companies therefore are required to be similar to non-treated companies in terms of observed characteristics. Some of the non-treated companies may have to be dropped to ensure comparability (Khandker, Koolwal and Samad, 2010 p. 56). In the absence of sufficient similar comparison companies, a non-random sub-sample of treated companies may have to be dropped (Ravallion, 2008). This situation might introduce a sampling bias in the treatment effect. Heckman et al. (1997) suggest dropping treatment observations with weak common support. Inferences on causality can only be made in the area of common support. In case of lack of common support or lack of overlap, the inference on causality becomes more and more difficult. Figure 6.1 presents two examples of the distribution of propensity score for non-treated (red dotted line) and treated units (black dotted line), with the common support being good in panel (a) and weak in panel (b). If the balancing property is satisfied, then the companies with the same propensity score must have the same distribution of observable characteristics independently of treatment status (Becker and Ichino, 2002). In other words firms that

[117] In our case, the self-selection problem is further alleviated as the sample of treated companies is a representative random draw of almost the entire population of privatized companies.

have similar propensity scores, are at least observationally similar. Propensity score can be estimated by any probability model. In many cases, PSM is used as a sole approach in policy evaluation.[118]

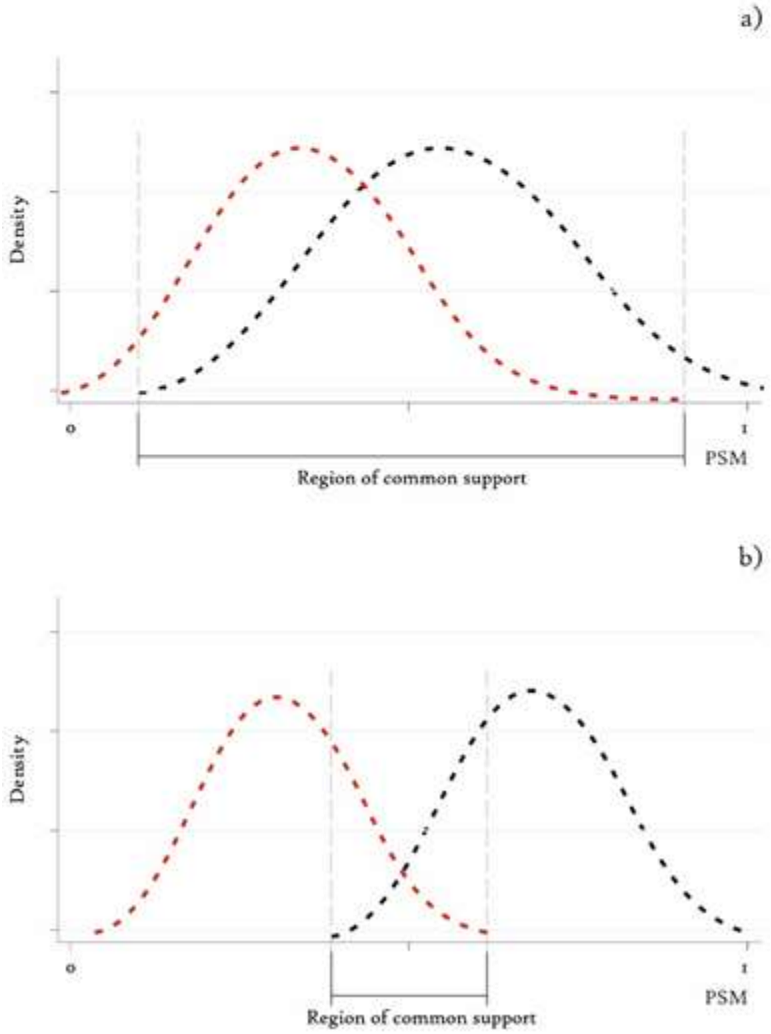


Figure 6.1. Region of common support. Examples of (a) good balancing and sufficient common support and (b) poor balancing and weak common support
Source: Author's own drawing based on multiple sources

On the basis of the propensity score, different matching algorithms are used to match two groups of units. They include nearest neighbour matching, calliper and radius matching, stratification and interval matching as well as kernel matching and local liner matching. Since the analysis of this Chapter does not use the propensity score as

[118] Rosenbaum and Rubin (1983) refer to the combination of these two assumptions (unconfoundness and overlap) as strong ignorability.

a sole estimation strategy for evaluating the effect of privatization, we will only briefly explain these approaches in this section.[119]

Nearest neighbour matching finds the closes match for a control unit based on propensity score. Two options of nearest neighbour matching are used in the literature, namely with or without replacement. In the former case, non-treated unit can be used more than once as a match, whereas in the latter case it is considered only once (Caliendo and Kopeinig, 2005). In cases when the propensity score distribution between the two groups is highly different, allowing replacements might improve the matching. For instance, if there are a large number of treated units with high propensity score but only few comparison units with high propensity score, then using without replacement matching might result in inadequate match; that is high propensity score units might get matched with low propensity score units. This can be overcome by allowing replacement which in turn reduces the number of distinct comparison units used to construct the counterfactual outcome (Smith and Todd, 2005).

The nearest neighbour matching might result in fairly poor matches if the closest neighbour is far away. *Caliper matching* tries to offer a solution to this problem. By imposing a tolerance level on the maximum propensity score distance (or the caliper), these poor matches can be avoided. The use of caliper involves matching with replacement but allowing only for those matches that fall within the pre-specified propensity range. A possible drawback of this method is that the specification of the appropriate tolerance level is difficult (Smith and Todd, 2005). A different type of caliper matching is suggested by Dehejia and Wahba (2002) known as *radius matching*. The basic idea of this type of matching is that it uses not only the nearest neighbour within each caliper but it uses all of the comparison units within the caliper. This approach improves the matching by using as many comparison units as are available

[119] See Imbens (2004) or Smith and Todd (2005) for more technical details.

within the caliper by allowing the use of fewer units when good matches are not available and additional units when good matches are available.

Stratification matching divides the range of variation of the propensity score into several intervals (strata), and ensures that within each interval the average propensity score of treated and control group do not differ. This method is also known as *interval matching*, *blocking and sub-classification* (Rosenbaum and Rubin, 1983). The appropriate number of strata to be used in empirical research is important to minimize the bias associated will all covariates used for matching. Imbens (2004) notes that the use of five strata is usually sufficient to eliminate 95 percent of bias associated with all covariates. Justifying the choice of the number of strata can be done by checking the balancing property of the propensity score within each stratum (Aakvik, 2001; Caliendo and Kopeinig, 2005). If the balancing property within each interval is not satisfied, then strata are too large and need to be split. In stratification matching, some treated units may be discarded since there may be no matching non-treated units in respective blocks (i.e. they fall outside the common support region).[120] In cases when the number of disregarded units is relatively small, this does not pose any problem in estimation (Bryson, Dorsett and Purdon, 2002). If the number of disregarded treated units is large, then concerns are raised whether the estimated effect of the remaining units can be viewed as representative since sample selection bias might be introduced. This method is used in our case given that it allows us to test the common support assumption (see Section 6.2.3.1 for details).

Other non-parametric approaches include *kernel* and *local linear matching*. The basic idea of these approaches is to use the weighted average of non-participants to construct a counterfactual match for each participating unit. Thus, one major advantage of these approaches is the lower the variance which is achieved because

[120] Note that the treatment effect for units outside the common support cannot be estimated.

more information is used. A drawback of these methods is that observations that are bad matches can be possibly used.

6.1.3 Difference in difference

This section explains the basic idea behind the 'difference in difference' (DID) method. Since the work by Ashenfelter (1978) and Ashenfelter and Card (1985), DID has become a widespread approach in policy evaluation while it is extensively used to assess the effect of various policies.[121] DID is also used in analysing the effects of the privatization policy in regulated sectors- for instance, Gonzalez-Eiras and Rossi (2007) focus on the electricity and health sectors; and Galiani, Gertler and Schargrodsky, (2005) on water supply services.

DID or the 'natural experiment approach' compares the changes in outcome over time of the group of treated companies and the comparison units. This approach typically considers the policy itself as an experiment (or treatment) and attempts to find a suitable comparison group that can mimic the properties of the control group from an experimental approach (Blundell and Dias, 2000). In the standard case, outcomes are observed for two groups for two time periods denoted $T \in \{0,1\}$. Period zero represents the pre-treatment phase while period one represents the post-treatment phase. The treated group is exposed to a treatment in period one. The comparison group is not exposed to the treatment during this period. Assume that Ap (Anp) is the outcome of participants (non-participants) after the intervention and Bp (Bnp) is the outcome of participants (non-participants) before the intervention, the first difference

[121] In other fields, the use of approaches akin to difference in difference can be traced even further back in time (for details see Lechner, 2011). DID is used to estimate the effects of Active Labour Market Programmes (see for instance: Ashenfelter, 1978, Ashenfelter and Card, 1985, Heckman and Hotz, 1989, Heckman, Ichimura and Todd, 1998, Blundell, Meghir, Costa Dias, and van Reenen, 2004), the effect of minimum wage on employment (e.g. Card and Krueger, 1994), the effect of immigration on the local labour market (e.g. Card, 1990), or the analysis of labour supply (e.g. Blundell, Duncan, and Meghir, 1998).

Ap–Bp (Anp–Bnp) represents the before-and-after comparison for the treatment (non-treatment) group. The expression (Bp–Ap)–(Bnp–Anp) therefore expresses the difference in difference measure when stripped from other explanatory variables besides the treatment indicator. Therefore, the expression (Bp–Ap)–(Bnp–Anp) differences out the aggregate shocks to which both groups have been exposed to and isolates the effect of treatment. Table 6.2 summarises this discussion.

Table 6.2. Difference in Difference approach

	Before	After	Difference
Participants	B_p	A_p	$A_p – B_p$
Non-participants	B_{np}	A_{np}	$A_{np} – B_{np}$
Difference in difference	**(DID)**		DID=($A_p – B_p$)–($A_{np} – B_{np}$)

Source: Author's own compilation

The difference in difference approach requires repeated observations of the units under consideration. The availability of 'before and after' data, for both groups of units, is the makes this approach superior to other approaches that rely only on single cross-section of data. The DID assumes that other factors, such as changes in economic conditions, affect both groups of units similarly. It allows to difference out the unobserved heterogeneity which is assumed to be constant over time. In the current context, the DID compares the change in performance indicators (employment and sales) of companies that went through privatization and uses the non-treated companies to eliminate the effect of other factors and isolate the causal impact of the policy alone. This method distils the impact of privatization on firm performance from simultaneously occurring external dynamics that affect all firms, such as deregulation as well as price and trade liberalization.

The treatment and comparison group do not necessarily need to have the same pre-intervention conditions. In an ideal setting (as in experimental methods), finding a suitable control group would mean finding a group of companies that are the same as the treated companies in every aspect apart from the treatment. As indicated, DID relaxes this assumption and instead merely assumes that the trend of treated and non-treated companies is similar over time. The difference in difference method is depicted graphically in Figure 6.2.

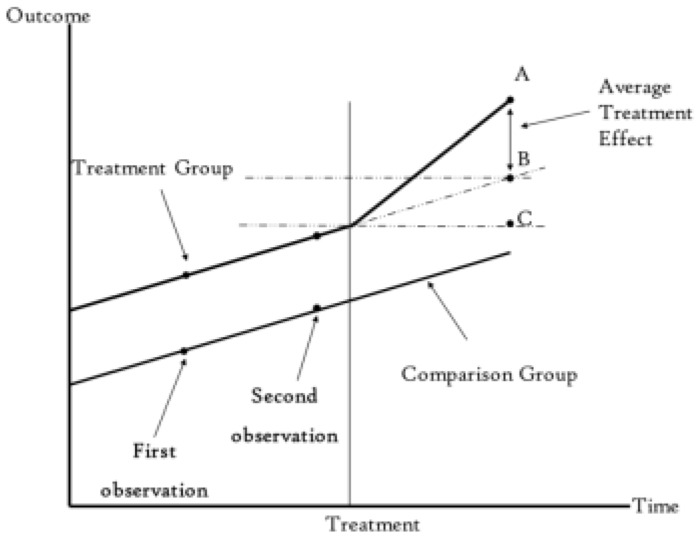


Figure 6.2. Graphical presentation of the difference in difference method.
Source: Author's own drawing based on multiple sources

A treatment group undergoes the treatment while the comparison group does not. In the absence of a comparison group, the distance A-C would have been seen as the treatment effect. That estimate would be based on the assumption that the difference in outcome is completely attributable to the treatment. Assuming that the trend of the two groups of companies is similar, the treatment effect is reduced to A-B because the distance B-C, which is attributable to other factors affecting both groups, is differenced out by the comparison group.

In a simple panel regression setting, the difference in difference model can be expressed as follows:

$$Y_{it} = \beta_0 + \delta D_{it} + \beta X_{it} + v_{it} \tag{6.2}$$

Where Y denotes the variable of interest, D denotes treatment, X denotes control variables, i denotes units and t denotes time periods. The coefficient δ is the treatment effect and β represents the effects of other control variables; v_{it} is a composite error term which can be decomposed into two components: (i) the unobserved firm effect or the firm fixed effect, and (ii) idiosyncratic or time-varying error term.

$$v_{it} = a_i + u_{it} \tag{6.3}$$

The cross-sectional unit-specific error, a_i, does not change over time and the idiosyncratic error u_{it}, varies over the cross-sectional units and time (Wooldridge, 2002). The motivation and benefits of decomposing the error terms into two parts are that if one could eliminate some part of the error term using panel data, one would be better off in terms of minimizing concerns for omitted variable bias caused by unmeasured unit-specific factors. The following equation expresses the incorporation of Equation (6.3) into Equation (6.2):

$$Y_{it} = \beta_0 + \delta D_{it} + \beta X_{it} + a_i + u_{it} \tag{6.4}$$

The resulting generalized equation can be easily extended to include other controls (or extended to accommodate multiple periods) (Angrist and Pischke, 2008). This is particularly important for a model that controls not only for the unobserved time-invariant heterogeneity, but also for heterogeneity in observed characteristics over a multiple-period setting (Khandker, Koolwal and Samad, 2010). This framework can be estimated using panel fixed-effects model. Consistent estimation is possible even with endogenous regressors X_{it}, provided that they are correlated only with the time-invariant component of the error term (Cameron and Trivedi, 2009). The panel data technique offer another powerful way to tackle issues related to omitted variable bias. It ensures that factors that are assumed to remain constant over time but are unobserved will not bias the estimated impact.

6.1.4 Matched difference in difference

As discussed in greater details in Chapter 2, simply comparing the 'before and after' change in output measures of units that went through privatization, does not indicate the causal impact of the privatization process. This is because many other factors, which are also likely to impact the output measures, also change over time. In other words, while the companies' specific differences are captured, the outside time-varying factors are not captured. Similarly, comparing the units that went through privatization with those that did not, might be tainted with bias if the two groups are systematically different and if no attempt is made to deal with such systematic differences.

However, the results would be improved if these two methods are combined with one another; that is if the before-and-after output changes of companies that went through privatization are compared with the before-and-after output changes of companies that did not. This is because the time-varying factors are captured by the latter group of companies since both groups are assumed to have been exposed to the roughly similar environment and changes in the environment. Non-participants in this case are used to difference out these outside effects, hence eliminating a great source of bias arising by simply calculating 'before and after' difference. Such DID estimators are capable of cancelling out company-level effects that are time-invariant between treated and non-treated companies. However, DID is not capable of addressing the issue of potential baseline imbalances between treated and non-treated companies in cases when there are large differences among two groups. If such imbalances are present, the results will be highly sensitive to model specifications and may in fact reflect findings that are not supported by the data.

In order to avoid such imbalances, PSM method is used to match companies of both groups as closely as possible. Actually, PSM is used extensively in its own right as an estimation strategy to determine the average treatment effect on the treated. However, the PSM estimator is criticized on the grounds of its strong assumption that the selection is based only on observable factors. Therefore, a combination of PSM with DID methods (which allows for some selection based on unobservable factors) is expected to significantly increase the quality of non-experimental evaluation results

(Blundell and Dias, 2000; Smith and Todd, 2005). Given that the data permits the use of combined methods, this method is chosen as the preferred empirical strategy in this chapter.

6.2 Empirical considerations

Estimating the effect of privatization on sales and employment of companies whose ownership has been transferred from social to private ownership, requires making an inference about the performance that would have been observed had the privatization process not been implemented. Since this cannot be observed in the absence of privatization, the establishment of the causal effect becomes a problem of inference with missing data. In this regard, the combined matched DID estimators are used to estimate the missing counterfactual. In the rest of this section the theoretical basis of the model, the data and the models and estimation procedures are discussed separately.

6.2.1 Discussion of the model

As argued in Chapters 1 and 2, companies under private ownership are expected to display improvements in performance, in particular in more competitive markets. From an empirical point of view, there are broadly two approaches to analysing the effects of ownership transformation. The first approach, and by far more frequently used, is to compare performance indicators of companies under different ownership. The second approach, employing longitudinal data, is to compare 'before and after' performance measures. This Chapter follows a broader literature on the impact of ownership transformation on companies' performance, while attempting to remedy some of the econometric problems that are endemic in this field. Given that many studies did not adopt an appropriate technique to account for selection bias, a large part of evidence could be left out of discussion since their results on the causal effect of privatization on firm performance are likely to be biased (Hagemejer, Tyrowicz and Svejnar, 2014). However, the heterogeneity in the direction of results varies for different indicators. For instance, even after controlling for selection bias, the results on the causal relationship between privatization and sales, more often than not, are found to be positive.[122] On the other hand, the results of the impact of privatization on employment are more diverging. Studies examining this relationship systemically provide inconclusive evidence ranging from negative to positive effects.[123]

Unlike most previous studies, the analysis in this Chapter uses a large representative sample of companies with observations over a seven year period. Moreover, the sample used here contains companies that did not undergo through a privatization process hence providing a good benchmark to isolate the effect of aggregate shocks. Also, controlling for selection bias is the main challenge in evaluating the effect of privatization. In the context of policy evaluation econometrics, several approaches are used to deal with selection bias problem, including instrumental variable approach, propensity score matching or the difference in difference. While all have their relative merits, a combination of matching technique with difference in difference arguably improves the estimation accuracy (Blundell and Costa Dias, 2000; Smith and Todd, 2005).

The estimations in this Chapter are based on this approach. This combined technique can capture the effect of ownership transformation on performance indicators (sales and employment) while differencing out the effect of aggregate shocks and the impact of other factors. DID estimator alone has the advantage of stripping the observable and unobserved time-invariant firm-level effects between treated and non-treated companies. Using fixed effect estimator (which is itself a within-unit estimator), DID can rule out all time-invariant company-level factors as sources of omitted variable bias. In effect, each company serves as its own control group. However, DID does not

[122] See for details Chapter 2.

[123] See Chapter 2 for details. Studies that control for foreign ownership report that privatized firms, particularly those with foreign owners, tend to increase or at least not reduce employment relative to firms with state ownership.

address the issue of potential baseline imbalances between treated and non-treated groups. If the companies used as comparison benchmark to cancel out the effect of aggregate shocks are systematically different, the results may be biased. In order to overcome this issue, the PSM is used to match companies of two groups hence increasing the precision of estimates. As discussed in Chapter 5, the privatization process in Kosovo is almost over with less than 10 percent of companies remaining to be privatized. Therefore the problem of selection bias is alleviated further given that we use a random representative sample of privatized companies and a random representative sample of non-privatized companies.

6.2.2 Data

The source of data is a survey of 133 privatized companies and 600 de-novo private companies in Kosovo. The survey was conducted in 2012 by Riinvest Institute for Development Research.[124] In this survey a stratified random representative sampling method was used which ensures the external validity of the estimates. Three levels of stratification were used: industry, company size and location.[125] The same survey questionnaire was administered to both groups of companies in order to allow for comparison. Additional specific questions were asked from privatized companies. The data was gathered via face-to-face interviews with key people in firms – owners or managers – who were well-informed about the developments in the firm and authorized to provide the information. Interviews were conducted by a team of trained interviewers. All questionnaires went under logical check in order to identify any inconsistencies in the completed questionnaires. In cases when inconsistencies were identified, the respondents were contacted again. Around 10 percent of them

[124] The author is a Senior Researcher at the Institute and was responsible for the design of the questionnaire and the survey process.

[125] The stratification by sector, size and region was made according to their share in the population. For the purpose of sector stratification, in absence of detailed information, only three categories were used: manufacturing, services and other sectors. For the purpose of size classification, three categories were used: small, medium and large. And finally, for the purpose of regional stratification, five regions were used: Prishtina, Mitrovica, Peja, Prizren and Gjilan.

were controlled on site. More than 50 percent of surveyed companies were contacted by phone to check that interviewers had visited them and collected the required data properly. In addition to the base sample, a separate sample of 133 privatized companies and 600 de-novo private companies were selected for eventual replacement of enterprises which were missing or could not be found from the base sample during the interviewing process. The selection of reserve sample followed the same criteria as the base sample and the replacement of companies was made pursuant to the same characteristics. Once the data was collected, it was entered and coded using MS Excel in spreadsheets prepared with the data fields and pop-up tables indicating relevant codes. After entry, two individuals, one using the questionnaire and one the spreadsheet, read aloud to one another to confirm the correctness of the responses.

In the case of privatized companies, the sample was selected from the data on the electronic registry provided by the Privatization Agency of Kosovo (PAK). However, the sample was selected only from the list of firms that were privatized before 2011, in order to allow for at least one year of operation under private ownership.[126] This period is considered as a reasonable time period for new owners to take over and start full-scale operation. The sample of 133 companies were selected out of a total 525 companies on the list. The sample size was calculated using the standard sample size calculator. The current sample size ensures valid results at a confidence level of 95 percent and a confidence interval of 7. The sample was randomly selected from the electronic registry stratified by sector, size and region. During the survey process, 32 firms had to be replaced with companies with similar characteristics. These firm had been liquidated or stopped their operation and therefore had to be replaced. In three cases the respondents were not willingness to participate in the survey.

[126] As indicated in Chapter 5, by 2011, more than 90 percent of companies had been privatized.

In the case of de-novo private companies, the sample was based on the electronic registry of Kosovo Tax Administration. The sample consists of 600 de-novo private companies. This sample size ensures valid results at confidence level of 95% and a confidence interval of 4. Again, the sample was randomly selected from the electronic registry stratified for industry, size and region.

Respondents were asked to provide historical data (from 2006 until 2011) on several variables including sales, number of employees, capacity utilisation and investment. Some questions required a numerical response while for others the response was a range to be selected from a list provided. The list of variables that were extracted for the purpose of this analysis is presented in Table 6.3. The percentage of missing data was very low (below 10 percent) for variables of interest (see Table 6.4).However, the data for capacity utilisation and investment had high level of missing observations especially for pre-privatization periods as the information on these categories were not part of the information provided in the privatization information package.[127] Therefore they were discarded altogether from the analysis. Other control variables are qualitative responses which were converted into binary variables.

[127] The privatization information package was provided for potential investors by PAK for each company before it was privatised . It contained facts and figures about the company and its performance indicators such the number of employees; level of sales and detailed description of assets and was . The last sentence is repetition.

Table 6.3. Description of variable

Name of the variable	Description
Dependent variable/s	
Sales*	Level of annual sales (sales figures were deflated; year 2000 was used as the base year)
Employment*	Total number of employees
Independent variables	
Treatment	Takes the value of 1 if a company has gone through privatization and 0 otherwise (i.e. 1 if treated and 0 otherwise)
PostTreatment	Takes the value of 1 in the year that the company is privatized and the following years, and 0 otherwise
Urban	1 if company operates in areas with more than 50,000 inhabitants and 0 otherwise
Age of the company*	Current year minus the year of establishment
Foreign/Domestic	1 if company has over 10 percent of foreign ownership and 0 otherwise
Manufacturing	1 if the company operates in manufacturing sector and 0 otherwise
Services	1 if the company operates in service sector and 0 otherwise
Other Sectors	1 if the company operates in other sectors and 0 otherwise (base category)

Special Spin-off	1 if the company has been privatised through special spin-off arrangement and 0 otherwise
Export dummy	1 if firm is engaged in export activities and 0 otherwise
p_treat_Man	Interaction term between PostTreatment and Manufacturing
p_treat_Serv	Interaction term between PostTreatment and Services
p_treat_Urban	Interaction term between PostTreatment and Urban
p_treat_Export	Interaction term between PostTreatment and Export
p_treat_Foreign	Interaction term between PostTreatment and Foreign
p_treat_SpecialSO	Interaction term between PostTreatment and Special Spin-off

* Continuous variables
Source: Author's own compilation

The summary statistics for all variables are provided in Table 6.4. For binary variables, the most important summary statistic is the fractions of the responses taking values 1 and 0. Most of our responses in the binary variables have sufficient variation, which is important for producing efficient results.

Table 6.4. Summary statistics

Variable	Observations	Fraction		Mean	Std. Dev.	Min	Max
		1	0				
Sales	5131	-	-	74,200.62	14,832,000.00	7,200	65,000,000
Employment	5131	-	-	25.38	68.30	1	855
Treatment	5131	18.14%	81.86%	0.13	0.34	0	1
PostTreatment	5131	12.53%	87.47%	0.19	0.39	0	1
Urban	5131	77.76%	22.24%	0.24	0.43	0	1
Age of the company	5109	-	-	14.57	7.51	4	58
Foreign/Domestic	5131	9.01%	90.99%	0.09	0.29	0	1
Manufacturing	5131	25.58%	74.42%	0.44	0.50	0	1

Services	5131	30.23%	69.77%	0.30	0.46	0	1
Other sectors	5131	44.19%	55.81%	0.26	0.44	0	1
Special Spin-off	5131	4.94%	95.06%	0.05	0.22	0	1
Export dummy	5131	20.20%	79.80%	0.20	0.40	0	1

Source: Author's own compilation based on STATA output

Summary statistics show that companies' annual sales range from just over 7,200 Euros to 65 million Euros. Companies in the sample are dominated by small firms (with an average of 25 employees) though the maximum number of employees reaches 855. Around 26 percent of observations are from the manufacturing sector; 30 from the service sector and the remaining are from other sectors. Around 9 percent of companies have at least 10 percent of foreign ownership. Around 22 percent of companies in the sample operate in areas with more than 50,000 inhabitants. Around 5 percent of companies were privatised through special spin-off arrangement. Around 18 percent of companies in the sample are privatised (treated) while the remaining are de-novo private companies. For almost 13 percent of firms, post-privatization data are observed. The discrepancy between treated and post-treatment data arise from the fact that companies were not all privatized at once. Therefore for some of them more post-privatization data are available.

The data used in this Chapter have several advantages. First, the same set of question (same questionnaire) was used for both groups of firms (treatment group and comparison group); and second, both groups operate in the same market environment (including the same accounting standards), hence the macro effects are expected to affect the behaviour of both groups similarly.[128] Also, since the data have a longitudinal dimension, one can make inference using the additional information provided by the time dimension. Having access to a panel data-set gives additional flexibility during the modelling process and less restrictive assumptions need to be made. Panel data enables us to control for time-invariant unobservable company-specific characteristics that affect performance (Wooldridge, 2002).

Difference-in-difference estimators are based on the assumption that the underlying 'trends' in the outcome variable of both treated and non-treated companies is similar.

[128] For a discussion of the potential issues arising in absence of these advantages, see Heckman et al., 1997 and Blundell and Dias, 2000.

This assumption is regularly referred to as Common Trend Assumption. This assumption cannot be tested with any formal testing procedure. Moreover, in cases when there are only two data points for each company, it is impossible to determine whether this assumption is even plausible. However, in cases when there are more than two data points for each company, one can get some idea if this assumption is in fact reasonable. To do so, a graphical presentation of the outcome variables of the two groups can serve as an indicator to see if these variables over time follow parallel trends. Given that the set of data used here has significant depth, it is possible to construct a graph which shows whether the outcome variable of treated and non-treated companies follow parallel trend. Moreover, most of the privatized companies have at least two data points before the privatization. As Figure 6.3 shows, the trend followed by both sets of companies is fairly similar. Part a) of Figure 6.3 presents the trend of log values of real sales levels while part b) shows the trend of log values of employment. Even though the there is a difference among groups, this difference is mainly systematic across years (formally that is what the common trend assumption means, that the difference between groups is constant over time). This property is sufficient for cancelling out aggregate fluctuations.

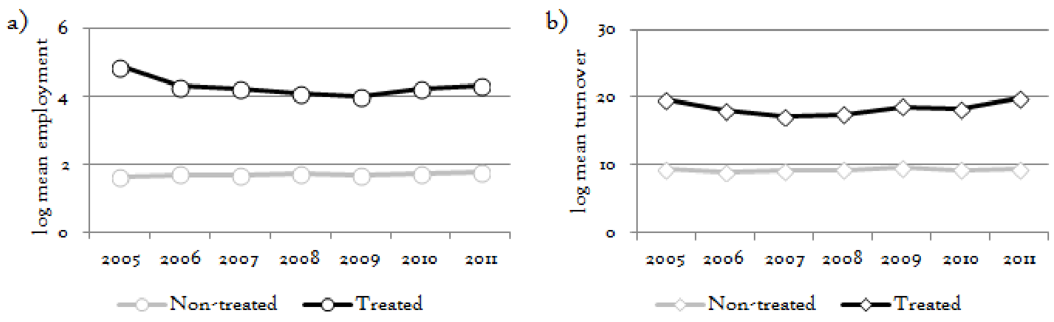


Figure 6.3. Trend of employment and sales figures between treated and non-treated groups
Source: Author's own compilation

6.2.3 Models and estimation procedure

The estimation process of matched difference in difference is run in two stages and the sequence of analysis is as follows. Initially, a propensity score algorithm is run in order to construct a matched sample of firms based on observable characteristics. As argued earlier in the Chapter, the validity of the impact evaluation relies on finding a good comparison group. Therefore, propensity score matching is used to find a valid control group which will correct the difference in difference estimates. The following subsections, describe the estimation procedure of the Matching model and the Difference in Difference estimation.

6.2.3.1 Matching model

Using the propensity score matching approach proposed by Rosenbaum and Rubin (1983), the intention is to extract a sub-sample of non-privatized companies in which the distribution of covariates was similar to that in the sample of privatized companies.[129] The first step was to estimate the conditional probability that companies from both samples have gone through privatization process during the study period given the vector of observed covariates. The conditional probability, i.e. the propensity score, is defined as the probability that a company in the sample is privatized, given a set of observed variables. In case of our control group it is defined as the conditional probability to go through privatization had they been eligible.[130]

[129] It is, however, possible that in cases where there are no matches for a particular privatized company, it is dropped from the sample.

[130] The control group in our case is the group of de-novo private companies that were not eligible to undergo privatization; however, they have similar observable attributes to those which were in the privatization group. They serve as a benchmark to 'difference out' the confounding factors and isolate the impact of the policy (the treatment effect) which is subsequently estimated as a difference between performance measures 'before and after' privatization.

The propensity scores are derived using a probit regression with a set of covariates. The matching is performed in cross-sectional dataset. All but one of the control variables used for matching procedure were time invariant variables, important to determine the likelihood for being selected for privatization. For the slowly changing variable (the age of the company) the averaged value is taken such that the matching can identify firms that are on average the most similar over the duration of the sample.

The matching model is as follows:

$$L_i = \left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 Region + \beta_2 Manufacturing + \beta_3 Services + \beta_4 Export +_5 AgeoftheCompany + \varepsilon_i \quad (6.5)$$

where the dependent variable is the likelihood that a company is earmarked for privatization. Independent variables include characteristics that are expected to affect their selection for ownership transformation. These variables include the location in which firm operates, the sector of operation, a dummy controlling for export activity during the pre-treatment period and the average age of the company over the duration of the period under investigation. Definition of variables is provided in Table 6.3.

As discussed in previous Chapters, governments are expected to initially sell companies that operate in more competitive markets. To measure product market competitiveness, a dummy variable (Urban) is used which takes the value of 1 if company operates a location with more than 50,000 inhabitants and 0 if it operates in smaller locations. As argued in Chapter 1, ceteris paribus, the more competitive a market in which the company operates, the more likely it is for the company to be selected for privatization. Similarly, two dummy variables depicting sector of operation (*manufacturing* and *services*) are included which are considered as an important determinant on how the ownership transformation is sequenced and how companies are selected for privatization. Based on the characteristics of the sector, Bornstein (1999) presents a concise categorization on the likelihood of different industrial sectors being selected for privatization. He argues that companies from sectors in which small scale investments are the norm (for example insurance services), are more likely to be initially selected for privatization. Conversely, companies from sectors in which substantial remedial capital spending and restructuring (perhaps even foreign investment) is required, are less likely to be initially sequenced for privatization. Likewise, export dummy controlling if firm was engaged in export activities in the initial period is included (in case of privatized companies, it means the export activity prior to privatization). As such, it controls for a pre-privatization behaviour that could make them more likely to get selected for privatization by the government but also to make them more attractive targets for foreign investors. Finally, an average age variable is included to provide an additional important dimension against which companies of two groups are matched.[131]

The propensity score matching technique is implemented by a STATA '*.ado*' file called *pscore.ado* which was developed by Becker and Ichino (2002). The *pscore* command estimates the propensity score, which in this case is the likelihood that a company is selected for privatization. The *pscore* command also tests the balancing property, which is the condition that propensity scores have the same distribution of observable characteristics independent of treatment status. The balancing property is necessary to estimate the causal effect of interest.

The results of the *pscore* matching algorithm include the regression output (probit in this case). They also include description of the estimated propensity score, identification of the optimal number of blocks as well as the balancing property test.

[131] Different theoretical predictions are provided in the literature to explain the relationship between age of the company on the one hand and its performance and growth on the other hand. For instance, Jovanovic (1982) predicts that over time low productivity firms exit, while high productivity firms remain in business. In terms of performance, Arrow (1962) predicted that as time passes, companies improve their performance due to accumulated knowledge about the production process as well as due to already established relations with customers and suppliers. Age seems to be an important determinant of companies' performance and growth. As such it might play an important role in predicting the likelihood of a company to be selected for privatization.

The common support restriction was imposed which restricts the analysis of the balancing property to all privatized and non-privatized companies in the region of common support. By imposing such a restriction, it is expected that the quality of matching is improved (Becker and Ichino, 2002). The results of the *pscore* probit regression are presented in Table 6.5. As these results show, all variables of interest are statistically significant and their magnitude and the direction of the effects are mostly as expected. Variables are jointly significant.[132] The propensity score estimation results in Table 6.5 suggest a positive correlation between market competitiveness, export activity, age of the company, service sector and manufacturing sector on the one hand, and the probability of being selected for privatization on the other.

Table 6.5. Estimation of the propensity score

Dependent variable (treatment) / Independent Variables	Coefficient	Standard Error	
Urban	0.335***	0.063	
Manufacturing	0.867***	0.067	
Services	0.313***	0.066	
Export	0.298***	0.058	
Age of the company	0.042***	0.004	
_constant term	-85.782***	7.580	
LR chi2(5)	-	431.84***	-
Pseudo R2	-	0.1154	-
Number of observations	-	5109	-

Source: Author's own compilation based on STATA output

The first part of the output of *pscore* run is presented in Appendix 6. The results show that the identified region of common support is [0.085 to 0.879]. The description of the estimated propensity score in the region of common support is presented in Appendix 7. Blocks, in which the mean propensity score is different between privatized and non-

[132] LR statistic is presented at the bottom of Table 6.5. With a p value of zero, it allows us to reject the hypothesis that all the slope coefficients associated with independent variables are simultaneously equal to zero.

privatized companies, are split in half. This algorithm continues until, the average propensity score of privatised and non-privatised is the same in all blocks. In our case, the optimal number of blocks is found to be eight (8). This number ensures that the mean propensity score for privatized and non-privatised companies is not different.

After establishing the optimal number of blocks, the *pscore* algorithm proceeds to test the balancing property for each variable. Test results show that the balancing property is satisfied at 1 percent level of significance.[133] Test results of the balancing property as well as the tabulated final distribution of privatized and non-privatized companies across blocs, is presented in Appendix 8. Results show that block identifiers for some non-privatized companies are missing as they lay outside the common support. Therefore the number of observations in the table in Appendix 8 is 4,816 instead of 5,131; suggesting that 45 companies were dropped. However, it is important to point out that none of the privatized companies were dropped, hence causing no problem in estimation.[134]Once the matching procedure is conducted, a unique identifier was used to match pairs in the panel dataset. In other words, one variable per company was used during the matching procedure. The information about the matched cases was then merged with the original dataset. Cases that are not matched were dropped. Thereafter, the resulting sub-sample of matched firms is referred to as the matched sample.

6.2.3.2 Matched Difference in Difference model

After the construction of the matched sample, the Difference in Difference for outcome indicators is estimated. This section tries to determine whether following privatization, the firms improve their performance measured in terms of selected performance indicators. Table 6.6 shows the details of the proxies for these

[133] This significance level is applied to test each variable and the balancing property is not rejected only if it holds for each variable.

[134] If the number of dropped privatized companies is considerable, problems in inferences might occur as a sample selection bias may be introduced in the estimates (Bryson, Dorsett and Purdon, 2002).

performance indicator as well as the predicted relationships (as described in Chapter 2).

Table 6.6. Performance indicators and the predicted relationship

Performance indicator	Proxies	Predicted relationship*
Sales	Real Sales = Nominal Sales/Producer Price Index	positive
Employment	Total Employment = Total Number of Employees	positive or negative

Source: Author's own compilation

Two baseline models are estimated, with (i) sales and (ii) employment as dependent variables. Additional extension models are also developed to see if the treatment effect on the treated has increased over time. Here, the two baseline models are explained separately.

Sales model:

The following model is estimated to investigate the impact of ownership transformation on sales:

$$lnsales_{it} = \alpha_i + \beta_1 PostTreatment_{it} + \beta_2 p\_treat\_Man + \beta_3 p\_treat\_Serv_{it} + \beta_4 p\_treat\_Reg_{it} + \beta_5 p\_treat\_Export_{it} + \beta_6 p\_treat\_Foreign_{it} + \beta_7 p\_treat\_SpecialSO_{it} + \varepsilon_i \qquad (6.6)$$

The depended variable ($lnsales_{it}$) is the log value of deflated sales. $PostTreatment$ takes a value of 1 in the year that the company underwent ownership transformation and the following years, and 0 otherwise. It is used to estimate the effect of the treatment on the treated. Although the time-invariant variables cannot be accommodated directly in a fixed effects model, they can still be interacted with other time-variant variables in particular with time dummies (Wooldridge, 2009 p. 484). The following are interacted with the variable $PostTreatment$ and are expected to capture effects of treatment on the treated. These interaction variables include, p_treat_Man and p_treat_Serv to control for sector differences of the treatment effect on the treated.

They control for manufacturing and service sectors respectively. The base category includes other sectors of operation. The following variables, p_treat_Reg, p_treat_Export, $p\_treat\_Foreign$ respectively control for region, export activity and foreign ownership differences of the treatment effect on the treated. An additional interaction term $p\_treat\_SpecialSO$ is included to control for differences of the treatment effect on the treated between companies that were privatized through the 'special spin-off' route and those that were privatized with regular spin-off.[135] The subscript i refers to companies (1,...,n) and t to years (2005,…, 2011). Finally, ε_i is the usual white noise error term. The interaction terms of year dummies (last two years of the investigation period) and post-treatment variables are also included as extension in an additional specification to see if the treatment effect on the treated has increased over time.

The procedure is based on fixed effects estimation as we are interested in the effect of a within-unit change in treatment. Fixed-effects regression controls for firm-specific unobserved and time-invariant characteristics that may influence the outcome variable. The regression results of specification 6.6 are presented in Appendix 9. After the estimation, the model is subjected to diagnostic tests. The test for heteroskedasticity checks if the variance of the residuals is non-constant over cross-sectional units which is a very common problem when working with panel data. Basically we assume *Homogeneity* of the *Variance of Residuals. The result of the Wald Test (presented in Appendix 10) shows that there is a large presence of* heteroskedasticity. A possible solution to account for heteroskedasticity is to report results with robust standard errors. The improved results with robust standard errors are reported in Appendix 11.

After running the regression with robust standard errors, the next step is to test for serial correlation, another common problem in panel data analysis. Results are

[135] For a concise discussion on the privatization methods in Kosovo, see Chapter 5.

checked for autocorrelation to see if the error in each time period contains a time-constant omitted factor, i.e. if error terms are correlated across time (Wooldridge, 2002, p. 176). The Wooldridge test for autocorrelation in panel data suggests that there is a serial correlation problem as there is first order autocorrelation in the data (see Appendix 12). A possible response to this problem is to estimate a dynamic model. However, the autocorrelation in the model might suggest that the dependent variable is affected by other variables not included explicitly in the model; therefore the dynamics are unobservable and so are contained within the residuals.

To overcome this problem, the dynamics is modelled in the error term using the Unobserved Components Model estimated based on Cochrane-Orcutt (1949). Following this method, slope coefficients of the static model conditional on AR(1) dynamics in the residuals are estimated. However, the Unobserved Component Model is valid only under the assumption that a particular type of parameter restriction known as Common Factor Restrictions (CFR) hold. Next, in BOX 1, we explain the CFR assumption based on Spanos (1986) and McGuirk and Spanos (2004). For simplicity, a bivariate model with an autoregressive error term of first order AR(1) is assumed:

BOX 1.

$$Y_{it} = \alpha + \alpha_2 X_{it} + \alpha_3 Z_{it} + \varepsilon_{it} \tag{6.7}$$

where: $\varepsilon_{it} = \rho\varepsilon_{it-1} + V_{it}$ (6.8)

ε_{it-1} **as a disturbance term and** V_{it} **as a the white noise component**

The first step is to lag once each variable of (6.7)**:** (6.9)

$Y_{it-1} = \alpha + \alpha_2 X_{it-1} + \alpha_3 Z_{it-1} + \varepsilon_{it-1}$

The second step is to solve Equation (6.9) **for** ε_{it-1}**:** (6.10)

$\varepsilon_{it-1} = Y_{it-1} - \alpha - \alpha_2 X_{it-1} - \alpha_3 Z_{it-1}$

The third step is to substitute Equation (6.10) **into Equation** (6.8)**:** (6.11)
$\varepsilon_{it} = \rho(Y_{it-1} - \alpha - \alpha_2 X_{it-1} - \alpha_3 Z_{it-1}) + V_{it}$

$$\varepsilon_{it} = \rho Y_{it-1} - \rho\alpha - \rho\alpha_2 X_{it-1} - \rho\alpha_3 Z_{it-1} + V_{it} \tag{6.12}$$

The forth step is to substitute Equation (6.12) **into Equation** (6.7)**:** (6.13)

$Y_{it} = \alpha + \alpha_2 X_{it} + \alpha_3 Z_{it} + \rho Y_{it-1} - \rho\alpha - \rho\alpha_2 X_{it-1} - \rho\alpha_3 Z_{it-1} + V_{it}$

The fifth step is to collect terms of Equation (6.13)**:** (6.14)

$Y_{it} = (1-\rho)\alpha + \alpha_2 X_{it} + \alpha_3 Z_{it} + \rho Y_{it-1} - \rho\alpha_2 X_{it-1} - \rho\alpha_3 Z_{it-1} + V_{it}$

Equation (6.14) **is a restricted version of the following dynamic linear regression model:** (6.15)

$Y_{it} = \alpha + \alpha_1 Y_{it-1} + \alpha_2 X_{it} + \alpha_3 Z_{it} + \alpha_4 X_{it-1} - \alpha_5 Z_{it-1} + V_{it}$

-In Equation (6.14) **the coefficient on** Y_{it-1} **is** ρ **while in Equation** (6.14) **the coefficient on** Y_{it-1} **is** α_1
-In Equation (6.14) **the coefficient on** X_{it-1} **is** – $\rho\alpha_2$ **while in Equation** (6.14) **the coefficient on** X_{it-1} **is** α_4
-In Equation (6.14) **the coefficient on** Z_{it-1} **is** – $\rho\alpha_3$ **while in Equation** (6.14) **the coefficient on** Z_{it-1} **is** α_5

Therefore, coefficient – $\rho\alpha_2$ **is the negative product of the coefficient on** Y_{it-1} **and** X_{it-1}
and, coefficient – $\rho\alpha_3$ **is the negative product of the coefficient on** Y_{it-1} **and** Z_{it-1}

As a result, the dynamic linear regression model in Equation (6.15)**, can be transferred into restricted version model in Equation** (6.14) **only if the following restrictions** [(i) and (ii)] **hold in Equation** (6.15):
(i) $-\alpha_4 = \alpha_1 * \alpha_2$, **and**
(ii) $-\alpha_5 = \alpha_1 * \alpha_5$

Restrictions in (i) **and** (ii) **are referred to as Common Factor Restrictions.**

In order to test the CFR, Equation 6.6 is transformed into a dynamic linear regression model of order one, Equation (6.16)

$$lnturover_{it} = \alpha_i + \beta_1 PostTreatment_{it} + \beta_2 p\_treat\_Man + \beta_3 p\_treat\_Serv_{it} + \beta_4 p\_treat\_Reg_{it} + \beta_5 p\_treat\_Export_{it} + \beta_6 p\_treat\_Foreign_{it} + \beta_7 p\_treat\_SpecialSO_{it} + \beta_8 L\_lnturover_{it-1} + \beta_9 L\_PostTreatment_{it-1} + \beta_{10} L\_p\_treat\_Man_{it-1} + \beta_{11} L\_p\_treat\_Serv_{it-1} + \beta_{12} L\_p\_treat\_Reg_{it-1} + \beta_{13} L\_p\_treat\_Export_{it-1} + \beta_{14} L\_p\_treat\_Foreign_{it-1} + \beta_{15} L\_p\_treat\_SpecialSO_{it-1} + \varepsilon_i \quad (6.16)$$

Following the estimation of the dynamic linear regression model of order one (Equation 6.16), the CFR on each variable is tested. Tests are conducted for both Fixed Effect Estimation and for pooled Ordinary Least Square (OLS). This double test is conducted in order to encompass the whole range of possible dynamic misspecification. This is because in the OLS regression, the coefficient of the lagged depended variable is subject to maximum upward bias, while in the Fixed Effects regression, the coefficient of the lagged depended variable is subject to downward bias (Bond, 2002). The CFR test is performed based on the derivation explained earlier. The results of the dynamic linear regression model of order one are presented in Appendix 13 (for Fixed Effect Estimation) and in Appendix 14 (for OLS regression). CFR tests are presented in BOX 2.[136] CFR tests indicate that CFRs of all variables hold. Also, the results of CFR tests are consistent across both Fixed Effects and OLS specification, thus increasing the reliability of the results. Therefore, given that CFRs hold, an unobserved components method to a fixed effects model specified in Equation 6.6 is applied. Results of the regression are presented in Appendix 16. The results are discussed in section 6.3.

[136] STATA printouts of CFR tests from both Fixed Effects and OLS are also presented in Appendix 15.

BOX 2. Results of the Common Factor Restrictions testing procedure for both OLS and Fixed Effects regressions (after the estimation of Equation 6.7)

Fixed effects	OLS
. testnl - _b[L_PostTreatment]=_b[L_lnsales]*_b[PostTreat ment] (1) -_b[L_PostTreatment] = _b[L_lnsales]*_b[PostTreatment] F(1, 4112) = 2.11 Prob > F = 0.1324	. testnl - _b[L_PostTreatment]=_b[L_lnsales]*_b[PostTreat ment] (1) -_b[L_PostTreatment] = _b[L_lnsales]*_b[PostTreatment] F(1, 4799) = 6.12 Prob > F = 0.0134
. testnl - _b[L_p_treat_Man]=_b[L_lnsales]*_b[p_treat_Man] (1) -_b[L_p_treat_Man] = _b[L_lnsales]*_b[p_treat_Man] F(1, 4112) = 1.90 Prob > F = 0.1684	. testnl - _b[L_p_treat_Man]=_b[L_lnsales]*_b[p_treat_Man] (1) -_b[L_p_treat_Man] = _b[L_lnsales]*_b[p_treat_Man] F(1, 4799) = 0.05 Prob > F = 0.8213
. testnl - _b[L_p_treat_Serv]=_b[L_lnsales]*_b[p_treat_Se rv] (1) -_b[L_p_treat_Serv] = _b[L_lnsales]*_b[p_treat_Serv] F(1, 4112) = 2.72 Prob > F = 0.0994	. testnl - _b[L_p_treat_Serv]=_b[L_lnsales]*_b[p_treat_Se rv] (1) -_b[L_p_treat_Serv] = _b[L_lnsales]*_b[p_treat_Serv] F(1, 4799) = 2.68 Prob > F = 0.1017
. testnl - _b[L_p_treat_Urban]=_b[L_lnsales]*_b[p_treat_U rban] (1) -_b[L_p_treat_Urban] = _b[L_lnsales]*_b[p_treat_Urban] F(1, 4112) = 6.03 Prob > F = 0.1141	. testnl - _b[L_p_treat_Urban]=_b[L_lnsales]*_b[p_treat_U rban] (1) -_b[L_p_treat_Urban] = _b[L_lnsales]*_b[p_treat_Urban] F(1, 4799) = 0.39 Prob > F = 0.5326
. testnl - _b[L_p_treat_Export]=_b[L_lnsales]*_b[p_treat_ Export] (1) -_b[L_p_treat_Export] = _b[L_lnsales]*_b[p_treat_Export] F(1, 4112) = 4.22 Prob > F = 0.1401	. testnl - _b[L_p_treat_Export]=_b[L_lnsales]*_b[p_treat_ Export] (1) -_b[L_p_treat_Export] = _b[L_lnsales]*_b[p_treat_Export] F(1, 4799) = 0.07 Prob > F = 0.7886
. testnl - _b[L_p_treat_Foreign]=_b[L_lnsales]*_b[p_treat _Foreign] (1) -_b[L_p_treat_Foreign] = _b[L_lnsales]*_b[p_treat_Foreign] F(1, 4112) = 2.62 Prob > F = 0.1056	. testnl - _b[L_p_treat_Foreign]=_b[L_lnsales]*_b[p_treat _Foreign] (1) -_b[L_p_treat_Foreign] = _b[L_lnsales]*_b[p_treat_Foreign] F(1, 4799) = 2.19 Prob > F = 0.1389
. testnl - _b[L_p_treat_SpecialSO]=_b[L_lnsales]*_b[p_tre at_SpecialSO] (1) -_b[L_p_treat_SpecialSO] = _b[L_lnsales]*_b[p_treat_SpecialSO] F(1, 4112) = 1.13 Prob > F = 0.2883	. testnl - _b[L_p_treat_SpecialSO]=_b[L_lnsales]*_b[p_tre at_SpecialSO] (1) -_b[L_p_treat_SpecialSO] = _b[L_lnsales]*_b[p_treat_SpecialSO] F(1, 4799) = 0.46 Prob > F = 0.4975

Employment model

The following model is estimated to investigate the impact of ownership transformation on employment:

$$lnemployment_{it} = \alpha_i + \beta_1 PostTreatment_{it} + \beta_2 p\_treat\_Man + \beta_3 p\_treat\_Serv_{it} + \beta_4 p\_treat\_Reg_{it} + \beta_5 p\_treat\_Export_{it} + \beta_6 p\_treat\_Foreign_{it} + \beta_7 p\_treat\_SpecialSO_{it} + \varepsilon_i \quad (6.17)$$

The depended variable ($lnemp_{it}$) is the log of the number of employees. The independent variables are the same as the ones in specification 6.6. Finally, ε_i is the usual white noise error term. Again, the procedure is based on fixed effects estimation given our interest in the effect of a within-unit change in treatment. The regression results of specification 6.17 are presented in Appendix 17. After the estimation, the model is subjected to diagnostic tests. *The results of Wald Test (presented in Appendix 18) show that there is a large presence of* heterskedasticity. A possible solution to account for heteroskedasticity is to report results with robust standard errors. The improved results with robust standard errors are reported in Appendix 19.

Next we checked for autocorrelation to see if the error in each time period contains a time-constant omitted factor, i.e. if error terms are correlated across time (Wooldridge, 2002, p. 176). The Wooldridge test for autocorrelation in panel data suggests that there is a serial correlation problem as there is first order autocorrelation in data (see Appendix 20). A possible response to this problem is to estimate a dynamic model. However, the autocorrelation in the model might suggest that the dependent variable is affected by other variables not included explicitly in the model; therefore the dynamics are unobservable and so are contained within the residuals.

Again, to overcome this problem, we test whether CFRs holds, so that we can use the Unobserved Components Model. CFR test is performed based on the derivation explained earlier. In order to test the CFRs, Equation 6.17 is transformed into a dynamic linear regression model of order one Equation 6.18.

$$lnturover_{it} = \alpha_i + \beta_1 PostTreatment_{it} + \beta_2 p\_treat\_Man + \beta_3 p\_treat\_Serv_{it} + \beta_4 p\_treat\_Reg_{it} + \beta_5 p\_treat\_Export_{it} + \beta_6 p\_treat\_Foreign_{it} + \beta_7 p\_treat\_SpecialSO_{it} + \beta_8 L\_lnturover_{it-1} + \beta_9 L\_PostTreatment_{it-1} + \beta_{10} L\_p\_treat\_Man_{it-1} + \beta_{11} L\_p\_treat\_Serv_{it-1} + \beta_{12} L\_p\_treat\_Reg_{it-1} + \beta_{13} L\_p\_treat\_Export_{it-1} + \beta_{14} L\_p\_treat\_Foreign_{it-1} + \beta_{15} L\_p\_treat\_SpecialSO_{it-1} + \varepsilon_i \qquad (6.18)$$

The results of the dynamic linear regression model of order one are presented in Appendix 21 (for Fixed Effect Estimation) and in Appendix 22 (for OLS regression). CFR tests are presented in BOX 3.[137] CFR tests presented in Box 2, indicate that CFRs hold for all variables. Also, CFR tests' results are consistent across both Fixed Effects and OLS specification, thus increasing the reliability of the results. Therefore, given that CFRs hold, an unobserved components method to a fixed effects model specified in Equation 6.17 is applied. Results of the regression are presented in Appendix 24. The results are discussed in section 6.3.

[137] STATA printouts of CFR tests from both Fixed Effects and OLS are also presented in Appendix 23.

BOX 3. Results of the Common Factor Restrictions testing procedure for both OLS and Fixed Effects regressions (after the estimation of Equation 6.7)

Fixed effects	OLS
. testnl - _b[L_PostTreatment]=_b[L_lnemp]*_b[PostTreatment] (1) -_b[L_PostTreatment] = _b[L_lnemp]*_b[PostTreatment] F(1, 4018) = 2.99 Prob > F = 0.2127	. testnl - _b[L_PostTreatment]=_b[L_lnemp]*_b[PostTreatment] (1) -_b[L_PostTreatment] = _b[L_lnemp]*_b[PostTreatment] F(1, 4705) = 0.83 Prob > F = 0.3615
. testnl - _b[L_p_treat_Man]=_b[L_lnemp]*_b[p_treat_Man] (1) -_b[L_p_treat_Man] = _b[L_lnemp]*_b[p_treat_Man] F(1, 4018) = 1.37 Prob > F = 0.1938	. testnl - _b[L_p_treat_Man]=_b[L_lnemp]*_b[p_treat_Man] (1) -_b[L_p_treat_Man] = _b[L_lnemp]*_b[p_treat_Man] F(1, 4705) = 1.95 Prob > F = 0.1631
. testnl - _b[L_p_treat_Serv]=_b[L_lnemp]*_b[p_treat_Serv] (1) -_b[L_p_treat_Serv] = _b[L_lnemp]*_b[p_treat_Serv] F(1, 4018) = 1.04 Prob > F = 0.3068	. testnl - _b[L_p_treat_Serv]=_b[L_lnemp]*_b[p_treat_Serv] (1) -_b[L_p_treat_Serv] = _b[L_lnemp]*_b[p_treat_Serv] F(1, 4705) = 1.81 Prob > F = 0.1784
. testnl - _b[L_p_treat_Urban]=_b[L_lnemp]*_b[p_treat_Urban] (1) -_b[L_p_treat_Urban] = _b[L_lnemp]*_b[p_treat_Urban] F(1, 4018) = 0.00 Prob > F = 0.9709	. testnl - _b[L_p_treat_Urban]=_b[L_lnemp]*_b[p_treat_Urban] (1) -_b[L_p_treat_Urban] = _b[L_lnemp]*_b[p_treat_Urban] F(1, 4705) = 1.70 Prob > F = 0.1928
. testnl - _b[L_p_treat_Export]=_b[L_lnemp]*_b[p_treat_Export] (1) -_b[L_p_treat_Export] = _b[L_lnemp]*_b[p_treat_Export] F(1, 4018) = 0.05 Prob > F = 0.8167	. testnl - _b[L_p_treat_Export]=_b[L_lnemp]*_b[p_treat_Export] (1) -_b[L_p_treat_Export] = _b[L_lnemp]*_b[p_treat_Export] F(1, 4705) = 3.85 Prob > F = 0.0497
. testnl - _b[L_p_treat_Foreign]=_b[L_lnemp]*_b[p_treat_Foreign] (1) -_b[L_p_treat_Foreign] = _b[L_lnemp]*_b[p_treat_Foreign] F(1, 4018) = 3.52 Prob > F = 0.0607	. testnl - _b[L_p_treat_Foreign]=_b[L_lnemp]*_b[p_treat_Foreign] (1) -_b[L_p_treat_Foreign] = _b[L_lnemp]*_b[p_treat_Foreign] F(1, 4705) = 0.64 Prob > F = 0.4237
. testnl - _b[L_p_treat_SpecialSO]=_b[L_lnemp]*_b[p_treat_SpecialSO] (1) -_b[L_p_treat_SpecialSO] = _b[L_lnemp]*_b[p_treat_SpecialSO] F(1, 4018) = 3.07 Prob > F = 0.0979	. testnl - _b[L_p_treat_SpecialSO]=_b[L_lnemp]*_b[p_treat_SpecialSO] (1) -_b[L_p_treat_SpecialSO] = _b[L_lnemp]*_b[p_treat_SpecialSO] F(1, 4705) = 0.07 Prob > F = 0.7932

6.3 Results

This section presents and discusses the results of the models specified in Equation 6.6 and Equation 6.17 and their extensions. Table 6.7 presents the estimation results, where the main baseline specification for Sales Model is presented in column 1 and the main baseline specification for the Employment Model is presented in column 3. Two other columns present extensions to baseline specifications for sales and employment (when the year dummies for the last two years are included).[138] The estimation results show that most variables are highly significant and direction of effect generally as expected. Results are similar across different specifications, suggesting robustness of coefficients.

In terms of sales, the results suggest that the impact of privatization process is positive. Ownership transformation is associated with an improvement in sales by almost 13 percent. The sector and region of operation do not seem to explain changes in sales after divestiture. However, privatized companies that are engaged in export activities seem to display higher performance improvement and so do companies that were privatized through special spin-off. A rather surprising finding is that companies that have at least 10 percent foreign ownership seem to exhibit lower sales improvement associated with ownership transformation. This is largely contrary to previous studies, however, in the context of Kosovo, it may be due to several specific reasons. Firstly, the variable captures only a relatively simple categorisation of foreign ownership and is unable to differentiate among foreign owners. Second, many of these companies were acquired by members of the Diaspora (classified as foreign owners) who do not necessarily have the capital and know-how to properly restructure newly privatised companies as their decision to initially invest in these companies might have been influenced by non-economic factors. When including year dummies, the

[138] STATA printouts of the model extensions of the baseline models are presented in Appendix 25 (for Sales Model) and in Appendix 26 (for Employment Model).

results are largely confirmed. The year dummies depicting the last two years of the investigation period show that there is a significant improvement in sales over time following ownership transformation.

Table 6.7. Estimation Results (unobserved component model)

	Sales model		Employment model	
	Column I	Column II	Column III	Column IV
	Baseline	Extended	Baseline	Extended
	lnSales	lnSales	lnEmp	lnEmp
Independent variables				
PostTreatment	0.128*** (0.042)	0.072* (0.043)	-0.405*** (0.039)	-0.419*** (0.039)
p_treat_Man	-0.079 (0.055)	-0.077 (0.055)	0.160*** (0.051)	0.161*** (0.051)
p_treat_Serv	-0.125* (0.066)	-0.139** (0.066)	0.187*** (0.061)	0.184*** (0.061)
p_treat_Cap	-0.024 (0.062)	-0.029 (0.061)	0.103* (0.057)	0.102* (0.057)
p_treat_Export	0.160*** (0.053)	0.164*** (0.053)	0.166*** (0.049)	0.167*** (0.049)
p_treat_Foreign	-0.157** (0.065)	-0.162** (0.065)	-0.093 (0.060)	-0.095 (0.060)
p_treat_SpecialSO	0.343*** (0.064)	0.345*** (0.063)	0.131** (0.059)	0.131** (0.059)
_cons	9.484*** (0.049)	9.481*** (0.049)	1.982*** (0.036)	1.981*** (0.036)
Year_TR_6	-	0.129*** (0.026)	-	0.015 (0.023)
Year_TR_7	-	0.192*** (0.029)	-	0.061** (0.027)
Wald chi2(8)	105.32***	-	181.16***	-
Wald chi2(10)	-	156.75***	-	187.18***
Number of observations	4816	4816	4752	4752
Number of groups	688	688	688	688

Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
Source: Author's own compilation based on STATA output

In terms of employment, the results suggest that the impact of privatization process is negative. These findings follow some of the studies (cited in Section 6.2.1) that find negative impact of ownership transformation on employment levels. Ownership transformation is associated with a drop in employment levels by almost 41 percent. In the current context – as described in Chapter 5 – these results are somehow predictable as some of these workers were not actively engaged in any productive work even though they had valid contracts and appeared on the payrolls of companies. Privatized companies from manufacturing and service sectors seem to do better in terms of employment compared to the base category. Similarly, the level of competition in product market proxied by variable Urban, seems to explain some heterogeneity in employment associated with ownership transformation. Privatized companies that are engaged in export activities seem to display better employment prospects than those that do not; and so do companies that were privatized through special spin-off. The impact of foreign ownership seems to be insignificant. When including year dummies, the results are largely confirmed. The year dummies depicting the last year of the investigation period shows a positive sign. This finding confirms previous studies that employment drops after divestiture but then catches up over time.

6.4 Limitations

Despite the fact that this Chapter has addressed important shortcomings that are endemic in the existing literature, few limitations of the investigations deserve some attention. The data provides only relatively simple categorisation of both private ownership and foreign ownership. As a consequence we are unable to distinguish relatively homogeneous groups of owners within each group. A more comprehensive dataset on the identity of owners (or type of owners) after divestiture (including the extent and quality of foreign ownership), would have allowed us to provide a more exhaustive analysis on the causal relationship between ownership and sales or employment.

An additional drawback of the analysis relates to the inability to get hold of information about the companies that were inactive after the privatization process. The proportion of companies that had to be replaced during the survey process was considerable (almost a quarter). As discussed in Chapter 5, in some cases firms have been liquidated or stopped their operation. In some other cases, new owners saw more benefit in treating these companies as real estate investments hence keeping them idle while expecting better market valuation of the property. In any case, the information for further investigation was not available. This might pose an additional source of bias that the reader should be aware of when interpreting the results. Finally, the data used in this Chapter are not directly comparable with those presented in Chapter 4 as they use different performance measures and different methodologies.

6.5 Conclusions

The main objective of this Chapter was to analyse the causal relationship between ownership transformation and companies' sales and employment. It draws upon the theoretical propositions set forth in Chapters 1 and 2 as well as upon the context of investigation presented in Chapter 5. This Chapter analysed this relationship using policy evaluation econometrics and addressed several problems that the literature on ownership transformation is beset with. As discussed on several occasions in this thesis, controlling for selection (endogeneity) bias of ownership is the main challenge in evaluating the effect of privatization. In the context of policy evaluation econometrics the combination of matching technique with difference in difference arguably best addresses this issue. Since data on 'before and after' privatization were obtained, the endogeneity problem associated with sample selection was largely addressed. Moreover, given that the privatization process in Kosovo is almost over with less than 10 percent of companies remaining ,to be privatized this problem was alleviated further as we used a random representative sample of almost all privatized companies and a random representative sample of non-privatized companies.

Using the fixed effect estimator, the DID method is able to difference out all time-invariant company-level factors as sources of omitted variable bias. However, in order to address the issue of potential baseline imbalances between treated and non-treated groups, DID was combined with PSM. This combined technique can isolate the effect of ownership transformation on performance indicators (employment and sales) while differencing out the aggregate shocks. The estimation process of matched difference in difference is run in two stages; initially a propensity score algorithm is run in order to construct a matched sample of firms based on observable characteristics by finding valid control group which will correct the difference in difference estimates. After the construction of the matched sample, the Difference in Difference for outcome indicators was estimated. Two baseline models looking at the sales and employment effects of privatization were estimated. Additional extension models were also estimated to see if the effect of treatment on the treated has increased over time.

The results remained robust in different specifications. In terms of sales, the results suggest that the impact of privatization process is positive; confirming findings of previous studies in transition countries. Ownership transformation is associated with an improvement in sales by almost 13 percent. The results also find that the effectiveness of the policy is heterogeneous depending on the export activity of companies and the method of privatization (special vs regular spin-off). However, the sector of operation and location do not seem to explain any heterogeneity in sales improvement associated with ownership transformation. On the other hand, unlike the bulk of previous literature, the results in this Chapter find a negative effect for foreign ownership on performance. Lastly, when year dummies are included, the expected results were largely confirmed, showing improvements in performance over time. In terms of employment, results suggest that the impact of privatization process has been negative which follows one stream of the previous (divergent) research. Results find that ownership transformation is associated with a drop in employment levels by almost 41 percent. The Kosovo specific context may to some extent explain this result. Similarly, the effectiveness of the policy is heterogeneous depending on various factors, including: sector of operation, location, export activity and method of privatization. However, the impact of foreign ownership seems to be insignificant. Again, when including time dummies, the previous results are largely confirmed and show that after a period of drop in employment after divesture it eventually starts to pick up.

Chapter 7

Concluding remarks

Contents

Introduction

This thesis aimed at investigating the impact of privatization on companies' performance in the successor states of former Yugoslavia (Bosnia and Herzegovina, Croatia, Kosovo, Macedonia, Montenegro, Serbia and Slovenia). The research is confined within the broad context of the neoclassical theory and its extensions, in line with the dominant empirical literature in this field. It started by reviewing a range of theories and concerns related to the impact of ownership and privatization policy. The aim was to investigate as broadly as possible relevant theories on the importance of ownership for companies' performance as well as the effectiveness of the privatization process in TEs (Chapter 1). It then analysed the existing empirical literature on these areas in the context of TEs. Here a summary of various features of reviewed empirical studies and their results, including their efforts to control for the selection bias problem, was presented (Chapter 2). Given the fact that the nature of ownership in former Yugoslavia was different from that in other socialist countries, the privatization process had to deal with different issues and concerns and respond to different interest groups. The thesis analysed the nature of 'social ownership' and how it was dealt with in the process of privatization in the successor states of former Yugoslavia. Also, a review of limited empirical studies that analyse the effect of ownership transformation on companies' performance in these countries was reported (Chapter 3). Having highlighted a number of problems that have dominated empirical studies on privatization and the absence of studies looking at the transformation of 'socially owned' enterprises, a cross-country empirical investigation of the impact of ownership on companies' efficiency in successor states of former Yugoslavia, using firm-level representative data from the BEEPS database and employing the Stochastic Frontier Analysis as well as a simulation based extension of the Heckman selection model for nonlinear models controlling for selection bias problem, was undertaken (Chapter 4). Here the issue of missing data, which is ignored in previous studies, was also addressed by applying for the first time the multiple imputation procedure in the context of privatization. Given that the first three rounds of BEEPS did not include Kosovo, the impact of privatization in this country had to be dealt with separately in the last two chapters. Firstly, in order to provide the relevant background information for the empirical analysis, the privatization process in Kosovo was discussed in detail and in the context of the state of Kosovo's economy before and after the war (Chapter 5). In the absence of any official data on enterprise ownership performance in Kosovo, the author conducted a representative survey of privatised enterprises and a large number of de-novo firms in order to obtain original data suitable for the policy evaluation econometric analysis which is preferable to the standard regression analysis prevalent in the literature. Using the propensity score matching and the difference in difference procedures, it was possible to identify the change in the performance of enterprises resulting from the change in their ownership from that caused by other reform measures and external events that affected all enterprises (Chapter 6).

The rest of this Chapter is organized as follows. Section 7.1 presents the main findings of the research. Section 7.2 will discuss the main contribution to knowledge provided by this thesis. Section 7.3 presents some policy implication while Section 7.4 points out the limitations of this research. Section 7.5 provides directions for future research.

7.1 Main findings

The first Chapter of this thesis outlined the main conceptual and theoretical foundations underlying the ownership debate. It started by discussing the arguments for state ownership which fall under two broad categories: firstly, state ownership is viewed as a remedy to market failures (related to market structures or public goods), and secondly, state ownership is considered as a policy instrument for advancing non-economic goals, such as maximising social welfare, even at a tolerable loss of economic efficiency.

This Chapter then discusses the case for private ownership. Here, several theories, including the key elements of property rights theory, public choice theory and principal-agent theory were presented. These theories support the contention that privatization improves companies' performance through better incentives, accountability, organizational performance, monitoring and control. According to these theories, relative inefficiency of SOEs is a function of ownership as well as a function of the behaviour of government and its agents. This Chapter also argued that the absence of competition, resulting from state ownership, may be another cause of the relative inefficiency of SOEs. This is especially important in the context of TEs where state ownership was not limited to natural monopolies (as in the case of many market economies) but to enterprises in all sectors.

Chapter 1 also investigated the privatization policy, particularly in the context of TEs where privatization was part of broader economic and political reforms. This was especially important from the empirical perspective since the effects of privatization must be distinguished from the effects of other reforms that were undertaken simultaneously in these countries. Here special attention was paid to methods of privatization as well as to the sequencing of the privatization reform. The main conclusion of this Chapter was that theory alone cannot provide conclusive answers about the effect of privatization, hence a review of empirical research was deemed important.

The second Chapter provided a critical review of the empirical research investigating the impact of ownership on companies' performance, with special focus on TEs. The empirical literature on privatization, especially those related to TEs, is very broad and there is considerable heterogeneity in the results. These differences arise from different factors, including diverse methodologies employed, differences in the indicators and measurement of performance and ownership as well as other genuine differences among countries and time periods covered. Most of the studies reviewed in this Chapter suffer from methodological problems, primarily the selection bias problem. The earlier studies, in particular, tended to ignore this problem altogether. Another major reason for the heterogeneity of results is the type of data used and the specific problem associated with survey data.

It was noted in Chapter 2 that studies accounting for the selection bias problem had less diverse results and the effect of privatization was mostly found to be positive. However, even a review of more recent studies in this Chapter suggests that there is still heterogeneity in the results. The lack of conclusive evidence can be attributed partly to the lack of attention paid to the selection bias problem partly to the fact that most of these studies use non-representatives samples of data which usually are not comparable. This Chapter infers that the relationship between privatization and companies' performance is not straightforward. As such, neither the theory nor the empirical literature were able to provide a definitive conclusion about the direction and magnitude of the effect of ownership transformation on companies' performance. Also, studies conducted in the context of TEs have generally not accounted for aggregate shocks of the transition process in order to be able to isolate the effect of privatization.

Chapter 3 provided a detailed analysis of the nature of social ownership in former Yugoslavia which was very distinct from that of other socialist economies. Here two important lines of arguments about the consequences of social ownership were considered. The first stemmed from the work of Ward (1958) and others who maintain that a labour managed firm will have lower performance as it will invest, employ and produce less compared to a profit maximising company. The second line of arguments came from the property rights theory which highlighted the impact of poorly defined property rights and ownership arrangements and showed that labour-managed firm have sub-optimal level of investments. Although a number of Yugoslav economists such as Horvat disputed the assumptions of these theories and maintained that these theories do not properly reflect the realities of Yugoslav labour managed firms, the inefficiencies arising from the absence of the disciplining effects of the market and well defined property rights could not be disputed.

This Chapter suggested that even though labour managed firms did not initially pursue profit maximising objective, still, after the start of the transition process they had to adjust themselves to the new realities of the market economy by pursuing profit maximising objectives in order to be able to survive in the new market conditions, particularly the disciplining effect of competition, the emerging hard budget constraint and the credible threat of bankruptcy. Chapter 3 also argued that despite the sweeping, and initially successful, reforms of the late 1980s, economic reforms were not ultimately successful as political problems in the League of Communists of Yugoslavia and ethnic tensions between Serb and other nationalities led to the disintegration of the federation.

This Chapter also analysed the privatization process in former Yugoslavia and its successor states which, despite sharing the legacies of the social ownership, followed different paths of privatizing their enterprises. The privatization process also led to the resolution of the problem of social ownership which in the final analysis led to the division of socially owned property between the state and the employees. Chapter 3 also reviewed the limited number of empirical evidence investigating the impact of privatization on companies' performance in the successor states of former Yugoslavia. The review showed that limited efforts have been made to control for selectin bias and other data related problems.

Chapter 4 embarked on the empirical investigation of the impact of ownership on the performance of companies in successor states of former Yugoslavia focusing on efficiency of these companies. As argued in this Chapter, the concept of efficiency has been largely ignored in the economic literature mainly due to the dominance of neoclassical economics which considers companies to be operating on their production possibility frontier and being fully efficient. However, in recent decades the measurement of efficiency and the analysis of the gap between the actual and potential levels of output has attracted greater attention from researchers and policy makers. This Chapter summarised the theoretical and empirical contributions that led to the development and expansion of efficiency analyses and reviewed the methods of estimating efficiency, including parametric and non-parametric techniques which provided the rational for using SFA as the appropriate method of estimation. SFA is used for estimating the impact of ownership on companies' performance by comparing the mean efficiency scores of companies with different ownership structures. It also investigates the performance of companies privatized to domestic and foreign owners. In order to control for selection bias problem which, as argued in Chapter 2, have been largely overlooked in previous studies the empirical investigation of this Chapter also employed simulation based extension of the Heckman selection model for nonlinear models (as proposed by Greene, 2006). Due to data limitations, the analysis of this Chapter was limited to technical efficiency. It used cross sectional pooled data of three rounds of BEEP surveys conducted in 2002, 2005 and 2009 covering over 3,800 companies with different ownership structures in six of the successor states (BEEP surveys of 2002 and 2005 were not conducted in Kosovo). The data are representative at country level and collected on the basis of the same methodology in all countries, and as such were suitable for inferring cross-country comparisons.

As is often the case when using survey data, the datasets used in this Chapter had a number of missing observations. The issue of missing data is usually ignored in the literature partly because with large datasets it has been assumed that the remaining data continues to be representative enough, and partly because methods of addressing the problem of missing data are complex. Missing data problem is dealt with by using Multiple Imputation procedure after carefully analysing alternative procedures. This procedure led to an increase of 44 percent in the number of companies with full data which is expected to improve the precision of estimates significantly. So far, to the best knowledge of the author, papers analysing the impact of ownership on companies' performance have ignored this problem without any discussion being provided.

After an extensive and detailed discussion on the choice of the functional form and distributional assumptions, this chapter used the more flexible Translog production function to estimate the inefficiency scores. Technical efficiency scores for each company in the dataset were calculated which were then used to explain variations in efficiency based on a number of environmental and firm-specific factors. The results indicated that companies under investigation were not fully efficient and therefore SFA was the appropriate method of estimation which is capable of capturing these inefficiencies. The results suggest that private companies owned by foreign investors have higher efficiency scores than private companies owned by domestic investors and SOEs. Also companies privatized by foreign investors outperform SOEs while those that were privatized by domestic investors display similar performance to SOEs. The results also suggest that countries as well as sectors of operation explain some of the variation in mean efficiency scores. Results suggest that the average efficiency scores of companies in the successor states vary across these countries with Slovenian companies being the most efficient, followed by those in Croatia, Montenegro, Bosnia, Serbia and Macedonia i.e., reflecting development of market based institutions and general economic environment in the region.

Chapter 5 analysed the privatization process in Kosovo which was the last of the successor states of former Yugoslavia to embark on large-scale privatization. It also analysed the state of Kosovo's economy within the former Yugoslav federation until now. This Chapter showed that privatization process in Kosovo was distinct from that in other successor states of former Yugoslavia, due to its economic and political specificities: it was designed and largely implemented by the international administration without any significant involvement of a national government, and the method of sale to highest bidders without providing any preference to workers or managers was the only method of privatization after the 1999. By allowing all interested parties to participate in the bidding process on equal footing, the ownership of privatized firms in Kosovo, unlike that in the successor states of former Yugoslavia, was not transferred to interest groups close to the political parties in power or to the former elite. However, even though the privatization method promoted foreign investors, the level of privatization-related FDI remained limited, which also reflects the overall conditions of the business environment in Kosovo.

Despite the fact that privatization in Kosovo has been almost completed, there is no empirical evidence investigating the effect of privatization on companies' performance. This void is filled by the empirical analysis undertaken in Chapter 6, to which Chapter 5 provided the relevant background information and context.

Chapter 6 investigated the privatization-induced performance changes of companies in Kosovo using policy evaluation econometrics, specifically a combination of Propensity Score Matching (PSM) and Difference In Difference (DID). This Chapter provided a review of the analytical framework and basic features of the policy evaluation econometrics. Here the pre- and post-privatization performance (expressed in terms of sales and employment) of two groups of companies privatized (or treated) companies and de-novo private firms (or non-treated companies) during the same time period were compared. In this context, PSM was used to match companies with similar traits from the two groups. Then, fixed effect estimators were employed so that each treated company serves as a comparison point for itself. Non-treated companies serve to identify and separate the effect of aggregate shock and changes in the environment to which both groups of companies were exposed. Therefore, the net effect of privatization is isolated.

This Chapter used data that were collected specifically for the purpose of this thesis and covered a period of seven years. The combination of PSM with DID is arguably the best methodology to address the issue of selection bias which is the main challenge in evaluating the effect of privatization on companies' performance. The problem of the identified serial correlation in the data was addressed using unobserved component model after confirming that Common Factor Restrictions hold.

The results indicated that, in terms of sales, privatization is associated with improvement in sales by almost 13 percent. On the other hand, employment is found to be negatively affected by privatization. The results suggest that after privatization, the level of employment dropped by 41 percent. However, these results ought to be interpreted with caution, as many workers were not actively engaged in any productive work even though they appeared on the payrolls of SOEs (without having received any wages). The sector and region of operation do not seem to explain differences in performance associated with privatization, while companies that are involved in export and those privatized through special spin-off exhibit higher performance improvement after privatization.

Contrary to the existing literature, this Chapter finds that companies that have at least 10 percent foreign ownership are associated with a drop in sales levels after privatization. Foreign ownership is found to be insignificant in case of employment. This may partly be explained by the fact that foreign ownership in this Chapter is captured by a relatively simple categorisation which is unable to differentiate between different foreign owners. Also, many of these companies were acquired by members of the Diaspora who might not possess the required know-how and skill to successfully restructure their companies as their decision to participate in the privatization process might have been motivated by other, non-economic reasons. This Chapter also found that following privatization sales continues to increase without interruption while employment suffers a large drop after privatisation and later on begins to grow.

To sum up, the main findings of this thesis are:

a. Companies in successor states of former Yugoslavia privatized by foreign investors outperform SOEs;
b. Companies in successor states of former Yugoslavia privatized by domestic investors display similar performance to SOEs;
c. Private foreign companies in successor states of former Yugoslavia have higher mean technical efficiency scores than SOEs and domestic de-novo private companies;
d. The mean technical efficiency scores of domestic private de-novo companies in successor states of former Yugoslavia is not statistically different from that of SOEs;
e. The heterogeneity across successor states of former Yugoslavia can also be partly explained by country characteristics and environment. Slovenian companies appear to be the most efficient followed by companies from Croatia, Montenegro, Bosnia, Serbia and Macedonia;
f. Privatization in Kosovo is associated with improvement in performance expressed in terms of sales and with a drop in employment levels;
g. Companies in Kosovo privatized by foreign investors display lower performance expressed in terms of sales than companies privatized by domestic investors;
h. Companies in Kosovo privatized by foreign investors display similar performance expressed in terms of employment to companies privatized by domestic investors;

i. Following privatization, the performance of companies in Kosovo expressed in terms of sales continue to increase without any break while employment suffers a significant drop after privatisation but later starts to pick up.

7.2 Contribution to knowledge

This thesis has made several contributions to knowledge in particular in the context of TEs and more significantly in the context of the transition in successor states of former Yugoslavia. So far there is no empirical evidence that jointly evaluates the impact of ownership and privatization on companies' performance in all successor states of former Yugoslavia. Also, there is no study that employs SFA in comparing the efficiency of firms with different ownership in these countries. To our knowledge, there is only one study (Kocenda, Hanousek and Masika, 2011) that uses this methodology in the context of TEs. However, even this study does not justify the choice of appropriate functional form and distributional assumptions that this methodology requires and does not properly control for selection bias.

Another contribution to knowledge of this thesis is that it employs data that are statistically representative for all countries under investigation while addressing the issue of missing data; a problem that is endemic in research employing survey data and is largely ignored in comparable studies without any discussion. Missing data are dealt with by using the Multiple Imputation procedure which is the most efficient way of addressing this issue. The use of Multiple Imputation increased the sample size and relaxed the assumption of missing completely at random, which is implicitly made in current literature without being acknowledged.

This thesis also investigates the privatization-induced performance changes in Kosovo empirically for the first time. Moreover, since the data for Kosovo have a longer time dimension, this investigation was also able to capture the dynamic effects of privatization. In addition, the use of policy evaluation techniques (in particular the combination of PSM with DID) has not been widely used in studies on privatisation as a remedy for estimation problems that are endemic in existing literature.

Similarly, by providing robust and statistically significant relationship between privatization and efficiency or sales, and in particular for finding robust and statistically significant negative relationship between privatization and employment, this thesis adds more evidence to the ambiguous theoretical and empirical literature on privatization in TEs.

The data used for this empirical investigation by the author is a primary dataset specifically collected through a large scale survey of a representative sample of companies in Kosovo. The sample was representative for both privatized and de-novo private companies, alleviating further the issue of sample selection bias.

Finally, this thesis has also contributed towards improvement of the BEEPS datasets. The author has identifying errors in the data which were reported to the World Bank and were subsequently corrected by the latter.

7.3 Policy implications

This thesis has provided evidence for a statistically significant relationship between ownership and companies' performance which has important policy implications. The main audience of these findings includes the government agencies in charge of designing and implementing privatization policies. These findings should also be interesting for other policy makers, such as parliament commissions. Privatization process is almost completed in all successor states of former Yugoslavia, therefore policy implications are not primarily directed towards these countries. However, these lesson can serve for other countries or for those sectors of the economy (like utilities) which are still not privatized.

First, results from the empirical investigation suggest that, in general, privatization seem to be associated with improvement in companies' performance expressed in terms of technical efficiency and real sales. Second, privatization to foreign investors is associated with higher efficiency in the successor states of former Yugoslavia. Therefore, it may be suggested that governments ought to encourage privatization-related foreign investments by: (i) improving the overall business environment which is conducive and attracts foreign investors, and (ii) designing a privatization process which does not discriminate against foreign investors.

Third, provided that privatization process seem to be associated with a drop in employment, policymakers should consider devising supporting schemes that will act as safety net for the laid off workers. Apart from alleviating the hardship of this transition, this would also increase the popular support for the policy.

7.4 Limitations

Besides the fact that this thesis has provided several important contributions to the existing literature, in particular in contributing towards improving the understanding of the ownership transformation and its impact on companies' performance in successor states of former Yugoslavia, still it has faced several limitations that need to be acknowledged and discussed.

First, the analysis related to successor states of former Yugoslavia relies on cross-sectional data and as such it cannot provide a dynamic assessment of the relationship between ownership and companies' performance. Also, in that context, the absence of information before privatization, makes it hard to control properly for pre-privatization condition of companies under investigation.

Second, the data for Kosovo and for the rest of successor states of former Yugoslavia provide only relatively simple categorisation of both private ownership and foreign ownership. Therefore, this thesis cannot distinguish between relatively homogeneous groups of owners within each group. Third, the data for successor states of former Yugoslavia did not provide information about the prices of inputs and outputs. Consequently this thesis was unable to account for both technical and allocative efficiency and had to be content with the former.

Fourth, in the case of Kosovo it was impossible to access information about the companies that were inactive after the privatization process. In turn, this missing information may be a source of a hidden bias. Finally, the data used for the successor states of former Yugoslavia and for Kosovo are not directly comparable. Therefore the thesis has had to use different methodologies and performance measures, reducing the comparability of the results for the two groups.

7.5 Directions for further research

Drawing on the limitations of this thesis, in what follows we try to elaborate a set of important points that can inform and direct future research in the field of privatization and company performance in the context of TEs and other countries that have similar characteristics.

First, given the theoretical and empirical ambiguity about the impact of privatization on companies' performance, and taking into account the availability of more recent studies on privatization, an updated Meta Regression Analysis that would follow the work of Djankov and Murrell (2002) is recommended.

Second, provided the data is available, it would be highly rewarding to supplement the quantitative analysis by using more qualitative information when controlling for selection bias. This would improve the understanding of the process of selection into privatization and improve the reliability of the results.

Third, future studies that employ SFA would greatly benefit from utilising data on prices of inputs and output. This would allow for decomposition of efficiency (inefficiency) component into technical and allocative efficiency (inefficiency). In turn, this would enable the identification of the source of inefficiency and departure from optimal frontier (cost minimizing, revenue or profit maximizing). This is particularly important from policy perspective as it would inform the policy making process.

Fourth, future studies would greatly benefit from finding more information about the type of new owners after privatization (including the extent and quality of foreign ownership) which would produce more insightful results on the relationship between the ownership structure and companies' performance. In particular, the extent of foreign ownership would allow to test for a non-linear relationship between foreign ownership and companies' performance. Last, broadening the time span of data could increase the quality of estimation and better capture the dynamic relationship between ownership and performance.

References

Aakvik, A. (2001) Bounding a Matching Estimator: The Case of a Norwegian Training Program, *Oxford Bulletin of Economics and Statistics*, 63(1), pp. 115-143.

Adam, C., Cavendish, W. and Mistry, S.P. (1992) *Adjusting Privatization: Case studies,* James Currey Ltd, London.

Afriat, S. N. (1972) Efficiency estimation of production functions. *International Economic Review*, 13(3), pp. 568–598.

Aghion, P. and Bolton, P. (1992) An Incomplete Contracts Approach to Financial Contracting, *Review of Economic Studies*, 59, pp. 473–494.

Aigner, D. and Chu, S. (1968) On Estimating the Industry Production Function, *American Economic Review*, Vol. 58, pp. 826-839.

Aigner, D., Lovell, C. A. K. and Schmidt, P. (1977) Formulation and estimation of stochastic frontier production function models, *Journal of Econometrics,* Vol. 6, pp. 21-37.

Akimova, I. and Schwödiauer, G. (2004) Ownership Structure, Corporate Governance and Enterprise Performance: Empirical Results for Ukraine, *International Advances in Economic Research*, 10(1), pp. 28-42.

Alchian, A. and Kessel, R. (1962) Competition, Monopoly and the Pursuit of Money, in *Aspects of Labor Economics*, edited by the National Bureau of Economic Research, Princeton: Princeton University Press.

Alchian, A.A. (1965) Some Economics of Property Rights, *Politico*, 30, pp. 816–829.

Alchian, A.A. (1977) *Economic Forces at Work*, Liberty Press, Indianapolis.

Allen, F. and Gale, D. (1999) Corporate Governance and Competition, Working Paper, Wharton School: The University of Pennsylvania, Philadelphia.

Allen, F. and Gale, D. (1999) Corporate Governance and Competition, Working paper, Wharton School, The University of Pennsylvania, Philadelphia PA.

Allison, P. D. (2002) *Missing data*, California: Sage Publications.

Andreyeva, T. (2003) Company performance in Ukraine. What governs its success, Economics Education and Research Consortium Working Paper 03/01.

Angelucci, M., Estrin, S., Konings, J. and Zólkiewski, Z. (2002) The Effect of Ownership and Competitive Pressure on Firm Performance in Transition Countries: Micro Evidence from Bulgaria, Romania and Poland, Working Paper 434, The William Davidson Institute.

Angrist, J. and Pischke, S. (2008) *Mostly Harmless Econometrics: An Empiricist's Companion,* Princeton: University of Princeton Press.

Arrow, K. (1962) Economic Welfare and the Allocation of Resources to Invention, In The Rate and Direction of Inventive Activity: Economic and Social Factors, edited by Universities- National Bureau Committee for Economic Research and the Committee on Economic Growth of the Social Science Research Councils, Princeton, NJ: Princeton University Press.

Ashenfelter, O. (1978) Estimating the effect of training programs on earnings, *Review of Economics and Statistics,* 60, pp. 47-57.

Ashenfelter, O. and Card, D. (1985) Using the longitudinal structure of earnings to estimate the effect of training programs, *Review of Economics and Statistics*, 67, pp. 648-60.

Averch, H. and Johnson, L. (1962) Behavior of the Firm under Regulatory Constraint, *American Economic Review*, 52, pp. 1052-69.

Azar, B. (2002) Finding a solution for missing data, *Monitor on Psychology*, 33, pp. 70.

Bakanova, M., Estrin, S., Pelipas, I. and Pukovic, S. (2006) Enterprise Restructuring in Belarus, William Davidson Institute Working Paper 823.

Baltagi, B.H. (2001). *Econometrics Analysis of Panel Data*, Chichester: Wiley.

Barnard, J. and Meng, X.L. (1999) Applications of Multiple Imputation in Medical Studies: From AIDS to NHANES, *Statistical Methods in Medical Research*, 8, pp. 17–36.

Barr, R. and Siems, T. (1994) Predicting bank failure using DEA to quantify management Quality. Federal Reserve Bank of Dallas, Financial Industry Studies Working Paper No. 1-94.

Batt, J. (1994) Political Dimensions of Privatization in Eastern Europe, in: Estrin, S. (ed.), *Privatization in Central and Eastern Europe*, London: Longman Group.

Battese, G.E. and Coelli, T.J. (1993) A stochastic frontier production function incorporating a model for technical inefficiency effects, working Papers in Econometrics and Applied Statistics No. 69, Department of Econometrics, University of New England, Armidale.

Bauer, P.W., Berger, A.N., Ferrier, G.D. and Humphrey, D.B. (1998) Consistency Conditions for Regulatory Analysis of Financial Institutions: A Comparison of Frontier Efficiency Methods, *Journal of Economics and Business*, 50, pp. 85-114.

Bayliss, K. (2005) Post-Conflict Privatisation: A Review of Developments in Serbia and Bosnia Herzegovina. ESAU Working Paper no. 12.

Becker, S. and Ichino, A. (2002) Estimation of Average Treatment Effects Based on Propensity Scores, *Stata Journal*, v2, n4, pp. 358-377.

Begović, B., Mijatović, B. and Živković, B. (2000) *The New Model of Privatization in Serbia*. Belgrade: Centre for Liberal Democratic Studies.

Bel, G. (2006) The Coining of Privatization and Germany's National Socialist Party, *Journal of Economic Perspectives*, 20, pp. 187-194.

Bera, A. K. and Sharma, S.C.(1999) Estimating Production Uncertainty in Stochastic Frontier Production Function Models, *Journal of Productivity Analysis,* 12:3, pp. 187-210.

Berger, A.N. (1993) Distribution-free estimates of efficiency in the U.S. banking industry and tests of the standard distributional assumptions, *The Journal of Productivity Analysis*. 4 (3), pp. 261-292.

Berger, A.N. and Mester, L.J. (1997) Inside the black box: What explains differences in the efficiencies of financial institutions, *Journal of Banking and Finance*, 21(7), pp. 895-947.

Bevan, A., Estrin, S. and Schaffer, M. (1999) Determinants of Enterprise Performance during Transition, Centre for Economic Reform and Transformation Working Paper 99/03.

Bishop, M. and Kay, J. (1988) *Does Privatisation Work? Lessons from the UK,* London: Centre for Business Strategy, London Business School.

Bishop, M. and Kay, J. A. (1989) Privatization in the United Kingdom: Lessons From Experience, *World Development,* 17, pp. 643-657.

Blanchard, Olivier.1997. *The Economics of Post-Communist Transition*, Oxford: Oxford University Press.

Bliss, R.T., Polutnik, L. and Pahar, M. (2007) "Entrepreneurship vs. privatization: the case of Slovenia: summary, *Frontiers of Entrepreneurship Research*: Vol. 27, 12, Article 2.

Blundell, R. and Costa Dias, M. (2000) Evaluation Methods for Non-Experimental Data, *Fiscal Studies*, vol. 21, no. 4, pp. 427-468.

Blundell, R. and Costa Dias, M. (2002) Alternative Approaches to Evaluation in Empirical Microeconomics, Institute for Fiscal Studies Centre for Microdata Methods and Practice Working Paper CWP10/02.

Blundell, R. and Costa Dias, M. (2009) Alternative Approaches to Evaluation in Empirical Microeconomics, *Journal of Human Resources*, Vol. 44, No. 3, pp. 565–640.

Blundell, R., Costa Dias, M., Meghir and Reenen, J.V. (2004) Evaluating the Employment Impact of a Mandatory Job Search Assistance Programme, *Journal of the European Economics Association,* 2(4), pp. 569-606.

Blundell, R., Duncan, A. and Meghir, C. (1998) Estimating Labor Supply Responses Using Tax Reforms, *Econometrica*, 66(4), pp. 827–61.

Bolton, P. and Roland, G. (1997) The Breakup of Nations: A Political Economy Analysis, *Quarterly Journal of Economics,* 112, pp. 1057–90.

Bonin, J.P. and Fukuda, W. (1996) The Multifactor Illyrian Firm Revisited, *Journal of Comparative Economics*, 10(2), 171-180.

Bonin, J.P., Hasan, I. and Wachtel, P. (2005) Bank Performance, Efficiency and Ownership in Transition Countries, *Journal of Banking and Finance*, 29, pp. 31-53.

Borcherding, T.E. (1977) *Budgets and bureaucrats: The sources of government growth*, Durham: Duke University Press.

Bos, J.W.B., Heid, F., Koetter, M., Kolari, J.W. and Kool, C.J.M. (2005) Inefficient or just different? Effects of heterogeneity on banking efficiency scores, Discussion Paper Series 2: Banking and Financial Studies 15/2005: 42pp Deutsche Bundesbank, Frankfurt am Main, Germany.

Boston, J. (1991) The Theoretical Underpinnings of Public Sector Restructuring in New Zealand, in: Boston, J., Martin, J., Pallot, J. and Walsh, P. (eds.), *Reshaping the State*, Auckland: Oxford University Press.

Boycko, M., Shleifer, A. and Vishny, R. W. (1996) A Theory of Privatization, *The Economic Journal,* Volume 106, No. 435, pp. 309-319.

Boycko, M., Shleifer, A. and Vishny, R.W. (1995) *Privatizing Russia*, Cambridge MA: MIT Press.

Boycko, M., Shleifer, Sh. and Vishny, R. W. (1994) Voucher Privatization, *Journal of Financial Economics,* 35, pp. 249-266.

Brada, J. C. (1996) Privatization in Transition- Or is it?, *Journal of Economic Perspectives,* Vol. 10, No.2, pp. 67-86.

Brock, B. and Durlauf, S. (2000) Interaction-Based Models, NBER Technical Working Paper 258.

Brown, J.D. and Earle, J.S. (2002) Gross Job Flows in Russian Industry Before and After Reforms: Has Destruction Become More Creative?, *Journal of Comparative Economics*, 30(1), pp. 96-133.

Brown, J.D., Earle, J.S. and Telegdy, A. (2006) The Productivity Effects of Privatization: Longitudinal Estimates from Hungary, Romania, Russia, and Ukraine, *Journal of Political Economy*, 114(1), pp. 61-99.

Bryson, A., Dorsett, R., and Purdon, S. (2002) The Use of Propensity Score Matching in the Evaluation of Labour Market Policies, Working Paper No. 4, Department for Work and Pensions.

Buchanan, J. M. (1972) *Theory of Public Choice*, Ann Arbor: University of Michigan Press.

Buchanan, J.M. (1977) Why Does Government Grow?, in: Borcherding, T.E. (ed.), *Budgets and Bureaucrats: The Sources of Government Growth*, Durham: Duke University Press.

Buchanan, J.M. (1978) Markets, States, and the Extent of Morals. *The American Economic Review* Vol. 68, No. 2, pp. 364-368.

Buchanan, J.M. and G. Tullock. (1962) *The Calculus of Consent: Logical Foundations of Constitutional Democracy*. Ann Arbor: University of Michigan Press.

Burtless, G. (1995) The Case for Randomized Field Trials in Economic and Policy Research, *Journal of Economic Perspectives*, 9(2), pp. 63-84.

Calcagno, P.T., Hefner, F. and Dan, M. (2006) Restructuring before privatization - putting the cart before the horse: a case study of the steel industry in Romania, *Quarterly Journal of Austrian Economics*, 9:1, pp. 27-45.

Caliendo, M. and Kopeinig, S. (2005) Some practical guidance for the implementation of propensity score matching, IZA Discussion Paper No. 1588. Bonn, Germany.

Cameron, A. C. and Trivedi, P. K. (2009) *Microeconometrics Using Stata,* College Station Texas: Stata Press.

Cameron, A.C, and Trivedi, P.K. (2005) *Microeconometrics: Methods and Applications*. Cambridge and New York: Cambridge University Press.

Canning, A. and Hare, P. (1994) The privatization process - economic and political aspects of the Hungarian approach, in: Estrin, S. (ed.), *Privatization in Central and Eastern Europe*, Harlow: Longman.

Card, D. (1990) The Impact of the Mariel Boatlifton the Miami Labor Market, *Industrial and Labor Relations Review*, 43(2), pp. 245–57.

Card, D. and Krueger, A.B. (1994) Minimum Wages and Employment: A Case Study of the Fast- Food Industry in New Jersey and Pennsylvania, *American Economic Review*, 84(4), pp. 772–93.

Carlin, W. and Mayer, C. (1992) Restructuring Enterprises in Eastern Europe, *Economic Policy*, 15: 311-346.

Carlin, W., Fries, S., Schaffer, M.E. and Seabright, P. (2001) Competition and Enterprise Performance in Transition Economies: Evidence from a Cross-country Survey, CEPR Discussion Paper 2840.

Caudill, S.B. and Ford, J.M. (1993) Biases in frontier estimation due to heteroscedasticity, *Economics Letters*, 41, pp. 17-20.

Caudill, S.B., Ford, J.M. and Gropper, D.M. (1995) Frontier Estimation and Firm Specific Inefficiency Measures in the Presence of Heteroscedasticity, *Journal of Business & Economic Statistics*, 13, pp. 105-111.

Cerovic, B. (2010) Impact of Initial Conditions on Transition Progress: The Case of Montenegro, *South-Eastern Europe Journal of Economics*, 8, pp. 153-171.

Charnes A., Cooper, W.W., Lewin, A.Y. and Seiford, L.M. (1994) *Data envelopment analysis: theory, methodology and application*. Boston: Kluwer Academic Publishers.

Choksi, A. M. (1979) State Intervention in the Industrialization of Developing Countries, World Bank, Staff Working Paper 341, Washington DC.

Chong, A. and Galdo, V. (2002) Streamlining and Privatization Prices in the Telecommunications Industry. Working paper, Inter-American Development Bank, Washington DC.

Chong, A., and Lopez-de-Silanes, F. (2002) Privatization and labor force restructuring around the world. Working paper, Yale University, New Haven CT.

Christensen, L.R. and Greene, W.H. (1976) The Journal of Political Economy, Vol. 84, pp. 655-676.

Christensen, L.R., Jorgensen, D.W. and Lau, L.J. (1971) Transcendental logarithmic production frontiers, *The Review of Economics and Statistics*, 55, pp. 28-45.

Claessens, S. and Djankov, S. (2002) Privatization Benefits in Eastern Europe, *Journal of Public Economics,* Volume 83, pp. 307-324.

Cobb, C. W. and Douglas P. H. (1928) A theory of production. *American Economic Review* 18(1), pp. 139–165.

Coelli, T. (1996) A guide to DEAP Version 2.1. A Data Envelopment Analysis Computer Program. Centre for Efficiency and Productivity Analysis, Department of Econometrics, University of New England, Armidale, Australia.

Coelli, T., Rao, D. S. P., O'Donell, C. J. and Battese, G. E. (2005) *An introduction to Efficiency and Productivity Analysis*, New York: Springer.

Collins, L.M., Schafer, J.L. and Kam, C.M. (2001) A comparison of inclusive and restrictive strategies in modern missing data procedures, *Psychological Methods*, 6, pp. 330–51.

Commander, S. and Svejnar, J. (2007) Do Institutions, Ownership, Exporting and Competition Explain Firm Performance? Evidence from 26 Transition Countries, mimeo.

Cook, P. and Kirkpatrick, C. (1988) Privatisation in Less Developed Countries. New York: St. Martin's Press.

Coricelli, F. and Rocha, R. (1991) A comparative analysis of the Polish and Yugoslav programmes, in: Marer, P. and Zecchini, S. (eds.), *The transition to a market economy,* Paris: OECD.

Crnobrnja, M. (1994) *The Yugoslav drama*, London: I.B.Tauris.

Cull, R., Matesova, J. and Shirley, M. (2002) Ownership Structure and the Temptation to Loot. Evidence from Privatized Firms in the Czech Republic, *Journal of Comparative Economics*, 30(1), pp. 1-24.

Davies, D.G. (1971) The Efficiency of Public versus Private firms: The Case of Australia's Two Airlines, *Journal of Law and Economics*, 14:1, pp. 149–165.

De Alessi, L. (1987) Property rights and privatization, Proceedings of the Academy of Political Science 36 (3), 24–35.

De Alessi, L. (1983) Property rights, transaction costs, and X-efficiency: An essay in economic theory, *American Economic Review*, 73, pp. 64-81.

De Alessi, L. (1980) The Economics of Property Rights: A Review of the Evidence, in Zerbe, R. (ed.), *Research in Law and Economics: a research annual*, Greenwich: Jai Press.

De Alessi, L. (1969) Implications of Property Rights for Government Investment Choices, *American Economic Review*, 59, pp. 16-23.

Dehejia, R. and Wahba, S. (2002) Propensity score matching methods for nonexperimental causal studies, *Review of Economics and Statistics*, 84(1), pp. 151-161.

Dempster, A. P., Laird, N. M. and Rubin, D. B. (1977) Maximum likelihood from incomplete data via the EM algorithm, *Journal of Royal Statistical Society*, Series B, 39, pp. 1-38.

Demsetz, H. A. (1968) Why Regulate Utilities?, *Journal of Law and Economics*, Vol. 11. pp. 55-66.

Demsetz, H. A. (1967) Toward a Theory of Property Rights, *The American Economic Review*, Vol. 57, issue 2, pp. 347-359.

Djankov, S. and Murrell, P. (2002) Enterprise Restructuring in Transition: A Quantitative Survey, *Journal of Economic Literature*, 40(3), pp.739-92.

Dobrinsky, R., Dochev, N., Mashiah, S. and Markov, N. (2001) Productivity and the Sources of Firm Level Efficiency in Bulgarian Manufacturing, In Final Report on ACE Project P97-8099-R: The determinants of Firm Level Prodduction Efficiency in Poland, Romania and Bulgaria: Ownership Effects, Competition Effects and Implications for EU Enlargement, co-ordinated by Jozef Konings.

Domadenik, P., Prasnikar, J. and Svejnar, J. (2003) Defensive and Strategic Restructuring of Firms during the Transition to a Market Economy. The William Davidson Institute Working Paper 541.

Domar, E. (1966) The Soviet Collective Form as a Producer Co-Operative, *American Economic Review*, 56, pp. 734-757.

Donais, T. (2002) The Politics of Privatization in Post-Dayton Bosnia, *Southeast European Politics*, Vol. III, No. 1, pp 3-19.

Downs, A. (1967) *Inside Bureaucracy*. Boston: Little, Brown and Company.

Drucker, P. F. (1969) *The Age of Discontinuity*, New York: Harper & Row.

Durrant, G. B. (2005) Imputation Methods for handling Item Nonresoponse in Social Sciences: A Methodological Review, NCRM Methods Review Papers, ESRC National Centre for Research Methods and Southampton Statistical Sciences Research Institute (S3RI), University of Southampton, NCRM/002.

Earle, J.S. and Estrin, S. (2003) Privatization, Competition, and Budget Constraints: Disciplining Enterprises in Russia, *Economics of Planning*, 36(1), pp. 1-22.

Earle, J.S. and Estrin, S. (1997) After voucher privatization: the structure of corporate ownership in Russian manufacturing industry, CEPR Discussion Paper No. 1736.

Earle, J.S. and Telegdy, A. (2002) Privatization Methods and Productivity Effects in Romanian Industrial Enterprises, *Journal of Comparative Economics*, 30(4), pp. 657-82.

EBRD, (various years), annual transition reports, London: *European Bank for Reconstruction and Development*.

El-Gamal, M.A. and Inanoglu, H. (2005) Inefficiency and heterogeneity in Turkish banking: 1990- 2000, *Journal of Applied Econometrics*, 20, pp. 641-664.

Ellman, M. (1989) *Socialist Planning*, Cambridge: Cambridge University Press.

Esser, J. (1998) Privatisation in Germany: symbolism in the social market economy?, in Parker, D. (ed.), *Privatisation in the European Union: Theory and Policy Perspectives*, London: Routledge.

Estrin, S. (1994) Economic transition and privatization: the issues, in Estrin, S. (ed.), *Privatization in Central and Eastern Europe*, New York: Longman Publishing.

Estrin, S. (1991) Yugoslavia: The Case of Self-Managing Market Socialism, *The Journal of Economic Perspectives*, Vol. 5, No. 4, pp. 187-194.

Estrin, S., Hanousek, J., Kocenda, E. and Svejnar, J. (2009) The Effects of Privatization and Ownership in Transition Economies. *Journal of Economic Literature* 47, 699–728.

Estrin, S. and Perotin, V. (1991) Does Ownership Always Matter? *International Journal of Industrial Organization*, 9, 1:55–72.

Estrin, S. and Svejnar, J. (1985) Explanations of earnings in Yugoslavia: the capital and labour schools compared, *Economic Analysis and Workers Management*, 19 (1), 1-12.

Estrin, S. and Bartlett, W.J. (1982) The effects of self-management: an empirical survey, in: Jones, D.C. and Svejnar, J. (eds.), *Participatory and Self-Managed Firms: Evaluating Economic Performance*. Lexington: Lexington Books.

Faggio, G. and Konings, J. (2003) Job Creation, Job Destruction and Employment Growth in Emerging Market Economies, *Economic Systems*, 27(2), pp. 129- 54.

Farrell, M. J. (1957) The measurement of productive efficiency, *The Journal of Royal Statistical Society*, 120, pp. 253-281.

Flaherty, D. (1988) Plan, Market and Unequal Regional Development in Yugoslavia, *Soviet Studies*, Vol.XL, No.1, pp. 100-124.

Flaherty, D. (1982) Economic Reform and Foreign Trade in Yugoslavia, *Cambridge Journal of Economics,* Vol.6, No.2, pp. 105-142.

Franicevic, V. (1999) Privatization in Croatia: Legacies and Context, *Eastern European Economics*, vol. 37, No. 2, pp. 5-54.

Fried, H., Lovell, K. C. and Schmidt, S. (2008) Efficiency and Productivity in: Fried H, Knox Lovell C, Schmidt (eds.), *The Measurement of Productive Efficiency and Productivity Growth,* Oxford: Oxford University Press.

Frydman, R., Gray, C., Hessel, M. and Rapczynski, A. (1999) When Does Privatisation Work? The Impact of Private Ownership on Corporate Performance in the Transition Economies, *The Quarterly Journal of Economics*, pp.115-1191.

Frydman, R., Gray, C., Hessel, M. Rapaczynski, A. (2000) The Limits of Discipline: Ownership and Hard Budget Constraints in the Transition Economies, *Economics of Transition,* 8(3), pp. 577-601.

Frydman, R., Hessel, M. and Rapaczynski, A. (2000) Why Ownership Matters? Entrepreneurship and the Restructuring of Enterprises in Central Europe, C.V. Starr Center for Applied Economics, New York University Working Paper 00-03.

Furubotn, E.G. and Pejovich, S. (1972) Property Rights and Economic Theory: A Survey of Recent Literature, *Journal of Economic Literature*, Vol. 10, issue 4, pp. 1137-1162.

Furubotn, E.G. (*1971) Toward a Dynamic* Model of the Yugoslav Firm, *The Canadian Journal of Economics*, vol. 4, no 2.

Furubotn E.G. and Pejovich S. (1970) Property Rights and the Behaviour of the Firm in Socialist State: The Example of Yugoslavia, *Zeitschrift für Nationalökonomie*, vol. 30, no. 5, pp. 431-454.

Galal, A., Jones, L., Tandon, P. and Vogelsang, I. (1994) *Welfare Consequences of Selling Public Enterprises: An Empirical Analysis*, published for the World Bank by Oxford University Press.

Galiani, S., Gertler, P. and Schargrodsky, E. (2005) Water for Life: The Impact of the Privatization of Water Services on Child Mortality, *Journal of Political Economy* 113(1), pp. 83–120.

Gelman, A., Van Mechelen, I., Verbeke, G., Heitjan, D.F. and Meulders, M. (2005) Multiple imputation for model checking: Completed-data plots with missing and latent data, *Biometrics,* 61, pp. 74–85.

Gertler, P.J., Martinez, S., Premand, P., Rawlings, L.B. and Vermeersch, C.M.J. (2010) Impact Evaluation in Practice. Washington DC: World Bank.

Glaeser, E.L. and Scheinkman, J.A. (1996) The Transition to Free Markets: Where to Begin Privatization, *Journal of Comparative Economics*, 22, pp. 23–42.

Glennerster, R. (2003) Evaluating Privatization in the Former Yugoslav Republic of Macedonia. Working paper, Kennedy School, Harvard University, Cambridge, MA.

Gligorov, V. (2004) Socialism and the Disintegration of SFR Yugoslavia, in: Mrak, M., Rojec, M. and Silva-Jáuregui, C. (eds.), *Slovenia: From Yugoslavia to the European Union* Washington: World Bank.

Goldberg, V.P. (1976) Regulation and Administered Contracts, *Bell Journal of Economics*, 7(2).

González-Eiras, M. and Rossi, M. (2007) The Impact of Electricity Sector Privatization on Public Health, Research Network Working Paper R-524. Washington, DC: Inter-American Development Bank.

Goud, R.B. (2003) The Determinants of Firm Performance: Empirical Evidence from 25 Countries in Central and Eastern Europe and the Former Soviet Union. Senior thesis, Reed College, Portland.

Graham, B.S. (2008) Identifying Social Interactions through Conditional Variance Restrictions, *Econometrica*, 76(3), pp. 643–60.

Graham, J. W. (2009) Missing Data Analysis: Making it Work in the Real World, *Annual Review of Psychology* 60:549-576.

Graham, J. W., Cumsille, P.E. and Elek-Fisk, E. (2003) Methods for handling missing data, in: Schinka, J.A. and Velicer, W. F. (eds.), *Research methods in psychology*. Volume 2 of Handbook of Psychology (I. B. Weiner, Editor-in-Chief). New York: Wiley.

Graham, J. W. and Hofer, S. M. (2000). Multiple imputation in multivariate research, in: Little, T.D., Schnabel, K.U. and Baumert, J. (eds.), *Modeling longitudinal and multiple-group data: Practical issues, applied approaches, and specific examples*, Hillsdale, NJ: Erlbaum.

Green, R. and Vogelsang, I. (1994) British Airways: A Turn-Around Anticipating Privatization, in: Bishop, M., Kay, J. and Mayer, C. (eds.), *Privatization and Economic Performance,* Oxford: Oxford University Press.

Greene, J.D. (2002) *Cities and Privatization: Prospects for the New Century*, Upper Saddle River: Prentice Hall.

Greene, W.H. (1980) On the Estimation of a Flexible Frontier Production Model, *Journal of Econometrics,* 3, pp. 101-115.

Greene, W.H. (1990) A gamma-distributed stochastic frontier model, *Journal of Econometrics*, Vol. 46, pp. 141-163.

Greene, W.H. (2006) A General Approach to Incorporating 'Selectivity' in a Model, Working Paper EC- 06-10, Stern School of Business, New York University, 2006.

Greene, W. H. (2008) The econometric approach to efficiency analysis, in: Fried. H., Lovell, K. and Schmidt, P. (eds.), *The measurement of productive efficiency and productivity growth,* Oxford: Oxford University Press.

Greene, W.H. (2008a) A Stochastic Frontier Model with Correction for Sample Selection, Working Paper EC- 08-09, Stern School of Business, New York University.

Greene, W.H. (2007) *Limdep, Version 8.0. Econometric Modeling Guide, Volume 2.* Econometric Software Inc.

Grigorian, D.A. (2000) Ownership and Performance of Lithuanian Enterprises, The World Bank Policy Research Working Paper Series 2343.

Grosfeld, I. and Tressel, T. (2002) Competition and Ownership Structure: Substitutes or Complements? Evidence from the Warsaw Stock Exchange, *Economics of Transition*, 10(3), pp. 525-551.

Grossfeld, I. and Hashi, I. (2001) The Evolution of Ownership Structure in Firms Privatised through Wholesale Schemes in the Czech Republic and Poland, Centre for Social and Economic Research, CASE Reports No. 49.

Grout, P.A. and Stevens, M. (2003) The Assessment: Financing and Managing Public Services, *Oxford Review of Economic Policy* 19(2): pp. 215-254.

Gupta, N., Ham, J.C. and Svejnar, J. (2001) Priorities and Sequencing in Privatization: Evidence from Czech Firm Panel Data, *European Economic Review*, 52 (2), pp. 183– 208.

Hadzic, M. (2002) Rethinking privatization in Serbia, *Eastern European economics*, Vol. 40, 6, pp. 6-23.

Hagemejer, J., Svejnar, J. and Tyrowicz, J. (2014) Measuring the Causal Effect of Privatization on Firm Performance, EACES Biennal Conference proceedings, Budapest, 4–6.

Hanousek, J., Kocenda, E. and Svejnar, J. (2007) Origin and Concentration: Corporate Ownership, Control, and Performance in Firms after Privatization, *Economics of Transition*, 15(1), pp. 1-31.

Hare, P. (1994) Privatization in comparative perspective: An overview of the emerging issues, in Estrin, S. (ed.), *Privatization in Central and Eastern Europe*, New York: Longman Publishing.

Hasenkamp, G. (1976) A Study of Multiple-Output Production Functions, *Journal of Econometrics*, Vol. 4, pp. 253-262.

Hashi, I. (1992) The disintegration of Yugoslavia: Regional disparities and the nationalities question, *Capital and Class*, 48, pp.41-88.

Havrylyshyn, O. and McGettigan, D. (1999) Privatization in Transition Countries: A Sampling of the Literature, IMF Working Paper, No. 99/6.

Heckman, J., LaLonde, R. and Smith, J. (1999) The Economics and Econometrics of Active Labor Market Programs, in: Ashenfelter, O. and Card, D. (eds.), *Handbook of Labor Economics Vol.III*, Amsterdam: Elsevier.

Heckman, J., Ichimura, H. and Todd, P.E. (1998) Matching as an econometric evaluation estimator, *Review of Economic Studies*, 65, pp. 261-94.

Heckman, J., Smith, A. and Clements, N (1997) Making the most out of programme evaluations and social experiments: accounting for heterogeneity in programme impacts, *Review of Economic Studies*, 64, pp. 487-535.

Heckman, J. and Hotz, V.J. (1989) Choosing Among Alternative Methods of Estimating the Impact of Social Programs: The Case of Manpower Training, *Journal of the American Statistical Association*, 84(408), pp. 862-874.

Heckman, J. (1979) Sample Selection Bias as a Specification Error, *Econometrica*, 47, pp. 153–161.

Hey, J.D. (1981) A Unified Theory of the Behaviour of Profit Maximizing, Labour-Managed and Joint-Stock Firms Operating Under Uncertainty, *Economic Journal*, Vol.92, pp. 364-74.

Hicks, J. (1935) The Theory of Monopoly: A Survey, *Econometrica*, Vol. 3, pp. 1-20.

Hiller, S. J. and Drezga, P. S. (1996) Progress and Challenges of Privatization: The Croatian Experience (Participation of Nongovernmental Parties in the World Trade Organization), *Journal of International Law*, Volume 17, pp. 383-413.

Hillman, A. L. and Milanovic, B. (1992) *Transition from Socialism in Eastern Europe: Domestic restructuring and Foreign Trade*, Washington DC: The World Bank.

Hodge, G. (2000) *Privatization: An International Review of Performance*. Boulder: Westview Press.

Holland, P. W. (1986) Statistics and causal inference. *Journal of the American Statistical,* Vol. 81, No. 396, pp. 945-960.

Holmstrom, B. and Milgrom, P. (1987) Aggregation and Linearity in the Provision of Intertemporal Incentives, *Econometrica*, 55, pp. 303-28.

Horrace, W.C. and Schmidt, P. (1996) Confidence statements for efficiency estimates from stochastic frontier models. *Journal of Productivity Analysis,* 7, pp. 257–282.

Horton, N. J. and Laird, N. M. (1999) Maximum Likelihood Analysis of Generalized Linear Models with Missing Covariates, *Statistical Methods in Medical Research*, 8, pp. 37–50.

Horvat B. (1986) Farewell to the Illyrian Firm, *Economic Analysis and Workers' Management,* Vol. XX, no. 1, pp. 23-29.

Horvat B. (1984) Work and Power: the Prospects for the Disalienation of Work, *Economic Analysis and Workers' Management,* vol.XVIII, no. 4, pp. 365-369.

Horvat, B. (1982) *The Political Economy of Socialism*, Oxford: Martin Robertson Press.

Horvat, B. (1976) *The Yugoslav Economic System*, New York: ME Sharpe.

Horvat, B. (1972) Critical Notes on the Theory of the Labor-Managed Firm and Some Macroeconomic Implications, *Ekonomska Analiza*, Vol.6, pp. 291-294.

Horvat, B. (1967) Prilog zasnivanja teorije jugoslavenskog poduzeca, *Economic Analysis and Workers' Management*, 1(1–2), pp. 1–7.

Hunya, G. and Kalotay, K. (2000) FDI and privatization in Central and Eastern Europe, *Transnational Corporations*, Vol 9 No. 1. pp. 39-66

Husain, A.M. and Sahay, R. (1992) Does Sequencing of Privatization Matter in Reforming Planned Economies?, IMF Staff Paper, Vol. 39, No. 4, pp. 801-824.

Imbens, G.W. and Wooldridge, J.M. (2009) Recent developments in the econometrics of program evaluation, *Journal of Economic Literature*, 47 (1), pp. 5–86.

Imbens, G.W. (2004) Nonparametric estimation of average treatment effects under exogeneity: a review, *Review of Economics and Statistics,* 86, pp. 4-29.

Irdam, D., Scheiring, G. and King, L. (2016) Mass Privatiaztion, in: **Hölscher**, J. and **Tomann**, H. (eds.), *Palgrave Dictionary of Emerging Markets and Transition Economics*, London: Palgrave Macmillan.

Ireland, N. J. (1987) The economic analysis of labour-managed firms, *Bulletin of Economic Research,* 39: 4.

Jelic, R., Briston, R. and Aussenegg, W. (2003) The Choice of Privatization Method and the Financial Performance of Newly Privatized Firms in Transition Economies, *Journal of Business Finance & Accounting*, 30, 7-8, pp. 905–940.

Jensen, M. C. and Meckling, W. H. (1976) Theory of the Firm: Managerial Behaviour, Agency Costs and Ownership Structure, *Journal of Financial Economics,* 3 (4), pp. 305-60.

Johnson, R.A. and Walzer, N. (2000) *Local Government Innovation: Issues and Trends in Privatization and Managed Competition*. Westport: Quorum Books.

Jondrow, J., Lovell, C., Schmidt, P. and Materov, I. (1982) On the estimation of technical inefficiency in the stochastic frontier production function model, *Journal of Econometrics*, vol.19, pp.233-238.

Jones, D.C. and Mygind, N. (2002) Ownership and Productive Efficiency: Evidence from Estonia, *Review of Development Economics*, 6(2), pp. 284-301.

Jones, D.C. and Mygind, N. (2000) The Effects of Privatization on Productive efficiency: Evidence from the Baltic Republics, *Annals of Public and Cooperative Economics*, 71(3), pp. 415-40.

Jovanovic, B. (1982) Selection and evolution of industry, *Econometrica*, 50(3), pp. 649–670.

Kaparakis, E.I., Miller, S.M. and Noulas, A.G. (1994) Short-Run Cost Inefficiency of Commercial Banks: A Flexible Frontier Approach. *Journal of Money, Credit and Banking*, 26(4), pp. 875-893.

KAS (2015) Results of the national accounts, *Annual Report*, Kosovo Agency of Statistics, Prishtina.

KAS (2013) Results of the labour force survey, *Annual Report*, Kosovo Agency of Statistics, Prishtina.

Kay, J.A. and Thompson, D.J. (1986) Privatization: a policy in search of a rationale, *The Economic Journal*, Vol. 96, pp.18-32.

Khandker, S.R., Koolwal, G. and Samad, H. (2010) Handbook on impact evaluation: Quantitative methods and practices. Washington, DC: World Bank.

Kikeri, S. and Nellis, J. (2002) Privatization in Competitive Sectors: The Record to Date, World Bank Policy Research working paper 2860, Washington DC.

KIPRED (2005) The United Nations Mission in Kosovo and the privatization of socially-owned property: a critical outline of the of the present privatization process in Kosovo, *Research Report*, Kosovo Institute for Policy Research and Development, Prishtina.

Kiss, J. (1994) Debt Management in Eastern Europe, *Eastern European Economics*, vol. 32, No. 3, pp. 52-75.

Kling, J.R., Jeffrey, B.L. and Lawrence, F.K. (2007) Experimental Analysis of Neighbourhood Effects, *Econometrica* 75 (1), pp. 83–119.

Knezevic, C.L., Domadenik, P. and Prasnikar, J. (2008) Performance, ownership, and management turnover in privatized Slovenian companies, *Eastern European economics*, Vol. 46, no. 4, pp. 77-93.

Kocenda, E., Hanousek, J. and Masika, M. (2011) Financial Efficiency and the Ownership of Czech Firms, William Davidson Institute Working Paper, No. 1016

Konings, J. and Xavier, A. (2003) Firm Performance and Selection in an Emerging Economy: Micro Evidence from Slovenia, Royal Economic Society Annual Conference 2003, 127.

Konings, J. and Lehmann, H. (2002) Marshall and Labor Demand in Russia: Going Back to Basics, *Journal of Comparative Economics*, 30(1), pp. 134-159.

Koopmans, T. (1951) *Activity analysis of production and allocation*, New York: John Wiley & Sons.

Kornaï, J. (1980) *The Economics of Shortage*, Amsterdam: North-Holland.

Kosak, M. and Zoric, J. (2011) Accounting for Heterogeneity in Cross-Country Bank Efficiency Comparisons: A Case of the New EU Member States, *Economics of Transition*, Vol 19, 3, pp. 473–494.

Kumbhakar, S. C. and Lovell, C. A. K. (2000) *Stochastic Frontier Analysis*, Cambridge University Press.

Kumbhakar, S.C. and Lovell, C.A.K. (2003) *Stochastic frontier analysis*, New York, USA: Cambridge University Press.

Laffont, J. (1994) The new economics of regulation ten years after, *Econometrica*, 62, pp. 507-538.

Laffont, J. and Tirole, J. (1993) *A Theory of Incentives in Procurement and Regulation*. Cambridge MA: MIT Press.

Lechner, M. (2011). The estimation of causal effects by difference-in-difference methods, *Foundations and Trends(R) in Econometrics* 4 (3), pp. 165–224.

Leibenstein, H. (1966) Allocative Efficiency vs. X-Efficiency, *American Economic review*, Vol. 56(3), pp. 392-415.

Linowes, D. (1990) The future of privatization: National forum. *Phi Kappa Phi Journal*, 70(2), pp. 2-5.

Liotta, P.H. (2001) Paradigm Lost: Yugoslav Self-Management and the Economics of Disaster, in *Dismembering the State: The Death of Yugoslavia and Why It Matters*, Maryland: Lexington Books.

Little, R.J.A. and Rubin, D.B. (1987) *Statistical Analysis with Missing Data*, New York: John Wiley and Sons.

Little, R. J. A. and Rubin, D. B. (2002) *Statistical Analysis With Missing Data (2nd ed.)*, New York: Wiley.

Little, R.J.A. (1992) Regression with missing X's: A review, *Journal of the American Statistical Association*, 87, pp. 1227-1237.

Lopez-de-Silanes, F. (1997) Determinants of Privatization Prices, *Quarterly Journal of Economics,* 112, pp. 965–1025.

Lydall, H. (1984) *Yugoslav Socialism: Theory and practice,* Oxford: Clarendon Press.

Magas, B. (1993) *The destruction of Yugoslavia: tracking the break-up*. Verso. London.

Mamatzakis, E., Staikouras, C. and Koutsomanoli A.F. (2008) Bank efficiency in the new European Union member states: Is there convergence?, *International Review of Financial Analysis*, 17, pp. 1156–1172.

Manski, C.F. (2000) Identification Problems and Decisions under Ambiguity: Empirical Analysis of Treatment Response and Normative Analysis of Treatment Choice, *Journal of Econometrics*, 95(2), pp. 415–42.

Maurel, M. (2001) Investment, Efficiency, and Credit Rationing: Evidence from Hungarian Panel Data, William Davidson Institute Working Paper 403.

McGuirk, A and Spanos, A. (2004) Revisiting Error Autocorrelation Correction: Common Factor Restrictions and Granger Non-Causality, American Agricultural Economics Association Meetings, available at: http://ageconsearch.umn.edu/bitstream/20176/1/sp04mc05.pdf, last accessed 29.09.2014.

Meade, J.E. (1974) Labour-Managed Firms in Conditions of Imperfect Competition, Economic Journal, pp. 817-24.

Meade, J.E. (1972) The Theory of Labour-Managed Firms and Profit Sharing, Economic Journal, Vol. 82, pp. 402-28.

Meeusen, W. and van den Broeck, J. (1977) Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error, *International Economic Review*, Vol. 18(2), pp. 435-444.

Megginson, W.L. (2005). *The Financial Economics of Privatization*. New York: Oxford University Press.

Megginson, W. L. and Netter, J. M. (2003) History and Methods of Privatization, in: Parker, D. and Saal, D. (eds), *International Handbook on Privatization*, Cheltenham: Edward Elgar.

Megginson, W. L. and Netter, J. M. (2001) From State to Market: A Survey of Empirical Studies on Privatization, *Journal of Economic Literature,* Vol. 39, No.2, pp.321-398.

Megginson, W. L., Nash, R. and van Randenborgh M. (1994) The Financial and Operating Performance of Newly Privatized Firms: An International Empirical Analysis', *Journal of Finance*, Vol. 49, pp. 403-452.

Mencinger, J. (1996) *Economics of Disintegration (From Slovenia's* Perspective, in: Crnobrnja, M. and Papic, Z. (eds.), *The Cost of War in Former-Yugoslavia*, Paris: Peace and Crisis Management Foundation.

Meng, X.L. (1995) Multiple imputation with uncongenial sources of input (with discussion), *Statistical Science*, 10, pp.538-573.

Mester, L.J. (1997) Measuring efficiency at US banks: accounting for heterogeneity is important, *European Journal of Operational Research*, 98, pp. 230-242.

Mickiewicz, T., Gerry, C. J. and Bishop, K. (2005) Privatization, Corporate control and Employment Growth: Evidence from a Panel of Large Polish Firms, 1996-2002, *Economic Systems,* Volume 29, pp. 98-119.

Milanovic, B. (1991) Poverty in Eastern Europe in the Years of Crisis, 1978 to 1987: Poland, Hungary, and Yugoslavia, *The world bank economic review*, Volume 5, no. 2, 187-205.

Milanovic, B. (1983) The Investment Behaviour of the Labor Managed Firm: A Property rights Approach, *Economic Analysis and Workers' Management,* vol. XVIII, no. 2, pp. 327-338.

Milenkovitch, D. (1984) Self-Management and Thirty Years of Yugoslav Self-Management, *ACES Bulletin*, Vol.XXV, No. 3, pp. 1-26.

Milenkovitch, D. (1971) *Plan and Market in Yugoslav Economic Thought*, New Haven: Yale University Press.

Miller, J. (2006) Evaluation of Mass Privatization in Bulgaria, William Davidson Institute Working Paper 814.

Milovanović, M. (2007) Property Rights, Liberty and Corruption in Serbia, *The Independent Review*, 12(2), pp. 213-34.

Miranda, R. (1994) Privatization and the Budget-Maximizing Bureaucrat, *Public Productivity and Management Review*, 17, pp. 355-69.

Mitra, S. (2001) Kosovo: economic and social reforms for peace and reconciliation, Working Paper, World Bank, Washington DC.

Mueller, D. C. (1984). Voting by veto and majority rule, in Horst, H. (ed.), *Public Finance and the Quest for Efficiency*, Detroit: Wayne State University Press.

Muthén, B., Kaplan, D. and Hollis, M. (1987) On structural equation modeling with data that are not missing completely at random, *Psychometrika*, 52, pp.431-462.

Nalebuff, B. and Stiglitz, J. E. (1983) Information, Competition and Markets, *American Economic Review*, 73(2), pp. 278-283.

Nellis, J. (2001) *The World Bank, Privatization and Enterprise Reform in Transition Economies: A Retrospective Analysis*, Washington, DC: Center for Global Development.

Nellis, J. (1994) Is Privatization Necessary?, World Bank Viewpoint Note 17, Washington DC.

Nellis, J. and Kikeri, S. (1989) Public Enterprise Reform: Privatization and the World Bank, World Development 17, pp. 659-672.

Nichols, A. (2007) Causal inference with observational data, *The Stata Journal*, 7, pp. 507-41.

Nickell, S.J. (1996) Competition and Corporate Performance, *Journal of Political Economy*, 104, pp. 724–746.

Niskanen, W.A. (1971) *Bureaucracy and Representative Government*, Chicago: Aldine Publishing Co.

Niskanen, W.A. (1968) The Peculiar Economics of Bureaucracy, *The American Economic Review*, Vol. 58, No. 2, pp. 293-305.

Okun, A. (1975) *Equality and Efficiency: The Big Trade-off*, Washington DC: Brookings Institution Press.

Orazem, P.F. and Vodopivec, M. (2004) Do Market Pressures Induce Economic Efficiency? The Case of Slovenian Manufacturing, 1994-2001, World Bank Policy Research Working Paper 3189.

Ostović, D. (1996) Privatization in Croatia, in Böhm, A. (ed.), *Privatization in Central & Eastern Europe 1991*, CEEPN, Annual Conference Series No. 6, Ljubljana.

Parker, D. (1998) *Privatisation in the European Union: Theory and Policy Perspectives*, London: Routledge.

Pejovich, S. (1992) A Property Rights Analysis of the Inefficiency of Investment Decisions by Labor-Managed Firms, *Journal of Institutional and Theoretical Economics,* 148, pp. 30-41.

Pejovich, S. (1990) *The Economics of Property Rights: Towards a Theory of Comparative Systems*, Boston: Kluwer.

Pejovich, S. (1966) *The Market-Planned Economy of Yugoslavia*, Minneapolis: University of Minnesota Press.

Perevalov, Y., Gimadii, I. and Dobrodey, V. (2000) Does Privatization Improve Performance of Industrial Enterprises? Empirical Evidence from Russia, *Post-Communist Economies*, 12 (3), pp. 337- 63.

Perotti, E. (1994) A Taxonomy of Post-Socialist Financial Systems: Decentralized Enforcement and the Creation of Inside Money, *The Economics of Transition,* Vol. 2 no.1, pp. 71-81.

Pervan, M., Pervan, I. and Todoric, M. (2012) Firm Ownership and Performance: Evidence for Croatian Listed Firms, World Academy of Science, Engineering & Technology, 6, pp. 1-28.

Peugh, J. L. and Enders, C. K. (2004) Missing data in educational research: A review of reporting practices and suggestions for improvement, *Review of Educational Research*, 74, pp. 525–556.

Pinto, B., Belka, M. and Krajewski, S., (1993) Transforming State Enterprises in Poland, *Brookings Papers on Economic Activity*, pp. 213-270.

Pivovarsky, A. (2001) How Does Privatization Work?: Ownership Concentration and Enterprise Performance in Ukraine, IMF Working Paper 01/42.

Podpiera, A. and Podpiera, J. (2005) Deteriorating Cost Efficiency in Commercial Banks Signals an Increasing Risk of Failure, Working Papers 2005/06, Czech National Bank, Research Department.

Prašnikar, J., Svejnar, J. and Domadenik, P. (2000) Enterprise in Post-privatisation Period: Firm-Level Evidence for Slovenia, East European Economics.

Prout, C. (1985) *Market socialism in Yugoslavia*. London: Oxford University Press.

Ravallion, M. (2008) Evaluating Anti-poverty Programs, in: Schultz, P.T. and Strauss, J. (eds.), *Handbook of Development Economics*, vol. 4, Amsterdam: North-Holland.

Richmond, J. (1974) Estimating the efficiency of production, *International Economic Review,* 15, no. 2, pp. 515-521.

Riinvest Institute (2008) Privatization in Kosovo: a glass half employ or half full, *Research Report*, Riinvest Institute for Development Research, Prishtina.

Riinvest Institute (2004) Privatization in Kosovo: Forwards and Backwards, *Research Report*, Riinvest Institute for Development Research, Prishtina.

Riinvest Institute (2002) Privatization of SOEs and the reform of utilities in Kosovo, *Research Report*, Riinvest Institute for Development Research, Prishtina.

Riinvest Institute (2001) Socially Owned Enterprises and their privatization, *Research Report*, Riinvest Institute for Development Research, Prishtina.

Riinvest Institute (2000) Post-War Reconstruction of Kosovo: Strategies and Policies, *Research Report*, Riinvest Institute for Development Research, Prishtina.

Riinvest Institute (1998) Economic Activities and Democratic Development of Kosovo, *Research Report*, Riinvest Institute for Development Research, Prishtina.

Ritter, C. and Simar, L. (1997) Pitfalls of Normal-Gamma Stochastic Frontier Models, *Journal of Productivity Analysis*, 8, pp. 167-182.

Rosenbaum, P.R. (2002) Covariance Adjustment in Randomized Experiments and Observational Studies, *Statistical Science*, 17(3), pp. 286–327.

Rosenbaum, P.R. and Rubin, D. B. (1983) The central role of the propensity score in observational studies for causal effects, *Biometrika,* 70, pp. 41-55.

Royston, P. (2005) Multiple Imputation of Missing Values: Update, *The Stata Journal,* 5, pp.188-201.

Rubin, D.B. (1987) *Multiple Imputation for Nonresponse in Surveys*, New York: John Wiley & Sons, Inc.

Rubin, D.B. (1978) Bayesian Inference for Causal Effects: The Role of Randomization, *Annals of Statistics*, 6 (1), pp. 34–58.

Rubin, D.B. (1976) Inference and Missing Data, *Biometrika*, 63, pp. 581–592

Sabirianova, K., Svejnar, J. and Terrell, K. (2005) Foreign Investment, Corporate Ownership, and Development: Are Firms in Emerging Markets Catching Up to the World Standard?, William Davidson Institute Working 734.

Salis, S. (2006) Evaluating the Causal Effect of Foreign Acquisition on Domestic Performances: The Case of Slovenian Manufacturing Firms, William Davidson Institute Working Paper 803.

Sappington D. and Stiglitz, J. (1987) Privatization, Information and Incentives, *Journal of Policy Analysis and Management,* Vol. 4, pp. 567-582.

Savas, E. (2000). *Privatization and Public–Private Partnerships,* New York: Chatham House Publishers.

Schafer, J.L. and Graham, J.W. (2002) Missing data: Our view of the state of the art, *Psychological Methods*, 7, 147-177.

Schafer, J.L. (2001) Multiple imputation with PAN; in: Collins, L.M. and Sayer A.G. (eds.), *New Methods for the Analysis of Change*, Washington, DC: American Psychological Association.

Schafer, J.L. (1999) Multiple imputation: A primer, *Statistical Methods in Medical Research*, 8, pp. 3–15.

Schafer, J.L. (1999a). NORM: Multiple imputation of incomplete multivariate data under a normal model, version 2. Software for Windows 95/98/NT, available from http://www.stat.psu.edu/~jls/misoftwa.html.

Schafer, J.L. and Olsen, M.K. (1998) Multiple imputation for multivariate missing-data problems: A data analyst's perspective, *Multivariate Behavioral Research*, 33, pp. 545–571.

Schafer, J.L. (1997) *Analysis of Incomplete Multivariate Data*, New York: Chapman and Hall.

Schure, P. and Wagenvoort, J.L.M. (1999) Economies of Scale and Efficiency in European Banking: New Evidence, Economic and Financial Reports, 99/01, EIB.

Schüsselbauer, G. (1999) Privatisation and restructuring in economies in transition: theory and evidence revisited, *Europe-Asia Studies*. Vol. 51, no. 1, pp. 65-73.

Seitz, W.D. (1971) Productive efficiency in the steam-electric generating industry, *Journal of Political Economy,* 79, no. 4, pp. 878-886.

Self, P. (1993) *Government by the Market? The politics of public choice,* Basingstoke: Macmillan.

Shapiro, C. and Willing, R.D. (1990) Economic Rationales for Privatization in Industrial and Developing Countries, in Suleiman, A. (ed.), *The Political Economy of Public-Sector Reform and Privatization,* Boulder: Westview Press.

Shephard, R. W. (1953) *Cost and production functions*, Princeton: Princeton University Press. Debreu, G. (1951) The Coefficient of Resource Utilization, *Econometrica*, 19, 3, pp. 273-292.

Sheshinski, E. and López-Calva, L. (1999) Privatization and Its Benefits: Theory and Evidence, HIID Development Discussion Paper 698, Harvard University, Cambridge MA.

Shirley, M.M. and Walsh, P. (2001) Public vs Private Ownership: The Current State of the Debate, World Bank Research Paper 2420.

Shirley, M.M. (1994) Privatization in Latin America: Lessons for Transitional Europe, *World Development*, 22:9, pp. 1313-1323.

Shirley, M.M., Kikeri, S. and Nellis, J. (1992) Privatization: the Lessons from Experience. World Bank Publication no 11104.

Shleifer, A. (1998) State versus Private Ownership, *Journal of Economic Perspectives,* Volume 12, No.4, pp. 133-150.

Simoneti, M., Damijan, J.P., Rojec, M. and Majcen, B. (2005) Case-by case versus Mass Pprivatization in Transition Economies: Initial Owner and Final Seller Effects on Performance of Firms in Slovenia, *World Development,* 33(10), pp. 1603-25.

Simoneti, M. and Gregoric, A. (2004) Managerial Ownership and Corporate Performance in Slovenian Post-privatisation Period, *European Journal of Comparative Economics*, 1(2), pp. 217-41.

Simonetti, M. and Jamnik, B. (2000) Capital market development in Slovenia: Investment and Enterprises financing, CEEPN Working Paper.

Singh, A. (1971) *Takeovers: Their Relevance to the Stock Market and the Theory of the Firm*, Cambridge: Cambridge University Press.

Slaveski, T. (1997) Privatization in the Republic of Macedonia: Five Years After, *Eastern European Economies*, Vol. 35, 1, pp. 31-51.

Smith, A.C. and Trebilcock, M.J. (2001) State-Owned Enterprises in Less Developed Countries: Privatization and Alternative Reform Strategies, *European Journal of Law and Economics*, 12: 217

Smith, J. and Todd, P. (2005) Rejoinder, *Journal of Econometrics*, Vol. 125, pp. 365-375.

Smith, J. (2000) A Critical Survey of Empirical Methods for Evaluating Active Labor Market Policies, *Schweiz. Zeitschrift fur Volkswirtschaft und Statistik*, Vol. 136(3), pp. 1-22.

Smith, S., Cin, B. and Vodopivec, M. (1997) Privatization Incidence, ownership Forms, and Firm Performance: Evidence from Slovenia, *Journal of Comparative Economics*, 25, pp. 158-179.

Soto, D.H. (1996) The Missing Ingredient: What Poor Countries Will Need to Make Their Markets Work, in: Anderson, T.L. and Hill, P.J. (eds.), *The Privatization Process*, United States of America: Rowman & Littlefield Publishers, Inc.

Spanos, A. (1986) *Statistical Foundations of Econometric Modelling*, Cambridge: Cambridge University Press.

Spencer, M. (2000) *The Lessons of Yugoslavia*, UK: Elsevier Science, Inc.

Staikouras, C., Mamatzakis, E. and Koutsomanoli A.F. (2008) Cost efficiency of the banking industry in the South Eastern European region, *Journal of International Financial Markets, Institutions and Money*, 18(5), pp. 483-497.

Starr, P. (1989) The Meaning of Privatization, in: Kahn, A. and Kamerman, Sh. (eds), Privatization and the Welfare State, Princeton: Princeton University Press.

Stavárek, D. (2006) Banking Efficiency in the Context of European Integration, *Eastern European Economics*, No. 4, Vol. 44, pp. 5-31.

Stevenson, R. (1980) Likelihood Functions for Generalized Stochastic Frontier Estimation, *Journal of Econometrics*, Vol. 13, pp. 58-66.

Stigler G (1976) The Xistence of X-efficiency, *American Economic Review,* 66, pp. 213-6.

Suklev, B. (1996) Privatization in the Republic of Macedonia, *Eastern European Economies,* Vol. 34, No. 6, pp. 5-17.

Sunstein, R. C. (1990) *After the rights revolution: Reconceiving the regulatory state*, Cambridge MA: Harvard University Press.

Timmer, C.P. (1971) Using a probabilistic frontier production frontier to measure technical efficiency, *Journal of Political Economy,* 79, no. 4, pp. 776-794.

Tullock, G. (1976) The Vote Motive, Institute of Economic Affairs, London.

UNDP (2012) Kosovo Human Development Report: private sector and employment, *Research Report*, United Nations Development Programme, Prishtina.

Uvalić, M. (2010). *Serbia's Transition – Towards a Better Future*, London: Palgrave Macmillan.

Uvalić, M. (1997) Privatization in the Yugoslav Successor States: Converting Self-management into Property Rights, in: Uvalić, M. and Whitehead-Voughan. D. (eds.), *Privatization Surprises in Central and Eastern Europe,* Aldershot: Edwar Elgar, pp. 267-302.

van Buuren, S., Boshuizen, H.C. and Knook, D.L. (1999) Multiple imputation of missing blood pressure covariates in survival analysis, *Statistics in Medicine*, 18(6), pp.681–694.

van Dyk, D. A. and Meng, X.L. (1997)On the Orderings and Groupings of Conditional Maximizations Within ECM-Type Algorithms, *Journal of Computational and Graphical Statistics*, 6, pp. 202–223.

Vanek, J. (1990) Beware of the Yeast of the Pharisees *Ekonomska Analiza,* 24, pp. 113—24.

Vanek, J. (1970) *The General Theory of Labor-Managed Market Economies*, New York: Ithaca, Cornell University Press.

Vanek, J. (1970) *The Labor-Managed Economy.* Ithaca: Cornell University Press.

Vickers, J. and Yarrow, G. (1991) Economic Perspectives on Privatization, *Journal of Economic Perspectives*, Vol. 5, pp. 111-132.

Vickers, J. and Yarrow, G. (1989) *Privatization. An Economic Analysis,* Cambridge: MIT Press.

Vining, A.R. and Boardman, A.E. (1992) Ownership versus Competition: Efficiency in Public Enterprise, *Public Choice*, Vol. 73, pp. 205-239.

von Hippel, P. T. (2004). Biases in SPSS 12.0 Missing Value Analysis. *American Statistician*, 58, pp.160–164.

Vujacic, I. and Vujacic, J.P. (2011) Privatization in Serbia: results and failures, *Economic Annals*, 56 (191), pp. 89-105.

Vujacic, I. (1996) Discontinued Privatization: The Case of Serbia, in: Crnobrnja, M. and Papić, Ž (eds.), *The Cost of War in Former-Yugoslavia*, Paris: Peace and Crisis Management Foundation.

Walker, J.S. and Vasconcellos, G.M. (1997) A *Financial-Agency Analysis Of Privatization, Managerial Incentives and Financial Contracting*, London: Associated University Press.

Walsh, P.P. and Whelan, C. (2001) Firm Performance and the Political Economy of Corporate Governance: Survey Evidence for Bulgaria, Hungary, Slovakia and Slovenia, *Economic Systems* 25(2), pp. 85-112.

Wang H.J. and Schmidt, P. (2002) One-Step and Two-Step Estimation of the Effects of Exogenous Variables on Technical Efficiency Levels, *Journal of Productivity Analysis*, 18, pp. 129-144.

Ward, B. N. (1958) The Firm in Illyria: Market Syndicalism, *American Economic Review,* No. 48, pp. 556-589.

Warzynski, F. (2003) Managerial Change, Competition, and Privatization in Ukraine, *Journal of Comparative Economics*, 31(2), pp. 297-314.

Wayman, J.C. (2003) Multiple Imputation For Missing Data: What Is It And How Can I Use It?, Annual Meeting of the American Educational Research Association, Chicago, IL.

Wilde, E.T., and Hollister, R. (2007) How Close Is Close Enough? Evaluating Propensity Score Matching Using Data from a Class Size Reduction Experiment, *Journal of Policy Analysis and Management* 26 (3), pp. 455-477.

Williamson, O.E. (1976) Franchise Bidding for Natural Monopolies - In General and with Respect to CATV, *Bell Journal of Economics*, 7(1).

Willner, J. (1996) Social Objectives, Market Rule and Public Policy, in: Pat, D. Yannis, K. and Sugden, R. (eds.), *Competitiveness, Subsidiarity and Industrial Policy*. New York: Routledge.

Winsten, C. B. (1957) Discussion on Mr. Farrell's Paper. *Journal of the Royal Statistical Society*, 120, pp. 282-284.

Wooldridge, J.M. (2009) *Introductory Econometrics: A Modern Approach*, 4e, Mason, OH: South-Western CENGAGE Learning.

Wooldridge, J.M. (2002) *Econometric Analysis of Cross Section and Panel Data,* Cambridge, MA: MIT Press.

World Bank (2015) Doing Business Report: country report, World Bank, Washington DC.

World Bank (2010) *Kosovo - Unlocking Growth Potential*: Strategies, Policies, Actions: Country Economic Memorandum, *World Bank, Washington DC.*

Yarrow, G. (1986) Privatization in Theory and Practice, *Economic Policy*, Vol. 2, pp. 324-364.

Young, R. and Johnson, D.R. (2011) Imputing the Missing Y's: Implications for Survey Producers and Survey Users, *Proceedings of the AAPOR Conference Abstracts*, pp. 6242–6248.

Zalduendo, J. (2003) Enterprise Restructuring and Transition: Evidence from the Former Yugoslav Republic Macedonia, International Monetary Fund Working Paper 03/136.

Zeckhauser, R.J. and Horn, M. (1989) The Control and Performance of State-owned Enterprises, in MacAvoy, P.W., Stanbury, W.T., Yarrow, G. and Zeckhauser, R.J. (eds.), *Privatization and State-owned Enterprise*, Boston MA: Kluwer.

Zelic J. (2005) Ownership Structure and Performance of the Serbian Enterprises, Zagreb International Review of Economics and Business, vol.8I, no.2, pp. 73-82.

Zhang, Y., Fitzpatrick, C. and Parker, D. (2002) Electricity Sector Reform in Developing Countries: An Econometric Assessment of the Effects of Privatisation, Competition and Regulation, Centre on Regulation and Competition Working Paper No. 31, University of Manchester.

ALBAN HASHANI

Appendices

Table of content

Appendix 1: The results of the selection model

Appendix 1.1: The results of the selection model with M1 dataset

```
-->probit; lhs=PART; rhs=one,lcap,llab, lnout, manufact, construc,
hotel_an, wholesal,urban,monteneg,bosnia,croatia,serbia,macedoni; Hold $


-->frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,private_,private0,monteneg,bosnia
, croatia,serbia,macedoni; Selection$


+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 18, 2013 at 07:15:45PM.|
| Dependent variable                LNOUT     |
| Weighting variable                 None     |
| Number of observations             3802     |
| Iterations completed                  4     |
| Log likelihood function       -20496.80     |
| Number of parameters                 36     |
| Info. Criterion: AIC =         10.80052     |
|   Finite Sample: AIC =         10.80070     |
| Info. Criterion: BIC =         10.85800     |
| Info. Criterion:HQIC =         10.82095     |
| Variances: Sigma-squared(v)=       .84399   |
|            Sigma-squared(u)=       .26694   |
|            Sigma(u)        =       .51667   |
|            Sigma(v)        =       .91869   |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    13.4536027       .79573428    16.907   .0000
 LCAP    |      .11593261       .10356212     1.119   .2629   12.4692717
 LLAB    |    1.63049966       .10078507    16.178   .0000   3.18923504
 LCAPS   |      .03762399       .00876911     4.291   .0000   79.8074927
 LLABS   |    -.03859458       .01405638    -2.746   .0060   6.40170411
 CAPL    |    -.05906201       .00767055    -7.700   .0000   41.7533449
 _2005   |      .63931443       .06857606     9.323   .0000    .30428360
 _2009   |      .35001977       .06799262     5.148   .0000    .47680945
 MANUFACT|    -.22636150       .06118332    -3.700   .0002    .26528804
 CONSTRUC|      .21403043       .08142004     2.629   .0086    .10635155
 HOTEL_AN|    -.31577072       .10808790    -2.921   .0035    .05819793
 WHOLESAL|      .41455737       .05717016     7.251   .0000    .36898080
 PRIVATE_|      .84633893       .32636875     2.593   .0095    .11373708
 PRIVATE0|      .36934403       .32169975     1.148   .2509    .87474151
 MONTENEG|    -.80855962       .10592155    -7.634   .0000    .03367799
 BOSNIA  |    -.96360281       .06794073   -14.183   .0000    .18316100
 CROATIA |    -.59793866       .07372928    -8.110   .0000    .15480059
 SERBIA  |   -1.47616329       .06925621   -21.315   .0000    .23751846
 MACEDONI|   -1.58867802       .07061987   -22.496   .0000    .20974889
 lnsgma_U|    -.66035769       .70965575     -.931   .3521
 gamma*_V|      .08480753       .01972915     4.299   .0000
---------+Index function for PROBIT selection model
 Constant|    -.39364659       .03804802   -10.346   .0000
```

LCAP	.13559614	.03629882	3.736	.0002	.000000
LLAB	.32070904	.08165565	3.928	.0001	.000000
LNOUT	.51863057	.11766570	4.408	.0000	.000000
MANUFACT	.10772143	.12538777	.859	.3903	.000000
CONSTRUC	.51687601	.08693428	5.946	.0000	.000000
HOTEL_AN	.85058995	.29747418	2.859	.0042	.000000
WHOLESAL	-.16272927	.09627607	-1.690	.0910	.000000
URBAN	.36625156	.09884561	3.705	.0410	.000000
MONTENEG	.20634474	.10936343	1.887	.0592	.000000
BOSNIA	.08951754	.09905942	.904	.3662	.000000
CROATIA	.84046848	.13109760	6.411	.0000	.000000
SERBIA	1.04372098	.01564062	66.731	.0000	.000000
MACEDONI	.93366847	.06228374	14.991	.0000	.000000
Rho(w,v)	.508365D-05	.04040809	.000	.9999	3.705289

Appendix 1.2: The results of the selection model with M2 dataset

```
-->probit; lhs=PART; rhs=one,lcap,llab, lnout, manufact, construc,
hotel_an, wholesal,urban,monteneg,bosnia,croatia,serbia,macedoni; Hold $



-->frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,private_,private0,monteneg,bosnia
, croatia,serbia,macedoni; Selection$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER  |
| Maximum Likelihood Estimates                 |
| Model estimated: Feb 18, 2013 at 07:06:58PM.|
| Dependent variable                LNOUT      |
| Weighting variable                 None      |
| Number of observations             3802      |
| Iterations completed                  1      |
| Log likelihood function       -19914.83      |
| Number of parameters                 36      |
| Info. Criterion: AIC =         10.49439      |
|   Finite Sample: AIC =         10.49456      |
| Info. Criterion: BIC =         10.55186      |
| Info. Criterion:HQIC =         10.51481      |
| Variances: Sigma-squared(v)=       .78234    |
|            Sigma-squared(u)=       .12592    |
|            Sigma(u)        =       .35485    |
|            Sigma(v)        =       .88450    |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    10.3568493      1.93911598     5.341   .0000
 LCAP    |    -.01537344       .14986398     -.103   .9183   12.4384413
 LLAB    |    1.26669863       .33628307     3.767   .0002   3.18732906
 LCAPS   |     .02845744       .01558771     1.826   .0679   79.5205668
 LLABS   |    -.02963820       .02477552    -1.196   .2316   6.39503602
 CAPL    |    -.02873102       .01535974    -1.871   .0614   41.7259685
 _2005   |     .42572982       .12644515     3.367   .0008    .30428360
 _2009   |     .20793073       .09416790     2.208   .0272    .47680945
 MANUFACT|    -.31989977       .10615707    -3.013   .0026    .26528804
 CONSTRUC|    -.04685071       .10870194     -.431   .6665    .10635155
 HOTEL_AN|    -.34554461       .16025216    -2.156   .0311    .05819793
 WHOLESAL|     .23358559       .10570334     2.210   .0271    .36898080
 PRIVATE_|     .43437269       .27329474     1.589   .1120    .11373708
 PRIVATE0|     .03907787       .25092286      .156   .8762    .87474151
 MONTENEG|    -.71986852       .23187586    -3.105   .0019    .03367799
 BOSNIA  |    -.84191667       .21378130    -3.938   .0001    .18316100
 CROATIA |    -.37102436       .12835124    -2.891   .0038    .15480059
 SERBIA  |   -1.09000431       .27287757    -3.994   .0001    .23751846
 MACEDONI|   -1.27778736       .30419730    -4.201   .0000    .20974889
 lnsgma_U|   -1.03605826       .47222570    -2.194   .0282
 gamma*_V|     .12273163       .02431076     5.048   .0000
---------+Index function for PROBIT selection model
 Constant|    -.42604670       .04237639   -10.054   .0000
 LCAP    |     .13779951       .04082672     3.375   .0007       .000000
 LLAB    |     .30215154       .08991239     3.361   .0008       .000000
```

LNOUT	.49237508	.12520749	3.932	.0001	.000000
MANUFACT	.07432981	.13834218	.537	.5911	.000000
CONSTRUC	.49204026	.09388169	5.241	.0000	.000000
HOTEL_AN	.92447109	.28723539	3.219	.0013	.000000
WHOLESAL	-.14239635	.10361621	-1.374	.1694	.000000
URBAN	.03889240	.91214241	.042	.6216	.000000
MONTENEG	.21109398	.11963051	1.765	.0776	.000000
BOSNIA	.12462101	.10811669	1.153	.2491	.000000
CROATIA	.88809420	.14239245	6.237	.0000	.000000
SERBIA	1.04291731	.20661882	5.048	.0000	.000000
MACEDONI	.73592040	.15539174	4.736	.0000	.000000
Rho(w,v)	.000000	.01315949	.000	1.0000	

Appendix 1.3: The results of the selection model with M3 dataset

```
-->probit; lhs=PART; rhs=one,lcap,llab, lnout, manufact, construc,
hotel_an, wholesal,urban,monteneg,bosnia,croatia,serbia,macedoni; Hold $
```

```
-->frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,private_,private0,monteneg,bosnia
, croatia,serbia,macedoni; Selection$
```

```
+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 18, 2013 at 06:59:54PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                 6      |
| Log likelihood function      -20711.54      |
| Number of parameters                36      |
| Info. Criterion: AIC =        10.91349      |
|   Finite Sample: AIC =        10.91366      |
| Info. Criterion: BIC =        10.97096      |
| Info. Criterion:HQIC =        10.93391      |
| Variances: Sigma-squared(v)=       .79115   |
|            Sigma-squared(u)=       .75195   |
|            Sigma(u)       =        .86715   |
|            Sigma(v)       =        .88946   |
+---------------------------------------------+
+--------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    18.9604210       .95944405    19.762   .0000
 LCAP    |    -.12651735       .08986516    -1.408   .1592   12.4659740
 LLAB    |    2.11887503       .07763564    27.293   .0000   3.18773079
 LCAPS   |     .05862598       .00773809     7.576   .0000   79.9309844
 LLABS   |     .09457102       .00937464    10.088   .0000   6.39589154
 CAPL    |    -.12748411       .00537707   -23.709   .0000   41.8737909
 _2005   |     .70918899       .05964892    11.889   .0000    .30428360
 _2009   |     .52509582       .05879738     8.931   .0000    .47680945
 MANUFACT|    -.22098924       .05569228    -3.968   .0001    .26528804
 CONSTRUC|    -.05465306       .07453172     -.733   .4634    .10635155
 HOTEL_AN|    -.44674061       .09617700    -4.645   .0000    .05819793
 WHOLESAL|     .26650871       .05294176     5.034   .0000    .36898080
 PRIVATE_|     .85527629       .22575725     3.788   .0002    .11373708
 PRIVATE0|     .48556925       .21981070     2.209   .0272    .87474151
 MONTENEG|   -1.31105024       .10485618   -12.503   .0000    .03367799
 BOSNIA  |   -1.43873647       .06539086   -22.002   .0000    .18316100
 CROATIA |    -.87307561       .06889874   -12.672   .0000    .15480059
 SERBIA  |   -1.63180892       .06284165   -25.967   .0000    .23751846
 MACEDONI|   -1.77579950       .06269043   -28.326   .0000    .20974889
 lnsgma_U|    -.14254388      1.37336818     -.104   .9173
 gamma*_V|     .11713553       .02026137     5.781   .0000
---------+Index function for PROBIT selection model
 Constant|    -.34775758       .03895937    -8.926   .0000
 LCAP    |     .06014602       .03650263     1.648   .0994      .000000
 LLAB    |     .28130521       .08173461     3.442   .0006      .000000
```

```
LNOUT   |     .53680725       .11834615     4.536   .0000      .000000
MANUFACT|     .07928597       .12438197      .637   .5238      .000000
CONSTRUC|     .52105674       .08710915     5.982   .0000      .000000
HOTEL_AN|     .76988567       .29156546     2.641   .0083      .000000
WHOLESAL|    -.23903739       .09648296    -2.478   .0132      .000000
URBAN   |     .04484121       .32444564      .138   .5321      .000000
MONTENEG|     .16096613       .11253577     1.430   .1526      .000000
BOSNIA  |     .01694449       .10047866      .169   .8661      .000000
CROATIA |     .74345076       .13367357     5.562   .0000      .000000
SERBIA  |    1.05066527       .01458413    72.042   .0000      .000000
MACEDONI|    1.41809925       .10783488    13.151   .0000      .000000
Rho(w,v)|     .00050794       .09486448      .005   .9957
```

Appendix 1.4: The results of the selection model with M4 dataset

```
-->probit; lhs=PART; rhs=one,lcap,llab, lnout, manufact, construc,
hotel_an, wholesal,urban,monteneg,bosnia,croatia,serbia,macedoni; Hold $



-->frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,private_,private0,monteneg,bosnia
, croatia,serbia,macedoni; Selection$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 18, 2013 at 11:43:13PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                38      |
| Log likelihood function       -19397.63     |
| Number of parameters                36      |
| Info. Criterion: AIC =         10.22232     |
|   Finite Sample: AIC =         10.22250     |
| Info. Criterion: BIC =         10.27979     |
| Info. Criterion:HQIC =         10.24275     |
| Variances: Sigma-squared(v)=       .81025   |
|            Sigma-squared(u)=       .18813   |
|            Sigma(u)        =       .43373   |
|            Sigma(v)        =       .90014   |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    12.5589048      7.22734447     1.738   .0823
 LCAP    |      .19457824     1.09981598      .177   .8596   12.5297980
 LLAB    |     1.22185759     1.14105779     1.071   .2843    3.18409598
 LCAPS   |    -.00596476       .09577478     -.062   .9503   80.7930617
 LLABS   |    -.03870146       .22381792     -.173   .8627    6.38534428
 CAPL    |    -.02801477       .09749930     -.287   .7739   42.0188930
 _2005   |      .55463483      .90670996      .612   .5407     .30428360
 _2009   |      .34891580      .88430015      .395   .6932     .47680945
 MANUFACT|    -.32232057       .88827969     -.363   .7167     .26528804
 CONSTRUC|    -.07861558      1.18427495     -.066   .9471     .10635155
 HOTEL_AN|    -.37251850      1.66885258     -.223   .8234     .05819793
 WHOLESAL|      .37439798      .69132476      .542   .5881     .36898080
 PRIVATE_|      .66722648     3.11915270      .214   .8306     .11373708
 PRIVATE0|      .18032566     3.05505827      .059   .9529     .87474151
 MONTENEG|    -.87232128      1.94918658     -.448   .6545     .03367799
 BOSNIA  |    -.92444761       .99475298     -.929   .3527     .18316100
 CROATIA |    -.40323544      1.04461524     -.386   .6995     .15480059
 SERBIA  |   -1.21654368       .89103779    -1.365   .1722     .23751846
 MACEDONI|   -1.48506930       .76425049    -1.943   .0520     .20974889
 lnsgma_U|    -.83532193       .50880009    -1.642   .1006
 gamma*_V|      .10520696      .02176551     4.834   .0000
---------+Index function for PROBIT selection model
 Constant|    -.41176560       .04195951    -9.813   .0000
 LCAP    |      .13284664      .03930205     3.380   .0007       .000000
 LLAB    |      .31563972      .08853431     3.565   .0004       .000000
```

```
LNOUT   |     .49628903       .12363533      4.014   .0001       .000000
MANUFACT|     .13371045       .13380680       .999   .3177       .000000
CONSTRUC|     .51001477       .09111668      5.597   .0000       .000000
HOTEL_AN|     .84319727       .30917425      2.727   .0064       .000000
WHOLESAL|    -.14054496       .09975681     -1.409   .1589       .000000
URBAN   |     .03116951       .11198112       .278   .4618       .000000
MONTENEG|     .21539806       .11533884      1.868   .0618       .000000
BOSNIA  |     .12922977       .10390712      1.244   .2136       .000000
CROATIA |     .86584784       .13600114      6.366   .0000       .000000
SERBIA  |    1.00314153       .05829636     17.208   .0000       .000000
MACEDONI|     .87174119       .28377305      3.072   .0021       .000000
Rho(w,v)|    -.00046075       .01448220      -.032   .9746
```

Appendix 1.5: The results of the selection model with M5 dataset

```
-->probit; lhs=PART; rhs=one,lcap,llab, lnout, manufact, construc,
hotel_an, wholesal,urban,monteneg,bosnia,croatia,serbia,macedoni; Hold $

-->frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,private_,private0,monteneg,bosnia
, croatia,serbia,macedoni; Selection$
+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 18, 2013 at 06:43:53PM.|
| Dependent variable              LNOUT       |
| Weighting variable               None       |
| Number of observations           3802       |
| Iterations completed                1       |
| Log likelihood function       -23811.09     |
| Number of parameters               36       |
| Info. Criterion: AIC =         12.54397     |
|   Finite Sample: AIC =         12.54415     |
| Info. Criterion: BIC =         12.60144     |
| Info. Criterion:HQIC =         12.56440     |
| Variances: Sigma-squared(v)=       .84207   |
|            Sigma-squared(u)=       .33004   |
|            Sigma(u)        =       .57449   |
|            Sigma(v)        =       .91765   |
+---------------------------------------------+
+--------+-------------+---------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+---------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    10.7105002      .26246346    40.808   .0000
 LCAP    |     .16858672      .04901301     3.440   .0006   12.5113557
 LLAB    |    1.22059637      .04536358    26.907   .0000   3.18724392
 LCAPS   |     .06579278      .00437131    15.051   .0000   80.4714121
 LLABS   |    -.06225712      .00933579    -6.669   .0000   6.39657099
 CAPL    |    -.01301444      .00452037    -2.879   .0040   41.9689242
 _2005   |     .49346671      .02908187    16.968   .0000    .30428360
 _2009   |     .32496679      .03359132     9.674   .0000    .47680945
 MANUFACT|    -.26244328      .03105182    -8.452   .0000    .26528804
 CONSTRUC|     .10102055      .03985572     2.535   .0113    .10635155
 HOTEL_AN|    -.35605853      .04730583    -7.527   .0000    .05819793
 WHOLESAL|     .26759011      .02808708     9.527   .0000    .36898080
 PRIVATE_|     .60891884      .11057013     5.507   .0000    .11373708
 PRIVATE0|     .19112036      .10707655     1.785   .0743    .87474151
 MONTENEG|    -.97548266      .06803348   -14.338   .0000    .03367799
 BOSNIA  |    -.90254846      .03531476   -25.557   .0000    .18316100
 CROATIA |    -.41710490      .03519411   -11.852   .0000    .15480059
 SERBIA  |   -1.18553711      .03362441   -35.258   .0000    .23751846
 MACEDONI|   -1.36448961      .03569934   -38.222   .0000    .20974889
 lnsgma_U|    -.55426533      .51111326    -1.084   .2782
 gamma*_V|     .08594395      .02212283     3.885   .0001
---------+Index function for PROBIT selection model
 Constant|    -.38765879      .03775699   -10.267   .0000
 LCAP    |     .12469637      .03721091     3.351   .0008      .000000
 LLAB    |     .30648760      .08110137     3.779   .0002      .000000
 LNOUT   |     .52442813      .11668800     4.494   .0000      .000000
 MANUFACT|     .07218459      .12602701      .573   .5668      .000000
 CONSTRUC|     .50041035      .08771498     5.705   .0000      .000000
```

HOTEL_AN|	.89080426	.29755864	2.994	.0028	.000000
WHOLESAL|	-.13731081	.09761739	-1.407	.1595	.000000
URBAN |	.04214881	.29251516	.144	.5899	.000000
MONTENEG|	.20499187	.11146845	1.839	.0659	.000000
BOSNIA |	.10729132	.10021495	1.071	.2843	.000000
CROATIA |	.85259444	.13020752	6.548	.0000	.000000
SERBIA |	1.14331017	.00999799	114.354	.0000	.000000
MACEDONI|	.90139976	.02399246	37.570	.0000	.000000
Rho(w,v)|	-.312583D-04	.02868525	-.001	.9991	

Appendix 2: The results of the Cobb-Douglas and Translog specifications

Appendix 2.1: the results of the Cobb-Douglas and Translog specifications with M1 dataset

Cobb-Douglas (Normal Distribution)

--> frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl; eff=ui_nCD$

```
+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Aug 31, 2012 at 07:56:00AM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                12      |
| Log likelihood function      -5551.855      |
| Number of parameters                 8      |
| Info. Criterion: AIC =         2.92470      |
|   Finite Sample: AIC =         2.92471      |
| Info. Criterion: BIC =         2.93784      |
| Info. Criterion:HQIC =         2.92937      |
| Variances: Sigma-squared(v)=      .76457    |
|            Sigma-squared(u)=      .89897    |
|            Sigma(v)        =      .87440    |
|            Sigma(u)        =      .94814    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=     1.28978    |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.26487006      .47423339    19.537   .0000
 LCAP    |     .04168509      .08735745      .477   .6332   12.5431453
 LLAB    |    1.06514666      .08625003    12.350   .0000   3.31781158
 LCAPS   |     .02259589      .00834503     2.708   .0068   80.8575222
 LLABS   |    -.01571203      .01380921    -1.138   .2552   6.93244022
 CAPL    |    -.02244377      .00833104    -2.694   .0071   43.7796496
---------+Variance parameters for compound error
 Lambda  |    1.08433535      .04537801    23.896   .0000
 Sigma   |    1.28978357      .00028378  4544.965   .0000
```

Translog (Normal Distribution)

```
--> frontier;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_2009,manufa...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_n$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Aug 31, 2012 at 07:57:11AM.|
| Dependent variable              LNOUT        |
| Weighting variable               None        |
| Number of observations           3802        |
| Iterations completed               27        |
| Log likelihood function       -5087.514      |
| Number of parameters               21        |
| Info. Criterion: AIC =         2.68728       |
|   Finite Sample: AIC =         2.68734       |
| Info. Criterion: BIC =         2.72176       |
| Info. Criterion:HQIC =         2.69953       |
| Variances: Sigma-squared(v)=       .63087    |
|            Sigma-squared(u)=       .61332    |
|            Sigma(v)       =        .79428    |
|            Sigma(u)       =        .78315    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.11544    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+---------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient   | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.21141520      .42692767    21.576   .0000
 LCAP    |     .13924596      .07809129     1.783   .0746   12.5431453
 LLAB    |    1.07081002      .07738390    13.838   .0000   3.31781158
 LCAPS   |     .00693499      .00750151      .924   .3552   80.8575222
 LLABS   |    -.03445386      .01239535    -2.780   .0054   6.93244022
 CAPL    |    -.01177458      .00746352    -1.578   .1147   43.7796496
 _2005   |     .39256592      .04082039     9.617   .0000    .30483956
 _2009   |     .28194640      .04589429     6.143   .0000    .43819043
 MANUFACT|    -.23774755      .04394266    -5.410   .0000    .27275118
 CONSTRUC|     .07398378      .05728708     1.291   .1965    .10362967
 HOTEL_AN|    -.31361317      .06845778    -4.581   .0000    .06102052
 WHOLESAL|     .23962405      .04222078     5.675   .0000    .34744871
 MONTENEG|    -.84251487      .09511005    -8.858   .0000    .03051026
 BOSNIA  |    -.82194223      .04969203   -16.541   .0000    .19542346
 CROATIA |    -.41072531      .05199767    -7.899   .0000    .15307733
 SERBIA  |   -1.03833442      .04718417   -22.006   .0000    .24671226
 MACEDONI|   -1.18519887      .05000165   -23.703   .0000    .19358233
 PRIVATE_|     .41627059      .06521667     6.383   .0000    .10126249
 PRIVATE0|     .06502018      .05093234     1.277   .2017    .77880063
---------+Variance parameters for compound error
 Lambda  |     .98599343      .04344731    22.694   .0000
 Sigma   |    1.11543642      .00024145  4619.688   .0000
```

Appendix 2.2: the results of the Cobb-Douglas and Translog specifications with M2 dataset

Cobb-Douglas (Normal Distribution)

```
--> frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl; eff=ui_nCD$
Normal exit from iterations. Exit status=0.

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 08:27:11PM.|
| Dependent variable                LNOUT      |
| Weighting variable                 None      |
| Number of observations             3802      |
| Iterations completed                 13      |
| Log likelihood function       -5638.577      |
| Number of parameters                  8      |
| Info. Criterion: AIC =          2.97032      |
|   Finite Sample: AIC =          2.97033      |
| Info. Criterion: BIC =          2.98346      |
| Info. Criterion:HQIC =          2.97499      |
| Variances: Sigma-squared(v)=       .78391    |
|            Sigma-squared(u)=       .98814    |
|            Sigma(v)        =       .88539    |
|            Sigma(u)        =       .99405    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.33118    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+---------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    10.1385504       .47097215    21.527   .0000
 LCAP    |    -.05496894       .08577193     -.641   .5216   12.5520749
 LLAB    |    1.00182269       .08468628    11.830   .0000   3.31500890
 LCAPS   |     .02790481       .00813898     3.429   .0006   81.0507172
 LLABS   |    -.01051194       .01396958     -.752   .4518   6.92244484
 CAPL    |    -.01911379       .00815976    -2.342   .0192   43.8058639
---------+Variance parameters for compound error
 Lambda  |    1.12272962       .04601787    24.398   .0000
 Sigma   |    1.33118321       .00029421  4524.665   .0000
```

Translog (Normal Distribution)

```
--> frontier;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_2009,manufa...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_n$
Normal exit from iterations. Exit status=0.

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 08:28:00PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                26      |
| Log likelihood function       -5168.892     |
| Number of parameters                21      |
| Info. Criterion: AIC =          2.73009     |
|   Finite Sample: AIC =          2.73015     |
| Info. Criterion: BIC =          2.76457     |
| Info. Criterion:HQIC =          2.74234     |
| Variances: Sigma-squared(v)=       .68866   |
|            Sigma-squared(u)=       .55415   |
|            Sigma(v)        =       .82986   |
|            Sigma(u)        =       .74441   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.11482   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+---------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    10.0461447      .42702986    23.526   .0000
 LCAP    |     .02605870      .07692471      .339   .7348   12.5520749
 LLAB    |    1.00920305      .07613709    13.255   .0000   3.31500890
 LCAPS   |     .01391434      .00732503     1.900   .0575   81.0507172
 LLABS   |    -.02678556      .01254521    -2.135   .0328   6.92244484
 CAPL    |    -.00880098      .00729760    -1.206   .2278   43.8058639
 _2005   |     .39880111      .04190835     9.516   .0000    .30483956
 _2009   |     .28326886      .04728548     5.991   .0000    .43819043
 MANUFACT|    -.28485059      .04489568    -6.345   .0000    .27275118
 CONSTRUC|    -.05929766      .05869459    -1.010   .3124    .10362967
 HOTEL_AN|    -.29026973      .07030151    -4.129   .0000    .06102052
 WHOLESAL|     .29391926      .04314489     6.812   .0000    .34744871
 MONTENEG|    -.68804526      .09703774    -7.090   .0000    .03051026
 BOSNIA  |    -.75949340      .05065559   -14.993   .0000    .19542346
 CROATIA |    -.36667344      .05322256    -6.889   .0000    .15307733
 SERBIA  |    -.99833948      .04835320   -20.647   .0000    .24671226
 MACEDONI|   -1.19079605      .05077371   -23.453   .0000    .19358233
 PRIVATE_|     .47259789      .06678451     7.076   .0000    .10126249
 PRIVATE0|     .07055631      .05209628     1.354   .1756    .77880063
---------+Variance parameters for compound error
 Lambda  |     .89703892      .04266445    21.025   .0000
 Sigma   |    1.11481735      .00024189  4608.736   .0000
```

Appendix 2.3: the results of the Cobb-Douglas and Translog specifications with M3 dataset

Cobb-Douglas (Normal Distribution)

```
--> frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl; eff=ui_nCD$
Normal exit from iterations. Exit status=0.

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 09:01:50PM.|
| Dependent variable               LNOUT       |
| Weighting variable                None       |
| Number of observations            3802       |
| Iterations completed                13       |
| Log likelihood function      -5582.155       |
| Number of parameters                 8       |
| Info. Criterion: AIC =         2.94064       |
|   Finite Sample: AIC =         2.94065       |
| Info. Criterion: BIC =         2.95378       |
| Info. Criterion:HQIC =         2.94531       |
| Variances: Sigma-squared(v)=      .77842     |
|            Sigma-squared(u)=      .90918     |
|            Sigma(v)        =      .88228     |
|            Sigma(u)        =      .95351     |
| Sigma = Sqr[(s^2(u)+s^2(v)]=     1.29908     |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+--------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.67362480      .47106648    20.536   .0000
 LCAP    |    -.03249230      .08672847     -.375   .7079   12.4886891
 LLAB    |    1.19570210      .08638597    13.841   .0000   3.31824505
 LCAPS   |     .03133721      .00830644     3.773   .0002   80.1882398
 LLABS   |     .00245415      .01370387      .179   .8579   6.93183529
 CAPL    |    -.03858629      .00828427    -4.658   .0000   43.6208371
---------+Variance parameters for compound error
 Lambda  |    1.08073236      .04523694    23.890   .0000
 Sigma   |    1.29907917      .00028608  4540.993   .0000
```

Translog (Normal Distribution)

```
--> frontier;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_2009,manufa...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_n$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:02:36PM.|
| Dependent variable                LNOUT     |
| Weighting variable                 None     |
| Number of observations             3802     |
| Iterations completed                 26     |
| Log likelihood function       -5088.708     |
| Number of parameters                 21     |
| Info. Criterion: AIC =          2.68791     |
|   Finite Sample: AIC =          2.68797     |
| Info. Criterion: BIC =          2.72239     |
| Info. Criterion:HQIC =          2.70016     |
| Variances: Sigma-squared(v)=       .69866   |
|            Sigma-squared(u)=       .42287   |
|            Sigma(v)        =       .83586   |
|            Sigma(u)        =       .65029   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.05903   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.96122799       .42202953    23.603   .0000
 LCAP    |    -.04183842       .07664436     -.546   .5852   12.4886891
 LLAB    |    1.23372018       .07674993    16.075   .0000   3.31824505
 LCAPS   |     .02700276       .00735803     3.670   .0002   80.1882398
 LLABS   |    -.02221785       .01223070    -1.817   .0693   6.93183529
 CAPL    |    -.02970761       .00733852    -4.048   .0001   43.6208371
 _2005   |     .48450291       .04090015    11.846   .0000    .30483956
 _2009   |     .23439614       .04580250     5.118   .0000    .43819043
 MANUFACT|    -.23189174       .04400201    -5.270   .0000    .27275118
 CONSTRUC|    -.00399787       .05738407     -.070   .9445    .10362967
 HOTEL_AN|    -.27610057       .06871579    -4.018   .0001    .06102052
 WHOLESAL|     .33021561       .04225313     7.815   .0000    .34744871
 MONTENEG|    -.65789594       .09508212    -6.919   .0000    .03051026
 BOSNIA  |    -.77636918       .04936204   -15.728   .0000    .19542346
 CROATIA |    -.37036598       .05214188    -7.103   .0000    .15307733
 SERBIA  |   -1.01025864       .04696440   -21.511   .0000    .24671226
 MACEDONI|   -1.17515009       .04952117   -23.730   .0000    .19358233
 PRIVATE_|     .28700235       .06547056     4.384   .0000    .10126249
 PRIVATE0|    -.02027755       .05105795     -.397   .6913    .77880063
---------+Variance parameters for compound error
 Lambda  |     .77798515       .04212338    18.469   .0000
 Sigma   |    1.05902759       .00022906  4623.422   .0000
```

Appendix 2.4: the results of the Cobb-Douglas and Translog specifications with M4 dataset

Cobb-Douglas (Normal Distribution)

```
--> frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl; eff=ui_nCD$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:29:12PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                13      |
| Log likelihood function      -5513.414      |
| Number of parameters                 8      |
| Info. Criterion: AIC =         2.90448      |
|   Finite Sample: AIC =         2.90449      |
| Info. Criterion: BIC =         2.91762      |
| Info. Criterion:HQIC =         2.90915      |
| Variances: Sigma-squared(v)=       .73561   |
|            Sigma-squared(u)=       .92085   |
|            Sigma(v)        =       .85767   |
|            Sigma(u)        =       .95961   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.28703   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.44438224       .47649446    19.821   .0000
 LCAP    |    -.00274195       .08764341     -.031   .9750   12.4505278
 LLAB    |    1.08730646       .08335027    13.045   .0000   3.31788738
 LCAPS   |     .02915794       .00835505     3.490   .0005   79.6547910
 LLABS   |    -.01375357       .01358851    -1.012   .3115   6.93107360
 CAPL    |    -.02686434       .00806698    -3.330   .0009   43.4437872
---------+Variance parameters for compound error
 Lambda  |    1.11885029       .04577396    24.443   .0000
 Sigma   |    1.28703405       .00028237  4557.895   .0000
```

Translog (Normal Distribution)

```
--> frontier;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_2009,manufa...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_n$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:29:38PM.|
| Dependent variable                LNOUT     |
| Weighting variable                 None     |
| Number of observations             3802     |
| Iterations completed                 27     |
| Log likelihood function       -4976.808     |
| Number of parameters                 21     |
| Info. Criterion: AIC =          2.62904     |
|   Finite Sample: AIC =          2.62911     |
| Info. Criterion: BIC =          2.66353     |
| Info. Criterion:HQIC =          2.64130     |
| Variances: Sigma-squared(v)=       .58928   |
|            Sigma-squared(u)=       .59583   |
|            Sigma(v)        =       .76764   |
|            Sigma(u)        =       .77190   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.08863   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.73352365       .42297568    23.012   .0000
 LCAP    |    -.00140954       .07714660     -.018   .9854   12.4505278
 LLAB    |    1.19591831       .07338748    16.296   .0000   3.31788738
 LCAPS   |     .02596842       .00737120     3.523   .0004   79.6547910
 LLABS   |    -.02316070       .01200610    -1.929   .0537   6.93107360
 CAPL    |    -.02766344       .00708112    -3.907   .0001   43.4437872
 _2005   |     .38412254       .03968983     9.678   .0000     .30483956
 _2009   |     .21434110       .04437171     4.831   .0000     .43819043
 MANUFACT|    -.31010134       .04268193    -7.265   .0000     .27275118
 CONSTRUC|    -.02488468       .05571735     -.447   .6551     .10362967
 HOTEL_AN|    -.32688804       .06647774    -4.917   .0000     .06102052
 WHOLESAL|     .23206042       .04099229     5.661   .0000     .34744871
 MONTENEG|    -.70155789       .09272034    -7.566   .0000     .03051026
 BOSNIA  |    -.83360954       .04786150   -17.417   .0000     .19542346
 CROATIA |    -.40330553       .05055160    -7.978   .0000     .15307733
 SERBIA  |   -1.04775940       .04542185   -23.067   .0000     .24671226
 MACEDONI|   -1.23461057       .04802947   -25.705   .0000     .19358233
 PRIVATE_|     .44494945       .06343360     7.014   .0000     .10126249
 PRIVATE0|     .06656795       .04934519     1.349   .1773     .77880063
---------+Variance parameters for compound error
 Lambda  |    1.00554573       .04348539    23.124   .0000
 Sigma   |    1.08862510       .00023349  4662.323   .0000
```

Appendix 2.5: the results of the Cobb-Douglas and Translog specifications with M5 dataset

Cobb-Douglas (Normal Distribution)

```
--> frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl; eff=ui_nCD$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 10:33:50PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                13      |
| Log likelihood function      -5606.845      |
| Number of parameters                 8      |
| Info. Criterion: AIC =         2.95363      |
|   Finite Sample: AIC =         2.95364      |
| Info. Criterion: BIC =         2.96676      |
| Info. Criterion:HQIC =         2.95830      |
| Variances: Sigma-squared(v)=      .78690    |
|            Sigma-squared(u)=      .92599    |
|            Sigma(v)        =      .88707    |
|            Sigma(u)        =      .96228    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=     1.30877    |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    10.0243692       .51171435    19.590   .0000
 LCAP    |    -.09181951       .09292105     -.988   .3231   12.4987458
 LLAB    |    1.15090785       .08712791    13.209   .0000   3.31958432
 LCAPS   |     .03393954       .00873846     3.884   .0001   80.1716606
 LLABS   |    -.02167912       .01367843    -1.585   .1130   6.93701034
 CAPL    |    -.02677198       .00831919    -3.218   .0013   43.5413882
---------+Variance parameters for compound error
 Lambda  |    1.08478339       .04532863    23.932   .0000
 Sigma   |    1.30877182       .00028580  4579.391   .0000
```

Translog (Normal Distribution)

```
--> frontier;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_2009,manufa...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_n$
Normal exit from iterations. Exit status=0.

+-----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                  |
| Model estimated: Sep 01, 2012 at 10:34:18PM.|
| Dependent variable               LNOUT        |
| Weighting variable                None        |
| Number of observations            3802        |
| Iterations completed                27        |
| Log likelihood function       -5127.682       |
| Number of parameters                21        |
| Info. Criterion: AIC =          2.70841       |
|   Finite Sample: AIC =          2.70847       |
| Info. Criterion: BIC =          2.74289       |
| Info. Criterion:HQIC =          2.72066       |
| Variances: Sigma-squared(v)=       .68856     |
|            Sigma-squared(u)=       .50091     |
|            Sigma(v)        =       .82979     |
|            Sigma(u)        =       .70775     |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.09063     |
| Stochastic Production Frontier, e=v-u.        |
+-----------------------------------------------+
+---------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.92883384       .46002482    21.583   .0000
 LCAP    |    -.02465934       .08281592     -.298   .7659   12.4987458
 LLAB    |    1.15573796       .07802208    14.813   .0000   3.31958432
 LCAPS   |     .02241629       .00781128     2.870   .0041   80.1716606
 LLABS   |    -.03388140       .01226248    -2.763   .0057   6.93701034
 CAPL    |    -.01859330       .00741880    -2.506   .0122   43.5413882
 _2005   |     .45159302       .04129741    10.935   .0000    .30483956
 _2009   |     .27827930       .04614032     6.031   .0000    .43819043
 MANUFACT|    -.19089240       .04435171    -4.304   .0000    .27275118
 CONSTRUC|     .15198830       .05795532     2.623   .0087    .10362967
 HOTEL_AN|    -.23790655       .06955669    -3.420   .0006    .06102052
 WHOLESAL|     .29222198       .04270763     6.842   .0000    .34744871
 MONTENEG|    -.58139747       .09605840    -6.053   .0000    .03051026
 BOSNIA  |    -.75097892       .04991713   -15.045   .0000    .19542346
 CROATIA |    -.46097993       .05265003    -8.756   .0000    .15307733
 SERBIA  |   -1.09484642       .04723879   -23.177   .0000    .24671226
 MACEDONI|   -1.17165878       .05005596   -23.407   .0000    .19358233
 PRIVATE_|     .44550028       .06601330     6.749   .0000    .10126249
 PRIVATE0|     .08487372       .05156086     1.646   .0997    .77880063
---------+Variance parameters for compound error
 Lambda  |     .85292082       .04225848    20.183   .0000
 Sigma   |    1.09062753       .00023426  4655.717   .0000
```

Appendix 3: The results of the Translog specification controlling for type of new owner after privatization

Appendix 3.1: the results of the Translog specification assuming normal distribution controlling for type of new owner after privatization with M1 dataset

```
frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,PriFORE,PRIDOM,monteneg,bosnia,
croatia,serbia,macedoni$
 +---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 18, 2013 at 06:40:22PM.|
| Dependent variable              LNOUT       |
| Weighting variable              None        |
| Number of observations          3802        |
| Iterations completed              26        |
| Log likelihood function       -5110.663     |
| Number of parameters              21        |
| Info. Criterion: AIC =         2.69945      |
|   Finite Sample: AIC =         2.69952      |
| Info. Criterion: BIC =         2.73394      |
| Info. Criterion:HQIC =         2.71171      |
| Variances: Sigma-squared(v)=       .64669   |
|            Sigma-squared(u)=       .59767   |
|            Sigma(v)        =       .80417   |
|            Sigma(u)        =       .77309   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.11551   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.24445231       .42734867    21.632   .0000
 LCAP    |     .14526152       .07861374     1.848   .0646   12.5431453
 LLAB    |    1.07139206       .07792357    13.749   .0000   3.31781158
 LCAPS   |     .00589344       .00755100      .780   .4351   80.8575222
 LLABS   |    -.03821490       .01244815    -3.070   .0021   6.93244022
 CAPL    |    -.01011685       .00750717    -1.348   .1778   43.7796496
 _2005   |     .38638908       .04077260     9.477   .0000    .30483956
 _2009   |     .27425304       .04498254     6.097   .0000    .43819043
 MANUFACT|    -.22720540       .04414818    -5.146   .0000    .27275118
 CONSTRUC|     .05715483       .05731903      .997   .3187    .10362967
 HOTEL_AN|    -.30997040       .06890751    -4.498   .0000    .06102052
 WHOLESAL|     .26587155       .04224699     6.293   .0000    .34744871
 PRIFORE |     .09369421       .03429511     2.732   .0063    .06259863
 PRIDOM  |     .00643420       .02153120      .299   .7651    .57364545
 MONTENEG|    -.85933812       .09568282    -8.981   .0000    .03051026
 BOSNIA  |    -.83436096       .04987682   -16.728   .0000    .19542346
 CROATIA |    -.40176581       .05242551    -7.664   .0000    .15307733
 SERBIA  |   -1.04138828       .04747506   -21.935   .0000    .24671226
 MACEDONI|   -1.18646067       .05029577   -23.590   .0000    .19358233
---------+Variance parameters for compound error
 Lambda  |     .96135942       .04322480    22.241   .0000
 Sigma   |    1.11550880       .00024130  4622.946   .0000
```

Appendix 3.2: the results of the Translog specification assuming normal distribution controlling for type of new owner after privatization with M2 dataset

```
frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,PriFORE,PRIDOM,monteneg,bosnia,
croatia,serbia,macedoni$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 18, 2013 at 07:17:25PM.|
| Dependent variable                LNOUT     |
| Weighting variable                 None     |
| Number of observations             3802     |
| Iterations completed                 26     |
| Log likelihood function       -5197.921     |
| Number of parameters                 21     |
| Info. Criterion: AIC =          2.74536     |
|   Finite Sample: AIC =          2.74542     |
| Info. Criterion: BIC =          2.77984     |
| Info. Criterion:HQIC =          2.75761     |
| Variances: Sigma-squared(v)=       .70855   |
|            Sigma-squared(u)=       .53627   |
|            Sigma(v)        =       .84175   |
|            Sigma(u)        =       .73230   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.11571   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    10.1901714       .42765636    23.828   .0000
 LCAP    |     .01107895       .07753883      .143   .8864   12.5520749
 LLAB    |    1.00840133       .07676543    13.136   .0000   3.31500890
 LCAPS   |     .01483082       .00738506     2.008   .0446   81.0507172
 LLABS   |    -.03197476       .01260625    -2.536   .0112   6.92244484
 CAPL    |    -.00673703       .00734928     -.917   .3593   43.8058639
 _2005   |     .38827253       .04193361     9.259   .0000    .30483956
 _2009   |     .26168286       .04649143     5.629   .0000    .43819043
 MANUFACT|    -.27417071       .04517413    -6.069   .0000    .27275118
 CONSTRUC|    -.08204724       .05880153    -1.395   .1629    .10362967
 HOTEL_AN|    -.28521422       .07087446    -4.024   .0001    .06102052
 WHOLESAL|     .32402554       .04323916     7.494   .0000    .34744871
 PRIFORE |     .10104955       .03529660     2.863   .0042    .06259863
 PRIDOM  |     .01070030       .02204313      .485   .6274    .57364545
 MONTENEG|    -.70563297       .09776108    -7.218   .0000    .03051026
 BOSNIA  |    -.77053242       .05091469   -15.134   .0000    .19542346
 CROATIA |    -.35538894       .05374291    -6.613   .0000    .15307733
 SERBIA  |    -.99656719       .04872943   -20.451   .0000    .24671226
 MACEDONI|   -1.18786447       .05113811   -23.229   .0000    .19358233
---------+Variance parameters for compound error
 Lambda  |     .86997037       .04254438    20.449   .0000
 Sigma   |    1.11571345       .00024169  4616.240   .0000
```

Appendix 3.3: the results of the Translog specification assuming normal distribution controlling for type of new owner after privatization with M3 dataset

```
frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,PriFORE,PRIDOM,monteneg,bosnia,
croatia,serbia,macedoni$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Feb 18, 2013 at 06:58:47PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                26      |
| Log likelihood function       -5103.514     |
| Number of parameters                21      |
| Info. Criterion: AIC =          2.69569     |
|   Finite Sample: AIC =          2.69576     |
| Info. Criterion: BIC =          2.73018     |
| Info. Criterion:HQIC =          2.70795     |
| Variances: Sigma-squared(v)=       .70947   |
|            Sigma-squared(u)=       .41113   |
|            Sigma(v)        =       .84230   |
|            Sigma(u)        =       .64119   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.05858   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.92747150       .42098913    23.581   .0000
 LCAP    |    -.03985889       .07693916     -.518   .6044   12.4886891
 LLAB    |    1.23048903       .07704591    15.971   .0000   3.31824505
 LCAPS   |     .02662099       .00738688     3.604   .0003   80.1882398
 LLABS   |    -.02465317       .01224126    -2.014   .0440   6.93183529
 CAPL    |    -.02800861       .00735839    -3.806   .0001   43.6208371
 _2005   |     .46458879       .04076662    11.396   .0000    .30483956
 _2009   |     .19939627       .04486902     4.444   .0000    .43819043
 MANUFACT|    -.22835007       .04411885    -5.176   .0000    .27275118
 CONSTRUC|    -.02517895       .05729382     -.439   .6603    .10362967
 HOTEL_AN|    -.27302968       .06900301    -3.957   .0001    .06102052
 WHOLESAL|     .34742840       .04219599     8.234   .0000    .34744871
 PRIFORE |     .08638707       .03514192     2.458   .0140    .06259863
 PRIDOM  |     .01752172       .02148473      .816   .4148    .57364545
 MONTENEG|    -.67049212       .09544078    -7.025   .0000    .03051026
 BOSNIA  |    -.77986115       .04942651   -15.778   .0000    .19542346
 CROATIA |    -.36392899       .05243777    -6.940   .0000    .15307733
 SERBIA  |   -1.00750620       .04714259   -21.371   .0000    .24671226
 MACEDONI|   -1.17705103       .04968841   -23.689   .0000    .19358233
---------+Variance parameters for compound error
 Lambda  |     .76124081       .04221625    18.032   .0000
 Sigma   |    1.05858374       .00022873  4628.073   .0000
```

Appendix 3.4: the results of the Translog specification assuming normal distribution controlling for type of new owner after privatization with M4 dataset

```
frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,PriFORE,PRIDOM,monteneg,bosnia,
croatia,serbia,macedoni$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Feb 18, 2013 at 07:05:41PM.|
| Dependent variable               LNOUT       |
| Weighting variable                None       |
| Number of observations            3802       |
| Iterations completed                27       |
| Log likelihood function       -5005.088      |
| Number of parameters                21       |
| Info. Criterion: AIC =          2.64392      |
|   Finite Sample: AIC =          2.64398      |
| Info. Criterion: BIC =          2.67840      |
| Info. Criterion:HQIC =          2.65617      |
| Variances: Sigma-squared(v)=       .60223    |
|            Sigma-squared(u)=       .59274    |
|            Sigma(v)        =       .77603    |
|            Sigma(u)        =       .76989    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      1.09314    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.89408057       .42390210    23.340   .0000
 LCAP    |    -.01888919       .07769519     -.243   .8079   12.4505278
 LLAB    |    1.19557108       .07396926    16.163   .0000   3.31788738
 LCAPS   |     .02705507       .00742636     3.643   .0003   79.6547910
 LLABS   |    -.02825680       .01206383    -2.342   .0192   6.93107361
 CAPL    |    -.02560002       .00713117    -3.590   .0003   43.4437872
 _2005   |     .37348608       .03973423     9.400   .0000    .30483956
 _2009   |     .19381005       .04378910     4.426   .0000    .43819043
 MANUFACT|    -.30061929       .04294625    -7.000   .0000    .27275118
 CONSTRUC|    -.04553990       .05582823     -.816   .4147    .10362967
 HOTEL_AN|    -.32351618       .06698848    -4.829   .0000    .06102052
 WHOLESAL|     .26048453       .04107030     6.342   .0000    .34744871
 PRIFORE |     .09753902       .03299544     2.956   .0031    .06259863
 PRIDOM  |     .01451979       .02113956      .687   .4922    .57364545
 MONTENEG|    -.71588268       .09339632    -7.665   .0000    .03051026
 BOSNIA  |    -.84342875       .04810956   -17.531   .0000    .19542346
 CROATIA |    -.39270677       .05102808    -7.696   .0000    .15307733
 SERBIA  |   -1.04693728       .04576260   -22.878   .0000    .24671226
 MACEDONI|   -1.23169337       .04835149   -25.474   .0000    .19358233
---------+Variance parameters for compound error
 Lambda  |     .99208701       .04339529    22.862   .0000
 Sigma   |    1.09314424       .00023424  4666.709   .0000
```

Appendix 3.5: the results of the Translog specification assuming normal distribution controlling for type of new owner after privatization with M5 dataset

```
frontier;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl,_2005,
_2009,manufact,construc,hotel_an,wholesal,PriFORE,PRIDOM,monteneg,bosnia,
croatia,serbia,macedoni$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Feb 18, 2013 at 07:12:35PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                26      |
| Log likelihood function      -5152.972      |
| Number of parameters                21      |
| Info. Criterion: AIC =         2.72171      |
|   Finite Sample: AIC =         2.72177      |
| Info. Criterion: BIC =         2.75619      |
| Info. Criterion:HQIC =         2.73397      |
| Variances: Sigma-squared(v)=      .69932    |
|            Sigma-squared(u)=      .50317    |
|            Sigma(v)        =      .83625    |
|            Sigma(u)        =      .70934    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=     1.09658    |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    10.0839311       .46026717    21.909   .0000
 LCAP    |    -.03612127       .08331051     -.434   .6646   12.4987458
 LLAB    |    1.16151633       .07855582    14.786   .0000   3.31958432
 LCAPS   |     .02311800       .00785803     2.942   .0033   80.1716606
 LLABS   |    -.03755807       .01230546    -3.052   .0023   6.93701034
 CAPL    |    -.01765591       .00745989    -2.367   .0179   43.5413882
 _2005   |     .44966830       .04127874    10.893   .0000    .30483956
 _2009   |     .27512259       .04524592     6.081   .0000    .43819043
 MANUFACT|    -.18015913       .04457955    -4.041   .0001    .27275118
 CONSTRUC|     .13543706       .05802058     2.334   .0196    .10362967
 HOTEL_AN|    -.23584887       .07003246    -3.368   .0008    .06102052
 WHOLESAL|     .32092813       .04275391     7.506   .0000    .34744871
 PRIFORE |     .08710026       .03498245     2.490   .0128    .06259863
 PRIDOM  |    -.00612948       .02179648     -.281   .7785    .57364545
 MONTENEG|    -.59649951       .09669328    -6.169   .0000    .03051026
 BOSNIA  |    -.76321600       .05012285   -15.227   .0000    .19542346
 CROATIA |    -.45312729       .05309399    -8.534   .0000    .15307733
 SERBIA  |   -1.09645261       .04754323   -23.062   .0000    .24671226
 MACEDONI|   -1.16791462       .05035914   -23.192   .0000    .19358233
---------+Variance parameters for compound error
 Lambda  |     .84823799       .04231114    20.048   .0000
 Sigma   |    1.09658075       .00023538  4658.838   .0000
```

Appendix 4: The results of the Cobb-Douglas and Translog specifications assuming truncated, exponential and gamma distribution

Appendix 4.1: the results of the Cobb-Douglas and Translog specifications with M1 dataset

Cobb-Douglas (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_tCD$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Aug 31, 2012 at 08:00:41AM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                98      |
| Log likelihood function       -5543.853     |
| Number of parameters                 9      |
| Info. Criterion: AIC =         2.92102      |
|   Finite Sample: AIC =         2.92103      |
| Info. Criterion: BIC =         2.93580      |
| Info. Criterion:HQIC =         2.92627      |
| Variances: Sigma-squared(v)=       .85401   |
|            Sigma-squared(u)=     95.58804   |
|            Sigma(v)        =       .92413   |
|            Sigma(u)        =      9.77691   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      9.82049   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+--------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.01332185       .46094753    19.554   .0000
 LCAP    |     .03391324       .08198742      .414   .6791   12.5431453
 LLAB    |    1.08529118       .07661979    14.165   .0000   3.31781158
 LCAPS   |     .02369405       .00755927     3.134   .0017   80.8575222
 LLABS   |    -.01410013       .01191442    -1.183   .2366   6.93244022
 CAPL    |    -.02443000       .00692118    -3.530   .0004   43.7796496
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |   -195.538266      3539.80180     -.055   .9559
---------+Variance parameters for compound error
 Lambda  |    10.5796168      94.3685052      .112   .9107
 Sigma   |    9.82049147      87.0189787      .113   .9101
```

Translog (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_t$
Maximum iterations reached. Exit iterations with status=1.

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Aug 31, 2012 at 08:01:16AM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed               101      |
| Log likelihood function      -5070.980      |
| Number of parameters                22      |
| Info. Criterion: AIC =         2.67911      |
|   Finite Sample: AIC =         2.67918      |
| Info. Criterion: BIC =         2.71523      |
| Info. Criterion:HQIC =         2.69194      |
| Variances: Sigma-squared(v)=      .66297    |
|            Sigma-squared(u)=    73.60286    |
|            Sigma(v)        =      .81423    |
|            Sigma(u)        =     8.57921    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=     8.61776    |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.07255730      .42550297    21.322   .0000
 LCAP    |     .12496173      .07325720     1.706   .0880   12.5431453
 LLAB    |    1.09828941      .06938247    15.829   .0000   3.31781158
 LCAPS   |     .00867539      .00664602     1.305   .1918   80.8575222
 LLABS   |    -.03024427      .01037991    -2.914   .0036   6.93244022
 CAPL    |    -.01499744      .00611377    -2.453   .0142   43.7796496
 _2005   |     .39280294      .04506296     8.717   .0000    .30483956
 _2009   |     .29906413      .04657095     6.422   .0000    .43819043
 MANUFACT|    -.24354994      .04599457    -5.295   .0000    .27275118
 CONSTRUC|     .06549737      .05889791     1.112   .2661    .10362967
 HOTEL_AN|    -.32613509      .07559026    -4.315   .0000    .06102052
 WHOLESAL|     .23341356      .04095187     5.700   .0000    .34744871
 MONTENEG|    -.85281010      .08456684   -10.084   .0000    .03051026
 BOSNIA  |    -.82251761      .05119294   -16.067   .0000    .19542346
 CROATIA |    -.41144369      .05713282    -7.202   .0000    .15307733
 SERBIA  |   -1.03236397      .04849133   -21.290   .0000    .24671226
 MACEDONI|   -1.18011643      .05110071   -23.094   .0000    .19358233
 PRIVATE_|     .42636631      .07081939     6.020   .0000    .10126249
 PRIVATE0|     .06808053      .05694039     1.196   .2318    .77880063
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |   -168.903388     2002.04733     -.084   .9328
---------+Variance parameters for compound error
 Lambda  |    10.5365763     61.3825857      .172   .8637
 Sigma   |    8.61776276     49.9028304      .173   .8629
```

Cobb-Douglas (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_eCD$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER  |
| Maximum Likelihood Estimates                 |
| Model estimated: Aug 31, 2012 at 08:02:37AM.|
| Dependent variable               LNOUT       |
| Weighting variable                None       |
| Number of observations            3802       |
| Iterations completed                11       |
| Log likelihood function       -5543.768      |
| Number of parameters                 8       |
| Info. Criterion: AIC =         2.92045       |
|   Finite Sample: AIC =         2.92046       |
| Info. Criterion: BIC =         2.93358       |
| Info. Criterion:HQIC =         2.92511       |
| Exponential frontier model                   |
| Variances: Sigma-squared(v)=       .85379    |
|            Sigma-squared(u)=       .23473    |
|            Sigma(v)        =       .92401    |
|            Sigma(u)        =       .48449    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.01057532       .47752457    18.869   .0000
 LCAP    |     .03402777       .08792117      .387   .6987   12.5431453
 LLAB    |    1.08544358       .08773153    12.372   .0000   3.31781158
 LCAPS   |     .02368901       .00845160     2.803   .0051   80.8575222
 LLABS   |    -.01408338       .01410798     -.998   .3182   6.93244022
 CAPL    |    -.02444808       .00858817    -2.847   .0044   43.7796496
---------+Variance parameters for compound error
 Theta   |    2.06402389       .16433772    12.560   .0000
 Sigmav  |     .92400926       .02004093    46.106   .0000
```

Translog (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_e$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Aug 31, 2012 at 08:03:09AM.|
| Dependent variable                LNOUT     |
| Weighting variable                 None     |
| Number of observations             3802     |
| Iterations completed                 25     |
| Log likelihood function       -5070.767     |
| Number of parameters                 21     |
| Info. Criterion: AIC =          2.67847     |
|   Finite Sample: AIC =          2.67853     |
| Info. Criterion: BIC =          2.71295     |
| Info. Criterion:HQIC =          2.69072     |
| Exponential frontier model                  |
| Variances: Sigma-squared(v)=       .66125   |
|            Sigma-squared(u)=       .18659   |
|            Sigma(v)        =       .81317   |
|            Sigma(u)        =       .43197   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.06490214       .42684642    21.237   .0000
 LCAP    |     .12579602       .07831946     1.606   .1082   12.5431453
 LLAB    |    1.09859956       .07858090    13.980   .0000   3.31781158
 LCAPS   |     .00862599       .00757723     1.138   .2549   80.8575222
 LLABS   |    -.03021268       .01270030    -2.379   .0174   6.93244022
 CAPL    |    -.01503051       .00770560    -1.951   .0511   43.7796496
 _2005   |     .39249633       .04033087     9.732   .0000    .30483956
 _2009   |     .29834041       .04573638     6.523   .0000    .43819043
 MANUFACT|    -.24333565       .04348077    -5.596   .0000    .27275118
 CONSTRUC|     .06544649       .05663008     1.156   .2478    .10362967
 HOTEL_AN|    -.32583859       .06746629    -4.830   .0000    .06102052
 WHOLESAL|     .23328994       .04187641     5.571   .0000    .34744871
 MONTENEG|    -.85288483       .09454401    -9.021   .0000    .03051026
 BOSNIA  |    -.82258300       .04910714   -16.751   .0000    .19542346
 CROATIA |    -.41153019       .05119393    -8.039   .0000    .15307733
 SERBIA  |   -1.03227520       .04669800   -22.105   .0000    .24671226
 MACEDONI|   -1.18005465       .04955742   -23.812   .0000    .19358233
 PRIVATE_|     .42713972       .06442321     6.630   .0000    .10126249
 PRIVATE0|     .06879647       .05021498     1.370   .1707    .77880063
---------+Variance parameters for compound error
 Theta   |    2.31499516       .16775180    13.800   .0000
 Sigmav  |     .81317073       .01662937    48.900   .0000
```

Cobb-Douglas (Gamma Distribution)

```
--> frontier;model=g;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_gCD$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Aug 31, 2012 at 08:12:24AM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                13      |
| Log likelihood function      -5543.768      |
| Number of parameters                 9      |
| Info. Criterion: AIC =         2.92097      |
|   Finite Sample: AIC =         2.92098      |
| Info. Criterion: BIC =         2.93575      |
| Info. Criterion:HQIC =         2.92622      |
| Normal-Gamma frontier model                  |
| Variances: Sigma-squared(v)=       .85357   |
|            Sigma-squared(u)=       .23495   |
|            Sigma(v)        =       .92389   |
|            Sigma(u)        =       .48471   |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.01160753       .45885798    19.639   .0000
 LCAP    |     .03403357       .08190301      .416   .6778   12.5431453
 LLAB    |    1.08542048       .07654926    14.179   .0000   3.31781158
 LCAPS   |     .02368800       .00755271     3.136   .0017   80.8575222
 LLABS   |    -.01408556       .01185242    -1.188   .2347   6.93244022
 CAPL    |    -.02444573       .00691134    -3.537   .0004   43.7796496
---------+Variance parameters for compound error
 Theta   |    2.06654100       .16212262    12.747   .0000
 P       |    1.00335802       .13403210     7.486   .0000
 Sigmav  |     .92389050       .01952866    47.309   .0000
```

Translog (Gamma Distribution)

```
--> frontier;model=g;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_g$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Aug 31, 2012 at 08:36:33AM.|
| Dependent variable               LNOUT       |
| Weighting variable                None       |
| Number of observations            3802       |
| Iterations completed                26       |
| Log likelihood function      -5070.762       |
| Number of parameters                22       |
| Info. Criterion: AIC =         2.67899       |
|   Finite Sample: AIC =         2.67906       |
| Info. Criterion: BIC =         2.71512       |
| Info. Criterion:HQIC =         2.69183       |
| Normal-Gamma frontier model                  |
| Variances: Sigma-squared(v)=       .66183    |
|            Sigma-squared(u)=       .18602    |
|            Sigma(v)        =       .81353    |
|            Sigma(u)        =       .43131    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+---------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.06133839       .42306519    21.418   .0000
 LCAP    |     .12574074       .07305972     1.721   .0852   12.5431453
 LLAB    |    1.09873293       .06923533    15.870   .0000   3.31781158
 LCAPS   |     .00863272       .00662734     1.303   .1927   80.8575222
 LLABS   |    -.03019406       .01028298    -2.936   .0033   6.93244022
 CAPL    |    -.01504506       .00608487    -2.473   .0134   43.7796496
 _2005   |     .39252056       .04491900     8.738   .0000    .30483956
 _2009   |     .29841967       .04635363     6.438   .0000    .43819043
 MANUFACT|    -.24334738       .04584707    -5.308   .0000    .27275118
 CONSTRUC|     .06542575       .05871755     1.114   .2652    .10362967
 HOTEL_AN|    -.32587698       .07534633    -4.325   .0000    .06102052
 WHOLESAL|     .23326173       .04078802     5.719   .0000    .34744871
 MONTENEG|    -.85295987       .08427088   -10.122   .0000    .03051026
 BOSNIA  |    -.82258160       .05105143   -16.113   .0000    .19542346
 CROATIA |    -.41152330       .05695503    -7.225   .0000    .15307733
 SERBIA  |   -1.03224925       .04836182   -21.344   .0000    .24671226
 MACEDONI|   -1.18003337       .05096145   -23.155   .0000    .19358233
 PRIVATE_|     .42717118       .07053591     6.056   .0000    .10126249
 PRIVATE0|     .06880780       .05676258     1.212   .2254    .77880063
---------+Variance parameters for compound error
 Theta   |    2.30203378       .15735198    14.630   .0000
 P       |     .98580922       .13049087     7.555   .0000
 Sigmav  |     .81352782       .01652887    49.219   .0000
```

Appendix 4.2: the results of the Cobb-Douglas and Translog specifications with M2 dataset

Cobb-Douglas (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_tCD$


+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 08:28:48PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                97      |
| Log likelihood function       -5630.331     |
| Number of parameters                 9      |
| Info. Criterion: AIC =         2.96651      |
|   Finite Sample: AIC =         2.96652      |
| Info. Criterion: BIC =         2.98129      |
| Info. Criterion:HQIC =         2.97176      |
| Variances: Sigma-squared(v)=      .87838    |
|            Sigma-squared(u)=   106.88996    |
|            Sigma(v)        =      .93722    |
|            Sigma(u)        =    10.33876    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=    10.38115    |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.91398564       .47452427    20.892   .0000
 LCAP    |   -.07184324        .08331848     -.862   .3885   12.5520749
 LLAB    |   1.03087879        .07335667    14.053   .0000   3.31500890
 LCAPS   |    .03012695        .00756867     3.980   .0001   81.0507172
 LLABS   |   -.00772681        .01142077     -.677   .4987   6.92244484
 CAPL    |   -.02224674        .00641685    -3.467   .0005   43.8058639
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |  -206.775198       4203.13614     -.049   .9608
---------+Variance parameters for compound error
 Lambda  |    11.0313440      110.620405      .100   .9206
 Sigma   |    10.3811527      103.462366      .100   .9201
```

Translog (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_t$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 08:29:33PM.|
| Dependent variable                LNOUT      |
| Weighting variable                 None      |
| Number of observations             3802      |
| Iterations completed                101      |
| Log likelihood function       -5154.468      |
| Number of parameters                 22      |
| Info. Criterion: AIC =          2.72302      |
|   Finite Sample: AIC =          2.72309      |
| Info. Criterion: BIC =          2.75915      |
| Info. Criterion:HQIC =          2.73586      |
| Variances: Sigma-squared(v)=       .71104    |
|            Sigma-squared(u)=     66.23501    |
|            Sigma(v)        =       .84323    |
|            Sigma(u)        =      8.13849    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      8.18206    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+---------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.93335890       .44353366    22.396   .0000
 LCAP    |     .00706560       .07602335      .093   .9260   12.5520749
 LLAB    |    1.04378435       .06677208    15.632   .0000   3.31500890
 LCAPS   |     .01639113       .00682819     2.401   .0164   81.0507172
 LLABS   |    -.02194631       .01003906    -2.186   .0288   6.92244484
 CAPL    |    -.01289469       .00573674    -2.248   .0246   43.8058639
 _2005   |     .39629428       .04587149     8.639   .0000    .30483956
 _2009   |     .29759196       .04720235     6.305   .0000    .43819043
 MANUFACT|    -.29320862       .04698271    -6.241   .0000    .27275118
 CONSTRUC|    -.06792307       .06282433    -1.081   .2796    .10362967
 HOTEL_AN|    -.30064214       .07761641    -3.873   .0001    .06102052
 WHOLESAL|     .28666509       .04251447     6.743   .0000    .34744871
 MONTENEG|    -.69434286       .08816641    -7.875   .0000    .03051026
 BOSNIA  |    -.75637226       .05365784   -14.096   .0000    .19542346
 CROATIA |    -.36672670       .05942081    -6.172   .0000    .15307733
 SERBIA  |    -.98966307       .05106846   -19.379   .0000    .24671226
 MACEDONI|   -1.18171648       .05303862   -22.280   .0000    .19358233
 PRIVATE_|     .48085006       .07267794     6.616   .0000    .10126249
 PRIVATE0|     .07352367       .05806715     1.266   .2054    .77880063
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |   -157.390037      2033.60811     -.077   .9383
---------+Variance parameters for compound error
 Lambda  |    9.65157302      61.2287898      .158   .8747
 Sigma   |    8.18205622      51.5040567      .159   .8738
```

Cobb-Douglas (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_eCD$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 08:30:46PM.|
| Dependent variable              LNOUT       |
| Weighting variable               None       |
| Number of observations           3802       |
| Iterations completed               11       |
| Log likelihood function       -5630.254     |
| Number of parameters                8       |
| Info. Criterion: AIC =         2.96594      |
|   Finite Sample: AIC =         2.96595      |
| Info. Criterion: BIC =         2.97908      |
| Info. Criterion:HQIC =         2.97061      |
| Exponential frontier model                   |
| Variances: Sigma-squared(v)=       .87833   |
|            Sigma-squared(u)=       .26239   |
|            Sigma(v)        =       .93719   |
|            Sigma(u)        =       .51224   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+--------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.91293354       .47150831    21.024   .0000
 LCAP    |    -.07209765       .08599289     -.838   .4018   12.5520749
 LLAB    |    1.03135178       .08607605    11.982   .0000   3.31500890
 LCAPS   |     .03016423       .00822659     3.667   .0002   81.0507172
 LLABS   |    -.00763469       .01431089     -.533   .5937   6.92244484
 CAPL    |    -.02231249       .00843328    -2.646   .0082   43.8058639
---------+Variance parameters for compound error
 Theta   |    1.95221342       .14610552    13.362   .0000
 Sigmav  |     .93719270       .02038580    45.973   .0000
```

Translog (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_e$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 08:31:29PM.|
| Dependent variable                LNOUT      |
| Weighting variable                 None      |
| Number of observations             3802      |
| Iterations completed                 25      |
| Log likelihood function       -5154.251      |
| Number of parameters                 21      |
| Info. Criterion: AIC =          2.72238      |
|   Finite Sample: AIC =          2.72245      |
| Info. Criterion: BIC =          2.75687      |
| Info. Criterion:HQIC =          2.73464      |
| Exponential frontier model                   |
| Variances: Sigma-squared(v)=       .70937    |
|            Sigma-squared(u)=       .17491    |
|            Sigma(v)        =       .84224    |
|            Sigma(u)        =       .41822    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+---------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient   | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.94933551       .42536919    23.390   .0000
 LCAP    |     .00422764       .07677502      .055   .9561   12.5520749
 LLAB    |    1.04501857       .07687660    13.593   .0000   3.31500890
 LCAPS   |     .01665816       .00736336     2.262   .0237   81.0507172
 LLABS   |    -.02169644       .01284831    -1.689   .0913   6.92244484
 CAPL    |    -.01305712       .00750639    -1.739   .0820   43.8058639
 _2005   |     .39667330       .04148400     9.562   .0000    .30483956
 _2009   |     .29804622       .04713064     6.324   .0000    .43819043
 MANUFACT|    -.29255675       .04446398    -6.580   .0000    .27275118
 CONSTRUC|    -.06776184       .05805763    -1.167   .2432    .10362967
 HOTEL_AN|    -.30068084       .06948171    -4.327   .0000    .06102052
 WHOLESAL|     .28648334       .04283891     6.687   .0000    .34744871
 MONTENEG|    -.69451343       .09648241    -7.198   .0000    .03051026
 BOSNIA  |    -.75750959       .05014871   -15.105   .0000    .19542346
 CROATIA |    -.36762435       .05246608    -7.007   .0000    .15307733
 SERBIA  |    -.98986987       .04798231   -20.630   .0000    .24671226
 MACEDONI|   -1.18271497       .05047689   -23.431   .0000    .19358233
 PRIVATE_|     .48135689       .06602689     7.290   .0000    .10126249
 PRIVATE0|     .07298111       .05147722     1.418   .1563    .77880063
---------+Variance parameters for compound error
 Theta   |    2.39108589       .18973407    12.602   .0000
 Sigmav  |     .84223862       .01701005    49.514   .0000
```

Cobb-Douglas (Gamma Distribution)

```
--> frontier;model=g;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_gCD$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 08:42:13PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                13      |
| Log likelihood function       -5630.254     |
| Number of parameters                 9      |
| Info. Criterion: AIC =         2.96647      |
|   Finite Sample: AIC =         2.96648      |
| Info. Criterion: BIC =         2.98125      |
| Info. Criterion:HQIC =         2.97172      |
| Normal-Gamma frontier model                 |
| Variances: Sigma-squared(v)=       .87837   |
|            Sigma-squared(u)=       .26235   |
|            Sigma(v)        =       .93722   |
|            Sigma(u)        =       .51220   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.91274174       .47447091    20.892   .0000
 LCAP    |    -.07209985       .08316083     -.867   .3859   12.5520749
 LLAB    |    1.03135683       .07330653    14.069   .0000   3.31500890
 LCAPS   |     .03016457       .00755967     3.990   .0001   81.0507172
 LLABS   |    -.00763416       .01139428     -.670   .5029   6.92244484
 CAPL    |    -.02231305       .00640966    -3.481   .0005   43.8058639
---------+Variance parameters for compound error
 Theta   |    1.95178754       .15373910    12.695   .0000
 P       |     .99939953       .13433641     7.440   .0000
 Sigmav  |     .93721622       .02042741    45.880   .0000
```

Translog (Gamma Distribution)

```
--> frontier;model=g;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_g$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 09:02:38PM.|
| Dependent variable                LNOUT      |
| Weighting variable                 None      |
| Number of observations             3802      |
| Iterations completed                 27      |
| Log likelihood function       -5154.251      |
| Number of parameters                 22      |
| Info. Criterion: AIC =          2.72291      |
|   Finite Sample: AIC =          2.72298      |
| Info. Criterion: BIC =          2.75904      |
| Info. Criterion:HQIC =          2.73575      |
| Normal-Gamma frontier model                  |
| Variances: Sigma-squared(v)=       .70946    |
|            Sigma-squared(u)=       .17481    |
|            Sigma(v)        =       .84230    |
|            Sigma(u)        =       .41810    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.94874601       .44242218    22.487   .0000
 LCAP    |     .00421485       .07595001      .055   .9557   12.5520749
 LLAB    |    1.04504235       .06671616    15.664   .0000   3.31500890
 LCAPS   |     .01665982       .00682430     2.441   .0146   81.0507172
 LLABS   |    -.02169334       .00999220    -2.171   .0299   6.92244484
 CAPL    |    -.01305982       .00572644    -2.281   .0226   43.8058639
 _2005   |     .39667517       .04575325     8.670   .0000    .30483956
 _2009   |     .29805653       .04710753     6.327   .0000    .43819043
 MANUFACT|    -.29256277       .04692416    -6.235   .0000    .27275118
 CONSTRUC|    -.06776529       .06272281    -1.080   .2800    .10362967
 HOTEL_AN|    -.30068538       .07749167    -3.880   .0001    .06102052
 WHOLESAL|     .28647609       .04237949     6.760   .0000    .34744871
 MONTENEG|    -.69452198       .08801618    -7.891   .0000    .03051026
 BOSNIA  |    -.75750883       .05354609   -14.147   .0000    .19542346
 CROATIA |    -.36762366       .05933070    -6.196   .0000    .15307733
 SERBIA  |    -.98986369       .05095258   -19.427   .0000    .24671226
 MACEDONI|   -1.18270974       .05287696   -22.367   .0000    .19358233
 PRIVATE_|     .48136145       .07250908     6.639   .0000    .10126249
 PRIVATE0|     .07298160       .05800440     1.258   .2083    .77880063
---------+Variance parameters for compound error
 Theta   |    2.38880247       .16921832    14.117   .0000
 P       |     .99754124       .13266517     7.519   .0000
 Sigmav  |     .84229586       .01654095    50.922   .0000
```

Appendix 4.3: the results of the Cobb-Douglas and Translog specifications with M3 dataset

Cobb-Douglas (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_tCD$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:03:41PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed               101      |
| Log likelihood function      -5573.815      |
| Number of parameters                 9      |
| Info. Criterion: AIC =         2.93678      |
|   Finite Sample: AIC =         2.93679      |
| Info. Criterion: BIC =         2.95156      |
| Info. Criterion:HQIC =         2.94203      |
| Variances: Sigma-squared(v)=       .86781   |
|            Sigma-squared(u)=     95.05430   |
|            Sigma(v)        =       .93156   |
|            Sigma(u)        =      9.74958   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      9.79398   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.43809825       .47951942    19.682   .0000
 LCAP    |    -.04405302       .08620476     -.511   .6093   12.4886891
 LLAB    |    1.21981128       .07951957    15.340   .0000   3.31824505
 LCAPS   |     .03281816       .00803008     4.087   .0000   80.1882398
 LLABS   |     .00452511       .01140122      .397   .6914   6.93183529
 CAPL    |    -.04096727       .00716954    -5.714   .0000   43.6208371
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |   -193.163414      3385.94514     -.057   .9545
---------+Variance parameters for compound error
 Lambda  |    10.4658165      90.3422468      .116   .9078
 Sigma   |    9.79398361      83.9815866      .117   .9072
```

Translog (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_t$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:04:45PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed               101      |
| Log likelihood function      -5075.362      |
| Number of parameters                22      |
| Info. Criterion: AIC =         2.68141      |
|   Finite Sample: AIC =         2.68148      |
| Info. Criterion: BIC =         2.71754      |
| Info. Criterion:HQIC =         2.69425      |
| Variances: Sigma-squared(v)=       .69927   |
|            Sigma-squared(u)=     60.14154   |
|            Sigma(v)        =       .83622   |
|            Sigma(u)        =      7.75510   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      7.80005   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.85477407       .44177959    22.307   .0000
 LCAP    |    -.04964251       .07796696     -.637   .5243   12.4886891
 LLAB    |    1.25324093       .07035916    17.812   .0000   3.31824505
 LCAPS   |     .02805343       .00715838     3.919   .0001   80.1882398
 LLABS   |    -.01825942       .01010899    -1.806   .0709   6.93183529
 CAPL    |    -.03229185       .00622109    -5.191   .0000   43.6208371
 _2005   |     .48105194       .04465601    10.772   .0000    .30483956
 _2009   |     .25222711       .04645163     5.430   .0000    .43819043
 MANUFACT|    -.23977597       .04535369    -5.287   .0000    .27275118
 CONSTRUC|    -.01569570       .05895748     -.266   .7901    .10362967
 HOTEL_AN|    -.28920211       .07490968    -3.861   .0001    .06102052
 WHOLESAL|     .32020971       .04118579     7.775   .0000    .34744871
 MONTENEG|    -.65720302       .08519481    -7.714   .0000    .03051026
 BOSNIA  |    -.77129627       .05231507   -14.743   .0000    .19542346
 CROATIA |    -.36707239       .05763247    -6.369   .0000    .15307733
 SERBIA  |    -.99961962       .05002849   -19.981   .0000    .24671226
 MACEDONI|   -1.16475175       .05191431   -22.436   .0000    .19358233
 PRIVATE_|     .29746205       .06818787     4.362   .0000    .10126249
 PRIVATE0|    -.01841650       .05445411     -.338   .7352    .77880063
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |   -155.101659      1997.30062     -.078   .9381
---------+Variance parameters for compound error
 Lambda  |    9.27394088      58.6175487      .158   .8743
 Sigma   |    7.80005178      48.8744972      .160   .8732
```

Cobb-Douglas (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_eCD$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:14:48PM.|
| Dependent variable                LNOUT     |
| Weighting variable                 None     |
| Number of observations             3802     |
| Iterations completed                 12     |
| Log likelihood function       -5573.722     |
| Number of parameters                  8     |
| Info. Criterion: AIC =          2.93620     |
|   Finite Sample: AIC =          2.93621     |
| Info. Criterion: BIC =          2.94934     |
| Info. Criterion:HQIC =          2.94087     |
| Exponential frontier model                  |
| Variances: Sigma-squared(v)=       .86760   |
|            Sigma-squared(u)=       .23813   |
|            Sigma(v)        =       .93145   |
|            Sigma(u)        =       .48799   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.43556487       .47070678    20.046   .0000
 LCAP    |    -.04379637       .08665498     -.505   .6133   12.4886891
 LLAB    |    1.21944822       .08726505    13.974   .0000   3.31824505
 LCAPS   |     .03280250       .00834215     3.932   .0001   80.1882398
 LLABS   |     .00466001       .01401057      .333   .7394   6.93183529
 CAPL    |    -.04097513       .00848316    -4.830   .0000   43.6208371
---------+Variance parameters for compound error
 Theta   |    2.04923004       .16168051    12.675   .0000
 Sigmav  |     .93144970       .02002594    46.512   .0000
```

Translog (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_e$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 09:15:17PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                26      |
| Log likelihood function       -5075.152     |
| Number of parameters                21      |
| Info. Criterion: AIC =          2.68077     |
|   Finite Sample: AIC =          2.68084     |
| Info. Criterion: BIC =          2.71526     |
| Info. Criterion:HQIC =          2.69303     |
| Exponential frontier model                   |
| Variances: Sigma-squared(v)=       .69849   |
|            Sigma-squared(u)=       .14818   |
|            Sigma(v)       =       .83576   |
|            Sigma(u)       =       .38495   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+---------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.85587652       .41974061    23.481   .0000
 LCAP    |    -.04981131       .07628277     -.653   .5138   12.4886891
 LLAB    |    1.25271444       .07710431    16.247   .0000   3.31824505
 LCAPS   |     .02806050       .00736322     3.811   .0001   80.1882398
 LLABS   |    -.01826720       .01248511    -1.463   .1434   6.93183529
 CAPL    |    -.03224842       .00748259    -4.310   .0000   43.6208371
 _2005   |     .48119827       .04052719    11.873   .0000    .30483956
 _2009   |     .25221364       .04572511     5.516   .0000    .43819043
 MANUFACT|    -.23965865       .04366601    -5.488   .0000    .27275118
 CONSTRUC|    -.01535276       .05689257     -.270   .7873    .10362967
 HOTEL_AN|    -.28897051       .06803592    -4.247   .0000    .06102052
 WHOLESAL|     .32070295       .04197975     7.639   .0000    .34744871
 MONTENEG|    -.65766382       .09476280    -6.940   .0000    .03051026
 BOSNIA  |    -.77190351       .04891142   -15.782   .0000    .19542346
 CROATIA |    -.36764895       .05151149    -7.137   .0000    .15307733
 SERBIA  |   -1.00057771       .04660515   -21.469   .0000    .24671226
 MACEDONI|   -1.16506881       .04922271   -23.669   .0000    .19358233
 PRIVATE_|     .29695049       .06490940     4.575   .0000    .10126249
 PRIVATE0|    -.01878997       .05055682     -.372   .7101    .77880063
---------+Variance parameters for compound error
 Theta   |    2.59775586       .22297091    11.651   .0000
 Sigmav  |     .83575904       .01635777    51.092   .0000
```

Cobb-Douglas (Gamma Distribution)

```
--> frontier;model=g;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_gCD$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:32:52PM.|
| Dependent variable                LNOUT     |
| Weighting variable                 None     |
| Number of observations             3802     |
| Iterations completed                 13     |
| Log likelihood function       -5573.722     |
| Number of parameters                  9     |
| Info. Criterion: AIC =          2.93673     |
|   Finite Sample: AIC =          2.93674     |
| Info. Criterion: BIC =          2.95151     |
| Info. Criterion:HQIC =          2.94198     |
| Normal-Gamma frontier model                 |
| Variances: Sigma-squared(v)=       .86753   |
|            Sigma-squared(u)=       .23820   |
|            Sigma(v)        =       .93141   |
|            Sigma(u)        =       .48806   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.43589129       .47754197    19.759   .0000
 LCAP    |    -.04379218       .08613969     -.508   .6112   12.4886891
 LLAB    |    1.21943855       .07950033    15.339   .0000   3.31824505
 LCAPS   |     .03280193       .00802608     4.087   .0000   80.1882398
 LLABS   |     .00465894       .01137985      .409   .6822   6.93183529
 CAPL    |    -.04097412       .00716638    -5.718   .0000   43.6208371
---------+Variance parameters for compound error
 Theta   |    2.05003940       .16052248    12.771   .0000
 P       |    1.00108714       .13368931     7.488   .0000
 Sigmav  |     .93141105       .02008292    46.378   .0000
```

Translog (Gamma Distribution)

```
--> frontier;model=g;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_g$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 09:51:57PM.|
| Dependent variable               LNOUT       |
| Weighting variable                None       |
| Number of observations            3802       |
| Iterations completed                29       |
| Log likelihood function       -5075.151      |
| Number of parameters                22       |
| Info. Criterion: AIC =          2.68130      |
|   Finite Sample: AIC =          2.68137      |
| Info. Criterion: BIC =          2.71743      |
| Info. Criterion:HQIC =          2.69414      |
| Normal-Gamma frontier model                  |
| Variances: Sigma-squared(v)=       .69836    |
|            Sigma-squared(u)=       .14832    |
|            Sigma(v)        =       .83568    |
|            Sigma(u)        =       .38512    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+---------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient   | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.85681989       .43949951    22.427   .0000
 LCAP    |    -.04979583       .07790446     -.639   .5227   12.4886891
 LLAB    |    1.25268191       .07031980    17.814   .0000   3.31824505
 LCAPS   |     .02805857       .00715313     3.923   .0001   80.1882398
 LLABS   |    -.01827307       .01002435    -1.823   .0683   6.93183529
 CAPL    |    -.03224444       .00620850    -5.194   .0000   43.6208371
 _2005   |     .48119641       .04458772    10.792   .0000    .30483956
 _2009   |     .25219007       .04627968     5.449   .0000    .43819043
 MANUFACT|    -.23964944       .04530905    -5.289   .0000    .27275118
 CONSTRUC|    -.01533920       .05889055     -.260   .7945    .10362967
 HOTEL_AN|    -.28895785       .07478995    -3.864   .0001    .06102052
 WHOLESAL|     .32071697       .04114482     7.795   .0000    .34744871
 MONTENEG|    -.65765668       .08511161    -7.727   .0000    .03051026
 BOSNIA  |    -.77190976       .05223120   -14.779   .0000    .19542346
 CROATIA |    -.36765381       .05756933    -6.386   .0000    .15307733
 SERBIA  |   -1.00059018       .04996386   -20.026   .0000    .24671226
 MACEDONI|   -1.16508067       .05179360   -22.495   .0000    .19358233
 PRIVATE_|     .29694126       .06801903     4.366   .0000    .10126249
 PRIVATE0|    -.01879266       .05439921     -.345   .7297    .77880063
---------+Variance parameters for compound error
 Theta   |    2.60214606       .18716878    13.903   .0000
 P       |    1.00428156       .13288985     7.557   .0000
 Sigmav  |     .83568119       .01558942    53.606   .0000
```

Appendix 4.4: the results of the Cobb-Douglas and Translog specifications with M4 dataset

Cobb-Douglas (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_tCD$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:30:35PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed               101      |
| Log likelihood function       -5503.424     |
| Number of parameters                 9      |
| Info. Criterion: AIC =          2.89975     |
|   Finite Sample: AIC =          2.89976     |
| Info. Criterion: BIC =          2.91453     |
| Info. Criterion:HQIC =          2.90500     |
| Variances: Sigma-squared(v)=       .82714   |
|            Sigma-squared(u)=     96.52697   |
|            Sigma(v)        =       .90947   |
|            Sigma(u)        =      9.82481   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      9.86682   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.18602655      .46949775    19.566   .0000
 LCAP    |    -.01027587      .08479354     -.121   .9035   12.4505278
 LLAB    |    1.10311724      .07661975    14.397   .0000   3.31788738
 LCAPS   |     .03022229      .00792341     3.814   .0001   79.6547910
 LLABS   |    -.01295800      .01177162    -1.101   .2710   6.93107360
 CAPL    |    -.02832914      .00689247    -4.110   .0000   43.4437872
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |   -195.308436     2912.53916     -.067   .9465
---------+Variance parameters for compound error
 Lambda  |    10.8027334     79.2830244      .136   .8916
 Sigma   |    9.86681893     71.9912500      .137   .8910
```

Translog (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_t$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:33:31PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                95      |
| Log likelihood function      -4957.944      |
| Number of parameters                22      |
| Info. Criterion: AIC =         2.61964      |
|   Finite Sample: AIC =         2.61972      |
| Info. Criterion: BIC =         2.65577      |
| Info. Criterion:HQIC =         2.63248      |
| Variances: Sigma-squared(v)=       .62408   |
|            Sigma-squared(u)=     71.36356   |
|            Sigma(v)        =       .78998   |
|            Sigma(u)        =      8.44770   |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      8.48455   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+---------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+-------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.55712815       .42980546    22.236   .0000
 LCAP    |   -.00780056       .07583614     -.103   .9181   12.4505278
 LLAB    |   1.20832900       .06681687    18.084   .0000   3.31788738
 LCAPS   |    .02685122       .00696099     3.857   .0001   79.6547910
 LLABS   |   -.02095151       .01015161    -2.064   .0390   6.93107360
 CAPL    |   -.02924772       .00585869    -4.992   .0000   43.4437872
 _2005   |    .38262874       .04340890     8.815   .0000    .30483956
 _2009   |    .22463794       .04403717     5.101   .0000    .43819043
 MANUFACT|   -.31919453       .04401111    -7.253   .0000    .27275118
 CONSTRUC|   -.03594596       .05762588     -.624   .5328    .10362967
 HOTEL_AN|   -.33913837       .07235030    -4.687   .0000    .06102052
 WHOLESAL|    .22400871       .04024726     5.566   .0000    .34744871
 MONTENEG|   -.71183098       .08353789    -8.521   .0000    .03051026
 BOSNIA  |   -.83210012       .04927408   -16.887   .0000    .19542346
 CROATIA |   -.40329840       .05402472    -7.465   .0000    .15307733
 SERBIA  |  -1.03888635       .04666673   -22.262   .0000    .24671226
 MACEDONI|  -1.22721844       .04883185   -25.132   .0000    .19358233
 PRIVATE_|    .45466437       .06858944     6.629   .0000    .10126249
 PRIVATE0|    .06942601       .05424208     1.280   .2006    .77880063
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |  -168.953916      1696.62694     -.100   .9207
---------+Variance parameters for compound error
 Lambda  |   10.6934954      52.7154826      .203   .8392
 Sigma   |   8.48455301      41.6002794      .204   .8384
```

Cobb-Douglas (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_eCD$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 09:35:36PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                12      |
| Log likelihood function      -5503.312      |
| Number of parameters                 8      |
| Info. Criterion: AIC =         2.89916      |
|   Finite Sample: AIC =         2.89917      |
| Info. Criterion: BIC =         2.91230      |
| Info. Criterion:HQIC =         2.90383      |
| Exponential frontier model                  |
| Variances: Sigma-squared(v)=       .82669   |
|            Sigma-squared(u)=       .23974   |
|            Sigma(v)        =       .90923   |
|            Sigma(u)        =       .48963   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.18450915       .47827500    19.203   .0000
 LCAP    |    -.01033689       .08786282     -.118   .9063   12.4505278
 LLAB    |    1.10333152       .08399026    13.136   .0000   3.31788738
 LCAPS   |     .03023134       .00841658     3.592   .0003   79.6547910
 LLABS   |    -.01294482       .01381235     -.937   .3487   6.93107360
 CAPL    |    -.02835382       .00823311    -3.444   .0006   43.4437872
---------+Variance parameters for compound error
 Theta   |    2.04235170       .15377934    13.281   .0000
 Sigmav  |     .90922757       .01948466    46.664   .0000
```

Translog (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_e$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 09:36:17PM.|
| Dependent variable              LNOUT      |
| Weighting variable               None      |
| Number of observations           3802      |
| Iterations completed               25      |
| Log likelihood function       -4957.703    |
| Number of parameters               21      |
| Info. Criterion: AIC =         2.61899     |
|   Finite Sample: AIC =         2.61906     |
| Info. Criterion: BIC =         2.65348     |
| Info. Criterion:HQIC =         2.63125     |
| Exponential frontier model                 |
| Variances: Sigma-squared(v)=       .62371   |
|            Sigma-squared(u)=       .17508   |
|            Sigma(v)        =       .78975   |
|            Sigma(u)        =       .41842   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+--------+-------------+---------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+---------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.55699717      .42189053    22.653   .0000
 LCAP    |    -.00818138      .07699456     -.106   .9154   12.4505278
 LLAB    |    1.20914539      .07390897    16.360   .0000   3.31788738
 LCAPS   |     .02687637      .00740134     3.631   .0003   79.6547910
 LLABS   |    -.02110859      .01223351    -1.725   .0844   6.93107360
 CAPL    |    -.02924960      .00724241    -4.039   .0001   43.4437872
 _2005   |     .38272849      .03925264     9.750   .0000    .30483956
 _2009   |     .22450063      .04410020     5.091   .0000    .43819043
 MANUFACT|    -.31908224      .04224171    -7.554   .0000    .27275118
 CONSTRUC|    -.03555264      .05507348     -.646   .5186    .10362967
 HOTEL_AN|    -.33920911      .06550334    -5.179   .0000    .06102052
 WHOLESAL|     .22377839      .04063803     5.507   .0000    .34744871
 MONTENEG|    -.71194664      .09176406    -7.758   .0000    .03051026
 BOSNIA  |    -.83274767      .04725885   -17.621   .0000    .19542346
 CROATIA |    -.40385513      .04978713    -8.112   .0000    .15307733
 SERBIA  |   -1.03931303      .04498802   -23.102   .0000    .24671226
 MACEDONI|   -1.22750268      .04757308   -25.802   .0000    .19358233
 PRIVATE_|     .45431303      .06257707     7.260   .0000    .10126249
 PRIVATE0|     .06940811      .04869309     1.425   .1540    .77880063
---------+Variance parameters for compound error
 Theta   |    2.38991789      .17036192    14.028   .0000
 Sigmav  |     .78975480      .01587022    49.763   .0000
```

Cobb-Douglas (Gamma Distribution)

```
--> frontier;model=g;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_gCD$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 09:53:25PM.|
| Dependent variable               LNOUT     |
| Weighting variable                None     |
| Number of observations            3802     |
| Iterations completed                14     |
| Log likelihood function       -5503.308     |
| Number of parameters                 9     |
| Info. Criterion: AIC =         2.89969     |
|   Finite Sample: AIC =         2.89970     |
| Info. Criterion: BIC =         2.91447     |
| Info. Criterion:HQIC =         2.90494     |
| Normal-Gamma frontier model                  |
| Variances: Sigma-squared(v)=       .82753   |
|            Sigma-squared(u)=       .23892   |
|            Sigma(v)       =       .90969   |
|            Sigma(u)       =       .48879   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.18059177       .46625849    19.690   .0000
 LCAP    |    -.01036344       .08467718     -.122   .9026   12.4505278
 LLAB    |    1.10341451       .07652459    14.419   .0000   3.31788738
 LCAPS   |     .03023585       .00791082     3.822   .0001   79.6547910
 LLABS   |    -.01294091       .01173626    -1.103   .2702   6.93107360
 CAPL    |    -.02836140       .00687758    -4.124   .0000   43.4437872
---------+Variance parameters for compound error
 Theta   |    2.03297727       .15073288    13.487   .0000
 P       |     .98744913       .13059249     7.561   .0000
 Sigmav  |     .90968838       .01918492    47.417   .0000
```

Translog (Gamma Distribution)

```
--> frontier;model=g;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_g$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 10:20:57PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                27      |
| Log likelihood function      -4957.689      |
| Number of parameters                22      |
| Info. Criterion: AIC =         2.61951      |
|   Finite Sample: AIC =         2.61958      |
| Info. Criterion: BIC =         2.65564      |
| Info. Criterion:HQIC =         2.63235      |
| Normal-Gamma frontier model                 |
| Variances: Sigma-squared(v)=       .62467   |
|            Sigma-squared(u)=       .17413   |
|            Sigma(v)        =       .79036   |
|            Sigma(u)        =       .41729   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.55101418       .42584874    22.428   .0000
 LCAP    |    -.00824868       .07560761     -.109   .9131   12.4505278
 LLAB    |    1.20929858       .06673896    18.120   .0000   3.31788738
 LCAPS   |     .02688502       .00693760     3.875   .0001   79.6547910
 LLABS   |    -.02109593       .01010581    -2.088   .0368   6.93107360
 CAPL    |    -.02926417       .00584318    -5.008   .0000   43.4437872
 _2005   |     .38276141       .04325767     8.848   .0000    .30483956
 _2009   |     .22457370       .04394620     5.110   .0000    .43819043
 MANUFACT|    -.31914272       .04394342    -7.263   .0000    .27275118
 CONSTRUC|    -.03560222       .05754943     -.619   .5362    .10362967
 HOTEL_AN|    -.33926706       .07226746    -4.695   .0000    .06102052
 WHOLESAL|     .22371797       .04015206     5.572   .0000    .34744871
 MONTENEG|    -.71205753       .08336257    -8.542   .0000    .03051026
 BOSNIA  |    -.83272999       .04920146   -16.925   .0000    .19542346
 CROATIA |    -.40385350       .05392954    -7.489   .0000    .15307733
 SERBIA  |   -1.03924048       .04660264   -22.300   .0000    .24671226
 MACEDONI|   -1.22744589       .04874120   -25.183   .0000    .19358233
 PRIVATE_|     .45435400       .06843696     6.639   .0000    .10126249
 PRIVATE0|     .06941659       .05410126     1.283   .1995    .77880063
---------+Variance parameters for compound error
 Theta   |    2.36771981       .15228653    15.548   .0000
 P       |     .97618946       .12759467     7.651   .0000
 Sigmav  |     .79036115       .01558858    50.701   .0000
```

Appendix 4.5: the results of the Cobb-Douglas and Translog specifications with M5 dataset

Cobb-Douglas (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_tCD$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 10:35:10PM.|
| Dependent variable              LNOUT       |
| Weighting variable               None       |
| Number of observations           3802       |
| Iterations completed              101       |
| Log likelihood function     -5598.443       |
| Number of parameters                9       |
| Info. Criterion: AIC =        2.94973       |
|   Finite Sample: AIC =        2.94975       |
| Info. Criterion: BIC =        2.96451       |
| Info. Criterion:HQIC =        2.95499       |
| Variances: Sigma-squared(v)=     .88065     |
|            Sigma-squared(u)=   93.54861     |
|            Sigma(v)       =      .93843     |
|            Sigma(u)       =     9.67205     |
| Sigma = Sqr[(s^2(u)+s^2(v)]=     9.71747     |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.77457961       .51796585    18.871   .0000
 LCAP    |    -.10010381       .09171629    -1.091   .2751   12.4987458
 LLAB    |    1.16664839       .08302849    14.051   .0000   3.31958432
 LCAPS   |     .03499595       .00841312     4.160   .0000   80.1716606
 LLABS   |    -.02058368       .01196480    -1.720   .0854   6.93701034
 CAPL    |    -.02829581       .00727061    -3.892   .0001   43.5413882
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |   -189.166772      3159.78142     -.060   .9523
---------+Variance parameters for compound error
 Lambda  |    10.3066576      84.7487291      .122   .9032
 Sigma   |    9.71747151      79.3523819      .122   .9025
```

Translog (Truncated Distribution)

```
--> frontier;model=t;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_t$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 10:37:46PM.|
| Dependent variable                LNOUT      |
| Weighting variable                 None      |
| Number of observations             3802      |
| Iterations completed                101      |
| Log likelihood function       -5113.210      |
| Number of parameters                 22      |
| Info. Criterion: AIC =          2.70132      |
|   Finite Sample: AIC =          2.70139      |
| Info. Criterion: BIC =          2.73745      |
| Info. Criterion:HQIC =          2.71416      |
| Variances: Sigma-squared(v)=       .70489    |
|            Sigma-squared(u)=     63.13685    |
|            Sigma(v)       =       .83958    |
|            Sigma(u)       =      7.94587    |
| Sigma = Sqr[(s^2(u)+s^2(v)]=      7.99010    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+---------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.77258386       .46850490    20.859   .0000
 LCAP    |    -.02964060       .08138412     -.364   .7157   12.4987458
 LLAB    |    1.17287091       .07459879    15.722   .0000   3.31958432
 LCAPS   |     .02329466       .00739047     3.152   .0016   80.1716606
 LLABS   |    -.03081363       .01054974    -2.921   .0035   6.93701034
 CAPL    |    -.02079859       .00640030    -3.250   .0012   43.5413882
 _2005   |     .45010740       .04604949     9.774   .0000    .30483956
 _2009   |     .29326605       .04809036     6.098   .0000    .43819043
 MANUFACT|    -.19928121       .04592698    -4.339   .0000    .27275118
 CONSTRUC|     .14043116       .06033050     2.328   .0199    .10362967
 HOTEL_AN|    -.24911241       .07648954    -3.257   .0011    .06102052
 WHOLESAL|     .28347039       .04158188     6.817   .0000    .34744871
 MONTENEG|    -.58463218       .08530916    -6.853   .0000    .03051026
 BOSNIA  |    -.74843805       .05208105   -14.371   .0000    .19542346
 CROATIA |    -.46227360       .05944452    -7.777   .0000    .15307733
 SERBIA  |   -1.08675658       .05011138   -21.687   .0000    .24671226
 MACEDONI|   -1.16573396       .05186451   -22.477   .0000    .19358233
 PRIVATE_|     .45140330       .07122701     6.338   .0000    .10126249
 PRIVATE0|     .08639572       .05596846     1.544   .1227    .77880063
---------+Offset [mean=mu(i)] parameters in one sided error
 Mu      |   -156.330019      1938.73361     -.081   .9357
---------+Variance parameters for compound error
 Lambda  |    9.46413342      57.5893865      .164   .8695
 Sigma   |    7.99010269      48.2278149      .166   .8684
```

Cobb-Douglas (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_eCD$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 10:39:09PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                12      |
| Log likelihood function      -5598.342      |
| Number of parameters                 8      |
| Info. Criterion: AIC =         2.94915      |
|   Finite Sample: AIC =         2.94916      |
| Info. Criterion: BIC =         2.96229      |
| Info. Criterion:HQIC =         2.95382      |
| Exponential frontier model                  |
| Variances: Sigma-squared(v)=       .88025   |
|            Sigma-squared(u)=       .23979   |
|            Sigma(v)        =       .93821   |
|            Sigma(u)        =       .48968   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.76200220       .51294126    19.031   .0000
 LCAP    |    -.09856394       .09304571    -1.059   .2895   12.4987458
 LLAB    |    1.16704650       .08761507    13.320   .0000   3.31958432
 LCAPS   |     .03489906       .00878382     3.973   .0001   80.1716606
 LLABS   |    -.02044628       .01388469    -1.473   .1409   6.93701034
 CAPL    |    -.02836914       .00846514    -3.351   .0008   43.5413882
---------+Variance parameters for compound error
 Theta   |    2.04214205       .16108718    12.677   .0000
 Sigmav  |     .93821428       .02005652    46.779   .0000
```

Translog (Exponential Distribution)

```
--> frontier;model=e;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_e$

+---------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 01, 2012 at 10:39:55PM.|
| Dependent variable              LNOUT       |
| Weighting variable               None       |
| Number of observations           3802       |
| Iterations completed               25       |
| Log likelihood function       -5112.985     |
| Number of parameters               21       |
| Info. Criterion: AIC =         2.70068      |
|   Finite Sample: AIC =         2.70074      |
| Info. Criterion: BIC =         2.73516      |
| Info. Criterion:HQIC =         2.71293      |
| Exponential frontier model                  |
| Variances: Sigma-squared(v)=       .70440   |
|            Sigma-squared(u)=       .16000   |
|            Sigma(v)        =       .83928   |
|            Sigma(u)        =       .40001   |
| Stochastic Production Frontier, e=v-u.      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.77898616      .45821395    21.342   .0000
 LCAP    |    -.03088922      .08249503     -.374   .7081   12.4987458
 LLAB    |    1.17163460      .07811374    14.999   .0000   3.31958432
 LCAPS   |     .02338483      .00781246     2.993   .0028   80.1716606
 LLABS   |    -.03071856      .01245914    -2.466   .0137   6.93701034
 CAPL    |    -.02074403      .00753189    -2.754   .0059   43.5413882
 _2005   |     .44974251      .04082219    11.017   .0000    .30483956
 _2009   |     .29337513      .04594888     6.385   .0000    .43819043
 MANUFACT|    -.19854853      .04398350    -4.514   .0000    .27275118
 CONSTRUC|     .14109501      .05739916     2.458   .0140    .10362967
 HOTEL_AN|    -.24841327      .06880293    -3.611   .0003    .06102052
 WHOLESAL|     .28408927      .04241359     6.698   .0000    .34744871
 MONTENEG|    -.58134369      .09594759    -6.059   .0000    .03051026
 BOSNIA  |    -.74782472      .04947455   -15.115   .0000    .19542346
 CROATIA |    -.46153948      .05194290    -8.886   .0000    .15307733
 SERBIA  |   -1.08596841      .04689544   -23.157   .0000    .24671226
 MACEDONI|   -1.16486549      .04971159   -23.432   .0000    .19358233
 PRIVATE_|     .45213636      .06531608     6.922   .0000    .10126249
 PRIVATE0|     .08618693      .05100506     1.690   .0911    .77880063
---------+Variance parameters for compound error
 Theta   |    2.49996166      .20471418    12.212   .0000
 Sigmav  |     .83928486      .01649878    50.870   .0000
```

Cobb-Douglas (Gamma Distribution)

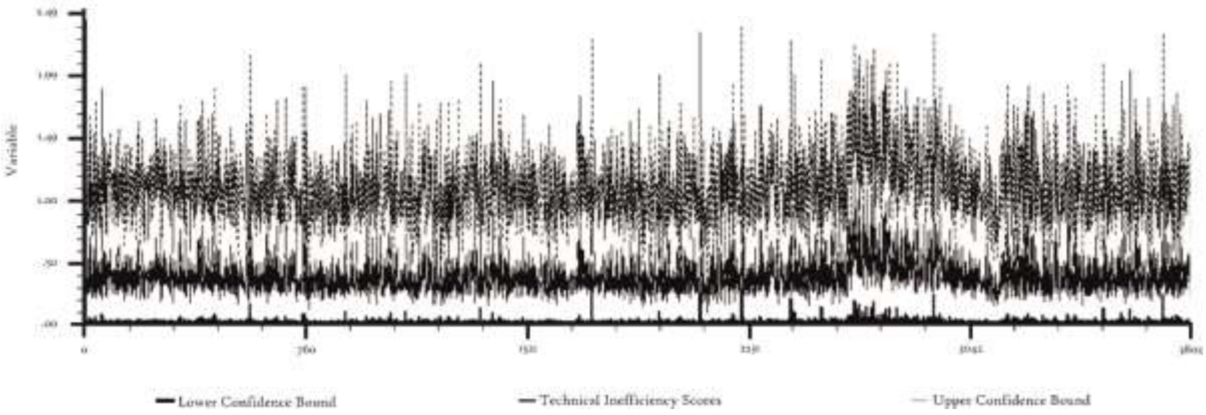
```
--> frontier;model=g;lhs=Lnout; rhs=one,lcap,llab,lcaps,llabs,capl;
eff=ui_gCD$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 10:49:45PM.|
| Dependent variable               LNOUT      |
| Weighting variable                None      |
| Number of observations            3802      |
| Iterations completed                13      |
| Log likelihood function       -5598.342     |
| Number of parameters                 9      |
| Info. Criterion: AIC =         2.94968      |
|   Finite Sample: AIC =         2.94969      |
| Info. Criterion: BIC =         2.96446      |
| Info. Criterion:HQIC =         2.95493      |
| Normal-Gamma frontier model                  |
| Variances: Sigma-squared(v)=       .88031   |
|            Sigma-squared(u)=       .23972   |
|            Sigma(v)        =       .93825   |
|            Sigma(u)        =       .48962   |
| Stochastic Production Frontier, e=v-u.      |
+----------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.76170005       .51317938    19.022   .0000
 LCAP    |    -.09856580       .09158887    -1.076   .2818   12.4987458
 LLAB    |    1.16705256       .08292192    14.074   .0000   3.31958432
 LCAPS   |     .03489934       .00839990     4.155   .0000   80.1716606
 LLABS   |    -.02044581       .01194272    -1.712   .0869   6.93701034
 CAPL    |    -.02836972       .00726267    -3.906   .0001   43.5413882
---------+Variance parameters for compound error
 Theta   |    2.04142910       .15721501    12.985   .0000
 P       |     .99902936       .13304050     7.509   .0000
 Sigmav  |     .93824967       .01978171    47.430   .0000
```

Translog (Gamma Distribution)

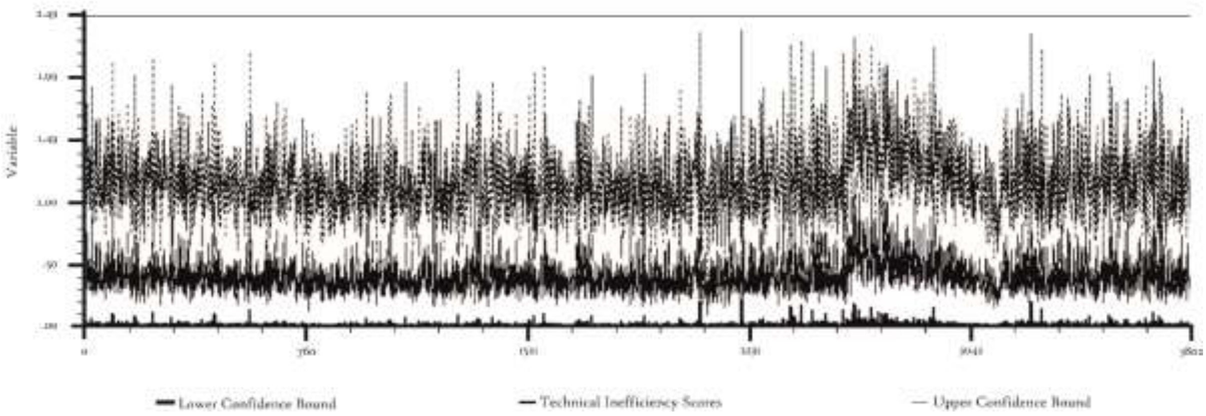
```
--> frontier;model=g;lhs=Lnout;
rhs=one,lcap,llab,lcaps,llabs,capl,_2005,_200...
    monteneg,bosnia,croatia,serbia,macedoni,private_,private0;eff=ui_g$

+----------------------------------------------+
| Limited Dependent Variable Model - FRONTIER |
| Maximum Likelihood Estimates                 |
| Model estimated: Sep 01, 2012 at 11:06:51PM.|
| Dependent variable                LNOUT      |
| Weighting variable                 None      |
| Number of observations             3802      |
| Iterations completed                 27      |
| Log likelihood function       -5112.985      |
| Number of parameters                 22      |
| Info. Criterion: AIC =          2.70120      |
|   Finite Sample: AIC =          2.70127      |
| Info. Criterion: BIC =          2.73733      |
| Info. Criterion:HQIC =          2.71404      |
| Normal-Gamma frontier model                  |
| Variances: Sigma-squared(v)=       .70445    |
|            Sigma-squared(u)=       .15996    |
|            Sigma(v)        =       .83931    |
|            Sigma(u)        =       .39995    |
| Stochastic Production Frontier, e=v-u.       |
+----------------------------------------------+
+---------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient   | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+---------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|    9.77866324       .46447599    21.053   .0000
 LCAP    |    -.03089175       .08128810     -.380   .7039   12.4987458
 LLAB    |    1.17164226       .07451175    15.724   .0000   3.31958432
 LCAPS   |     .02338523       .00737798     3.170   .0015   80.1716606
 LLABS   |    -.03071720       .01046270    -2.936   .0033   6.93701034
 CAPL    |    -.02074498       .00637899    -3.252   .0011   43.5413882
 _2005   |     .44974352       .04592913     9.792   .0000     .30483956
 _2009   |     .29338131       .04794010     6.120   .0000     .43819043
 MANUFACT|    -.19855076       .04586842    -4.329   .0000     .27275118
 CONSTRUC|     .14109214       .06024758     2.342   .0192     .10362967
 HOTEL_AN|    -.24841557       .07632458    -3.255   .0011     .06102052
 WHOLESAL|     .28408567       .04152279     6.842   .0000     .34744871
 MONTENEG|    -.58134656       .08524127    -6.820   .0000     .03051026
 BOSNIA  |    -.74782405       .05200986   -14.379   .0000     .19542346
 CROATIA |    -.46153940       .05932665    -7.780   .0000     .15307733
 SERBIA  |   -1.08596518       .05004583   -21.699   .0000     .24671226
 MACEDONI|   -1.16486382       .05179372   -22.490   .0000     .19358233
 PRIVATE_|     .45213829       .07093243     6.374   .0000     .10126249
 PRIVATE0|     .08618758       .05591954     1.541   .1232     .77880063
---------+Variance parameters for compound error
 Theta   |    2.49867970       .17283804    14.457   .0000
 P       |     .99867064       .13208999     7.561   .0000
 Sigmav  |     .83931353       .01600673    52.435   .0000
```

Appendix 5: Confidence interval for technical inefficiencies in all five imputed datasets (M1-M5)

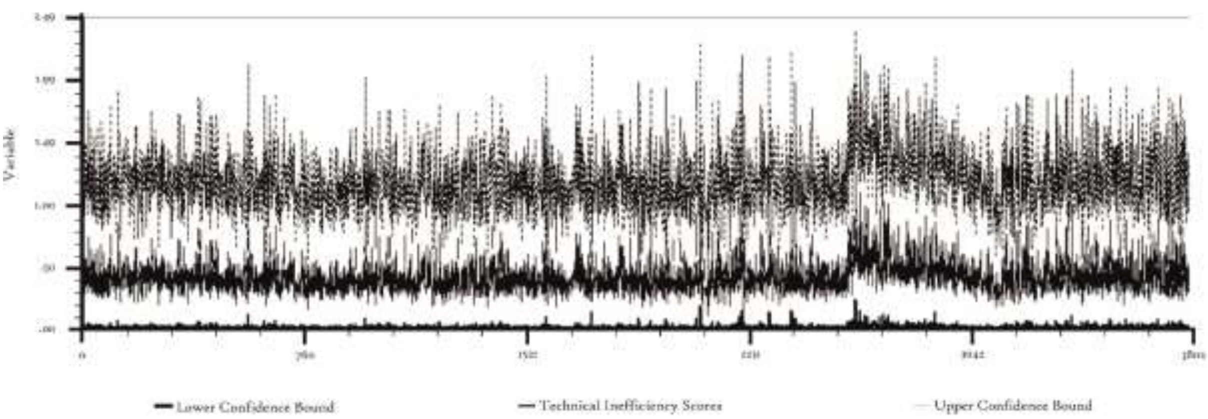
M1:



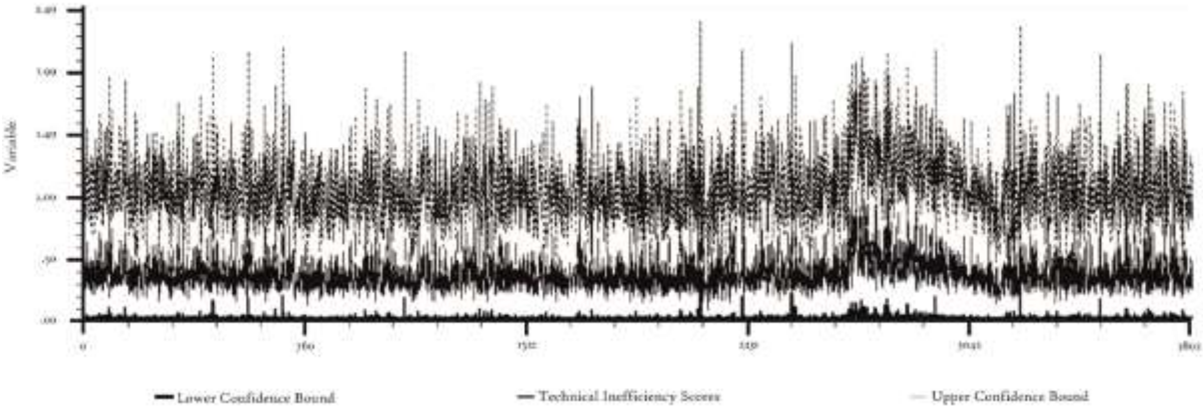
M2:



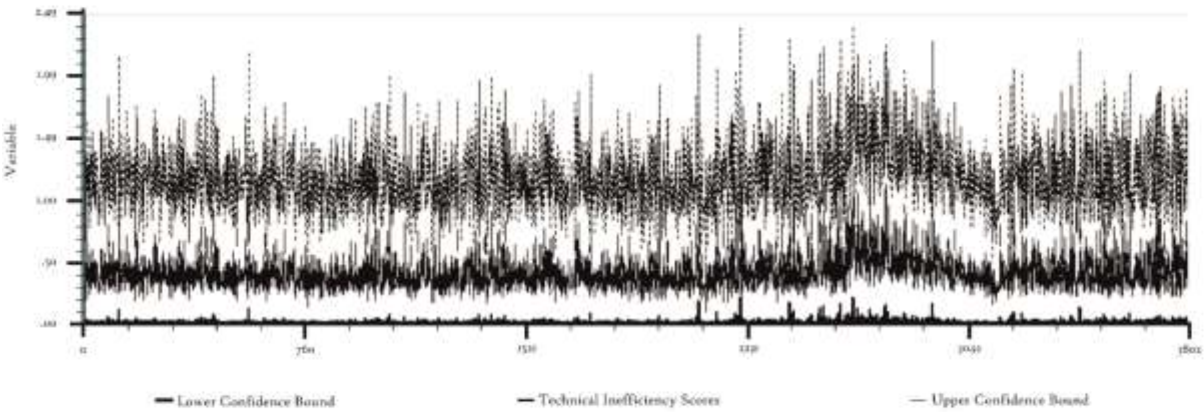
M3:



M4:



M5:



Source: *Author's own drawing based on LIMDEP outputs*

Appendix 6: Stata output of pscore run

```
. pscore  treat  region manufacturing  services export_dummy age_of_company, pscore(ps
> ) blockid(blockf1) comsup level(0.001)


****************************************************
Algorithm to estimate the propensity score
****************************************************


The treatment is treat

      treat |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |      4,466       87.04       87.04
          1 |        665       12.96      100.00
------------+-----------------------------------
      Total |      5,131      100.00


Estimation of the propensity score

Iteration 0:   log likelihood =  -1870.983
Iteration 1:   log likelihood = -1660.9382
Iteration 2:   log likelihood = -1655.0974
Iteration 3:   log likelihood = -1655.0652
Iteration 4:   log likelihood = -1655.0652

Probit regression                                 Number of obs   =       4816
                                                  LR chi2(5)      =     431.84
                                                  Prob > chi2     =     0.0000
Log likelihood = -1655.0652                       Pseudo R2       =     0.1154

------------------------------------------------------------------------------
       treat |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      region |   .3347895   .0628078     5.33   0.000     .4578905    .2116884
manufactur~g |   .8674654   .0666854    13.01   0.000     .7367644    .9981665
    services |   .3133977   .0656506     4.77   0.000     .1847249    .4420705
export_dummy |   .2980906   .0583884     5.11   0.000     .1836514    .4125297
year_of_es~t |   .0420903   .0037851    11.12   0.000     .0346717    .0495089
       _cons |  -85.78173   7.579934   -11.32   0.000    -100.6381   -70.92533
------------------------------------------------------------------------------


Note: the common support option has been selected
The region of common support is [.08519401, .87855251]
```

Appendix 7: description of the estimated propensity score in the region of common support

```
                 Estimated propensity score
-------------------------------------------------------------
      Percentiles      Smallest
 1%     .0072855       .0016095
 5%       .02159       .0016095
10%     .0334084       .0016095       Obs                4816
25%     .0595017       .0016095       Sum of Wgt.        4816

50%     .0989317                      Mean           .1324371
                        Largest       Std. Dev.      .1029051
75%     .1611916       .4606557
90%     .3023156       .4606557       Variance       .0105895
95%     .3457308       .4606557       Skewness       1.337436
99%     .4439854       .4606557       Kurtosis       4.195004
-------------------------------------------------------------
```

Appendix 8: test results of the balancing property as well as the tabulated final distribution of privatized and non-privatized companies across blocs

```
******************************************************
Step 1: Identification of the optimal number of blocks
Use option detail if you want more detailed output
******************************************************


The final number of blocks is 8

This number of blocks ensures that the mean propensity score
is not different for treated and controls in each blocks




**********************************************************
Step 2: Test of balancing property of the propensity score
Use option detail if you want more detailed output
**********************************************************


The balancing property is satisfied


This table shows the inferior bound, the number of treated
and the number of controls for each block


  Inferior |
  of block |         treat
of pscore  |         0          1 |     Total
-----------+----------------------+----------
         0 |       711         45 |       756
       .05 |       931         21 |       952
      .075 |       703         81 |       784
        .1 |     1,162        202 |     1,364
        .2 |       386         63 |       449
        .3 |       170        117 |       287
       .35 |        50          6 |        56
        .4 |        48        120 |       168
-----------+----------------------+----------
     Total |     4,161        655 |     4,816

Note: the common support option has been selected


*******************************************
End of the algorithm to estimate the pscore
*******************************************
```

Appendix 9: regression results of specification 6.6

```
. xtreg lnturn PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_tre
> at_Foreign p_treat_SpecialSO , fe i(number)

Fixed-effects (within) regression               Number of obs      =      4816
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0348                         Obs per group: min =         7
       between = 0.1105                                        avg =       7.0
       overall = 0.0848                                        max =         7

                                                F(7,4121)          =     21.25
corr(u_i, Xb)  = 0.2492                         Prob > F           =    0.0000

------------------------------------------------------------------------------------
           lnturn |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------+-----------------------------------------------------------------
    PostTreatment |   .1792926   .0350849     5.11   0.000     .1105072    .2480779
      p_treat_Man |  -.1038937   .0463616    -2.24   0.025    -.1947874   -.0129999
     p_treat_Serv |  -.1405732   .0548661    -2.56   0.010    -.2481403   -.0330061
      p_treat_Reg |  -.0227193   .0516617    -0.44   0.660     -.124004    .0785655
   p_treat_Export |   .1177943   .0454124     2.59   0.010     .0287615    .2068271
  p_treat_Foreign |  -.1494783   .0546229    -2.74   0.006    -.2565686   -.0423881
p_treat_SpecialSO |   .3193365   .0539774     5.92   0.000     .2135117    .4251612
            _cons |   9.475743   .0043735  2166.62   0.000     9.467169    9.484318
------------------+-----------------------------------------------------------------
          sigma_u |  1.6734936
          sigma_e |  .24923323
              rho |  .97830117   (fraction of variance due to u_i)
------------------------------------------------------------------------------------
F test that all u_i=0:     F(687, 4121) =   289.65          Prob > F = 0.0000
```

Appendix 10: Wald test for heteroskedasticity

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (688)  =   1.6e+06
Prob>chi2 =      0.0000
```

Appendix 11: the improved results with robust standard errors

```
. xtreg lnturn PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_tre
> at_Foreign p_treat_SpecialSO,fe vce(robust)

Fixed-effects (within) regression               Number of obs      =      4816
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0348                         Obs per group: min =         7
       between = 0.1105                                        avg =       7.0
       overall = 0.0848                                        max =         7

                                                F(7,687)           =      7.83
corr(u_i, Xb)  = 0.2492                         Prob > F           =    0.0000

                                   (Std. Err. adjusted for 688 clusters in number)
------------------------------------------------------------------------------------
                  |               Robust
           lnturn |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------+-----------------------------------------------------------------
    PostTreatment |   .1792926   .1169584     1.53   0.126    -.0503462    .4089313
      p_treat_Man |  -.1038937    .110401    -0.94   0.347    -.3206576    .1128703
     p_treat_Serv |  -.1405732   .1224842    -1.15   0.251    -.3810615    .0999151
      p_treat_Reg |  -.0227193   .0826423    -0.27   0.783     -.184981    .1395425
   p_treat_Export |   .1177943    .084066     1.40   0.162    -.0472628    .2828514
  p_treat_Foreign |  -.1494783   .1262648    -1.18   0.237    -.3973896    .0984329
p_treat_SpecialSO |   .3193365   .0792919     4.03   0.000      .163653    .4750199
            _cons |   9.475743   .0054459  1739.99   0.000     9.465051    9.486436
------------------+-----------------------------------------------------------------
          sigma_u |  1.6734936
          sigma_e |  .24923323
              rho |  .97830117   (fraction of variance due to u_i)
------------------------------------------------------------------------------------
.
```

Appendix 12: Wooldridge test for autocorrelation

```
. xtserial lnturn PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_
> treat_Foreign p_treat_SpecialSO

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,     687) =     61.658
           Prob > F =      0.0000
.
```

Appendix 13: Results of the dynamic linear regression model of order one - fixed effects

```
. xtreg lnturn PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_Forei
> gn p_treat_SpecialSO L_lnturn L_PostTreatment L_p_treat_Man L_p_treat_Serv L_p_treat_Reg L_p
> _treat_Export L_p_treat_Foreign L_p_treat_SpecialSO , fe i(number)

Fixed-effects (within) regression               Number of obs      =      4815
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0628                         Obs per group: min =         6
       between = 0.5240                                        avg =       7.0
       overall = 0.4203                                        max =         7

                                                F(15,4112)         =     18.36
corr(u_i, Xb)  = 0.6089                         Prob > F           =    0.0000

------------------------------------------------------------------------------------
             lnturn |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------------
      PostTreatment |   .1045879   .0422953     2.47   0.013     .0216663    .1875096
        p_treat_Man |  -.0405111   .0565242    -0.72   0.474    -.1513292     .070307
       p_treat_Serv |   -.178536   .0666415    -2.68   0.007    -.3091894   -.0478826
        p_treat_Reg |  -.0952584   .0600886    -1.59   0.113    -.2130645    .0225477
     p_treat_Export |   .1758347   .0531311     3.31   0.001      .071669    .2800004
    p_treat_Foreign |  -.1109565   .0648847    -1.71   0.087    -.2381655    .0162526
  p_treat_SpecialSO |   .2543892   .0650759     3.91   0.000     .1268053    .3819732
           L_lnturn |    .034734   .0049835     6.97   0.000     .0249635    .0445044
    L_PostTreatment |   .1389322   .0325839     4.26   0.000     .0750501    .2028142
      L_p_treat_Man |  -.0547916   .0418858    -1.31   0.191    -.1369105    .0273274
     L_p_treat_Serv |   .0888871   .0515007     1.73   0.084    -.0120822    .1898563
      L_p_treat_Reg |   .1186665   .0480145     2.47   0.013     .0245321     .212801
   L_p_treat_Export |  -.0858304   .0397752    -2.16   0.031    -.1638114   -.0078494
  L_p_treat_Foreign |  -.0752636   .0500692    -1.50   0.133    -.1734263     .022899
L_p_treat_SpecialSO |   .0415587   .0487719     0.85   0.394    -.0540605    .1371779
              _cons |   9.137265   .0473351   193.03   0.000     9.044462    9.230067
--------------------+---------------------------------------------------------------
            sigma_u |  1.6173321
            sigma_e |  .24583401
                rho |  .97741782   (fraction of variance due to u_i)
------------------------------------------------------------------------------------
F test that all u_i=0:     F(687, 4112) =    60.85           Prob > F = 0.0000

.
```

Appendix 14: Results of the dynamic linear regression model of order one - OLS

```
. reg lnturn PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_Foreign
>  p_treat_SpecialSO L_lnturn L_PostTreatment L_p_treat_Man L_p_treat_Serv L_p_treat_Reg L_p_t
> reat_Export L_p_treat_Foreign L_p_treat_SpecialSO

      Source |       SS       df       MS              Number of obs =    4815
-------------+------------------------------           F( 15,  4799) = 1303.64
       Model |  11307.3012    15  753.820082           Prob > F      =  0.0000
    Residual |  2774.99535  4799  .578244499           R-squared     =  0.8029
-------------+------------------------------           Adj R-squared =  0.8023
       Total |  14082.2966  4814  2.92527972           Root MSE      =  .76042

------------------------------------------------------------------------------------
             lnturn |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------------
      PostTreatment |  -.0965941   .0955376    -1.01   0.312    -.2838916    .0907034
        p_treat_Man |   .3209574   .1236203     2.60   0.009     .0786049    .5633099
       p_treat_Serv |  -.3888244   .1513075    -2.57   0.010    -.6854564   -.0921924
        p_treat_Reg |   .2541499   .1399722     1.82   0.069    -.0202598    .5285596
     p_treat_Export |   .2662116   .1171831     2.27   0.023     .0364791    .4959442
    p_treat_Foreign |   .4258836   .1477717     2.88   0.004     .1361834    .7155838
  p_treat_SpecialSO |   .5911001   .1431172     4.13   0.000     .3105247    .8716755
           L_lnturn |   .8832728   .0068044   129.81   0.000      .869933    .8966126
    L_PostTreatment |   .2336785   .0955653     2.45   0.015     .0463268    .4210303
      L_p_treat_Man |  -.3005087   .1237769    -2.43   0.015    -.5431681   -.0578493
     L_p_treat_Serv |   .5016198   .1513076     3.32   0.001     .2049876    .7982519
      L_p_treat_Reg |  -.2790673   .1399952    -1.99   0.046    -.5535221   -.0046124
   L_p_treat_Export |  -.2541349   .1172571    -2.17   0.030    -.4840125   -.0242573
  L_p_treat_Foreign |  -.5120196   .1477696    -3.46   0.001    -.8017158   -.2223234
L_p_treat_SpecialSO |  -.4625487   .1431908    -3.23   0.001    -.7432683   -.1818292
              _cons |   1.084853   .0645638    16.80   0.000     .9582785    1.211428
------------------------------------------------------------------------------------
```

Appendix 15: CFR tests from Fixed Effects and OLS

After fixed effects:

```
. testnl  -_b[L_PostTreatment]=_b[L_lnturn]*_b[PostTreatment]

  (1)  -_b[L_PostTreatment] = _b[L_lnturn]*_b[PostTreatment]

            F(1, 4112) =        2.11
              Prob > F =        0.1324

.
. testnl  -_b[L_p_treat_Man]=_b[L_lnturn]*_b[p_treat_Man]

  (1)  -_b[L_p_treat_Man] = _b[L_lnturn]*_b[p_treat_Man]

            F(1, 4112) =        1.90
              Prob > F =        0.1684

.
. testnl  -_b[L_p_treat_Serv]=_b[L_lnturn]*_b[p_treat_Serv]

  (1)  -_b[L_p_treat_Serv] = _b[L_lnturn]*_b[p_treat_Serv]

            F(1, 4112) =        2.72
              Prob > F =        0.0994

.
. testnl  -_b[L_p_treat_Reg]=_b[L_lnturn]*_b[p_treat_Reg]

  (1)  -_b[L_p_treat_Reg] = _b[L_lnturn]*_b[p_treat_Reg]

            F(1, 4112) =        6.03
              Prob > F =        0.1141

.
. testnl  -_b[L_p_treat_Export]=_b[L_lnturn]*_b[p_treat_Export]

  (1)  -_b[L_p_treat_Export] = _b[L_lnturn]*_b[p_treat_Export]

            F(1, 4112) =        4.22
              Prob > F =        0.1401

.
. testnl  -_b[L_p_treat_Foreign]=_b[L_lnturn]*_b[p_treat_Foreign]

  (1)  -_b[L_p_treat_Foreign] = _b[L_lnturn]*_b[p_treat_Foreign]

            F(1, 4112) =        2.62
              Prob > F =        0.1056

.
. testnl  -_b[L_p_treat_SpecialSO]=_b[L_lnturn]*_b[p_treat_SpecialSO]

  (1)  -_b[L_p_treat_SpecialSO] = _b[L_lnturn]*_b[p_treat_SpecialSO]

            F(1, 4112) =        1.13
              Prob > F =        0.2883
```

After OLS:

```
. testnl  -_b[L_PostTreatment]=_b[L_lnturn]*_b[PostTreatment]

  (1)  -_b[L_PostTreatment] = _b[L_lnturn]*_b[PostTreatment]

            F(1, 4799) =        6.12
              Prob > F =        0.0134



.
. testnl  -_b[L_p_treat_Man]=_b[L_lnturn]*_b[p_treat_Man]

  (1)  -_b[L_p_treat_Man] = _b[L_lnturn]*_b[p_treat_Man]

            F(1, 4799) =        0.05
              Prob > F =        0.8213

.
. testnl  -_b[L_p_treat_Serv]=_b[L_lnturn]*_b[p_treat_Serv]

  (1)  -_b[L_p_treat_Serv] = _b[L_lnturn]*_b[p_treat_Serv]

            F(1, 4799) =        2.68
              Prob > F =        0.1017

.
. testnl  -_b[L_p_treat_Reg]=_b[L_lnturn]*_b[p_treat_Reg]

  (1)  -_b[L_p_treat_Reg] = _b[L_lnturn]*_b[p_treat_Reg]

            F(1, 4799) =        0.39
              Prob > F =        0.5326

.
. testnl  -_b[L_p_treat_Export]=_b[L_lnturn]*_b[p_treat_Export]

  (1)  -_b[L_p_treat_Export] = _b[L_lnturn]*_b[p_treat_Export]

            F(1, 4799) =        0.07
              Prob > F =        0.7886

.
. testnl  -_b[L_p_treat_Foreign]=_b[L_lnturn]*_b[p_treat_Foreign]

  (1)  -_b[L_p_treat_Foreign] = _b[L_lnturn]*_b[p_treat_Foreign]

            F(1, 4799) =        2.19
              Prob > F =        0.1389

.
. testnl  -_b[L_p_treat_SpecialSO]=_b[L_lnturn]*_b[p_treat_SpecialSO]

  (1)  -_b[L_p_treat_SpecialSO] = _b[L_lnturn]*_b[p_treat_SpecialSO]

            F(1, 4799) =        0.46
              Prob > F =        0.4975
```

Appendix 16: Results - unobserved components model

```
. xtregar lnturn PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_For
> eign p_treat_SpecialSO

RE GLS regression with AR(1) disturbances       Number of obs      =      4816
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0339                         Obs per group: min =         7
       between = 0.1123                                        avg =       7.0
       overall = 0.0871                                        max =         7

                                                Wald chi2(8)       =    105.32
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------------
           lnturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------------+-----------------------------------------------------------------
    PostTreatment |   .1283409   .0421614     3.04   0.002      .045706    .2109757
      p_treat_Man |  -.0793982   .0550769    -1.44   0.149    -.1873468    .0285505
     p_treat_Serv |  -.1247654   .0663282    -1.88   0.060    -.2547662    .0052354
      p_treat_Reg |  -.0242529   .0619287    -0.39   0.695     -.145631    .0971252
   p_treat_Export |   .1596424   .0530319     3.01   0.003     .0557017    .2635831
  p_treat_Foreign |  -.1568557   .0654376    -2.40   0.017    -.2851112   -.0286003
p_treat_SpecialSO |   .3430197   .0639552     5.36   0.000     .2176699    .4683695
            _cons |   9.484211   .0491733   192.87   0.000     9.387833    9.580589
------------------+-----------------------------------------------------------------
           rho_ar |  .34631158   (estimated autocorrelation coefficient)
          sigma_u |  1.5793656
          sigma_e |  .32573043
          rho_fov |  .95919997   (fraction of variance due to u_i)
            theta |  .88954545
------------------------------------------------------------------------------------
```

Appendix 17: regression results of specification 6.17

```
. xtreg lnemp PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_Foreig
> n p_treat_SpecialSO, fe i(number)

Fixed-effects (within) regression               Number of obs      =      4752
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0951                         Obs per group: min =         3
       between = 0.0671                                        avg =       6.9
       overall = 0.0319                                        max =         7

                                                F(7,4057)          =     60.94
corr(u_i, Xb)  = -0.2528                        Prob > F           =    0.0000

------------------------------------------------------------------------------------
           lnemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------------
   PostTreatment |  -.4515769   .0302895   -14.91   0.000    -.5109609   -.3921929
     p_treat_Man |   .1543467   .0400249     3.86   0.000      .075876    .2328174
    p_treat_Serv |   .1859877   .0473669     3.93   0.000     .0931225    .2788529
     p_treat_Reg |   .1100795   .0446005     2.47   0.014      .022638    .1975211
  p_treat_Export |   .1405723   .0392054     3.59   0.000     .0637082    .2174364
 p_treat_Foreign |  -.1062121    .047157    -2.25   0.024    -.1986657   -.0137586
p_treat_SpecialSO |   .0567967   .0465997     1.22   0.223    -.0345643    .1481577
           _cons |   2.015133   .0038094   528.99   0.000     2.007664    2.022601
-----------------+------------------------------------------------------------------
         sigma_u |  1.4709846
         sigma_e |  .21516788
             rho |  .97905191   (fraction of variance due to u_i)
------------------------------------------------------------------------------------
F test that all u_i=0:     F(687, 4057) =   256.19           Prob > F = 0.0000

.
```

Appendix 18: Wald test for heteroscedasticity

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (688)  =   4.8e+06
Prob>chi2 =      0.0000

.
```

Appendix 19: the improved results with robust standard errors

```
. xtreg lnemp PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_Foreig
> n p_treat_SpecialSO,fe vce(robust)

Fixed-effects (within) regression               Number of obs      =      4752
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0951                         Obs per group: min =         3
       between = 0.0671                                        avg =       6.9
       overall = 0.0319                                        max =         7

                                                F(7,687)           =     25.89
corr(u_i, Xb)  = -0.2528                        Prob > F           =    0.0000

                                    (Std. Err. adjusted for 688 clusters in number)
-----------------------------------------------------------------------------------
                  |               Robust
            lnemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------+----------------------------------------------------------------
    PostTreatment |  -.4515769   .0427878   -10.55   0.000    -.5355874   -.3675664
      p_treat_Man |   .1543467   .0642062     2.40   0.016     .0282827    .2804107
     p_treat_Serv |   .1859877   .0889929     2.09   0.037     .0112569    .3607185
      p_treat_Reg |   .1100795   .0657173     1.68   0.094    -.0189513    .2391103
   p_treat_Export |   .1405723   .0652195     2.16   0.031     .0125189    .2686258
  p_treat_Foreign |  -.1062121   .0763348    -1.39   0.165    -.2560896    .0436653
p_treat_SpecialSO |   .0567967   .0680826     0.83   0.404    -.0768781    .1904716
            _cons |   2.015133   .0034022   592.30   0.000     2.008453    2.021813
------------------+----------------------------------------------------------------
          sigma_u |  1.4709846
          sigma_e |  .21516788
              rho |  .97905191   (fraction of variance due to u_i)
-----------------------------------------------------------------------------------

.
```

Appendix 20: Wooldridge test for autocorrelation

```
. xtserial lnemp PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_For
> eign p_treat_SpecialSO

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      687) =    309.869
           Prob > F =      0.0000

.
```

Appendix 21: Results of the dynamic linear regression model of order one - fixed effects

```
. xtreg lnemp PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_Foreig

> n p_treat_SpecialSO L_lnemp L_PostTreatment L_p_treat_Man L_p_treat_Serv L_p_treat_Reg L_p_t
> reat_Export L_p_treat_Foreign L_p_treat_SpecialSO , fe i(number)

Fixed-effects (within) regression               Number of obs      =      4721
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.1157                         Obs per group: min =         2
       between = 0.2181                                        avg =       6.9
       overall = 0.1580                                        max =         7

                                                F(15,4018)         =     35.05
corr(u_i, Xb)  = 0.3274                         Prob > F           =    0.0000

------------------------------------------------------------------------------------
              lnemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------------+---------------------------------------------------------------
      PostTreatment |  -.3843119   .0369688   -10.40   0.000    -.4567911   -.3118326
        p_treat_Man |   .0652204   .0492676     1.32   0.186    -.0313714    .1618122
       p_treat_Serv |   .1394663   .0580083     2.40   0.016      .025738    .2531947
        p_treat_Reg |   .1183267   .0522397     2.27   0.024     .0159079    .2207455
     p_treat_Export |   .1202575   .0461591     2.61   0.009     .0297601     .210755
    p_treat_Foreign |   -.189297   .0565703    -3.35   0.001    -.3002062   -.0783879
  p_treat_SpecialSO |   .1174001   .0565265     2.08   0.038     .0065767    .2282235
            L_lnemp |   .0534862   .0059555     8.98   0.000       .04181    .0651623
    L_PostTreatment |  -.0619667   .0286534    -2.16   0.031    -.1181433   -.0057902
      L_p_treat_Man |   .0982729    .036629     2.68   0.007     .0264597    .1700861
     L_p_treat_Serv |   .0366004   .0448146     0.82   0.414    -.0512611    .1244619
      L_p_treat_Reg |  -.0078062   .0418703    -0.19   0.852    -.0898951    .0742827
   L_p_treat_Export |  -.0141667   .0345999    -0.41   0.682    -.0820017    .0536684
  L_p_treat_Foreign |   .0896588    .043956     2.04   0.041     .0034807    .1758369
L_p_treat_SpecialSO |  -.1147822   .0425231    -2.70   0.007     -.198151   -.0314134
              _cons |   1.922914     .01255   153.22   0.000     1.898309    1.947519
--------------------+---------------------------------------------------------------
            sigma_u |  1.4025277
            sigma_e |  .21342078
                rho |  .97736873   (fraction of variance due to u_i)
------------------------------------------------------------------------------------
F test that all u_i=0:     F(687, 4018) =    41.61           Prob > F = 0.0000

.
```

Appendix 22: Results of the dynamic linear regression model of order one - OLS

```
. reg lnemp PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_Foreign
> p_treat_SpecialSO L_lnemp L_PostTreatment L_p_treat_Man L_p_treat_Serv L_p_treat_Reg L_p_tre
> at_Export L_p_treat_Foreign L_p_treat_SpecialSO

      Source |       SS       df       MS              Number of obs =    4721
-------------+------------------------------           F( 15,  4705) = 1776.99
       Model |  8413.59523    15  560.906349           Prob > F      =  0.0000
    Residual |  1485.13243  4705  .315649825           R-squared     =  0.8500
-------------+------------------------------           Adj R-squared =  0.8495
       Total |  9898.72766  4720  2.09718806           Root MSE      =  .56183

------------------------------------------------------------------------------------
             lnemp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
     PostTreatment |  -.2944318   .0710517    -4.14   0.000    -.4337265   -.1551371
       p_treat_Man |   .0397174    .091726     0.43   0.665    -.1401084    .2195432
      p_treat_Serv |   .0215707   .1120055     0.19   0.847    -.1980125     .241154
       p_treat_Reg |   .2826231   .1035463     2.73   0.006     .0796238    .4856224
    p_treat_Export |   .1067894   .0867404     1.23   0.218    -.0632623    .2768412
   p_treat_Foreign |   .1039363   .1100031     0.94   0.345    -.1117213     .319594
 p_treat_SpecialSO |    .710603   .1060054     6.70   0.000     .5027828    .9184233
           L_lnemp |   .9071606   .0062727   144.62   0.000     .8948631     .919458
   L_PostTreatment |    .308028   .0712682     4.32   0.000     .1683089    .4477471
     L_p_treat_Man |   .0422598   .0920945     0.46   0.646    -.1382885    .2228081
    L_p_treat_Serv |   .0773011   .1121417     0.69   0.491    -.1425491    .2971512
     L_p_treat_Reg |  -.3412495   .1036181    -3.29   0.001    -.5443894   -.1381096
  L_p_treat_Export |   .0070098   .0869138     0.08   0.936    -.1633819    .1774016
 L_p_treat_Foreign |  -.1490354   .1105096    -1.35   0.178     -.365686    .0676152
L_p_treat_SpecialSO |  -.661833   .1061047    -6.24   0.000    -.8698479   -.4538181
             _cons |   .1723937     .01432    12.04   0.000     .1443198    .2004676
------------------------------------------------------------------------------------

.
```

Appendix 23: CFR tests from Fixed Effects and OLS

After fixed effects:

```
. testnl  -_b[L_PostTreatment]=_b[L_lnemp]*_b[PostTreatment]

  (1)  -_b[L_PostTreatment] = _b[L_lnemp]*_b[PostTreatment]

            F(1, 4018) =        2.99
              Prob > F =        0.2127

.
. testnl  -_b[L_p_treat_Man]=_b[L_lnemp]*_b[p_treat_Man]

  (1)  -_b[L_p_treat_Man] = _b[L_lnemp]*_b[p_treat_Man]

            F(1, 4018) =        1.37
              Prob > F =        0.1938

.
. testnl  -_b[L_p_treat_Serv]=_b[L_lnemp]*_b[p_treat_Serv]

  (1)  -_b[L_p_treat_Serv] = _b[L_lnemp]*_b[p_treat_Serv]

            F(1, 4018) =        1.04
              Prob > F =        0.3068

.
. testnl  -_b[L_p_treat_Reg]=_b[L_lnemp]*_b[p_treat_Reg]

  (1)  -_b[L_p_treat_Reg] = _b[L_lnemp]*_b[p_treat_Reg]

            F(1, 4018) =        0.00
              Prob > F =        0.9709

.
. testnl  -_b[L_p_treat_Export]=_b[L_lnemp]*_b[p_treat_Export]

  (1)  -_b[L_p_treat_Export] = _b[L_lnemp]*_b[p_treat_Export]

            F(1, 4018) =        0.05
              Prob > F =        0.8167

.
. testnl  -_b[L_p_treat_Foreign]=_b[L_lnemp]*_b[p_treat_Foreign]

  (1)  -_b[L_p_treat_Foreign] = _b[L_lnemp]*_b[p_treat_Foreign]

            F(1, 4018) =        3.52
              Prob > F =        0.0607

.
. testnl  -_b[L_p_treat_SpecialSO]=_b[L_lnemp]*_b[p_treat_SpecialSO]

  (1)  -_b[L_p_treat_SpecialSO] = _b[L_lnemp]*_b[p_treat_SpecialSO]

            F(1, 4018) =        3.07
              Prob > F =        0.0979

.
```

After fixed OLS:

```
. testnl  -_b[L_PostTreatment]=_b[L_lnemp]*_b[PostTreatment]

  (1)  -_b[L_PostTreatment] = _b[L_lnemp]*_b[PostTreatment]

            F(1, 4705) =        0.83
              Prob > F =        0.3615


. testnl  -_b[L_p_treat_Man]=_b[L_lnemp]*_b[p_treat_Man]

  (1)  -_b[L_p_treat_Man] = _b[L_lnemp]*_b[p_treat_Man]

            F(1, 4705) =        1.95
              Prob > F =        0.1631

.
. testnl  -_b[L_p_treat_Serv]=_b[L_lnemp]*_b[p_treat_Serv]

  (1)  -_b[L_p_treat_Serv] = _b[L_lnemp]*_b[p_treat_Serv]

            F(1, 4705) =        1.81
              Prob > F =        0.1784

.
. testnl  -_b[L_p_treat_Reg]=_b[L_lnemp]*_b[p_treat_Reg]

  (1)  -_b[L_p_treat_Reg] = _b[L_lnemp]*_b[p_treat_Reg]

            F(1, 4705) =        1.70
              Prob > F =        0.1928

.
. testnl  -_b[L_p_treat_Export]=_b[L_lnemp]*_b[p_treat_Export]

  (1)  -_b[L_p_treat_Export] = _b[L_lnemp]*_b[p_treat_Export]

            F(1, 4705) =        3.85
              Prob > F =        0.0497

.
. testnl  -_b[L_p_treat_Foreign]=_b[L_lnemp]*_b[p_treat_Foreign]

  (1)  -_b[L_p_treat_Foreign] = _b[L_lnemp]*_b[p_treat_Foreign]

            F(1, 4705) =        0.64
              Prob > F =        0.4237

.
. testnl  -_b[L_p_treat_SpecialSO]=_b[L_lnemp]*_b[p_treat_SpecialSO]

  (1)  -_b[L_p_treat_SpecialSO] = _b[L_lnemp]*_b[p_treat_SpecialSO]

            F(1, 4705) =        0.07
              Prob > F =        0.7932
```

Appendix 24: Results of the unobserved components model

```
. xtregar lnemp PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_Fore
> ign p_treat_SpecialSO

RE GLS regression with AR(1) disturbances       Number of obs      =      4752
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0913                         Obs per group: min =         3
       between = 0.0220                                        avg =       6.9
       overall = 0.0081                                        max =         7

                                                Wald chi2(8)       =    181.16
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0000

------------------- theta --------------------
  min      5%       median        95%      max
0.7886   0.8439     0.8439     0.8439   0.8439

-----------------------------------------------------------------------------------
            lnemp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------------+----------------------------------------------------------------
    PostTreatment |  -.4054415   .0389178   -10.42   0.000     -.481719   -.3291639
      p_treat_Man |    .160112    .050684     3.16   0.002     .0607733    .2594508
     p_treat_Serv |   .1870905   .0613262     3.05   0.002     .0668933    .3072877
      p_treat_Reg |   .1028738    .057125     1.80   0.072    -.0090891    .2148367
   p_treat_Export |   .1657226   .0485954     3.41   0.001     .0704773    .2609678
  p_treat_Foreign |   -.093397   .0603534    -1.55   0.122    -.2116875    .0248934
p_treat_SpecialSO |   .1311398   .0588193     2.23   0.026     .0158561    .2464234
            _cons |   1.982374   .0356671    55.58   0.000     1.912468     2.05228
------------------+----------------------------------------------------------------
           rho_ar |  .44190604   (estimated autocorrelation coefficient)
          sigma_u |  1.2766404
          sigma_e |  .32986715
          rho_fov |  .93741465   (fraction of variance due to u_i)
-----------------------------------------------------------------------------------
```

Appendix 25: Results of the unobserved components model (model extension) – sales as dependent variable

```
. xtregar lnturn PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_For
> eign p_treat_SpecialSO YRT6 YRT7

RE GLS regression with AR(1) disturbances       Number of obs      =      4816
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0513                         Obs per group: min =         7
       between = 0.1113                                        avg =       7.0
       overall = 0.0798                                        max =         7

                                                Wald chi2(10)      =    156.75
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0000

-----------------------------------------------------------------------------------
           lnturn |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------------+----------------------------------------------------------------
    PostTreatment |    .072435   .0425914     1.70   0.089    -.0110426    .1559126
      p_treat_Man |  -.0766299   .0546091    -1.40   0.161    -.1836617     .030402
     p_treat_Serv |  -.1388687   .0657702    -2.11   0.035    -.2677759   -.0099615
      p_treat_Reg |  -.0293607   .0613947    -0.48   0.632    -.1496921    .0909706
   p_treat_Export |   .1637911   .0526039     3.11   0.002     .0606893    .2668929
  p_treat_Foreign |  -.1619078    .064874    -2.50   0.013    -.2890586    -.034757
p_treat_SpecialSO |   .3453786   .0634148     5.45   0.000     .2210879    .4696693
             YRT6 |   .1286123   .0255912     5.03   0.000     .0784544    .1787702
             YRT7 |   .1920416   .0286138     6.71   0.000     .1359597    .2481236
            _cons |   9.481198   .0490638   193.24   0.000     9.385035    9.577362
------------------+----------------------------------------------------------------
           rho_ar |   .3380325   (estimated autocorrelation coefficient)
          sigma_u |  1.5792026
          sigma_e |  .32434094
          rho_fov |  .95952525   (fraction of variance due to u_i)
            theta |  .89110335
-----------------------------------------------------------------------------------
```

Appendix 26: Results of the unobserved components model (model extension) – employment as dependent variable

```
. xtregar lnemp PostTreatment p_treat_Man p_treat_Serv p_treat_Reg p_treat_Export p_treat_Fore
> ign p_treat_SpecialSO YRT6 YRT7

RE GLS regression with AR(1) disturbances       Number of obs      =      4752
Group variable: number                          Number of groups   =       688

R-sq:  within  = 0.0920                         Obs per group: min =         3
       between = 0.0214                                        avg =       6.9
       overall = 0.0077                                        max =         7

                                                Wald chi2(10)      =    187.18
corr(u_i, Xb)      = 0 (assumed)                Prob > chi2        =    0.0000

------------------- theta --------------------
  min      5%       median        95%      max
0.7888   0.8440     0.8440     0.8440   0.8440

-----------------------------------------------------------------------------------
            lnemp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------------+----------------------------------------------------------------
    PostTreatment |  -.4189661   .0394805   -10.61   0.000    -.4963464   -.3415857
      p_treat_Man |   .1607786   .0506549     3.17   0.002     .0614968    .2600604
     p_treat_Serv |   .1842773   .0613163     3.01   0.003     .0640996    .3044551
      p_treat_Reg |   .1018442   .0570954     1.78   0.074    -.0100607    .2137491
   p_treat_Export |   .1668884    .048569     3.44   0.001     .0716949    .2620819
  p_treat_Foreign |  -.0945321   .0603228    -1.57   0.117    -.2127627    .0236985
p_treat_SpecialSO |   .1314117   .0587853     2.24   0.025     .0161947    .2466287
             YRT6 |   .0154415     .02287     0.68   0.500     -.029383    .0602659
             YRT7 |   .0612851   .0265882     2.30   0.021     .0091732     .113397
            _cons |   1.981266   .0356725    55.54   0.000     1.911349    2.051183
------------------+----------------------------------------------------------------
           rho_ar |  .44193879   (estimated autocorrelation coefficient)
          sigma_u |  1.2752056
          sigma_e |  .32927219
          rho_fov |  .93749448   (fraction of variance due to u_i)
-----------------------------------------------------------------------------------
```