

BELARUSIAN BANKING IN THE CONTEXT OF FRONTIER EFFICIENCY

by

Valentin Zelenyuk and Aliaksandr Abrashkevich

Abstract

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 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) tried to establish conditions that would allow them to seize the control over their companies after large-scale privatization starts. In their paper on Russian privatization and related corporate governance issues Black et al (2000) 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 we view the transformation of Belarusian part of soviet monobank system into major commercial banks controlled by groups of state-owned companies and the massive entry of new banks during this period as an intensive preparation for a large-scale privatization. However, after the election of the first 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 possesses a significant share (directly, via the National Bank and Ministries, or indirectly, when a group of SOEs owns shares of a bank). This observation suggests that under current economic conditions and political realities the state is likely to use its control over the sector as an additional tool, especially useful in conducting state-led modernization and social programs. Second, *non-banking* foreign institutions own many of small Belarusian banks. This feature enables us to conclude that the role of banks with foreign capital in introduction and implementation of western-standard managerial practices eliminating managerial inefficiencies in Belarus is likely to be lower than in most CEE countries.

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

In 2000-2004 Belarusian banking sector experienced rapid growth. However, as it might be expected, performance differed in many respects between groups of banks. Our results point at the influence of ownership structure, transparency and National Bank (NBRB) regulatory actions on the observed inefficiencies. This study provides insights on the effects of the direct control of the state over some key banks.

The rest of the paper is organized as follows. Section 1 discusses the recent research done on banking sector frontier efficiency, as well as some aspects of banking in transition. Section 2 presents the estimation procedure applied in this study. Section 3 makes a short overview of industry's development. Section 4 presents empirical results. Section 5 discusses conclusions.

1. PREVIOUS WORK IN THE AREA

In recent years the academic research on the performance of financial institutions 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 in 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.

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. Their own result using US banking data showed 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. Berger and Mester (1997) focused on differences in the economic efficiency concept used. 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.

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 (e.g., see Altunbas et al. (2000), Schure et al. (2004), Drake and Hall (2003), Akhigbe and McNulty (2003) on developed countries and Carvallo and Casman (2005), Isik and Hassan (2002), Saha and Ravisankar (1999) on developing).

In their recent book on transition Gros and Steinherr (2004) 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. The authors attribute this state of affairs primarily to the lack of the rule of law: bankruptcy is more a 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. 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, there is a risk of building a highly concentrated financial system. In this situation both legislative measures and openness to foreign competition must be actively used in order to avoid excessive concentration.

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. Yildirim and Philippatos (2002) analysed the evolution of competitive conditions in transition countries' banking sectors during 1993-2000. 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"¹.

We also would like to mention the study by Neunhöffer (2000) focusing on those specific features that make Belarusian economic model an 'outlier'. The collapse of the Soviet Union and subsequent failures of liberal reforms in neighboring countries convinced many citizens in Belarus that its economy 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 'social block' that supported the proposed by the newly elected president Lukashenka 'alternative project': centralized allocative structures with the state playing the leading role in the formulation of the development model. 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 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 resulting in failure of this policy. This forced Belarusian authorities to rely fully on the classical protectionism in trade and state-led modernisation.

¹ 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; see Mertens and Urga (2001) and Shepetko (2004).

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. 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 ($k=1, \dots, n$) decision making units (banks). Each bank uses N inputs $\mathbf{x}^k = (x_1^k, \dots, x_N^k)$ and produces M outputs $\mathbf{y}^k = (y_1^k, \dots, y_M^k)$. All banks have an access to the same technology, under free disposability of outputs and free disposability of inputs axioms DEA technology estimator will be defined as follows:

$$\hat{T} = \{(\mathbf{x}, \mathbf{y}): \mathbf{y} \leq \sum_{k=1}^n z^k \mathbf{y}^k, \mathbf{x} \geq \sum_{k=1}^n z^k \mathbf{x}^k, \sum_{k=1}^n z^k = 1, z^k \geq 0, k=1, \dots, n\}, \quad (1)$$

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

$$\partial \hat{P}(\mathbf{x}^k) = \{\mathbf{y}: \mathbf{y} \in \hat{P}(\mathbf{x}^k), \mathbf{q}\mathbf{y} \notin \hat{P}(\mathbf{x}^k), \forall \mathbf{q} \in (1, \infty)\}, \mathbf{x}^k \in \mathbb{R}_+^N \quad (2)$$

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

$$TE_o(\mathbf{x}^k, \mathbf{y}^k) = \max(\mathbf{q}: \mathbf{q}\mathbf{y}^k \in \hat{P}(\mathbf{y}^k)), \quad (3)$$

Consequently, the state of the perfect estimated technical efficiency of an observation $(\mathbf{x}^0, \mathbf{y}^0) \in \hat{T}$ will be defined as a situation when this observation belongs to the estimated technological frontier. In Farrell sense this happens if and only if $\mathbf{y}^0 \in \partial \hat{P}(\mathbf{x}^0)$ or whenever $TE_o(\mathbf{x}^0, \mathbf{y}^0) = 1$. So the quantity $(TE_o(\mathbf{x}^0, \mathbf{y}^0) - 1) \cdot 100\%$ 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 ($i=1, \dots, n; j=1, \dots, t$) as (this linear programming problem can be relatively easily solved using almost any mathematical software package):

:

$$TE_0^{ij}(\mathbf{x}^{ij}, \mathbf{y}^{ij}) = \max_{\mathbf{q}, z^1, \dots, z^t} \mathbf{q} \quad (4)$$

$$s.t. \quad \sum_{k=1}^n \sum_{p=1}^t z^{kp} y_m^{kp} \geq \mathbf{q} y_m^{ij}, m=1, \dots, M,$$

$$\sum_{k=1}^n \sum_{p=1}^t z^{kp} x_l^{kp} \leq x_l^{ij}, l=1, \dots, N,$$

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

$$\mathbf{q} \geq 1,$$

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

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. This task will be accomplished with the help of regression analysis. Specifically, we assume and test the following specification:

$$\begin{aligned} TE_0^{ij} = & \beta_1 + \beta_2 State_i + \beta_3 Quasi_Private_i + \beta_4 NBRB_i + \beta_5 Foreign_b_i + \beta_6 Fez_i + \\ & + \beta_7 (Transparency_i LN(Branch_per_share_in_assets)) + \beta_8 Extra_funds_NBRB_{ij} + \\ & + e_{ij} = \mathbf{C}_{ij} \mathbf{B} + e_{ij}, \end{aligned} \quad (5)$$

where

TE_0^{ij} - true Farrell output-oriented technical efficiency score of bank i in period j , $i = 1, \dots, n$ and $j=1, \dots, t$

$State_i$ - 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).

$Foreign_b_i$ - 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).

e_{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 (5) are bounded by unity, so the

distribution of e_{ij} is restricted by the condition $e_{ij} \geq 1 - \mathbf{C}_{ij} \mathbf{B}$. 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:

$$TE_{ij}^{\hat{}} \approx \mathbf{C}_{ij} \mathbf{B} + e_{ij}, \quad (6)$$

where

$$e_{ij} \sim N(0, \mathbf{s}_e^2), \text{ such that } e_{ij} \geq 1 - \mathbf{C}_{ij} \mathbf{B} \quad i=1, \dots, n \text{ and } j=1, \dots, t$$

Refer to Simar and Wilson (2003) for more details on the algorithm we apply.

3. DESCRIPTION OF THE INDUSTRY

In this chapter we will take a closer look at Belarusian banking sector. We first carefully look at the influence of the 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.

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.

After the election of the new president in 1994 the plans for liberal reforms were completely removed from the economic agenda. 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 (Neunhöffer (2000)). Nevertheless, in such a

controversial setting the fast growth in banking starts to take off in the year 2000 heated by favourable situation on external markets traditional for Belarusian export.

Entry and Exit. 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).

Table 1. Newly established and liquidated banks 1991-2004

<i>Time period</i>	<i>Number of newly established banks</i>			<i>Number of liquidated banks</i>
	<i>Total</i>	<i>were liquidated before 2004 or were under liquidation in 2004</i>	<i>still were in operation in 2004</i>	
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 authors

Also, 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 indicates how radical the changes of the business environment faced by small private banks were.

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.

Concentration. 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 from 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.

The industry concentration, as measured by Herfindahl-Hirshman Index, in the period our dataset covers has slightly fallen (from 2718 to 2153). However, the sum of six largest banks' shares remained extremely stable (0.851 on 01.07.2002; 0.855 on 01.07.2004), 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, assets of which are still incomparably large than those of the rest of industry participants.

The high concentration itself can be hardly regarded as a specific feature distinguishing Belarusian banking. In their paper Yildirim and Philippatos (2002) 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. Consequently, the stability of concentration measures rather than their high values constitute specifics of Belarusian banking.

Ownership Structure. 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 2). 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. 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 (2002)).

Table 2. 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

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.

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 written by Valentin Zelenyuk.

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 (details are in Table 3).

Table 3. 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 4 summarizes this information. 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 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.

Table 4. Number of banks with certain ownership structure

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

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 5. 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 in the total amount of inputs attracted; similar for outputs). 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 5. Data description (in millions of USD)

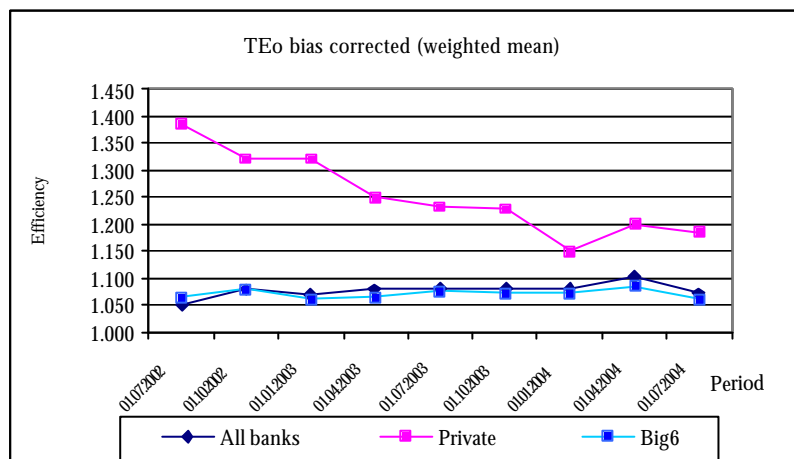
Variable	Mean		Median		Standard deviation		Min		Max	
	<i>Big6</i>	<i>Private</i>	<i>Big6</i>	<i>Private</i>	<i>Big6</i>	<i>Private</i>	<i>Big6</i>	<i>Private</i>	<i>Big6</i>	<i>Private</i>
Levels										
Input										
Own capital (X_1)	112.1	5.0	56.1	5.7	32.0	3.6	0.0	0.5	382.2	12.9
Deposits of clients (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 (X_3)	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 (Y_2)	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										
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 (X_3)	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 (Y_2)	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 \widehat{TE}_o^{ij} (obtained on step (4) of Algorithm 2 described in Section 2) of the output oriented measure of technical efficiency we aggregate these results in order to explore the overall and the sub-group levels of efficiency.

We compute weighted mean technical efficiencies ², which allow us to incorporate relative economic importance of each decision making unit into aggregation (see Figure 1). 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)).

Figure 2. Bias-corrected weighted mean technical efficiencies.



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.

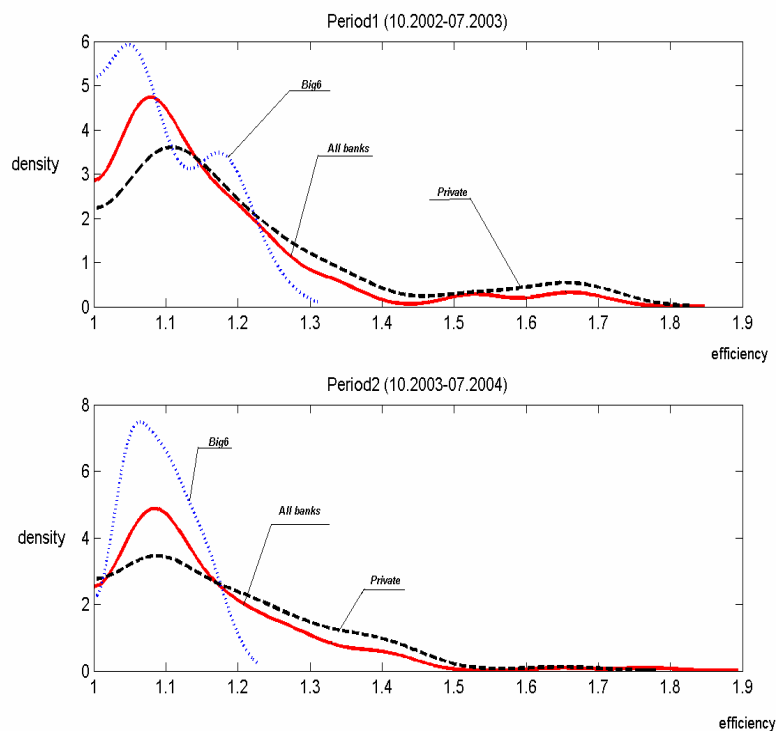
The kernel density estimation allows us not only to focus on the mean of distribution but also to see how dispersed it is. For the purpose of kernel density estimation we divide our observations into two

² 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 7 for details.

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 2.

Visual inspection of densities in Figure 3 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 2. 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.

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. Many papers (for instance 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..." (Usosky (2005)).

This policy is a key element in the already mentioned above economic model 'classical protectionism in trade + state-led modernisation' (Neunhöffer (2000)). 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 or market power, 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.

Table 6. Some characteristics of ‘involvement’ in competition for inputs.

Variable	Mean		Median		Standard deviation		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 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 primary 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 $(Transparency_i$

$LN(\text{Branch_per_share_in_assets}_i)$. 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 $\text{Branch_per_share_in_assets}_i$ may be suspected in not being primarily interested in intermediation, which we attribute to their ‘pocket’ status. Table 6 shows that *Private* banks when compared to the industry’s averages are indeed less transparent and have smaller networks of branches.

Table 7. Regression results

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

Notes: (i) The regressand is the bootstrap-bias-corrected DEA estimate 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).

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 7.

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 *Privatø*). In the first specification we

³ The alternative AAM formulation is: inputs $[(X_1+X_3), X_2]$, outputs $[(Y_2 + Y_3), Y_1]$ (notation as in Table 5)

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 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 of 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 hypotheses 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 $Transparency_i LN(Branch_per_share_in_assets)$ 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.

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