BELARUSIAN BANKING IN THE CONTEXT OF FRONTIER EFFICIENCY

by

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Abstract

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This paper has analysed the development of Belarusian banking sector in 2002-2004 from the intermediation efficiency perspective. We applied two-stage semi-parametric bootstrap procedure of estimation and inference proposed by Simar and Wilson (2003) in order to explore the differences in inefficiency between sub-groups of banks characterized by different ownership structure. When compared to foreign banks, banks tightly controlled by the state are more efficient, while ordinary private banks less. The former might be seen as a consequence of government's efforts to force related banks to be engaged in intermediation as actively as possible paying little attention to risks. The latter combined with such characteristics as transparency and branching is explained by low correlation of optimisation programs of banks with hypothesized 'pocket' status with achievement of relative intermediation efficiency. The introduction of free economic zone banks looks like a success story so far. More importantly, the overall tendency to higher efficiency among private banks was observed.

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INTRODUCTION

Today it has become commonplace in surveys of performance of transition economies to refer to Belarusian economic model as to an obvious outlier or, and this happens even more often, not to refer to it at all. The reason for this is the dominance of the state regulation in economy and unreliable official statistics. Nevertheless, despite certain methodological difficulties, regulation of some sectors provides us with an additional chance to reveal (indirectly) the fact that the overall controversial picture of the development of Belarusian economy over the last 4-5 years on the level of certain markets can be clearly seen as the result of preferential treatment of separate players. Presumably, Belarusian banking sector can serve as a good example of this.

Chronologically as well as conceptually, the development of banking sector in independent Belarus can be roughly split into two very dissimilar periods. The period between 1991 and 1994 may be viewed as a period of moderate reforms and preparation for privatization of major state-owned enterprises. The view that privatization is an inevitable event was shared by the majority of economic agents at that time and was supported by the evidence from the faster reforming neighboring countries. This had certain impact on expectations. Insiders (mostly top management of state-owned enterprises) in many cases tried to establish conditions that would allow them to seize the control over their companies after privatization starts. In their paper on Russian privatization and related corporate governance issues Black et al (2000), in particular, consider various schemes such as 'loans-for-shares' in order to illustrate what a role leading Russian banks played in privatization of the most attractive pieces of state property. Motivated by similar considerations it is tempting to view the establishment of major Belarusian commercial banks by groups of state-owned companies during this period, at

least partially, as an intensive preparation for a large-scale privatization. However, after the election of the new president in 1994 the plans for liberal reforms and further privatization were completely removed from the economic agenda. As a result, conservation of current ownership structure occurred, inflow of FDI narrowed and, in particular, no respectable foreign bank had showed its interest in Belarusian market until early 2000s.

This contradictory development is reflected in the two distinctive features of Belarusian banking sector. First, in the capital of most large and some medium-size banks state posses a significant share. However, these banks are mostly owned by the state indirectly, i.e. most of them were jointly established by state-owned enterprises in the beginning of 1990s. Second, non-banking foreign institutions own many of Belarusian banks with significant participation of foreign capital. The first observation seems to suggest that under current economic conditions and political realities indirect state ownership of this type can be possibly viewed as a rather beneficial factor (owners become the main clients, they are usually big or numerous, asymmetry of information is lower, etc.); the second observation forces to conclude that the role of banks with foreign capital in introduction and implementation of western-standard managerial practices in Belarus is likely to be lower than in most CEE countries.

In 2002-2004 Belarusian banking sector experienced rapid growth, total assets of the industry more than doubled. However, as it might be expected, performance differed in many respects between groups of banks. In this work we devote attention primarily to the influence of ownership structure, transparency and National Bank (NBRB) regulatory actions on the observed inefficiencies.

This study employs the Frontier efficiency approach with inherent aggregation over some inputs and outputs as it promises a good way to overcome the difficulties involved in working with the insufficiently detailed official statistics on

banking. The research will involve two stages. In the first stage the efficiency score estimates will be obtained using Data Envelopment Analysis (DEA). In the second stage the efficiency score estimates will be used in regression analysis in order to find the most important inefficiency correlates.

This study is of interest for several reasons: to the best of my knowledge, this is the first attempt to explore the performance of Belarusian banking sector in the frontier efficiency context. It also determines and quantifies the differences in inefficiency levels between both banks of different size and the sub-groups within the diverse group of small-size banks. This study may provide insights on the effects of the direct control of the National Bank over some key banks. Moreover, the differences in the way banks benefited (in terms of efficiency) from the rapid economic growth in recent years may have important policy implications, namely, it may empirically determine the type of foreign banking institutions whose entrance the National Bank needs to encourage in order to promote efficiency via increased competition.

The rest of the paper is organized as follows. Chapter 1 discusses the recent research on banking sector frontier efficiency, both theoretical and empirical as well as some aspects of banking in transition. Chapter 2 presents DEA methodology and details on the estimation procedure applied in this study. Chapter 3 makes a short overview of Belarusian banking industry development. Chapter 4 presents empirical results. Chapter 5 discusses conclusions.

Chapter 1

LITERATURE REVIEW

In recent years the academic research on the performance of financial institutions, banks in particular, has increasingly concentrated on the frontier efficiency approach and related estimation techniques. For instance, among 130 works included by Berger and Humphrey (1997) in their review of studies of financial institutions frontier efficiency, as many as 116 were written or published during 1992-1997.

Such a rapid growth of interest to the area is presumably due to both achievements in understanding the reasons for presence or absence of robustness of estimated efficiency with respect to chosen approach and interesting (though often controversial) empirical findings. In this review we will consider frontier efficiency and banking in transition as separate but related issues, consequently, the review will be divided into two conceptual blocks.

The first block the attempts to highlight the dynamic interdependence of several frontier efficiency research directions. This block will be organized in the following way. First, we discuss the four variants of efficiency approach and devote some attention to the studies that attempted to characterize the differences in the results these methods often yield in empirical research. Then we outline some recent works devoted to efficiency of banking institutions in specific countries with additional focus on differences found in performance of certain groups of banks and finish by considering a group of studies which used the efficiency score estimates (obtained on the first stage) in regression analyses in

order to discover the most important inefficiency correlates and draw some policy conclusions.

In the second block we will focus on the question of optimal configuration of financial markets in Eastern Europe, illustrate important advices given in the related literature by recent frontier efficiency research done on transition countries. And conclude by referring to the features that make Belarusian economic model an "outlier" requiring careful implementation of approaches widely used for other transition countries.

Without going to the details of estimation procedures we may view differences in frontier efficiency methods following Bauer et al. (1997) as differences in assumptions made about the shape of the frontier, the presence of random error and its assumed distribution. Traditionally, these methods also differed with respect to the concept of efficiency they employed with parametric methods using economic efficiency and non-parametric mostly focusing on technical efficiency. However, nothing in each method itself precludes researchers from measuring economic instead of technical efficiency or vice versa, for instance, in many recent studies researchers incorporated information on prices into their Data Envelopment Analysis (DEA) efficiency estimations (Ferrier and Lovell (1990), Bauer et al. (1997), etc.).

Data Envelopment Analysis and Free Disposal Hull (FDH) represent parametric approach; both methods use linear programming techniques. In DEA (the most frequently used parametric approach) an efficient firm is one for which no other firm or linear combination of firms produces as much or more of every output given inputs (in output orientation case). Such firms connected by piecewise line segments in the input/output space constitute the estimated DEA efficient frontier. An obvious advantage of DEA is that it does not impose any specific functional form on the technology set. On the other hand, it does not allow a

measurement error or chance (good or bad luck) to influence observed efficiency, i.e. it assumes absence of the random error. Also, DEA relies on comparability with linear combinations of other firms. This leads to self-identifiers problem, a situation when a firm that is not directly comparable to any other firm or a linear combination of any number of firms (say, due to its large size) is assigned the highest efficiency score.

The main parametric frontier efficiency methods are Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA) and Distribution-Free Approach (DFA). The primary difference between them is the distributional assumption used to separate inefficiency from random error. The main advantage of these methods is that they are less likely to misidentify the specification or measurement error as inefficiency, however, at cost of imposing more structure on the shape of the frontier.

It is natural given the differences in the underlying assumptions to expect that empirical estimations employing different efficiency frontier approaches are likely to yield different results (especially if one approach is parametric and the other one is non-parametric). This ambiguity forced some researchers to apply simultaneously more than two approaches, at least one parametric and one non-parametric approach, to the same data set (Ferrier and Lovell (1990), Eisenbeis et al. (1996), Berger and Hannan (1998)). The study by Berger and Hannan (1998) suggested that average efficiencies obtained using different parametric methods were comparable. Eisenbeis et al. (1996) found rather significant rank correlations when identifying best-practice firms between DEA and SFA.

However, as Bauer et al. (1998) pointed out in their review of previous studies the evidence on consistency of different efficiency frontier methods appears to be quite limited and sometimes contradictory, especially with respect to the possible use in regulatory analysis. In the same paper they proposed a set of consistency

conditions which efficiency measures should meet in order to derive policy implications. Namely, "efficiency estimates should be consistent in their efficiency levels, rankings, and identification of best and worst firms, consistent over time and with competitive conditions in the market, and consistent with standard non-frontier measures of performance" (Bauer et al. (1998)). Authors applied variants of all four major approaches to the US banking data and tried to evaluate the degree to which these methods satisfy the proposed consistency conditions. The general result was that both variants of parametric and non-parametric methods are more or less consistent with other methods within their own group. However, little evidence of correspondence was found for results obtained using any pair of a non-parametric and a parametric approach. In addition, variants of DEA seemed not to be in line with some standard non-frontier measures of performance, while all parametric models at least did not contradict them. Authors refrained from drawing definite conclusions, mostly because of the fact that inclusion of allocative inefficiency into their DEA estimation resulted in surprisingly low efficiency measures.

The study of Berger and Mester (1997) further investigated the potential sources of the substantial variation in measured efficiency. Besides other explanations authors focus on differences in the economic efficiency concept used. The concepts of profit, alternative profit and cost efficiency each assumes different optimization program. The authors showed empirically that "measurement of each of the efficiency concepts does add some independent informational value". They also find that measures of cost efficiency are not positively correlated with measures of profit efficiency. After all, it seems that the unresolved ambiguity over the consistency of different frontier efficiency approaches has further motivated researchers to use more than one approach in their empirical studies (for instance, see Isik and Hassan (2002)).

Despite the remaining controversies regarding the choice of the appropriate frontier efficiency approach, the body of empirical studies of banking industries in different countries and geographical regions continues to grow. It appears that the choice of questions a particular study attempts to answer depends on the type of country under consideration. Researchers tend to focus on questions related to deregulations, scale economies, effects of mergers and sometimes regional differences when they analyse the banking sector of a developed country, while paying attention to the differences in performance between groups of foreign, public and private domestic banks in most studies of less developed countries. We outline here only several examples of this.

There are numerous studies devoted to the efficiency of European banking. For instance, the study of Altunbas et al. (2000) applied a parametric methodology to a large sample of EU banks and found that scale economies are widespread for small banks and for larger banks of certain size. It was also found that inefficiency measures are substantially higher than scale economies (*20-25%* vs. *5-7%*). In addition, it was shown that the larger is a bank, the more it benefits from reduction in cost due to technical progress despite the absence of scale economies. The more recent paper by Schure et al. (2004) have focused on the impact the Second Banking Directive of the European Union has had on the efficiency of banks; it has used a parametric technique. The findings are essentially the same: technological progress and competition promoted by the Directive lowered costs; small saving banks can exploit economies of scale, managerial inability to control costs remains the main source of inefficiency. A similar study of Japanese banking industry by Drake and Hall (2003) employed the DEA methodology and showed that large banks are least inefficient and are operating above minimum efficient scale. This conclusion enabled the authors to question the positive impact of planned large-scale bank mergers in Japan and to suggest mergers on lower-scale, especially local ones. Interestingly, the paper by

Akhigbe and McNulty (2003) contains almost reversed empirical results: small US banks are more profit efficient than large banks and, in addition, those of small banks operating in "non-metropolitan statistical areas" are more profit efficient than their counterparts in "metropolitan statistical areas".

The recent papers devoted to banking in developing countries in the context of frontier efficiency attempt both regional and country-specific studies. In the paper by Carvallo and Casman (2005) the common cost frontier for 16 Latin American and Caribbean Countries was constructed (specific environmental variables for each country were included in estimation) in order to explore cost inefficiencies and scale economies. The authors found a wide range of inefficiency levels across countries with largest economies being the least efficient. The results with respect to bank size were less surprising: very small and very large banks are significantly more inefficient than banks of other sizes. The fact that significant economies of scale seemed to exist at any level of output constituted another peculiarity of this study, as for most countries and regions in previous studies economies of scale were found to be exhausted at relatively low levels of outputs. Authors also concluded that despite liberalization of financial markets worldwide and resulting increased international and domestic competition, banks tended to become more efficient mostly in countries that grow faster and have banking systems with less market power. In similar fashion Isik and Hassan (2002) argue that the observed inefficiencies in the Turkish banking sector are technical in nature and mostly can be attributed to the diseconomies of scale. The authors also doubt whether the increased state demand for funds to finance high growth policies given the oligopolistic nature of Turkish banking market will lead to scale adjustments, instead they suggest implementing a package of reforms promoting competition in banking.

However, in many cases researchers focus on differences in performance between domestic and foreign banks. Interestingly, some country studies have showed quite divergent results under different specifications. For instance, Sathye (2003) under one model specification obtained higher mean efficiency for public banks than that of foreign and private banks; however, a change in underlying specification partly reversed the results: the group of foreign banks received greater mean efficiency than the group of publicly owned banks and the conclusion of relative efficiency of public banks versus private remained unchanged. It is also intriguing that in both cases most of the banks on the efficient frontier were foreign. However, the study of Saha and Ravisankar (1999) focused only on efficiency of publicly owned Indian banks and found that their efficiency is quite high and tends to increase with time that seems to support the findings of Sathye (2003). Nevertheless, many studies have reached meaningful results. A paper by Hasan and Marton (2002) can serve as a good example. The authors claimed that liberal policies towards entry of foreign banks were in part responsible for the creation of a relatively stable and efficient banking system in Hungary. They also supported this conclusion by finding empirical evidence that foreign bank and banks with higher foreign ownership involvement were historically associated with lower levels of inefficiencies.

The two studies that were mentioned before may also serve as good examples of the use of efficiency estimates in finding their correlates and drawing policy conclusions based on these relationships. Akhigbe and McNulty (2003) empirically test the hypothesis of dependence of efficiency on certain factors related to competition conditions, location and to the composition of assets and liabilities. Essentially, the authors, by doing this, attempted to test several main behavioral hypotheses: such as structure-performance (SP), quiet life (QL), information advantage (IA) and some others. SP suggests that small banks in closed communities can charge higher prices for their services and pay less for

some of their inputs (say, deposits). QL hypothesis says that managers in smaller banks are tempted to shift banks' asset composition to less risky and profitable loans and securities, while IA supposes that smaller banks have access to better credit information. Regression analysis showed that estimated efficiencies in most cases were related in expected way to the explanatory variables associated with different types of behavior. In their paper Isik and Hassan (2002) found strong association between inefficiency and management-team structure, namely, that banks where the board is independent of management perform better and also that publicly traded banks which are exposed to stricter market control usually show more technical efficiency.

Financial institutions in transition countries are not yet playing the role they play in developed market economies. However, the negative symptoms have quite a different degree in the Commonwealth of Independent States (CIS) and CEEC-8[1] countries. Gros and Steinhherr (2004) present data on M2 to GDP and credit to private sector to GDP ratios in order to illustrate how demonetised these countries are in comparison to EU-12 members. The first indicator for CIS countries on average was equal *12.7%* and for CEEC-8 – *50%*, while the same number for EU-12 was 68.3% in 2002, showing little difference between CEEC-8 and EU-12. Nevertheless, second indicator points on the huge gap between all transition countries and EU: CIS – *8.1%*, CEEC-8 – *26.6%*, EU-12 – *108.7%* in 2002. This observation enables the authors to conclude "that standard transformation functions of banks, i.e. the transformation of maturities, transformation of risk and the transformation of scale (pooling of resources), are either not available at all or have to be provided by non-banks" in all transition countries (Gros and Steinhherr (2004)), particularly in CIS. The authors attribute this state of affairs primarily to the lack of the rule of law: bankruptcy is more a

[1] Eight Central and Eastern European Countries, namely: Slovenia, Hungary, Czech Rep., Slovakia, Poland, Estonia, Latvia, Lithuania.

political than a legal question; property rights are uncertain and difficult to assess in the absence of cadastres and clear real estate and land property rights; systematic uncertainty. Given these facts it is not surprising that banks in these countries tend to lend only to 'connected' borrowers and the private sector is forced to search for substitutes of bank credit, often in the form of inter-enterprise credit.

Despite the fact that current conditions for the successful development of banking sector are unfavourable in the most CIS countries Gros and Steinherr (2004) claim that "The American model, relying on the capital market and on segmented banking, is clearly inappropriate for Eastern Europe at its present state of development … The existence of a reasonably efficient, ordinary banking system that collects short-term deposits, handles transfers of funds, furnishes working capital to small and medium-sized firms and sufficiently well capitalized to cover ordinary banking risks, such as those of embedded in loan portfolios, is what emerging economies need the most. Banking needs to precede capital markets."

As for many other spheres in transition countries, the necessary preconditions for the desirable progress of financial market are confidence in political institutions and openness to foreign competition. Even if these preconditions are achieved low financial transparency and high information costs according to Gros and Steinherr (2004) make " 'insider' status on the part of responsible external monitors virtually mandatory in order to achieve a viable structure of corporate governance" leading to universal-type bank linkages. Unfortunately, universal banking model has its drawbacks. There is a risk of building a highly concentrated financial system – with all financial services provided by the small number of universal banks. In this situation both legislative measures and openness to foreign competition must be actively used in order to avoid excessive

concentration. The authors emphasize the importance of the latter proposing Hungary and Russia as two counter examples, good and bad respectively.

Some recent frontier efficiency studies seem to generally confirm the above view of challenges transition countries face during the process of their universal banking systems building and strategies to manage the risks. In this sense the studies by Yildirim and Philippatos (2002a and 2002b) could give a good overall picture: their dataset included information on 14 transition countries. Yildirim and Philippatos (2002b) analyze the evolution of competitive conditions in transition countries' banking sectors during 1993-2000. Their results suggest that during the whole period considered banks operated under conditions of monopolistic competition, except in Slovakia and Macedonia. Moreover, they find that there were two subsequent time trends in the development of competitive conditions during this time: in 1993-1996 the trend in competitive conditions was decreasing, while after 1996 it had the opposite direction. The authors attribute this change to the "inevitable impact of liberalization on competitive conditions". This fact seems to support the importance of Gros and Steinherr's (2004) argument regarding competition in universal banking systems and the role openness to foreign competition has to play in its development. Yildirim and Philippatos (2002b) also find that on average banks that obtain the higher proportion of their inputs from deposit market are able to receive higher interest revenues in per dollar of assets terms. Usually these banks are large. This fact can be interpreted as a confirmation of existence of tendencies to high concentration, which are partly offset by the fact that "large banks operate in a relatively more competitive environment compared to small banks or … competition is lower in local markets compared to national and international markets" (Yildirim and Philippatos (2002b).

Another study by the same authors (Yildirim and Philippatos (2002a)) found that higher efficiency levels for banks in transition countries are associated with large size and higher profitability and equity, a somewhat similar finding. However, the result concerning the efficiency level associated with foreign banks turned out to be more controversial. The authors applied two alternative concepts of efficiency: cost and profit. In the first case foreign banks were found to be more efficient, while in the second case less than domestically owned private banks and state-owned banks.

Usually, separate studies devoted to one transition country give similar but more detailed picture. The two studies devoted to Ukraine can serve as a good example of this. The study by Mertens and Urga (2001) analyzed 1998 production data on a sample of Ukrainian banks. The data suggested that small Ukrainian banks operated more efficiently in terms of cost but less efficiently in terms of profits. The authors attributed this difference to the existence of monopoly power in Ukrainian banking sector, as large banks having higher costs generated higher profits. The study by Shepetko (2004) used data set for the period 1998-2003. Similar to Mertens and Urga's (2001) result, Shepetko (2004) finds that group of large and medium-size banks and the group of small banks has significantly different distributions of efficiencies with the latter group having lower aggregate efficiency. However, the analysis also detects that "the production of individual banks as well as the aggregate efficiency of the banking industry overall to increase substantially indicating the tendency for within efficiency catching-up and thus revealing the banking industry to improve its performance" (Shepetko 2004)). This observation and the data on concentration (for example, Herfindahl - Hirschman Index decreased from *476.68* in 1998 to *394.46* in 2003) enables the author to characterize Ukrainian banking sector as "dynamic, fast growing and at this stage rather unconcentrated market". Again, the increased competition from the side of foreign banks seems to be an important contribution to the result.

Finally, we would like to mention the studies (in fact, only one was found) focusing on those specific features that make Belarusian economic model an 'outlier' requiring careful implementation of approaches widely used for other transition countries. The study by Neunhöffer (2000) views the situation in Belarus during 1990s – beginning of 2000s from a political economy perspective. Taking chronological approach, the author begins by considering the forces that apposed liberal reforms in the early 1990s. The collapse of the Soviet Union and subsequent liberal reforms in neighboring countries (especially their failures in Russia) convinced many citizens in Belarus that its economy characterized by the dominance of assembling plants tightly related to their partners in other FSU republics will be under a threat of de-industrialisation in case it loses the existing production links and becomes open to the competition in the global markets simultaneously. According to Neunhöffer (2000) workers of large state-owned enterprises, state bureaucracy and some other social groups formed a 'large coalition' or 'social block' that supported the proposed by the newly elected president Lukashenka 'alternative project'. The new authorities were focusing on the remaining centralized allocative structures with the state playing the leading role in the formulation of the development model. The attempts to promote regional integration (within FSU countries) in order to secure the existing production links have also received a special attention.

The resulting economic model was characterized by the dominance of trade as a form of relations with the global economy, while foreign direct investments and financial inflows remained essentially insignificant. Neunhöffer (2000) notes that Belarusian authorities, in principle, realize the need for foreign investments. However, none of the governments was ready to liberalize the whole economy. Instead they practised offering preferential treatment to foreign companies entering certain industries; however, this practice has never been even relatively systematic and transparent leading to the failure of this attempt to modernize

with the help of external resources. This forced Belarusian authorities to rely fully on the classical protectionism in trade and state-led modernisation.

Neunhöffer (2000) also claims that the 'social block' is getting more and more unstable as the time passes. The author sees the reason for this in the changing attitude to the economic perspectives of the chosen model of development from the side of state bureaucracy and the top-management of state-owned enterprises. For instance, top-management of state-owned enterprises has for a long time been protected from the risks of economic transformation, foreign competition, influences of unpredictable moves on the global market. During this time the top-management was able to improve the perspectives for the integration to the global economy by undertaking restructuring, modernisation from centrally provided funds and informal re-assignment of ownership rights. The author concludes by referring to the hidden conflict between the authoritarian Belarusian leader and the getting more and more 'reforms friendly' parts of the former 'social block' as to a key to both future economic and political development in Belarus.

Taking into account all the recent trends in the research in the frontier efficiency field as well as the specificity of the country, this paper will try to asses the differences in inefficiency levels between various groups of banks taking into account factors of ownership structure, transparency and actions by the National Bank. This will hopefully allow proposing optimal policies to promote efficiency and to identify entrants of desirable type.

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Chapter 2

METHODOLOGY

The empirical investigation this paper conducts should, in principle, involve two stages. First, Data Envelopment Analysis (DEA) technique should be applied to the dataset containing information regarding the combinations of inputs and outputs chosen by each bank in each period of observation. This procedure yields an estimate of production efficiency score for each individual bank in each individual period. Unfortunately, these estimates are serially correlated with unknown structure of dependency among them. Consequently, the second stage inference procedures when we regress efficiencies on environmental variables should account for this problem. Simar and Wilson (2003) proposed a coherent data generating process that allows environmental variables to influence efficiencies. This model may be estimated using two-stage semi-parametric bootstrap procedure that permits valid inference. Here we will follow their proposal.

DEA is one of the most popular approaches in theoretical measurement and empirical estimation of efficiency of various economic systems. Envisioned first by Farrell (1957), DEA received its name and popularity after the work of Charnes, Cooper and Rhodes (1978). A way of viewing non-parametric (DEA) efficiency measurement is through the Activity Analysis Models (AAM). An activity analysis model can be defined as a set of mathematical formulations intended to mimic a technology set from observed data of a particular real-world production process. There are two fundamental assumptions behind DEA as an AAM. First, we assume that all firms have access to the same technology, which in turn is assumed to be characterized by a technology set satisfying certain

regularity axioms. This assumption is needed to justify the estimation of one best practise frontier. However, it is allowed that, for various both exogenous (macroeconomic factors, measurement errors, etc.) and endogenous (managerial inefficiency) reasons, each particular decision making unit may not be on the frontier. Second, we assume that all observed input-output choices are feasible or, in other words, there are no errors of the type that would make an observation go beyond the technology set. The main advantage of DEA is that it does not require specification of a functional form of the best practice frontier. It also allows working in a multi-output setting without specifying any relationship between outputs. These are also the reasons why it might be sensitive to the presence of outliers in a sample and to measurement errors. These problems might, however, be satisfactory resolved with help of some recently developed methodologies. In this work, in particular, we will use bootstrapping and the separation of error term with second stage regression analysis.

Consider a banking industry composed of k $(k=1,\ldots,n)$ decision making units (banks). Each bank uses N inputs $\boldsymbol{x}^k=(x^k_1,\ldots,x^k_N)$ and produces M outputs $\boldsymbol{y}^k=(y^k_1,\ldots,y^k_M)$. All banks have an access to the same technology completely described by the technology set:

$$T\equiv\{(\boldsymbol{x}^k;\boldsymbol{y}^k):\boldsymbol{x}^k \textit{ can produce } \boldsymbol{y}^k\},\quad \boldsymbol{x}^k\in \mathrm{R}^{\mathrm{N}}_{+},\ \boldsymbol{y}^k\in \mathrm{R}^{\mathrm{M}}_{+}, \quad (2.1)$$

which can be equivalently characterized by the output set:

$$P(\boldsymbol{x}^k)\equiv\{\boldsymbol{y}^k:\boldsymbol{y}^k \textit{ is producible from } \boldsymbol{x}^k\},\ \boldsymbol{x}^k\in \mathrm{R}^{\mathrm{N}}_{+}, \quad (2.2)$$

Assume further that the technology satisfies the regularity axioms of production theory, including free disposability of outputs and free disposability of inputs axioms (for more details refer to Zelenyuk (2004)). Also in order to allow for the variable returns to scale we need to assume *convexity* defined as follows:

$$\text{If } (\boldsymbol{x}^k, \boldsymbol{y}^k) \in T,\ \forall\, k=1,..,n \quad \text{then} \quad \left(\sum_{k=1}^{n} z^k \boldsymbol{x}^k,\ \sum_{k=1}^{n} z^k \boldsymbol{y}^k\right) \in T,$$

$$\text{for all } z^k \text{ such that: } \sum_{k=1}^{n} z^k = 1,\ z^k \geq 0,\ k=1,\ldots,n \qquad (2.3)$$

Under these assumptions DEA technology estimator will be defined as follows:

$$\hat{T} \equiv \{(\boldsymbol{x}, \boldsymbol{y}): \boldsymbol{y} \leq \sum_{k=1}^{n} z^k \boldsymbol{y}^k,\ \boldsymbol{x} \geq \sum_{k=1}^{n} z^k \boldsymbol{y}^k,\ \sum_{k=1}^{n} z^k = 1,\ z^k \geq 0,\ k=1,\ldots,n\}, \qquad (2.4)$$

The resulting set is often called *the smallest convex free disposal hull* that fits all the input-output observations on production activities, $\{(\boldsymbol{x}^k, \boldsymbol{y}^k): k=1,\ldots,n\}$.

Now in order to be able to measure efficiency we define *frontier of the output set* (or *input isoquant*) in the following radial way:

$$\partial \hat{P}(\boldsymbol{x}^k) \equiv \{\boldsymbol{y}: \boldsymbol{y} \in \hat{P}(\boldsymbol{x}^k),\ \theta \boldsymbol{y} \notin \hat{P}(\boldsymbol{x}^k),\ \forall\, \theta \in (1,\infty)\},\ \boldsymbol{x}^k \in \mathrm{R}^{\mathrm{N}}_{+} \qquad (2.5)$$

In a similar manner we define the estimated efficiency of the bank k with the *output-oriented Farrell technical efficiency measure* as:

$$\hat{TE}_o(\boldsymbol{x}^k, \boldsymbol{y}^k) \equiv \max(\theta: \theta \boldsymbol{y}^k \in \hat{P}(\boldsymbol{y}^k)), \qquad (2.6)$$

Consequently, the state of the perfect estimated technical efficiency of an observation $(\boldsymbol{x}^0, \boldsymbol{y}^0) \in \hat{T}$ will be defined as a situation when this observation belongs to the estimated technological frontier. In Farrell sense this happens if and only if $\boldsymbol{y}^0 \in \partial \hat{P}(\boldsymbol{x}^0)$ or whenever $\hat{TE}_o(\boldsymbol{x}^0, \boldsymbol{y}^0) = 1$. This property has a quite simple interpretation: the value of $\hat{TE}_o(\boldsymbol{x}^0, \boldsymbol{y}^0)$ represents the quantity by which all outputs (or vector $\boldsymbol{y}^0$) must be increased simultaneously, while keeping input $\boldsymbol{x}^0$ constant and having the technology $\hat{P}(\boldsymbol{x}^0)$ unchanged in order to make this observation (this bank) technically efficient. So the quantity $[\hat{TE}_o(\boldsymbol{x}^0, \boldsymbol{y}^0) - 1]$

100%) can be interpreted as percentage of the output inefficiency where the actual output level taken as the base of percentage computation.

Since, we are essentially interested in the estimated efficiency scores rather than in estimation of the technology set itself, here we define DEA-estimate of output oriented Farrell technical efficiency score, under assumption of variable returns to scale and free disposability of all inputs and outputs, for bank *i* in period *j* (*i=1,…,n; j=1,…, t*) as:

$$\hat{TE}^{ij}_{o}(\boldsymbol{x}^{ij}, \boldsymbol{y}^{ij}) \equiv \max_{\theta, z^{11},\ldots,z^{nt}} \theta \qquad (2.7)$$

$$\text{s.t.} \quad \sum_{k=1}^{n}\sum_{p=1}^{t} z^{kp} y^{kp}_{m} \geq \theta\, y^{ij}_{m}, \; m=1,\ldots,M,$$

$$\sum_{k=1}^{n}\sum_{p=1}^{t} z^{kp} x^{kp}_{l} \leq x^{ij}_{l}, \; l=1,\ldots,N,$$

$$\sum_{k=1}^{n}\sum_{p=1}^{t} z^{kp} = 1,$$

$$\theta \geq 1,$$

$$z^{kp} \geq 0, \; k=1,\ldots,n\,; p=1,\ldots, t.$$

All the constraints in the problem (2.7) as well as the objective function are linear. Consequently, this optimisation problem is a linear programming (LP) problem. This LP problem can be relatively easily solved using almost any mathematical software package.

Regression analysis. The goal of the second stage of the analysis is to investigate the dependency of the production efficiency score estimates on bank and period

specific factors, namely, ownership structure, indicator of financial transparency[2], relative size of the network of branches, shocks influencing bank's choice of inputs/outputs (extra funds at the National Bank), random noise. This task will be accomplished with the help of regression analysis. Specifically, we assume and test the following specification:

$$TE^{ij}_{o} = \beta_1 + \beta_2\, State_i + \beta_3\, Quasi\_Private_i + \beta_4 NBRB_i + \beta_5\, Foreign\_b_i + \beta_6\, Fez_i +$$

$$+ \beta_7\, (Transparency_i\, LN(Branch\_per\_share\_in\_assets_i)) + \beta_8\, Extra\_funds\_NBRB_{ij} +$$

$$+\varepsilon_{ij} = \boldsymbol{C}_{ij}\boldsymbol{\beta} + \varepsilon_{ij}\ , \qquad (2.8)$$

where

TE^{ij}_{o} - true Farrell output-oriented technical efficiency score of bank i in period j, $i = 1,\ldots, n$ and $j=1,\ldots, t$

$State_i$ - ownership dummy taking the value of either zero or one; one indicates that bank i belongs to the group of banks in capital of which state's (but not NBRB's) share dominates (zero otherwise).

$Quasi\_Private_i$ - ownership dummy taking the value of either zero or one; one indicates that bank i owned primarily by local private capital, however, the share of state-owned companies in its capital is relatively high (zero otherwise).

$Nbrb_i$ - ownership dummy taking the value of either zero or one; one indicates that bank i belongs to the group of banks in capital of which NBRB's share dominates (zero otherwise).

[2] Inclusion of this variable into regression analysis was primarily motivated by the need to measure the degree of involvement into the competition for inputs and its influence on intermediation efficiency rather than by the need to account for the quality of corporate governance and its consequences (as it is in Zelenyuk and Zheka (2004)). For more discussion on the issue of competition for inputs and 'pocket banks' see Chapter 5, Section 4.2.

$Foreign\_b_i$ - ownership dummy taking the value of either zero or one; one indicates that bank i belongs to the group of private banks owned by foreign banking institution, zero otherwise.

Fez_i - ownership dummy taking the value of either zero or one; one indicates that bank i is registered in Free Economic Zones (FEZ), zero otherwise.

$Transparency_i$ – categorical variable taking integer values from zero to four; the value indicates how many of the following conditions bank i satisfies: (a) availability of web-page; (b) provision of information on major stakeholders on the web-page; (c) availability of quarterly financial reports on the page; (d) periodical publication of independent auditor's conclusions (Table 9 contains a short data description for this variable).

$Branch\_per\_share\_in\_assets_i$ – continuous variable measuring the ratio of branches of bank i to its share in the total assets of the industry in the last period of observation (t).

$Extra\_funds\_NBRB_{ij}$ – dummy variable, one indicates there is some evidence that bank i in period j held extra reserves at the National Bank (zero otherwise).

ε_{ij} - statistical noise

In DEA literature until recently researcher often applied *Tobit* estimator to such models. However, Simar and Wilson (2003) have shown inappropriateness of the *Tobit* estimator in this context. They proposed an approach based on truncated regression with bootstrap, illustrating in Monte Carlo experiments its good performance. Here we will follow Algorithm 2 (Simar and Wilson (2003)), which replaces the unobserved dependent variable TE^{ij}_o by the bias-corrected estimate of it (obtained using heterogeneous bootstrap). We also know that both sides of (2.8) are bounded by unity, so the distribution of ε_{ij} is restricted by the condition

$\varepsilon_{ij} \geq 1 - \boldsymbol{C}_{ij}\boldsymbol{\beta}$. For simplicity, we follow Simar and Wilson (2003) and assume that this distribution is truncated normal with zero mean, unknown variance and the left truncation point determined by the above condition. So, the resulting econometric model is:

$$\hat{TE}^{ij}_{o} \approx \boldsymbol{C}_{ij}\boldsymbol{\beta} + \varepsilon_{ij}, \qquad (2.9)$$

where

$$\varepsilon_{ij} \sim N(0, \sigma_{\varepsilon}^2), \text{ such that } \varepsilon_{ij} \geq 1 - \boldsymbol{C}_{ij}\boldsymbol{\beta}, \; i=1,\ldots, n \text{ and } j=1,\ldots,t$$

Algorithm we apply (adopted Algorithm 2 from Simar and Wilson (2003)):

1) Using the original dataset compute $\hat{TE}^{ij}_{o} = \hat{TE}^{ij}_{o}(\boldsymbol{x}^{ij}, \boldsymbol{y}^{ij} \mid \partial \hat{P})$ for all $i=1,\ldots,n$ and $j=1,\ldots,t$ using (2.7)

2) Use the method of maximum likelihood to obtain estimate $\hat{\boldsymbol{\beta}}$ of $\boldsymbol{\beta}$ as well as $\hat{\sigma}_{\varepsilon}^2$ of σ_{ε}^2 in the truncated regression of $\hat{TE}^{ij}_{o}$ on $\boldsymbol{C}_{ij}$ in (2.9)

3) Loop over the next four steps (3.1-3.4) L_1 times to obtain nt sets of bootstrap estimates $B_i = \{\hat{TE}^{ij}_{o\,b}{}^{*}\}_{b=1}^{L1}$:

3.1) For each ij ($i=1,\ldots,n$ and $j=1,\ldots,t$) draw ε_{ij} from $N(0, \hat{\sigma}_{\varepsilon}^2)$ distribution with left-truncation at $(1 - \boldsymbol{C}_{ij}\hat{\boldsymbol{\beta}})$.

3.2) Again for each ij ($i=1,\ldots,n$ and $j=1,\ldots,t$) compute $TE^{ij}_{o}{}^{*} = \boldsymbol{C}_{ij}\hat{\boldsymbol{\beta}} + \varepsilon_{ij}$

3.3) Set $\boldsymbol{x}^{ij*} = \boldsymbol{x}^{ij}$, $\boldsymbol{y}^{ij*} = \boldsymbol{x}^{ij}\ \hat{TE}^{ij}_{o} / \ TE^{ij*}_{o}$ for all *ij (i=1,…,n* and *j=1,…,t).*

3.4) Compute $\hat{TE}^{ij*}_{o} = \hat{TE}^{ij}_{o}\ (\boldsymbol{x}^{ij}\ ,\ \boldsymbol{y}^{ij}\ |\ \partial\ \hat{P}^{*})$ for all *ij (i=1,…,n* and *j=1,…,t),* where $\partial\ \hat{P}^{*}$ is obtained by replacing every $\boldsymbol{x}^{ij}$ with $\boldsymbol{x}^{ij*}$ and every $\boldsymbol{y}^{ij}$ with $\boldsymbol{y}^{ij*}$ in estimation of (2.4 - 2.5).

4) For each *ij* (*i=1,…,n* and *j=1,…,t)* compute the bias-corrected estimator $\hat{\hat{TE}}^{ij}_{o}$ using bootstrap estimate B_i obtained in (3) and the original estimate $\hat{TE}^{ij}_{o}$ (for more detailed description refer to Simar and Wilson (2003)).

5) Use the method of maximum likelihood to estimate the truncated regression of $\hat{\hat{TE}}^{ij}_{o}$ on $\boldsymbol{C}_{ij}$ in (2.9 using $\hat{\hat{TE}}^{ij}_{o}$ instead of $\hat{TE}^{ij}_{0}$) yielding estimates $(\hat{\hat{\beta}},\ \hat{\hat{\sigma}}^{2}_{\varepsilon})$.

6) Loop over the next three steps (6.1 – 6.3) L_2 times to obtain a set of bootstrap estimates $D=\{(\hat{\beta}^{*}_{ib},\ \hat{\sigma}^{2*}_{\varepsilon})_b\}^{L2}_{b=1}$:

6.1) For each *ij (i=1,…,n* and *j=1,…,t)* draw ε_{ij} from $N(0,\ \hat{\hat{\sigma}}^{2}_{\varepsilon})$ distribution with left-truncation at $(1 - \boldsymbol{C}_{ij}\ \hat{\hat{\beta}})$.

6.2) Again for each *ij (i=1,…,n* and *j=1,…,t)* compute $TE^{ij**}_{o} = \boldsymbol{C}_{ij}\ \hat{\hat{\beta}} + \varepsilon_{ij}$

6.3) Use the maximum likelihood method to estimate the truncated regression of TE^{ij**}_{o} on $\boldsymbol{C}_{ij}$ yielding estimates $(\hat{\hat{\beta}}^{*}, \hat{\hat{\sigma}}_{\varepsilon}^{2*})$.

7) Use bootstrap values in D and the original estimates $\hat{\hat{\beta}}, \hat{\hat{\sigma}}_{\varepsilon}^{2}$ to construct estimated percentile bootstrap confidence intervals for each element of β and for σ_{ε}^{2} (for more detailed description refer to Simar and Wilson (2003))

Chapter 3

DESCRIPTION OF THE INDUSTRY

In this chapter we will take a closer look at Belarusian banking sector and by doing so will try to prepare grounds for better understanding of limitations that the organization of the industry imposes on our analysis. Since this understanding will motivate subsequent steps of our research we will first carefully look at the influence of the exogenous political shock of the middle of 1990s on banking. And then briefly discuss whether this shock may be regarded as an important determinant of today's development of Belarusian banking sector, namely, issues of ownership, presence of foreign financial institutions, market concentration and the qualitative side of the recent rapid growth will be viewed in its light.

Industry's History. The new period in the history of Belarusian banking started in 1991 after the independence of the Republic of Belarus was announced. The starting point was similar to those of other transition countries, i.e. "the monobank system was transformed into a two tier banking system by breaking up the monobank into the central bank and a number of commercial banks in each country by new regulatory frameworks. New commercial banks were allowed to engage into wide range of banking activities, usually specializing in sectors" (Yildirim and Philippatos (2002b)). The subsequent growth in the number of newly established banks accompanied by moderate liberalization lasted only till the end of 1994. The political events of 1994 culminated in the first presidential elections and had an impact on almost every institution in the country in the following several years.

Not surprisingly, the development of banking sector in independent Belarus during the last 12 years can be viewed as taking place in conceptually different business environments. The time between 1991 and 1994 may be viewed as a period of moderate reforms and preparation for privatization of major state-owned enterprises. The majority of economic agents at that time viewed further privatization and liberalization as inevitable events. However, after the election of the new president in 1994 the plans for liberal reforms and further privatization were completely removed from the economic agenda. As a result, conservation of current ownership structure occurred, inflow of FDI narrowed and the pessimistic expectations of entrepreneurs on the revival of soviet-type regulation of economy started to fulfill. The new authorities focused on the remaining centralized allocative structures with the state playing the leading role in the formulation of the development model and relying on the classical protectionism in trade. However, as time passed the top-management and some other interest groups within state bureaucracy "were improving their perspectives for the integration to the global economy by undertaking restructuring or modernisation from centrally provided funds and informal re-assignment of ownership rights" (Neunhöffer (2000)). Their lobbying efforts heated by favourable situation on external markets traditional for Belarusian export (especially in Russia) prompted the authorities to experiment with the design of the system, however, without widespread liberalization and by only insignificantly weakening state control. Nevertheless, in such a controversial setting the fast growth in banking starts to take off in the year 2001.

Entry and Exit. The information presented in Table 1 pictures some of the features of these historical developments on example of banking. As Table 1 shows, the consequences of 1994 change of economic course for the banking sector became evident shortly: the number of newly established banks dropped sharply in 1995, during 1997-2000 only two banks were established (the lowest

number for the whole period under consideration). Moreover, among *14* banks registered between 1991-92 *9* were in operation by the end of 2004, while out of *20* banks established during years 1993-94 only *7* survived. This observation, probably, indicates how radical the changes of the business environment faced by small private banks were: increased state regulation and absence of large state-owned 'connected borrowers' pushed them out of the market.

Table 1. Newly established and liquidated banks 1991-2004

Time period	*Number of newly established banks*			*Number of liquidated banks*
	Total	*were liquidated before 2004 or were under liquidation in 2004*	*still were in operation in 2004*	
1991 – 1992	14	5	9	0
1993 – 1994	20	13	7	0
1995 – 1996	3	1	2	0
1997 – 1998	1	0	1	6
1999 – 2000	1	0	1	6
2001 – 2002	6	0	6	6
2003 – 2004	4	0	4	1

Notes: Banks that were merged during the period are not counted.

Source: NBRB with calculations by author

It is also worth noting, that the banks established after 1996 are not so numerous (only *12*), however, none of them failed by the end of 2004. Six of these banks are established in Free Economic Zones and operating under a privileged regime. The other six are likely to be attached to specific projects that are somehow ensured against risk associated with the desire of the state to control all significant economic assets.

Concentration. These historical observations may also serve as a key to the explanation of the observed high concentration in the sector. The banks that dominate the industry today were all established in 1991-92 by diverse interest groups usually related to a specific industry (for instance, *Belagraprapmbank*, the

second largest bank, was established jointly by a large number of food processing plants and important agricultural producers in 1991). Moreover, these banks inherited certain assets form the Belarusian part of soviet monobank system. While most private banks were hurt by the pressure the new government put on the private sector, the large banks surrounded by influential 'connected borrowers' received further indirect support from the state. Moreover, their predetermined stability attracted some customers of small private banks in the end of 1990s. Table 2 shows that the industry concentration, as measured by Herfindahl-Hirshman Index, in the period our dataset covers has slightly fallen.

Table 2. Market concentration indices

	Number of banks	HHI	CR6
01.07.2002	26	2718	0.851
01.10.2002	28	2679	0.844
01.01.2003	28	2320	0.854
01.04.2003	29	2268	0.844
01.07.2003	29	2283	0.849
01.10.2003	30	2248	0.849
01.01.2004	30	2228	0.856
01.04.2004	30	2108	0.840
01.07.2004	31	2153	0.855

Notes: HHI – Herfindahl-Hirshman Index, defined as the sum of the squares of the firm's market shares;
CR6 – six-firm concentration ratio, defined as the sum of the six largest firms' market shares.
Source: NBRB with calculations by author

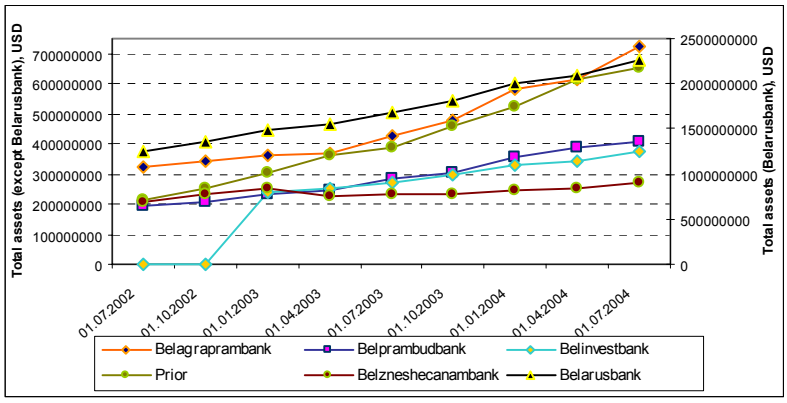
However, the sum of six largest banks' shares remained extremely stable, despite the fact that *5* new banks were established. The difference in these two measures of concentration can be attributed to the increased competition within the group of the six largest banks (see Figure 1), assets of which are still incomparably large than those of the rest of industry participants.

According to the Horizontal Mergers Guidelines (The US Department of Justice and Federal Trade Commission, 1992) markets with concentration levels as measured by Herfindahl-Hirschman Index (HHI) are categorized as

"unconcentrated (HHI below *1000*), moderately concentrated (HHI between *1000* and *1800*), and highly concentrated (HHI above *1800*)". According to this approach Belarusian market for banking products remains highly concentrated.

The high concentration itself can be hardly regarded as a specific feature distinguishing Belarusian banking. In their paper Yildirim and Philippatos (2002b) provide data on three largest banks concentration ratio (*CR3*) for *14* CEE countries. For instance, such countries as Estonia, Lithuania and Yugoslavia had *CR3* larger than *0.9* in 1999. However, it is important to note that *CR3* in every of these three countries fluctuated much between 1993 and 1999, something we do not observe in Belarus. Also, the pooled sample *CR3* went down from *0.805* in 1993 to *0.65* in 1999. Consequently, the stability of concentration measures rather than their high values constitute specifics of Belarusian banking.

Figure 1. Total assets of the six largest banks



Source: NBRB with calculations by author

It is also important to note that within the group of six largest banks the differences in size are also substantial. As Table 3 shows, only *Belarusbank* itself accounts for more that *41%* of all assets of the industry, followed by

Belagraprambank and *Prior Bank* with *13.2%* and *12%* shares respectively, *Belinvestbank* closes this list with a *5%* share.

Table 3. Total assets of six largest banks (01.10.2004)

Rank	Bank	Total assets, mln. USD	Asset share
	Banking system	5 478.70	100%
	6 largest banks:		
1	Belarusbank	2 252.43	41.1%
2	Belagraprambank	725.31	13.2%
3	Prior	655.48	12.0%
4	Belzneshecanambank	408.11	7.4%
5	Belprambudbank	373.06	6.8%
6	Belinvestbank	271.62	5.0%

Source: NBRB with calculations by author

Ownership Structure. Currently in the capital of most large and some medium-size banks state possesses a significant share. However, these banks are mostly owned by the state indirectly, i.e. most of them were jointly established by state-owned enterprises in the beginning of 1990s. As we have noted above, Belarusian authorities are still trying to keep their control over all significant economic assets within the country. The share of capital of the six largest banks both directly and indirectly controlled by the state can serve as a sufficiently good illustration of these efforts (see Table 4).

Table 4. Share of the state in the capital of the six largest banks (1.10.2001)

#	Bank	Share of the state in the capital
1	Belarusbank	100.0%
2	Belagraprambank	97.0%
3	Prior	35.0%
4	Belzneshecanambank	73.0%
5	Belprambudbank	40.0%
6	Belinvestbank	69.0%

Source: NBRB with calculations by author

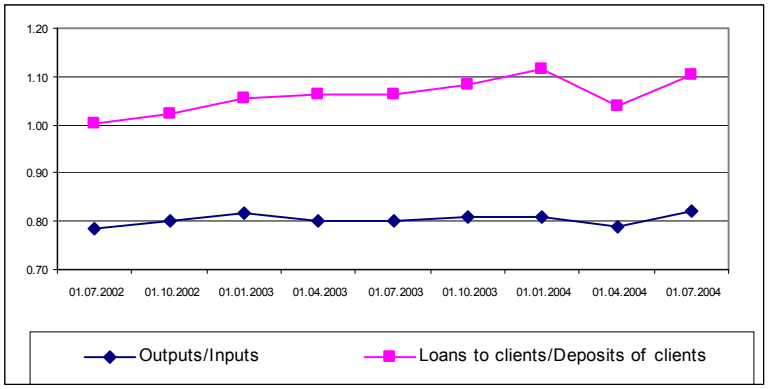
The situation with foreign capital participation in the industry is somewhat unusual for the region. Certain newly established banks at the beginning of 1990s (such as *Belnarodnybank* and *Zalaty Taler*) were primarily controlled by foreign owners. However, it is important to note that those foreign owners were non-banking institutions. Only in the beginning of 2000s two banks, one from Russia and one from Kazakhstan opened their businesses in Belarus (*Maskva-Minsk Bank* and *Astanaexsim Bank*, respectively). But the most significant entry occurred in 2003 when *Raiffeisen Zentralbank (RZB)* acquired *58%* of shares of the largest Belarusian private bank *Priorbank*. Although this last acquisition has positively influenced the competition among large banks, this is the only precedent of this kind by now. If we exclude *Priorbank* the share of foreign capital in assets of the industry remains less than *5%*. At the same time, by the end of 1999 the share of foreign ownership in the discussed above *14* CEE countries in terms of both total assets and capital was exceeding *65%*, making this market one of the most open among emerging ones (Yildirim and Philippatos (2002b)).

This observation enables us to suspect that the role of banks with foreign capital in introduction and implementation of western-standard managerial practices in Belarus was lower than in most CEE countries. Since often in empirical studies observed inefficiencies are attributed to managerial factors, the form and the extent of participation of foreign capital in the industry may be viewed as an important determinant of the observed differences in efficiency.

Recent Growth. During the period between 1.7.2002 and 1.7.2004 the total assets of the industry increased by *113.2%*. Two features of the qualitative side of this growth have already been discussed: number of banks increased by *7*, mostly due to the introduction of FEZ-banking, concentration measures remained high. It is also interesting to look at this growth via prism of intermediation. Figure 2 pictures two informative ratios: 'outputs/inputs' (see Table 5 for description)

ratio and also the ratio of their most important parts, i.e. 'loans to clients/deposits of clients'.

Figure 2. Ratios characterizing quality of intermediation.



Source: NBRB with calculations by author

'Outputs/inputs' ratio grew in *4* out of *8* periods, 'loans to clients/deposits of clients' appeared to be more volatile in 2004, although, were higher than *1* starting from 1.10.2002. The pattern exhibited by these two ratios suggests the presence of some sort of exogenous shocks that influences industry's intermediation ability. A natural candidate for its role is regulatory policy of the National Bank (reserve requirements, etc.).

This short overview of Belarusian banking industry allows distinguishing its specific features: stability of observed high concentration and the dominance of state ownership in the key banks are important by themselves but also may be viewed as entry deterring factors; this partially explains low participation of foreign capital and especially that of foreign banks. Entry occurs mostly in FEZ-banking. There are some prior signs that regulation of the industry periodically influences its intermediation capacity.

Chapter 4

EMPIRICAL INVESTIGATION

The analysis in this section will involve two stages. First, we will formulate an Activity Analysis Model that will serve as a framework for empirical investigation of intermediation efficiency of Belarusian banking sector. Next, we will apply two-stage semi-parametric bootstrap procedure of estimation and inference proposed by Simar and Wilson (2003). This will allow us to formulate and test the hypothesis of the dependence of observed inefficiencies on the type of ownership structure and influence of exogenous shocks.

All the necessary estimation procedures are performed in MatLab software using codes kindly provided by Professor Valentin Zelenyuk and slightly modified to fit the framework of this study.

4.1 Data and Model Specification

Our dataset is based upon quarterly reports of banks published by NBRB and covers the period between 1.07.2002 and 1.07.2004 (*9* observation points). In this work we will follow intermediation approach, which views a bank as an intermediary between lenders and borrowers (savers and investors). Consequently, financial assets a bank holds are regarded as outputs, while financial liabilities and physical factors of production as inputs. Specifically, we view here 'own capital', 'deposits of clients', 'interbank credits & other bank funds & other purchased funds' as inputs, and 'loans to clients', 'interbank loans' and 'securities & other earning assets' as outputs (details are in Table 5).

Table 5. Model specification

	Includes following rows of the standard quarterly report published by NBRB	Remarks
Input		
Own capital (X_1)	121	
Deposits of clients (X_2)	1205	Deposits of clients
Interbank credits & Other banks' Funds & Other purchased funds (X_3)	1202 + 1203 + 1204+ +1206 + 1207	Interbank credit + NBRB credit + Government credits + Other credits + Funds of other banks
Output		
Loans to clients (Y_1)	1107	
Interbank loans & Funds in other Banks (Y_2)	1106	Interbank loans + Funds in other banks
Securities& Other earning assets (Y_3)	1104 + 1105 + 1108	Government bonds + Securities in investment portfolio + Other assets

Note: The names used for inputs and outputs in the first column are chosen for the sake of brevity and do not fully reflect their economic and accounting content. For more information refer to the original forms of NBRB quarterly reports (http:\\www.nbrb.by)

In this study we view ownership structure as a key feature characterizing intermediation potential of each Belarusian bank. For the purposes of this work we distinguish *5* different types of ownership structure. Although, the total number of observations is quite high – *232*, the number of banks in each group as well as the number of observations per group vary substantially. Table 6 summarizes this information.

Table 6. Number of banks with certain ownership structure

Ownership type	***State owned (not NBRB)***	***Quasi-private (mixed state-private ownership)***	***Owned by NBRB***	***Private, owned by a non-bank***		***Private, owned by a foreign bank***
				Total	**Registred in FEZ**	
# of Banks	3	3	4	18	6	3
# of Observations	27	27	32	121	28	25

Although, it is appealing to explore differences in inefficiencies between groups of banks with certain ownership structure and their evolution in time, the limited

number of observations we have for all groups (except for the group *'Private, owned by a non-bank'*) places certain limitations. For the first step of our analysis involving aggregation of efficiencies over groups in different periods and kernel density estimation (which are both sensitive to the number of observations) we will focus on the two main groups: already mentioned *'Private, owned by a non-bank'* (or simply *Private*) and the group of the six largest banks (or *Big6*). The motivation is as follows: *Private* is the most numerous and diverse group of banks, given relatively unfavourable conditions for the private sector in the country their consequences for performance are of significant interest; banks belonging to the group of *Big6* (*2* state-owned banks, *2* NBRB-owned, *1* foreign bank, *1* quasi-private) dominate the industry, their efficiency (or inefficiency) determines the aggregate level of performance of the whole industry. Next, when turning to the regression analysis, we will consider the whole variety of ownership structures again and will try to quantify the existing differences in efficiency.

As mentioned before, we observe significant differences in size; moreover the inputs-outputs choice seems to be related to both size and ownership structure. A summary of descriptive statistics for inputs-outputs choices of two important sub-groups of banks is given in Table 7. Two observations arise from its brief examination: banks from different group seem to 'specialize' in different inputs and outputs; the choice of structure of both inputs and outputs for banks from *Big6* is much more stable relative to their counterparts in the group of *Private* banks (as measured by standard deviation of share of each input [output] in the total amount of inputs [output] attracted ['produced']). It is also informative to note that *Big6* banks work more with deposits of clients and loans to clients, while *Private* banks tend to rely more on own capital and pay more attention to interbank loans and to keep significant sums on accounts in other banks.

Table 7. Data description (in millions of USD)

Variable	***Mean***		***Median***		***Standard diviation***		***Min***		***Max***	
Levels	*Big6*	*Private*	*Big6*	*Private*	*Big6*	*Private*	*Big6*	*Private*	*Big6*	*Private*
Input										
Own capital (X_1)	112.1	5.0	56.1	5.7	32.0	3.6	0.0	0.5	382.2	12.9
Deposits of clients (X_2)	339.5	4.8	177.8	4.0	9.6	4.7	0.1	0.0	1 624.3	19.8
Interbank credits & Other banks funds & Other purchased funds (X3)	110.3	5.8	78.1	5.2	21.3	5.6	0.0	0.0	377.0	24.3
Output										
Loans to clients (Y_1)	356.3	4.6	195.0	4.1	18.5	4.7	0.1	0.0	1 575.5	21.6
Interbank loans & Funds in other banks (Y2)	35.4	5.6	27.6	3.7	4.0	5.5	0.0	0.2	143.9	29.2
Securities&Other earning assets (Y_3)	60.8	1.8	27.7	1.2	3.5	2.5	0.0	0.0	282.5	17.7
Share in overall amount of input or output	*Big6*	*Private*	*Big6*	*Private*	*Big6*	*Private*	*Big6*	*Private*	*Big6*	*Private*
Input										
Own capital (X_1)	0.21	0.43	0.16	0.36	0.07	0.23	0.10	0.03	0.57	0.99
Deposits of clients (X_2)	0.57	0.23	0.59	0.25	0.01	0.15	0.28	0	0.73	0.62
Interbank credits & Other banks funds & Other purchased funds (X3)	0.22	0.34	0.22	0.35	0.07	0.19	0.10	0.01	0.37	0.82
Output										
Loans to clients (Y_1)	0.76	0.32	0.75	0.35	0.01	0.24	0.18	0	0.94	0.79
Interbank loans & Funds in other banks (Y2)	0.11	0.56	0.09	0.48	0.02	0.27	0.02	0.13	0.29	1
Securities&Other earning assets (Y_3)	0.13	0.13	0.13	0.11	0.01	0.11	0.02	0	0.79	0.51

Source: NBRB with calculations by author

4.2. Empirical Results

After we have computed the bias-corrected estimator $\hat{\hat{TE}}^{ij}_{o}$ (obtained on step (4) of Algorithm 2 described in Section 2) of the output oriented measure of technical efficiency of each bank i ($i=1,\ldots,31$) in every period j ($j=1,\ldots,9$), for which we have an observation on input-output choice made by this bank, we aggregate these results in order to explore the overall and the sub-group levels of efficiency [3].

We start by considering unweighted mean efficiencies; the estimated results and their graphical representation are provided in Table 8 and Figure 3. We also compute weighted mean technical efficiencies, which allow us to incorporate relative economic importance of each decision making unit into aggregation (see Table 8 and Figure 4).

The approach we adopt here is the approach proposed by Simar and Zelenyuk (2003). In short, the aggregate efficiency of a sub-group of banks is estimated by taking weighted average of the efficiency scores of each bank belonging to this sub-group with weights being the outputs shares of the bank within its sub-group. Similarly, aggregate efficiency score of the whole industry is estimated by taking weighted average of the efficiency scores of each sub-group with weights being the output shares of the sub-group within the industry (for more discussion on aggregation based on economic optimization principle see Färe and Zelenyuk (2003), on price independent weights and statistical inference - Simar and Zelenyuk (2003)).

[3] The values for bias-corrected estimator of technical efficiency used in aggregation and kernel density estimation correspond to Specification 1 (VRS, Basic 3 by 3 model), see Table 10 for details.

Table 8. Bias-corrected unweighted and weighted mean technical efficiencies.

Period	Teo bias corrected (unweighted mean)			TEo bias corrected (weighted mean)		
	All banks	***Private***	***Big6***	***All banks***	***Private***	***Big6***
01.07.2002	1.220	1.307	1.142	1.050	1.385	1.063
01.10.2002	1.181	1.229	1.137	1.079	1.321	1.079
01.01.2003	1.193	1.295	1.082	1.067	1.321	1.059
01.04.2003	1.177	1.216	1.095	1.078	1.250	1.065
01.07.2003	1.163	1.216	1.102	1.084	1.233	1.075
01.10.2003	1.196	1.272	1.094	1.082	1.229	1.070
01.01.2004	1.130	1.135	1.097	1.081	1.150	1.072
01.04.2004	1.173	1.170	1.117	1.103	1.199	1.084
01.07.2004	1.136	1.167	1.065	1.073	1.186	1.061

The graphical representation below shows that bias-corrected unweighted mean technical efficiencies of the whole industry and of its two important sub-groups we are considering fluctuated much but had an overall decreasing trend over the *8* quarters of 2002-2004. It is interesting to note that in *5* out of *8* moves bias-corrected unweighted mean technical efficiencies of *Big6* banks and *Private* banks went in opposite directions.

Figure 3.Bias-corrected unweighted mean technical efficiencies.

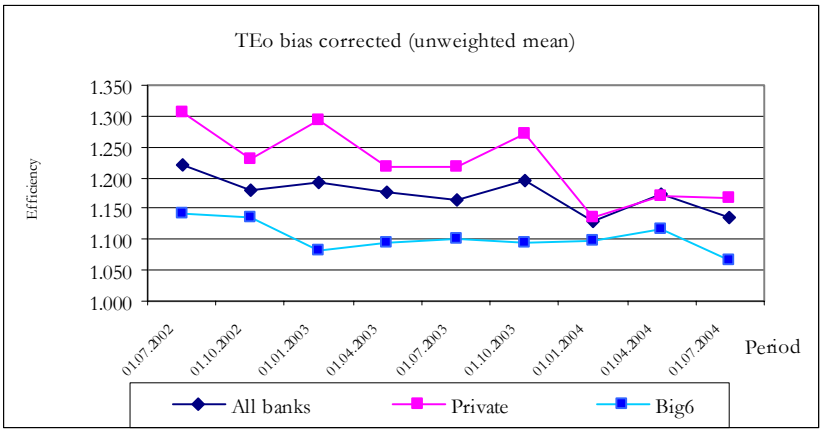
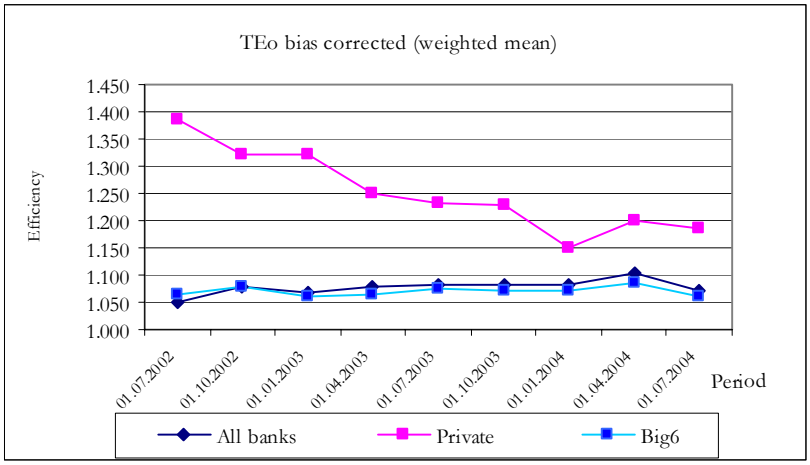


Figure 4. Bias-corrected weighted mean technical efficiencies.



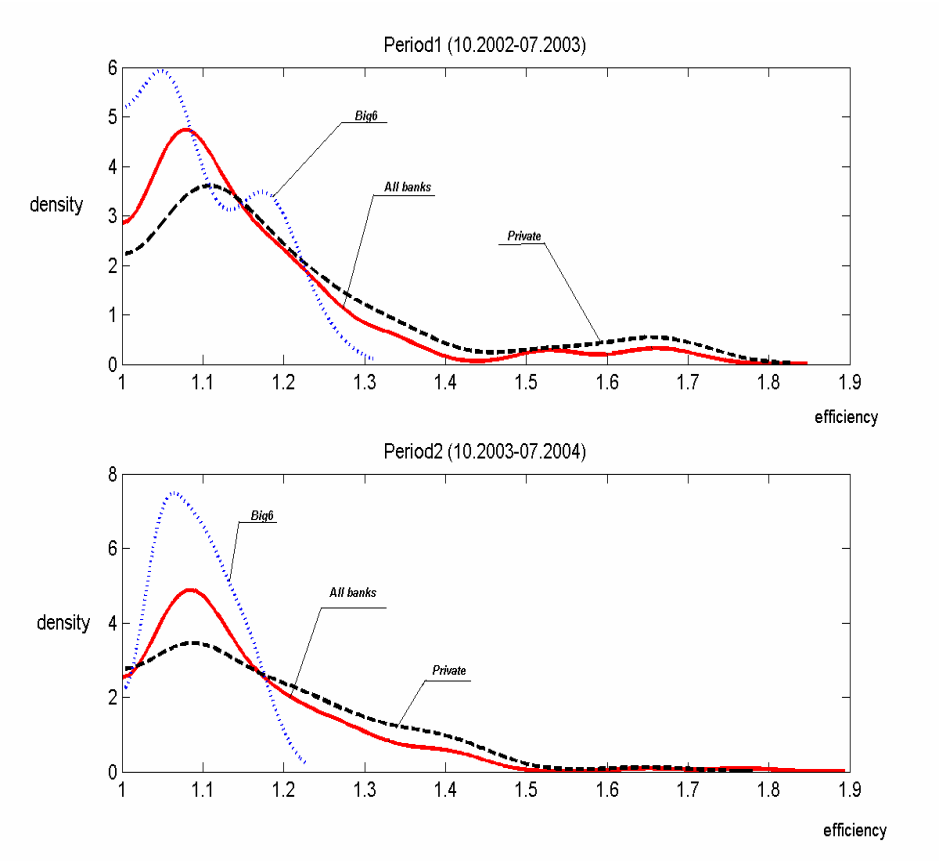
However, the same examination made for bias-corrected weighted mean technical efficiencies changes the picture somewhat. The group of *Private* banks was improving its aggregated weighted efficiency rapidly, while group efficiency of *Big6* banks fluctuated insignificantly between quite high values of *1.059* and *1.084* remaining close to the state of perfect technical efficiency. The overall aggregated weighted efficiency of the industry mostly followed the moves of *Big6*, reflecting the dominance of this group in markets for outputs.

The kernel density estimation allows us not only to focus on the mean of distribution but also to see how dispersed it is. For the purpose of kernel density estimation we will divide our observations into two yearlong periods: 10.2002-07.2003 and 10.2003-07.2004, i.e. we exclude the observations dated by 07.2002 in order to account for possible seasonality in the data. We perform calculations using reflection method, Gaussian kernel and Silverman robust bandwidth. Results are presented in Figure 5.

Visual inspection of densities in Figure 5 seems to confirm our previous findings: the position of peak of overall distribution almost did not change during these

two periods; the same is true for *Big6* banks; peak of distribution of efficiency for the group of *Private* banks moved closer to the state of absolute technical efficiency. Next, the observed change in the shapes of densities pictures a somewhat more detailed picture of industry's development.

Figure 5. Kernel density estimates (reflection method, Gaussian kernel, Silverman robust bandwidth)



First of all, significant density mass of *Private* banks with efficiencies between *1.45* and *1.8* moved closer to *1* in the second period, this, however, had no effect on the peak of the sub-group density and only made the tail between *1.2* and *1.5* fatter. Second, the density for the *Big6* banks has turned from a bi-modal to a uni-

modal shape. All these factors certainly influenced the overall density for the industry: its shape became smoother with a more pronounced peak. These findings seem to suggest that there is a general move towards higher intermediation efficiency among Belarusian banks, especially evident when we look at very inefficient *Private* banks. This fact will be useful in explanation of obtained results on the next stage – in regression analysis.

The usual motivation behind inclusion of ownership dummies in regression in the second stage is the hypothesized existence of a link between some types of ownership structure and managerial inefficiency. As discussed in Chapter 1, many papers (for instance, already mentioned Sathye (2003), Hasan and Marton (2002)) found significant differences between groups of banks with certain ownership structure. An important moment here is that only mixed empirical evidence exists regarding the superiority of any particular type of ownership structure in banking over any other one. In many cases the conclusion regarding superiority is conditional on the type of the concept of efficiency we apply and, even more importantly, on the environment a banking industry is functioning in.

In this study we employ the concept of intermediation efficiency, believing that it performs the best in terms of both capturing existing regulatory distortions in the economy and handling the not sufficiently 'transparent' official statistics. Unfortunately, no study has been found that explains within a rigorous framework the existing distortions in the overregulated Belarusian banking sector. Nevertheless, numerous publications in business press are available, the following passage in author's view summarizes one of the most often quoted characteristics of the industry: " The situation, as we witness it from year to year, is as follows: our banks do not provide primarily profitable enterprises with loans, as any other reasonable banking system does. Our banks are often forced to finance unprofitable enterprises, these actions, no doubt, reduce banks' profits. Naturally,

the banks do not do this following their own good will. No, they are following the 'recommendations' of the state … The monetary emission of the banking system is being equally 'leveled' over all SOEs without any relevant investigation…" (Ususky (2005)).

This policy is a key element in the already mentioned above economic model 'classical protectionism in trade + state-led modernisation'. Obviously, the ability of the state to make banks follow the desired 'recommendations' depends on the degree of state control over assets or the sphere of interests of a particular bank. Consequently, we should admit that differences in levels of intermediation efficiency between groups of banks with certain ownership structure will not only include associated managerial inefficiency, but also will reflect the ability of the state to distort optimisation programs by introducing 'recommendation'. In a sense, a bank closely controlled by the state may find itself in a situation where its view of costs, benefits and risks associated with a certain intermediation move is not very much relevant when faced with the need to follow to the general course of 'recommendations' it received. Consequently, it is often forced to take actions that both contribute to higher intermediation efficiency and deteriorate the quality of loan portfolio it holds.

On the other edge we see a number of small banks that are, presumably, connected to certain interest groups and established in order to finance specific projects, in many cases primarily from own capital. These projects might be so important or just so vulnerable to the unanticipated lack of fund that the foregone profit from holding an excessive amount of inputs at certain points in time might be neglected. In such cases the fulfilment of optimisation program need not correlate with the achievement of relative intermediation efficiency. Of course, this type of behaviour can be easily confused with a high degree of risk aversion exhibited by a banking institution working primarily as an intermediary.

In order to distinguish between different behavioural patterns we introduce another important explanatory variable. First of all, we assume that any bank acting primarily as an intermediary is interested in attracting inputs on markets for them as cheaply as possible; we go further by viewing financial transparency (influencing bank's attractiveness as it is seen by non-connected clients, deposit-holders and banks counter-agents) and branching (geographically dispersed clients) as two primarily ways to achieve this goal, a relatively low-cost and a high-cost, respectively. We interact these two measures in order to reinforce the argument, the resulting variable is $(Transparency_i\ LN(Branch\_per\_share\_in\_assets_i)$. If the corresponding coefficient in the regression is negative and significant this will support our reasoning. Consequently, very inefficient banks with low levels of both $Transparency_i$ and $Branch\_per\_share\_in\_assets_i$ may be suspected in not being primarily interested in intermediation, which we attribute to their 'pocket' status. Table 9 shows that *Private* banks when compared to the industry's averages are indeed less transparent and have smaller networks of branches.

Table 9. Some characteristics of 'involvement' in competition for inputs.

Variable	Mean		Median		Standard diviation		Min		Max	
	All banks	***Private***	***All banks***	***Private***	***All banks***	***Private***	***All banks***	***Private***	***All banks***	***Private***
Transparency	1.875	1.358	2	2	1.139	0.565	0	0	4	3
Branches per share in industry's assets	1.051	0.871	1.3	0	0.797	1.001	0	0	2.55	2.55
Transparency*Branches per share in industry's assets	2.489	1.486	1.77	0	2.535	1.983	0	0	9.2	5.1

In addition, we introduce *Extra_funds_NBRB* and *Own_capital_change* variables in order to account for period specific exogenous factors. We also estimate several specifications of model (2.8); the results are presented in Table 10.

Table 10. Regression results

Regressor	*Basic (3 by 3) Model*				*Alternative (2 by 2) Model*[4]	
	VRS		**CRS**		**VRS**	**CRS**
	Specification 1	**Specification 2**	**Specification 1**	**Specification 2**	**Specification 1**	**Specification 2**
Constant	1.2126***	1.2132***	1.2222***	1.2405***	1.2602***	1.2486***
State	-0.6937***	-0.6899**	-0.7870***	-0.7869**	-0.6536***	-0.6096***
Quasi_Private	-	0.0125	-	-0.0323	-	-
Nbrb	-0.3030***	-0.3036***	-0.3461***	-0.3641***	-0.3306***	-0.3364***
Foreign_b	-0.4095**	-0.4096***	-0.3236**	-0.3269***	-0.3210***	-0.2564**
Fez	-0.2475***	-0.2504***	-0.2675***	-0.2851***	-0.1666**	-0.1940**
*Transparency **						
LN(Branch_per_share_in_assets)	-0.0224**	-0.0220**	-0.0245**	-0.0215**	-0.0118	-0.0103
Extra_funds_NBRB	0.1544***	0.1529***	0.1795***	0.1806**	0.1444***	0.1535***
Own_capital_change	-	-0.0103	-	-0.0395	-	-
Sigma squared	0.0334	0.0332	0.0412	0.0404	0.0345	0.0364

Notes: (i) The regressand is the bootstrap-bias-corrected DEA estimaste of the unobserved efficiency score of bank *i* in period *j*; (ii) ***,**,* - correspond to significance from zero at 1%, 5%, 10% level, according to percentile bootstrap confidence intervals; (iii) Estimation according to Algorithm 2 Simar and Wilson (2003).

First, we test the sensitivity of the regression results to the assumptions underlying estimation of best practice frontier for our basic 3 by 3 AAM model formulated in Table 5, namely, returns to scale. For this purpose we use two specifications. In the second specification we introduce two shock variables, *Fez* dummy, 'transparency' and all ownership dummies (except for *Private*). In the first specification we include only variables that appeared statistically significant in the second specification. The results in Table 10 show that statistical significance (from zero) and magnitudes of all coefficients change only slightly when we move from Specification 1 to Specification 2 under both returns to scale assumptions for our basic 3 by 3 AAM. We conclude that the results for the 3 by 3 model are robust with respect to chosen specification. Note also that when we switch from

[4] The alternative AAM formulation is: inputs $[(X_1+X_3), X_2]$, outputs $[(Y_2 + Y_3), Y_1]$ (notation as in Table 5)

VRS to CRS assumptions the magnitudes and statistical significance for all variables remains close to their initial values.

Second, we check the robustness of the AAM formulation. We reduce dimensionality of the problem by aggregating some inputs and outputs and estimate Specification 1 under both CRS and VRS assumptions for this 2 by 2 alternative model. Again, we get close results in terms of both statistical significance and magnitudes under different returns to scale assumptions, which also compare well (except for the significance of transparency variable) to the results of our basic 3 by 3 model. Finally, we conclude that all six estimated models produced similar results. We will refer to the results corresponding to Specification 1 (VRS, Basic 3 by 3 model) for further discussion.

In both specifications we choose *Private* as a benchmark ownership type. As it was anticipated, there are two groups of banks which are more efficient if compared to the ordinary private banks: banks tightly controlled by the state (*State* and *NBRB*) and foreign banks together with *Private* banks established in free economic zones (*Foreign_b* and *Fez*). These findings are consistent with two hypothesises stated earlier: first, the ability of the state to distort optimisation programs of certain banks; second, transfer of certain managerial skills and practices by foreign banking institutions which positively influences efficiency. The observed relative efficiency of the *Fez* sub-group of *Private* banks may be attributed to the high concentration of small fast developing private enterprises located within a specified geographical area, which impose positive externalities on each other, and, consequently, on the banks they are working with. It also appeared that on average the level of efficiency of *Quasi_private* banks is insignificantly different from those of *Private* banks.

We also found that holding more funds at the National Bank 'than usual' reduces efficiency significantly. This is quite intuitive: we do not view this amount as a

part of outputs, therefore, the ratio of outputs to inputs immediately decreases pushing down intermediation efficiency.

As it was noted above, an important role in our analysis of regression results belongs to the coefficient attached to $Transparency_i$ $LN(Branch\_per\_share\_in\_assets_i)$ variable. It is negative and significant at *5%* confidence level. Combining this fact with the observation on *Private* banks having lower values of indicators related to involvement in competition for inputs (illustrated in Table 9), we return to the argument discussed above. There is some evidence that allows us to attribute relatively low transparency and high inefficiency of *Private* banks to their 'pocket' status.

To generalize, in our empirical analysis we found substantial differences in average levels of efficiency between groups of banks belonging to different ownership types. It is appealing to assume that banks owned by foreign banks take into account all existing risks and are not subject to substantial political or interest group pressure. If this is so they are the most reliable benchmark measuring natural level of intermediation efficiency. When compared to this benchmark banks tightly controlled by the state are more efficient, while ordinary private banks less. The former might be seen as a consequence of government's efforts to force related banks to be engaged in intermediation as actively as possible paying little attention to risks. The latter combined with such characteristics as transparency and branching is explained by low correlation of optimisation programs of banks with hypothesized 'pocket' status with achievement of relative intermediation efficiency. Although, these findings apply to the whole period under consideration, there are some prior signs that the rapid growth of the industry encourages greater involvement in intermediation on the side of the most inefficient private banks.

Chapter 5

CONCLUSIONS

The present paper has analysed the development of Belarusian banking sector in 2002-2004 from the intermediation efficiency perspective. We applied two-stage semi-parametric bootstrap procedure of estimation and inference proposed by Simar and Wilson (2003) in order to explore the differences in inefficiency between sub-groups of banks characterized by different ownership structure. We also used estimated results together with some other indicators to characterize the degree of correlation between optimization programs of banks of a particular type and the achievement of relative intermediation efficiency. We expected that in the absence of interest group and political pressures this correlation will be high but not perfect. In this light we interpret our main finding, namely, close relationship between ownership type and the level of relative intermediation efficiency.

First, we found that banks closely controlled by the state are the most efficient. This observation is consistent with many claims made by observers that government forces related banks to finance debt and social obligations of certain state-owned enterprises despite substantial credit risk associated with this type of lending. This explanation fits well the description of Belarusian economic model made in Neunhöffer (2000), where she stressed such features as 'state-led modernisation' and the reliance on the support from the 'social block'. If so, the level of intermediation efficiency exhibited by banks closely controlled by the state may be regarded as above normal. The over possible explanation is the availability of large state-owned connected borrowers and dominating position on markets for many inputs and outputs secured by entry barriers.

Second, banks owned by foreign banking institutions are the most efficient within the group of private banks. This finding is in line with international empirical evidence on transfer of certain managerial skills and practices by foreign banking institutions which positively influences efficiency. However, these banks are not numerous and therefore are also likely to benefit from the restricted (due to entry barriers) competition.

Third, ordinary private banks are the most inefficient and untransparent. An appealing explanation is based on the observation on industry entry and exit dynamics following the political events of 1994-1996 and the change of economic course. It seems that those not numerous small banks that managed to survive these events are related to certain interest groups. It is likely that these banks are primarily involved in serving their interests, which does not always go in the same direction with efficient intermediation.

Finally, several positive tendencies are observed. The introduction of free economic zone banks looks like a success story so far. This segment experienced fast entry and Fez banks turned out to be relatively efficient, although rather small. More importantly, the overall tendency to higher efficiency among private banks was observed. This gives a hope that the rapid growth of the economy and of the sector in particular during the last three year will enhance profitability of intermediation and will positively influence all industry participants.

Although it seems that this study provided us with some important insights into the nature of recent industry developments, it will be interesting to analyse its performance in other than intermediation contexts, especially in the context of profit and cost efficiency.

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APPENDIX I

Bias-corrected technical efficiencies

Bank name	Report date								
	01.07.2002	01.10.2002	01.01.2003	01.04.2003	01.07.2003	01.10.2003	01.01.2004	01.04.2004	01.07.2004
Belagraprambank	1.020	1.028	1.033	1.029	1.022	1.037	1.037	1.037	1.036
Belprambudbank	1.243	1.185	1.081	1.176	1.246	1.054	1.136	1.188	1.035
Belarusbank	1.016	1.043	1.034	1.039	1.057	1.037	1.038	1.046	1.052
Belinvestbank	1.235	1.189	1.164	1.180	1.146	1.152	1.139	1.161	1.104
Prior	1.228	1.198	1.073	1.059	1.038	1.160	1.068	1.093	1.050
Belzneshecanambank	1.096	1.168	1.076	1.079	1.099	1.106	1.081	1.105	1.069
Parytet	1.081	1.078	1.066	1.043	1.038	1.036	1.098	1.189	1.079
Belnarodny Bank	1.063	1.074	excluded	excluded	1.339	1.651	1.080	1.058	1.127
Belindustryialny Bank	1.413	1.302	1.244	1.508	1.326	1.271	1.229	1.314	1.287
Belgazpram	1.150	1.238	1.135	1.533	1.187	1.190	1.196	1.768	1.259
Absalut	1.101	1.113	1.075	1.053	1.132	1.161	1.044	1.150	1.093
Dzhem	1.671	1.672	1.143	1.185	1.225	1.103	1.105	1.206	1.107
MinskComplex	excluded								
RRB	1.275	1.336	1.107	1.204	1.207	1.186	1.084	1.083	1.092
Minski Tranzitny Bank	1.452	1.145	1.080	1.094	1.094	1.064	1.061	1.045	1.070
Tehnabank	1.540	1.628	1.698	1.646	1.540	1.428	1.238	1.284	1.363
Zalaty Taler	1.259	1.144	1.129	1.248	1.242	1.388	1.181	1.220	1.238
Infabank	1.253	1.224	1.242	1.311	1.267	1.280	1.290	1.275	1.265
Slaunaftabank	1.045	1.047	1.030	1.055	1.041	1.123	1.158	1.132	1.098
Mezjgandl	1.078	1.115	1.056	1.069	1.065	1.081	1.094	1.071	1.106
Maskva-Minsk	excluded	1.132	1.146	1.153	1.119	1.127	1.039	1.056	1.033
Atam	1.180	1.099	1.175	1.119	1.147	1.132	1.158	1.190	1.188
Paunochny Investycyjny	1.317	1.061	1.102	1.037	1.059	1.133	1.080	1.066	1.102
Mezhnarodny Rezervny	1.097	1.097	1.258	1.206	1.373	1.328	1.068	1.059	1.088
Loro	n/a	1.099	1.093	1.083	1.115	1.440	1.094	1.053	1.042
Astanaexim	n/a	1.078	1.080	1.071	1.068	1.065	1.133	1.077	1.071
Gandlpram	excluded	excluded	excluded	n/a					
Belswiss	n/a			1.218	1.079	1.341	1.218	1.369	1.416
Mezhneksupracounictva	n/a					excluded	excluded	excluded	excluded
BelRas	n/a					1.185	1.268	1.410	1.182
Raton	n/a							1.091	1.094
Somvel	n/a								excluded