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Are private banks more efficient than public banks? Evidence from Russia

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Alexei Karas, Koen Schoors and Laurent Weill

Are private banks more efficient than public banks? Evidence from Russia

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Helsinki 2008

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All opinions expressed are those of the authors and do not necessarily reflect the views of the Bank of Finland.

Alexei Karas, Koen Schoors and Laurent Weill

Are private banks more efficient than public banks? Evidence from Russia

Abstract

We study whether bank efficiency is related to bank ownership in Russia. We find that foreign banks are more efficient than domestic private banks and – surprisingly – that domestic private banks are not more efficient than domestic public banks. These results are not driven by the choice of production process, the bank's environment, management's risk preferences, the bank's activity mix or size, or the econometric approach. The evidence in fact suggests that domestic public banks are more efficient than domestic private banks and that the efficiency gap between these two ownership types did not narrow after the introduction of deposit insurance in 2004. This may be due to increased switching costs or to the moral hazard effects of deposit insurance. The policy conclusion is that the efficiency of the Russian banking system may benefit more from increased levels of competition and greater access of foreign banks than from bank privatization.

JEL classification: G21; P30; P34; P52

Keywords: Bank efficiency; state ownership; foreign ownership; Russia

Alexei Karas, Koen Schoors and Laurent Weill

Are private banks more efficient than public banks? Evidence from Russia

Tiivistelmä

Tutkimme sitä, vaikuttaako venäläisten pankkien omistusrakenne niiden tehokkuuteen. Tulostemme mukaan ulkomaalaiset pankit ovat tehokkaampia kuin yksityiset venäläisten pankit. Yllättävää on se, että yksityiset pankit eivät tehokkaampia kuin julkisesti omistetut pankit. Näihin tuloksiin eivät vaikuta pankkien valitsema toimintatapa, toimintaympäristö, johdon preferenssit riskin suhteen, palveluvalikoima, koko tai käyttämämme analyysimenetelmä. Näyttää jopa siltä, että julkisesti omistetut pankit ovat tehokkaampia kuin yksityiset pankit, eikä tehokkuuskuilu ole pienentynyt vuoden 2004 jälkeen, jolloin Venäjällä tuli käyttöön talletustakuujärjestelmä. Saattaa olla, että johtuu pankin vaihtamiseen liittyvien kulujen noususta tai talletustakuun aiheuttamista käyttäytymismuutoksista. Näyttää siis siltä, että Venäjän pankkijärjestelmä hyötyisi enemmän kilpailun lisääntymisestä ja ulkomaisten pankkien tulosta markkinoille kuin pankkien yksityistämisestä.

Asiasanat: pankkien tehokkuus, julkinen omistus, ulkomaalainen omistus, Venäjä

1 Introduction

This paper assesses the efficiency of the nascent Russian banking system. The central question we pose is whether bank ownership has any effect on bank efficiency in Russia. We distinguish between foreign-owned banks (foreign banks), privately owned banks (private banks) and state-owned banks (public banks). We find that foreign banks are more efficient than domestic private banks and – surprisingly – that domestic private banks are not more efficient than domestic public banks. These results are not driven by differences in activity mix, risk preferences or bank environment, nor by the absence of explicit deposit insurance for domestic private banks.

Transition countries appear to be fertile testing grounds for comparative analysis of public and private banks' efficiency, but first appearances can be deceiving. Indeed, this comparative analysis failed to yield clear answers because in most countries foreign entry and bank privatization went hand in hand. As a consequence the empirical results for these countries were largely interpreted in terms of efficiency gaps between foreign and domestic ownership rather than between public and private ownership. In Russia however partial bank privatization was achieved relatively quickly, while foreign bank entry remained at a relatively low level in the first 15 years of transition[1]. Still, partial public ownership in various forms remained a robust characteristic of the Russian banking sector throughout the transition. The Central Bank of Russia (CBR) has played an important role through the commercial banks under its direct control, namely Sberbank and Vneshtorgbank. In addition, government bodies at several levels own banks. There are examples of villages, provinces, cities, federal bodies and state firms in this position. For October 2001 for example, we find that the 27 banks that are majority owned by state bodies (out of 1277 banks in total) control 53% of banking assets and 39% of banking liabilities. Neglecting the CBR's commercial banking activities through Sberbank and Vneshtorgbank., the remaining 25 public banks hold no less than 6% of total banking assets and 8% of total banking liabilities. The Russian banking industry therefore presents us with the exceptional opportunity to disentangle efficiency differences between foreign, public and private banks for a sufficiently large number of banks. This study therefore complements the literature on foreign

[1] The Central Bank of Russia (CBR) repeatedly showed its eagerness to restrict foreign entry to the banking sector. The Association of Russian Banks has consistently lobbied the government to limit foreign bank entry using the classic infant industry protection argument. Russia was ultimately forced to commit itself to a gradual opening of its financial market to foreign competition because of its desire to enter the WTO.

ownership and efficiency in emerging market economies and its conclusions contribute to our understanding of emerging-market-economy banking sectors.

Efficiency comparisons between public and private banks are cumbersome in emerging market economies because the two types of banks operate in different institutional environments; for example the implicit full deposit insurance typically enjoyed by public banks does not cover private banks. Any differences found in cost effectiveness between private and public banks may therefore be attributable to this difference in deposit insurance, which may render public banks' access to deposits less costly in terms of labor and physical capital. In Russia too, public banks were always covered, albeit implicitly, by deposit insurance, while household deposits held at private banks have been covered by deposit insurance only since 2004. To control for this we perform our estimations for two sub-samples, one before (2002) and one after (2006) the introduction of deposit insurance for household deposits at private banks. This allows us to assess whether any difference in efficiency may be partly attributable to differences in deposit insurance and whether the more level playing field of generalized deposit insurance for household deposits effectively reduces the efficiency difference.

In the following section we overview the bank efficiency literature related to our study. Section 3 presents the recent history of the Russian banking sector. This is followed by an overview of the data in section 4 and the estimation methodology in section 5. Section 6 lays out the main results. Section 7 provides further robustness checks by repeating the analysis for a size -matched sample and employing a very different econometric approach. We end with concluding remarks in section 8.

2 Related literature

The empirical literature on privatization in transition countries has found that the method and timing of privatization are related to its performance effects. Frydman et al. (1999) find that privatization has no beneficial effect on performance if firms fall under the sway of insider owners (managers or employees), while the positive performance effect is pronounced if the firm is privatized to outsider owners. Brown et al. (2006) document that

foreign privatization has larger productivity effects than domestic privatization in a set of four transition countries.

There is also ample evidence for transition countries that foreign firms are more efficient than domestic firms, be it in the banking sector or in other sectors. Foreign banks may be more efficient than domestic ones because of their more advanced technology, superior management practices, superior access to capital or implicit deposit insurance via the deep pockets of the foreign mother bank.

These economy-wide results are sustained by more detailed banking sector studies that apply stochastic frontier models. Weill (2003) shows in a study of the Czech Republic and Poland that foreign-owned banks are indeed more efficient than domestic-owned banks and that this is driven neither by differences in bank size nor by differences in the structure of activities. Hasan and Marton (2003) find in a Hungarian country-study that foreign banks were more efficient already in the period 1993-1997, early in transition. Fries and Taci (2005), in a study of 15 East European transition countries (including Russia), find that private banks are more cost efficient than state-owned banks. This confirms the result of Weill (2003) that privatized banks with majority foreign ownership are the most cost efficient. These are followed by newly established private banks, both domestic and foreign owned, and finally by privatized banks with majority domestic ownership, though these are still more efficient than state-owned banks. Bonin et al. (2005a) analyze the effects of ownership on bank efficiency for a set of eleven transition countries for the period 1996-2000. They apply a stochastic frontier approach to compute bank-specific efficiency scores and relate these to ownership in second-stage regressions. Foreign-owned banks are again confirmed to be more cost-efficient and to collect more deposits and grant more loans than other banks. The magnitude of increased efficiency from foreign ownership is 6% or higher. State-owned banks are not appreciably less efficient than de novo domestic private banks, but they are clearly less efficient than those already privatized, which supports the idea that better banks were privatized first. In a companion paper with comparable methodology, Bonin et al. (2005b) analyze whether the method and timing of bank privatization affect bank efficiency. They find that voucher privatization does not lead to increased efficiency and early-privatized banks are more efficient than later-privatized banks.

Kraft, Hofler and Payne (2006) study the Croatian banking system and find that new private and privatized banks are not more efficient than public banks and that privati-

zation does not immediately improve efficiency, while foreign banks are substantially more efficient than all domestic banks.

A number of studies apply data envelopment analysis to examine bank efficiency in Central and Eastern Europe. These include for example Grigorian and Manole (2006), who study 17 European transition countries, Jemric and Vujcic (2002), who look at Croatia, and Havrylchyk (2006), who studies Poland. In accordance with the findings of the stochastic frontier literature, all these studies find that foreign banks are more efficient than domestic ones. Grigorian and Manole (2006) find in addition that privatization does not automatically lead to higher efficiency, which is in line with Bonin et al. (2005a). This superior efficiency of foreign banks is however not always found in other emerging market economies. Sensarma (2006) finds that in India foreign banks are less efficient than either public or private domestic banks.

Two studies investigate bank efficiency in Russia. Fries and Taci (2005) study the cost efficiency of banks from 15 post-communist countries including Russia, between 1994 and 2001. They apply the one-stage Battese-Coelli (1995) stochastic frontier model and find that foreign ownership and private ownership are both associated with greater efficiency. Their findings, however, are based on a cross-country sample and so need not hold equally for every country. This observation holds particularly for Russia, given their very limited sample of Russian banks (48 out of more than 1000 existing banks).

Styrin (2005) solves these problems by using a large dataset of Russian banks obtained from the Central Bank of Russia for the period 1999-2002. While efficiency scores are estimated in a first stage using the stochastic frontier approach, they are regressed on a set of potential determinants, including public ownership and foreign ownership, in a second stage. Public ownership is innovatively defined as actual affiliation with the state as measured by the ratio of interest income received from the government to total interest income. This paper concludes in favor of a greater efficiency of foreign banks, whereas public ownership is not significant for explaining efficiency. The econometric two-stage approach and the exclusion of physical capital from the list of inputs are the paper's major limitations.

We use a similar dataset extended to 2006 and adopt the one-stage approach proposed by Battese and Coelli (1995) to investigate the cost efficiency of Russian banks. Be-

sides avoiding the limitations of previous studies we contribute to the literature by studying whether the introduction of generalized deposit insurance had any impact on banks' comparative efficiency.

3 History and problems of the Russian banking sector

The privatization of Russia's former 'spetsbanki'[2] was a relatively uncontrolled process that started before 1990, the official start of the bank privatization process, and was largely accomplished by the end of 1991, when the Soviet system collapsed. This secessionist privatization yielded a few large successors (Sberbank, Vneshtorgbank, Mosbiznesbank, Promstroibank and SBS–Agro) and more than 600 relatively small successors. Most of these were reluctant to restructure, as mirrored in higher costs, higher loan rates, poorer loan quality and smaller capital buffers (see Schoors, 2003). Not surprisingly most of the smaller successors faltered during the period 1995-1998. In the aftermath of the August 1998 crisis, the larger successors were also swept away, with the notorious exceptions of Sberbank and Vneshtorgbank, which survived as daughters of the CBR and now control a considerable part of the Russian banking market[3]. At present, the vast majority of Russian banks are not burdened by lingering Soviet deficiencies. Most private banks are de novo banks, as the privatized 'spetsbanki' faltered in the period 1992-1999, and most public banks were created after the collapse of the Soviet Union, by government bodies such as state enterprises, cities and federal, regional or local governments (see Tompson, 2004 and Vernikov, 2007). In our sample we include 25 in the latter category. Still, the banking sector has faced serious problems throughout its history.

Early in transition, banks clearly preferred speculation to lending (Schoors, 2001). Bank lending to the non-financial sector shrank year after year as a share of total banking assets, up to 1999. In 2003, bank loans to the non- financial sector amounted to just 17.0%

[2] In 1987 the Soviet Union turned its monobank system into a kind of two-tier banking system with a embryonal central bank (Gosbank) and specialized 'commercial banks'. The latter were Sberbank (the savings bank), Promstroibank (industry and construction), Zhilsotsbank (housing and communal financing), Agroprombank (Agriculture) and Vneshtorgbank.(foreign trade). These specialized banks are commonly referred to as 'spetsbanki'.
[3] In its 2005 Annual Report, Sberbank claims to hold 54.2% of total retail deposits, 44.1% of consumer loans, 32.2% of corporate loans, 16.6% of government securities and 26.5% of total Russian banking assets. The share in ruble-denominated retail deposits is even higher - over 70%.

of GDP and financed as little as 4.8% of fixed investment.[4] Since then, the situation has improved. This reluctance to lend seems rational with hindsight. The presence of soft legal constraints (Perotti, 2002) rendered the enforcement of overdue claims difficult or impossible. Bank lending was further depressed by huge information asymmetries between banks and their prospective customers, and by a lack of screening and monitoring skills in the banks themselves and the economy at large. Banks were therefore unable to identify good potential borrowers (Brana, Maurel and Sgard, 1999), and often preferred not to lend at all. Moreover, the vast number of tiny banks and the lack of a transparent information system for credit histories may have contributed to lending restraint (Pyle, 2002).

The largest part of the lending went to connected agents, regardless of the viability of the lending project, and with only very weak monitoring incentives (Laeven, 2001). Many of the newly founded private banks were captured by their owners. Such "pocket banks" operated as treasuries for a firm or a group of firms rather than independent banks. Note that the government, too, is to some extent a connected party, because several banks were captured by local, regional, or national governments. At the start of 2003, federal or regional authorities held majority stakes in 23 banks, the regional authorities held minority stakes in several more banks, and a large number of state enterprises were part-owners of banks (Tompson, 2004).

The average loan quality was negatively affected by the combined problems of connected lending, soft legal constraints, information asymmetries and the lack of screening and monitoring skills. A leaked analysis of Russian banks after the crisis of August 1998 shows that the major problem for banks was not the devaluation loss or the government default on treasury bills, but bad loans hidden and accumulated during the preceding period.[5] Schoors and Sonin (2005) explain how the Russian banking system was stuck in a passivity trap, where it is rational for each individual bank to hide bad loans rather than collecting them. Economic growth after 2000 allowed Russian banks to 'grow' out of bad loans, but the problem of loan quality is still a latent threat to the Russian banking system.

The Russian banking sector has in the past suffered from poor capitalization, especially considering the poor quality of assets and the large exposure to exchange rate risk. This overexposure was revealed when the devaluation in August 1998 changed the capital

[4] Data from the CBR Bulletin of Bank Statistics.

of many Russian banks from positive to negative overnight (Perotti, 2002). The CBR has steadily tightened capital standards since 1999, and Claeys and Schoors (2007) show that these standards are indeed enforced. As a result, capital levels have reached more acceptable levels. Still our data reveal that the average capitalization of the Russian banks is substantially higher than the weighted average capitalization, implying that capital buffers are lower in the banks that are most important for systemic stability.

The institutional stability of Russian banks has proven weak, with systemic problems in 1994, 1995, 1998 and 2004. Since 1992, more than 2000 Russian banks have been liquidated or have vanished. Sometimes this was due to a combination of the above-mentioned factors (poor capitalization, excessive speculative risk, endemic bad loans, connected lending, etc.), but there were also several instances of Ponzi schemes, where crooks cheated depositors and fled with their money. In the aftermath of the August 1998 crisis it became apparent that the soft legal constraints faced by banks encouraged asset stripping and left creditors to bear the brunt of the cost of failure (Perotti, 2002). Claeys and Schoors (2007) give an overview of the CBR's relatively weak prudential supervision and control during the first decade and show that rule-based enforcement of bank standards is difficult for the CBR because of conflicts with systemic stability concerns. Depositors reacted to this widespread institutional instability by either disciplining their banks in a sophisticated way[6] (Karas, Pyle and Schoors, 2006) or fleeing to the safe heavens of Sberbank and Vneshtorgbank that – like all public banks – were covered by an implicit state guarantee[7] (see OECD, 2004). Figure 1 shows how Sberbank's share of private deposits[8] reached a peak of close to 80% in 1998.

The government wanted to restore some competition in the deposit market and reacted by providing a form of partial deposit insurance. The federal law on deposit insurance was introduced in 2003, but the system only became operational in September 2004[9]. Sberbank was initially exempted and kept its full state guarantee until 1 January 2007,

[5] See 'The newly-wed and the nearly dead', Euromoney, June 1999.
[6] By interpreting very high promised deposit rates as a proxy for institutional instability.
[7] Sberbank has a huge branch network and carries a government guarantee. The government lent credibility to this guarantee by supporting Sberbank when needed and using it as a device to absorb deposits from large defunct deposit banks in the aftermath of the 1998 crisis. The same holds for Vneshtorgbank, as demonstrated in the mini-crisis in May–July 2004, when Vneshtorgbank acquired Gutabank, one of the larger deposit banks under attack. As a result, Sberbank and Vneshtorgbank continue to dominate a highly concentrated deposit market.
[8] Both ruble- and foreign currency-denominated private deposits.
[9] Although an unrelated and opaque form of state guarantee was already granted to all banks in July 2004, to stop the unfolding banking panic.

when it finally became subject to the new deposit insurance scheme. Other regulatory advantages of Sberbank (for example lower required reserves on ruble deposits) were also abolished. This gradually more level playing field ensured that Sberbank's share of private deposits gradually fell during the last five years to the still-very-high level of about 50% in 2006 (see figure 1).

In table 1 we summarize some of the crucial indicators of recent developments in the Russian banking system. By early 2006 there were 1253 banks, among which only 1045 money deposit banks (covered by the deposit insurance scheme) with 3295 bank branches. More than 30% of these bank branches were however still operated by Sberbank, such that the average bank had about two branches. Clearly the average Russian bank is tiny by European or world standards. By 2006 the Russian market included 62 majority foreign-owned banks, but their branch network was still relatively underdeveloped. On the other hand banking has clearly revived during the last five years, with bank lending rising from 17% of GDP in 2001 to 32% in 2006 and private deposits rising from 8% of GDP to 14% over the same period. Average interest rates seem still high in nominal terms but are low once inflation is taken into account. Clearly Russian banks are increasingly playing their role as effective intermediaries between saving and investment, but the banking system still suffers from the predominance of tiny banks with underdeveloped branch networks, excessive concentration, and a lack of foreign competition. Although private deposit collection is growing, it remains far behind corporate lending.

4 Data and variables

The quarterly bank balances and profit and loss accounts were made available to the authors by the financial information agency Interfax10. The chosen sample periods (2002 and 2006) are convenient to properly detect longitudinal effects of private ownership. Brown et al (2006) find that positive effects of domestic privatization appear immediately in Hungary, Romania, and Ukraine, but emerge only five years after privatization in Russia. In our study almost all remaining banks are de novo banks and the few remaining privatized

banks are considered 10 years or more after privatization, so any positive efficiency effects are expected to have appeared by then.

The panel is unbalanced because some banks fail, some merge, and some are founded during the sample period. If a bank merged or was acquired, we treat the resulting larger bank as "new". To identify foreign banks, we use the quarterly lists of 100% foreign-owned banks provided by the CBR since 1999. The lists of banks with the state as a majority owner are available at two points in time, February 1, 2002 (Matovnikov, 2002) and July 1, 2005 (Mamontov, 2005). These lists reveal that the state ownership category remains stable over our sample period.

We do estimations for the periods before (2002) and after (2006) the introduction of deposit insurance in 2004. For each sub-period, we use a balanced panel which is more convenient for application of the Battese-Coelli (1995) model. As efficiency scores are relative measures of performance, we need to have comparable banks in terms of activities. We therefore keep only banks with more-than 10% shares of deposits and loans in total assets. Our final sample consists of 747 banks (including 19 public banks and 26 foreign banks) for 2002 and 471 banks (including 15 public banks and 20 foreign banks) for 2006.

The literature disagrees on the role of deposits in banks' production process. The classical production approach treats deposits and loans as outputs, and labor and physical capital as inputs. The intermediation approach first used by Sealey and Lindley (1977) views banks as intermediaries between saving and investment in the economy, and treats earning assets as outputs and deposits as inputs.

The weak development of financial markets makes a clear focus on the lending and deposit activities of banks relevant for Russia. Therefore we tend to prefer the production approach in this paper. The intermediation approach has the disadvantage that deposits are neglected as an important output. But there is also an argument in favor of the intermediation approach. Public and foreign banks might have access to cheaper funding if depositors believe those banks to possess additional protection compared to private domestic banks. Public banks have enjoyed the explicit state guarantee backing their retail deposits, which was scrapped only at the end of 2003. In addition, their cost of funds is reduced by the perception that the state will stand behind them (Tompson, 2004). Foreign banks' deposits may also enjoy an implicit (by the mother bank) or an explicit deposit guarantee (in some

[10] Karas and Schoors (2005) provide a detailed description of the dataset and confirm its consistency with other data sources.

countries, clients of foreign branches of domestic banks are covered by the national deposit insurance scheme). Such guarantees – perceived or real – could affect input prices for deposits, but this is not considered in the production approach, where the cost of deposits is not included in the total cost. This provides a rationale for the intermediation approach, which considers deposits as an input rather than an output and includes the cost of deposits in the measure of total costs. In robustness checks, we substitute the intermediation for the production approach. Our results are however robust to the choice of the production process. This is not unexpected, given the finding of Wheelock and Wilson (1995) and Berger et al. (1997) that the choice of approach may have a considerable impact on the level of efficiency scores but not on their rankings.

For the production approach, the output variables are total deposits and total loans. The input prices are the price of physical capital, measured by the ratio of other operating expenses to fixed assets, and the price of labor, measured by the ratio of personnel expenses to total assets,[11] as data on the number of employees is not available (Altunbas et al. 2000, Weill, 2003). As observed by Maudos et al. (2002), the latter ratio can be interpreted as labor cost per worker (personnel expenses to number of employees) adjusted for differences in labor productivity (number of employees to total assets), since it is the product of these ratios. Total costs are the sum of personnel expenses and other operating expenses. Controls for environment, risk preferences and activities mix include seven geographical district dummies, the log of total assets, the log of equity, the share of bad loans in total loans, and the percentage breakdown of banks' total deposits and loans by counterpart (households, firms, government, banks).

For the intermediation approach, the output variables are total loans and total securities, while input prices are the deposit rate (measured as the ratio of interest paid on deposits to interest bearing deposits), the price of physical capital (defined above), and the price of labor (defined above). Total costs are the sum of interest paid on deposits, personnel expenses and other operating expenses.

Table 2 compares the means of key variables of private and public banks. Table 3 does the same for domestic and foreign banks. Both public and foreign banks are much bigger, slightly less capitalized and more frequently located in the Moscow area, relative to their

counterparts, respectively, private and domestic banks. These patterns are more pronounced in the second sub-period. Compared to private banks, public banks grant relatively more loans to companies and banks and relatively less loans to households. Not surprisingly, public banks rely relatively more on the government as a source of funding. Foreign banks are extremely active on the interbank market, in terms of both borrowing and lending, while domestic banks are predominantly occupied with core activities: granting loans to companies and individuals, and collecting core deposits. For all bank categories, household deposits have over time become a much more important source of funding.

5 Methodology

This section develops the methodology used to estimate cost efficiency of Russian banks. Cost efficiency refers to how close a bank's cost is to what an optimal bank's cost would be for producing the same bundle of outputs. It also concerns waste in the production process and the optimality of the chosen mix of inputs.

Several techniques have been proposed in the literature to measure efficiency with frontier approaches. While nonparametric approaches (e.g. DEA) use linear programming techniques, parametric approaches, such as the stochastic frontier approach, apply econometric tools to estimate the efficiency frontier. We adopt the stochastic frontier approach in our study, following many studies on banking efficiency in transition countries (Weill, 2003; Bonin et al., 2005a; Fries and Taci, 2005). In comparison to DEA, this approach has the advantage of disentangling inefficiency from statistical noise, taking exogenous events into account in the residual (distance from the efficiency frontier). In section 7 we also present DEA estimates as additional robustness checks.

The stochastic frontier approach assumes that total cost deviates from optimal cost by a random disturbance, v, and an inefficiency term, u. Thus the cost function is $TC = f(Y, P) + \varepsilon$ where TC represents total cost, Y is the vector of outputs, P the vector of input prices and ε the error term which is the sum of u and v. u is a one-sided component representing cost inefficiencies, meaning the degree of weakness of managerial performance. v is a two-sided component representing random disturbances, reflecting luck or measure-

[11] We use the Tukey box-plot to detect outliers: for each input price, we drop observations lying beyond the

ment errors. u and v are independently distributed, with u assumed to have a truncated normal distribution and v to have a normal distribution. σv^2 and σu^2 are the respective variances of u and v. According to Jondrow et al. (1982), firm-specific estimates of inefficiency terms can be calculated by using the distribution of the inefficiency term conditional on the estimate of the composite error term.

The more straightforward procedure is the so-called "two-stage procedure": in the first stage the stochastic frontier model is estimated, and in the second stage the efficiency scores obtained are regressed on a set of explanatory variables including ownership variables. Although often applied in the literature, this two-stage procedure presents two important econometric problems, as noted by Kumbhakar and Lovell (2000). First, it assumes that the efficiency terms are identically distributed in the estimation of the stochastic frontier model of the first stage, while in the second stage this assumption is contradicted by the fact that the regression of the efficiency terms on the explanatory variables suggests that the efficiency terms are not identically distributed. Second, the explanatory variables must be assumed to be uncorrelated with the variables of the cost frontier function, or else the maximum likelihood estimates of the parameters of the cost frontier function would be biased because of the omission of the explanatory variables in the first stage. But then, the estimated efficiency terms that are explained in the second stage are biased estimates, as they are estimated relative to a biased representation of the cost frontier.

Therefore, we chose the "one-stage procedure" proposed by Battese and Coelli (1995), which solves these econometric problems. They propose a procedure for panel data, in which the non-negative inefficiency term is assumed to have a truncated distribution with different means for each firm. As a result, the distributions of the inefficiency terms are not the same, but are expressed as functions of explanatory variables. The inefficiency terms are then independently but not identically distributed. They are obtained by truncation at zero of the $N(\mu_{it}, \sigma u^2)$ distribution: $\mu_{it} = z_{it}\,\delta$, where z_{it} is a vector of explanatory variables, and δ is a vector of parameters to be estimated.

The estimated model consists of the cost frontier function and an equation explaining inefficiency. As is common in the literature on bank efficiency in transition countries

range defined by the first and third quartile minus/plus two times the interquartile range.

(Weill, 2003, Bonin et al., 2005a, Fries and Taci, 2005), we use a standard translog specification of the cost frontier:

$$\ln\left(\frac{TC_{i,t}}{pk_{i,t}}\right) = \beta_0 + \sum_m \alpha_m \ln y_{m,i,t} + \frac{1}{2}\sum_m\sum_j \alpha_{mj,i,t} \ln y_{m,i,t} \ln y_{j,i,t} + \beta_1 \ln\left(\frac{pl_{i,t}}{pk_{i,t}}\right) + \beta_2\left[\ln\left(\frac{pl_{i,t}}{pk_{i,t}}\right)\right]^2 + \sum_m \gamma_m \ln\left(\frac{pl_{i,t}}{pk_{i,t}}\right)\ln y_{m,i,t} + \varepsilon_{i,t} \quad (1)$$

where *TC* is total cost, y_m m^{th} bank output (m=1,2), *pl* the price of labor, *pk* the price of physical capital, and ε the composite error term. Inefficiency is a function of bank-specific variables:

$$u_{it} = \delta z_{it} + W_{it} \quad (2)$$

where u_{it} is the inefficiency, z_{it} is a p*1 vector of explanatory variables, δ is a 1*p vector of parameters to be estimated, W_{it} is a random variable defined by the truncation of the normal distribution with mean zero, and $\sigma^2 = \sigma_u^2 + \sigma_v^2$ is the variance.

6 Results

We estimate the efficiency model for the period before generalized deposit insurance (2002) and after generalized deposit insurance (2006) to see whether the implementation of deposit insurance has modified the differences in efficiency between banks with different types of ownership. In all estimations, we include bank ownership variables in the equation explaining inefficiency. Two alternative definitions of public ownership are employed. On the one hand, we include a dummy variable taking the value of one if the bank is publicly-owned. On the other hand, following Styrin (2005), we measure public ownership by the ratio of interest income received from the government to total interest income. Foreign ownership is taken into account through a dummy variable equaling one if the bank is foreign-owned.

Insert table 4 around here

Table 4 presents the main results. Panel A gives the results for public banks defined according to ownership; panel B for public banks defined according to their activities. In the interpretation, one must keep in mind that the econometric model identifies inefficiency. Therefore a minus sign indicates that an increase in the explanatory variable implies lower inefficiency, i.e. higher efficiency.

The baseline specification (a) of panel A shows that foreign banks are more efficient than domestic private banks and public banks, and that public banks are more efficient than domestic private banks after the introduction of deposit insurance. Indeed, while the estimates for public ownership are negative and insignificant in specification (a), specification (d) indicates that the efficiency gap between public banks and domestic private banks becomes significant after the introduction of generalized deposit insurance. In an economic sense, the efficiency differences are considerable. This is also true in panel B where public banks are identified according to their activities rather than their ownership.

In the baseline specifications (a) and (d), we implicitly assume that the bank's environment (determined by its location) and risk preferences are management choices. One could however argue that environment is exogenous to management decisions. Consequently, the influence of environment should be disentangled, to get a satisfactory measure of bank efficiency. In this strand of literature, Dietsch and Lozano-Vivas (2000) have notably shown that environment can explain cross-country differences in bank efficiency. Furthermore, Hugues and Mester (1993) and Mester (1996) have shown that efficiency differences may also derive from differences in managers' risk preferences. Indeed the degree of risk aversion has an impact on cost efficiency. Risk-loving managers may keep the capital down to its cost-minimizing level (the regulatory threshold), while risk-averse managers may prefer to hold higher levels of capital. Consequently, by omitting the level of equity from the cost frontier, we may consider a bank inefficient although it behaves optimally given the risk preferences of its managers. Berger and Mester (1997) provide an additional reason to include the level of equity in the estimation of the cost efficiency model, based on the fact that the bank's insolvency risk depends on the equity available to absorb losses. This insolvency risk may lead to higher bank costs[12]. This issue takes on particular impor-

[12] In our framework, higher solvency risk could affect the costs included in the cost function through higher labor costs and higher costs of physical capital (to convince depositors to make their deposits, banks with lower capital need to invest more in their branch networks).

tance in transition economies like Russia where the insolvency risk of banks is not negligible.

In specifications (b) before generalized deposit insurance and (e) after generalized deposit insurance, we therefore include some environmental variables in the cost frontier. We use information on the district of the bank, taking into consideration the geographical breakdown of Russia into 7 districts. We therefore include in the cost frontier 6 dummy variables, equaling one if the bank is located in the concerned district. In specifications (c) and (f), we include the logarithm of equity in the estimation of the cost frontier to control for risk preferences, in addition to environmental variables, following notably Mester (1996), Altunbas et al. (2000) and Weill (2003). All these specifications show that the baseline results are very robust. Foreign banks are consistently the most efficient ones, and public banks are consistently more efficient than domestic private banks.

This first set of results suggests that in Russia public banks are more rather than less efficient than domestic private banks. This is in accordance with Styrin (2005) but differs from Fries and Taci (2005). Note however that the latter study obtained results on a cross-country sample from 15 transition countries including only a very limited sample of Russian banks. In addition, our results surprisingly suggest that this efficiency advantage was enhanced rather than reduced by the implementation of the deposit insurance scheme.

Since the results in table 4 do not take into account the possible effect of systematic differences in the deposit rate[13], table 5 repeats the regressions of table 4, applying the intermediation approach instead of the production approach. In the intermediation approach the deposit rate is an input cost in the cost function and the total deposit cost is included in the measure of total cost.

Insert table 5 around here

The estimates in table 5 indicate that our unexpected results are very robust to the choice of a production process. Applying the intermediation approach, we again find that foreign banks exhibit superior efficiency, that public banks tend to be more efficient than domestic private banks, and that the latter efficiency gap becomes statistically significant after the introduction of deposit insurance. It is suggested therefore that the superior effi-

[13] Public banks could have systematically lower deposit rates than private banks.

ciency of public over private banks is not an inheritance of some communist past, but a fact of contemporaneous Russian banking markets.

One explanation for this puzzle could be that public and private banks have different sets of activities and that the typical activity mix of public banks involves fewer costs than that which is typical of private banks. In table 6, we test this idea by including measures of the activity mix in the equation explaining inefficiency.

Include table 6 around here

In each panel of table 6, we consider the activity mix in the form of lending and deposit shares by type of customer (households, firms, government, banks) and the average loan quality (measured as the ratio of classified loans to total loans).[14] In panels A and B we apply the production approach, in panels C and D the intermediation approach. Panels A and C identify public banks by ownership, while panels B and D identify public banks by revealed activities involving the government. In each panel we have 4 specifications. In specification (a) we include the regional dummies in the estimation of the efficient frontier and all the activity mix variables in the equation explaining inefficiency. In specification (b) we additionally include equity in the estimation of the efficient frontier. In specification (c) we include the regional dummies and the activity mix variables in the estimation of the efficient frontier, leaving only loan quality as an explanatory variable for the residual inefficiency. In specification (d) we include the regional dummies, equity and the set of activity mix variables in the estimation of the frontier, again leaving only loan quality as an explanatory variable for residual inefficiency. Our three main results are highly robust in all these exercises. Foreign banks are again more efficient than domestic private banks. Public banks tend to be more efficient than domestic private ones. This effect seems to be stronger after than before the introduction of deposit insurance. Moreover, the results are stronger rather than weaker in some cases. In panel A, for example (production approach, public ownership), the public banks' superior efficiency becomes statistically evident even for the pre-deposit-insurance period. In panel C (intermediation approach, public ownership), the

[14] Since the bank share and the government share are zero for many banks, their sum is the omitted variable for both lending and deposits. The results do not change if instead households or firms are the excluded category.

public banks become less inefficient than even the foreign banks in the pre-deposit-insurance period.

7 Further robustness checks

The summary statistics in table 2 indicate that public banks are on average very large compared to domestic private banks. If scale economies are present in the Russian banking sector, these considerable size differences may explain our results. Note however that one could also hypothesize that large Russian private banks are less efficient than their smaller competitors. Claeys and Schoors (2007) find that large Russian banks enjoy regulatory forbearance from the part of the Central Bank of Russia. Having such soft legal constraints means that managers of larger banks are subject to less regulatory pressure. This gives the managers greater freedom to maximize the private benefits of control, which may come at the cost of lower efficiency. To control for the size effect we repeat our estimations for a size-matched sample. The matching procedure for the two sub-periods is as follows:

1. We exclude the largest public banks, Sberbank, Vneshtorgbank and Gazprombank from the two samples. They dominate the market and their special status (see above) may drive the results.
2. For each of the remaining public banks, we identify in each time period 20 size-matched (size in terms of total assets) private domestic banks. Specifically, we select the closest 10 larger and the closest 10 smaller private domestic banks that have not been selected yet for the given period. This yields two lists of matching banks, one for the sample before deposit insurance and one for the sample after deposit insurance.
3. Finally, we balance the sample by dropping all banks that fail to show up in all 4 quarters of the sub-period.

This procedure yields 123 matching private domestic banks before deposit insurance (492 bank observations) and 141 matching private domestic banks after deposit insurance (564 bank observations). All foreign banks are retained in the sample. In annex A.1 we present summary statistics for this matched sample. One observes that the size differences are now substantially smaller than in the full sample of table 2.

Insert table 7 around here

In table 7, we repeat the estimations with all possible controls of panel A in table 6. In annex A.2 we show the reproduced estimations with the size-matched datasets from the remaining panels of table 6. Our three main findings are robust, but the estimated efficiency gap becomes smaller in most specifications. The public bank variable remains negative in all specifications of all panels, although its significance falters in some specifications of the intermediation approach (see Annex A.2). Apparently the observed efficiency gap between public and private banks is not only driven by size differences or by the special position enjoyed by CBR-owned large public banks, but also by some genuine efficiency differences.

As a further robustness check we employed a two-stage DEA procedure. In the first stage we estimate time-specific bank efficiency scores for each quarter. We use the quarterly efficiency scores for each bank to compute its mean efficiency scores for each year (2002 before the reform, 2006 after the reform). In a second stage, we regress these mean efficiency scores on a set of determinants (public ownership, foreign ownership, activity) using a Tobit estimator. This exercise was performed on both the full and size-matched samples. Results for the second stage Tobit regressions are presented in table 8. Note that DEA is a totally different estimation strategy, often leading to quite different results. The interpretation of the signs is now different, since DEA measures efficiency rather than inefficiency and since the estimates are time-specific rather than panel estimates.

Insert table 8 around here.

From table 8 we observe that foreign banks are again found to be more efficient than domestic banks. The efficiency of publicly owned banks is never significantly different from that of private banks. The introduction of deposit insurance again seems to affect efficiency differences in favor of foreign banks and public banks. In the case of publicly owned banks, the signs of the estimates change from insignificantly negative in 2002 to insignificantly positive in 2006.

8 Concluding remarks

For the Russian banking market we document three highly robust results with respect to bank efficiency. Foreign banks are more efficient than domestic private banks (no surprise), domestic private banks are not more efficient than public banks (surprise) and the introduction of deposit insurance increased any existing efficiency gap between public and private banks (big surprise). These results are not driven by the choice of production process, environment, risk preferences, activity mix, size, or econometric approach.

This result of foreign banks' superior efficiency agrees with most of the related literature on transition countries. Namely, Weill (2003), Fries and Taci (2005) and Bonin et al. (2005a) come to similar conclusions based on samples of banks from various transition countries. This finding is also highly robust in the specifications that take account of environment, equity, size and structure of activities. It may find its origin in both reasons proposed by Weill (2003). On the one hand, most shareholders of foreign banks are themselves banks. Consequently, these shareholders can provide their know-how in organization and risk analysis to their subsidiaries. On the other hand, foreign banks would benefit from better corporate governance as shareholders originating from Western economies would be more accustomed to monitoring bank managers.

But why are private banks not more efficient than public banks in Russia? This unexpected finding is neither in accordance with the general prior that public ownership is less efficient than private ownership, nor with the findings of Bonin et al. (2005a) and Fries and Taci (2005) for cross-country samples of banks from Central and Eastern European countries. Implicit state guarantees may have rendered Russia's public banks' access to deposits less costly in terms of labor and physical capital, resulting in higher efficiency. A greater depositor base may in turn lead to a greater pool of loan applicants. Therefore, public banks may also benefit from granting a larger amount of loans than private banks for the same level of costs, because they must expend less effort to find borrowers. But if this explanation is true, the creation of a more level playing field via the introduction of a generalized deposit insurance scheme, no matter how incomplete, should have mitigated the efficiency difference, and yet we obtained the opposite result. So this explanation must be abandoned. Still deposit insurance may have played a role through moral hazard. There is strong evidence that Russian private domestic banks were subject to strong and sophisti-

cated market discipline before the introduction of deposit insurance (see Karas, Schoors and Pyle, 2006). This forced them to improve their efficiency. The introduction of deposit insurance may however have reduced the pressure from market discipline, without replacing it with sufficiently strong regulatory pressure. In short, the introduction of deposit insurance may have introduced moral hazard, leading to more, rather than less, inefficient management practices in private banks.

Alternatively, the observed increase in the efficiency gap between public and private banks may be due to increased switching costs (see Kim et al., 2003). These switching costs notably derive from costs linked to the time and effort needed to close an account and open it elsewhere, to become comfortable with unfamiliar procedures and new bank employees, and from costs related to the loss of capitalized value of established relationships. Switching costs may also endogenously result from the fact that banks benefit from better information on their clients as compared to their competitors (Sharpe, 1990; Rajan, 1992). The widespread trust in public banks accumulated through their long dominance of the Russian retail markets and the renewed distrust of private banks after the 'mini-crisis' of May-July 2004 (see above) may have increased the costs of switching from public to private banks. More importantly, the several weeks of turbulence on the Russian inter-bank market triggered by the CBR's intervention in the case of a bank accused of money-laundering, reduced depositors' trust in the banking system and led to a "flight to quality", i.e. a shift of deposits from private to public banks.

Given the fact that Russian public banks are not more inefficient than private ones, the large state presence in the Russian banking sector is not necessarily the cause of its relative inefficiency and the well-known corollaries of lower credit levels and more financial instability. The implication is that bank privatization will not necessarily improve the efficiency of the Russian banking system. Since the main inefficiency seems to reside with domestic private banks, the system's efficiency may benefit more from increased competition than from privatization. This can be achieved by creating a more level and more stable regulatory playing field for all banks, an objective on which the CBR is making progress, and by opening the market to foreign competition. In this light, the CBR's relentless ef-

forts[15] of the last years (2006-2007) to get rid of inefficient and fraudulent banks regardless of their size and the increasing access of foreign banks to the Russian banking sector may be more instrumental in boosting the sector's efficiency than yet another round of chaotic privatization.

[15] These efforts are deeply resented by some banks that fear losing their license and culminated in the brutal murder in October 2006 of the Mr. Kozlov, vice president of the CBR in charge of bank licensing policy. The CBR reacted by reinforcing its effort to sweep though the banking licenses.

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Table 1 Some Indicators of recent developments in the Russian banking sector

Data as at start of period unless otherwise indicated	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***
Number of credit organizations	2126	2003	1828	1668	1518	1409
with banking license	1311	1319	1329	1329	1299	1253
license to attract private deposits	1239	1223	1202	1190	1165	1045
license to conduct foreign currency operations	764	810	839	845	839	827
general license	244	262	293	310	311	301
license for operations with precious metals	163	171	175	181	182	184
Foreign credit organizations with banking license	130	125	126	128	131	136
fully foreign owned	22	23	27	32	33	41
50 to 100% foreign owned	11	12	10	9	9	11
Total number of branches	3793	3433	3326	3219	3238	3295
of which branches of Sberbank	1529	1233	1162	1045	1011	1009
of which branches of fully foreign owned banks	7	9	12	15	16	29
Corporate Lending/GDP (eop)	17%	19%	22%	25%	27%	32%
Private deposits/GDP	8%	10%	11%	12%	13%	14%
Lending/Gross fixed capital formation (eop)	92%	105%	120%	137%	149%	177%
Inflation (eop)	18.6%	15.1%	12.0%	11.7%	10.9%	9.0%
Deposit rate (period average)	4.9%	5.0%	4.5%	3.8%	4.0%	4.1%
Lending rate (period average)	17.9%	15.7%	13.0%	11.4%	10.7%	10.5%

Sources: Rosstat, CBR and International Financial Statistics (IMF).
Lending defined as lending of deposit money banks to private and public enterprises, excluding financial companies.

Table 2 Means of key variables for private and public banks

	2002		*2006*	
	Private banks	***Public banks***	***Private banks***	***Public banks***
Characteristics				
Total assets	1,213.56	17,585.80	2,934.71	160,481.92
Total costs (production)	49.26	593.51	142.65	6,575.91
Total costs (intermediation)	57.90	696.50	168.36	7,941.45
Loans	901.67	12,400.59	2,182.47	118,575.98
Deposits	855.46	9,406.17	2,278.33	127,781.46
Investment assets	73.60	2,283.15	380.68	29,776.67
Price of labor	0.0106	0.0105	0.0102	0.0078
Price of physical capital	1.8113	1.5108	1.8488	2.0085
Price of borrowed funds	0.0111	0.0089	0.0121	0.0110
Equity/total assets	0.2726	0.2348	0.1837	0.1297
Bad loans / loans	0.0184	0.0247	0.0189	0.0114
Loan activities				
Household loans / loans	0.0790	0.0232	0.1915	0.1474
Firm loans / loans	0.6649	0.6622	0.6292	0.6654
Government loans / loans	0.0108	0.0104	0.0066	0.0181
Bank loans / loans	0.2453	0.3042	0.1726	0.1691
Deposit activities				
Household dep./ deposits	0.2285	0.1267	0.4180	0.3526
Firm deposits / deposits	0.6080	0.5889	0.4796	0.3888
Government dep. /deposits	0.0262	0.1298	0.017	0.1232
Bank dep. / deposits	0.1373	0.1547	0.0908	0.1355
Environment				
Moscow area	0.5192	0.5789	0.3706	0.4667
Number of observations	2912	76	1824	60

Table 3 Means of key variables for domestic and foreign banks

	2002		*2006*	
	Domestic banks	***Foreign banks***	***Domestic banks***	***Foreign banks***
Characteristics				
Total assets	1,385.31	8,414.93	7,521.01	17,674.06
Total cost (production)	55.35	277.95	332.89	677.80
Total cost (intermediation)	64.70	336.12	398.33	812.46
Loans	998.13	6,629.65	5,559.31	13,329.95
Deposits	860.11	6,975.06	5,902.71	14,675.99
Investment assets	111.20	645.49	1,243.35	2,974.54
Price of labor	0.0107	0.0077	0.0103	0.0073
Price of physical capital	1.7828	2.3836	1.8528	1.8800
Price of borrowed funds	0.0112	0.0088	0.0122	0.0096
Equity/total assets	0.2725	0.2462	0.1827	0.1677
Bad loans / loans	0.0184	0.0216	0.0172	0.0508
Loan activities				
Household loans / loans	0.0792	0.0337	0.1904	0.1838
Firm loans / loans	0.6718	0.4709	0.6360	0.5036
Government loans / loans	0.0112	0.0001	0.0073	0.0001
Bank loans / loans	0.2379	0.4954	0.1663	0.3125
Deposit activities				
Household dep./ deposits	0.2290	0.1401	0.4277	0.1498
Firm deposits / deposits	0.6150	0.4012	0.4809	0.3811
Government dep. /deposits	0.0299	0.0001	0.0159	0.0001
Bank dep. / deposits	0.1261	0.4585	0.0755	0.4691
Environment				
Moscow area	0.5118	0.7692	0.3503	0.9000
Number of observations	2884	104	1804	80

Table 4 Inefficiency of public banks, production approach

Panel A: Public banks defined as state-owned banks						
	Before generalized deposit insurance (2002)			***After generalized deposit insurance (2006)***		
Frontier characteristics	***(a) Baseline***	***(b) environment***	***(c) Equity and environment***	***(d) Baseline***	***(e) environment***	***(f) Equity and environment***
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Public banks	-2.321	-2.346	-2.226	-2.915***	-3.527***	-1.924***
	(1.37)	(1.38)	(1.24)	(4.19)	(4.34)	(4.04)
Foreign banks	-2.393*	-2.544***	-2.560	-6.325***	-6.594***	-4.788***
	(1.95)	(2.67)	(1.34)	(3.88)	(4.00)	(3.35)
Log-likelihood	-2203.909	-2192.782	-2189.672	-1278.612	-1270.417	-1200.630
Panel B: Public banks defined as banks that receive a high share of interest income from government bodies						
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Public banks	-2.125	-2.357	-2.172	-3.398***	-3.633***	-2.903***
	(0.88)	(1.01)	(0.84)	(4.35)	(3.70)	(4.66)
Foreign banks	-2.370**	-2.535***	-2.550	-6.519***	-6.739***	-4.965***
	(1.97)	(2.80)	(1.54)	(3.31)	(3.30)	(2.95)
Log-likelihood	-2205.207	-2194.002	-2190.745	-1282.249	-1274.881	-1202.208

'Environment' means that regional dummies are included in the estimation of the cost frontier. 'Equity' refers to the inclusion of the bank's equity in the estimation of the cost frontier. N=2988 for the first period, N=1884 for the second period. Absolute t-statistics in parentheses, *, **, *** denote an estimate significantly different from zero at the 10%, 5% or 1% level.

Table 5 Inefficiency of public banks, intermediation approach

Panel C: Public banks defined as state-owned banks						
	Before generalized deposit insurance (2002)			***After generalized deposit insurance (2006)***		
Frontier characteristics	***(a) Baseline***	***(b) environment***	***(c) Equity and environment***	***(d) Baseline***	***(e) environment***	***(f) Equity and environment***
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Public banks	-3.018	-2.801	-2.507	-2.886***	-3.268***	-1.994***
	(1.60)	(1.58)	(1.35)	(4.01)	(2.90)	(4.10)
Foreign banks	-1.290**	-1.187*	-1.084**	-7.020***	-7.162***	-5.862***
	(2.08)	(1.66)	(2.41)	(3.63)	(2.66)	(3.82)
Log-likelihood	-1983.526	-1972.305	-1968.205	-1040.960	-1035.344	-1015.842
Panel D: Public banks defined as banks that receive a high share of interest income from government bodies						
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Public banks	-0.776	-1.387	-1.134	-3.888***	-4.243***	-2.968***
	(0.53)	(0.85)	(0.74)	(3.54)	(3.80)	(4.52)
Foreign banks	-1.141	-1.071	-0.976	-7.093***	-7.240***	-5.943***
	(1.17)	(1.13)	(1.58)	(3.02)	(3.37)	(4.21)
Log-likelihood	-1986.681	-1975.090	-1970.917	-1042.721	-1037.439	-1016.970

'Environment' means that regional dummies are included in the estimation of the cost frontier. 'Equity' refers to the inclusion of the bank's equity in the estimation of the cost frontier. N=2988 for the first period, N=1884 for the second period. Absolute t-statistics in parentheses, *, **, *** denote an estimate significantly different from zero at the 10%, 5% or 1% level.

Table 6 Robustness to differences in activity mix

Panel A Public banks defined as state-owned banks, production approach

Pre-generalized deposit insurance (2002)				
Frontier characteristics	***(a) environment***	***(b) equity and environment***	***(c) environment and activities***	***(d) equity and environment and activities***
Intercept	Yes	Yes	Yes	Yes
Public banks	-1.041**	-1.153***	-0.679**	-0.801**
	(2.04)	(3.06)	(2.03)	(2.23)
Foreign banks	-0.803***	-0.873***	-0.584**	-0.653
	(2.85)	(2.61)	(2.06)	(1.58)
Household deposits %	Yes	Yes	-	-
Firm deposits %	Yes	Yes	-	-
Household loans %	Yes	Yes	-	-
Firm loans %	Yes	Yes	-	-
Bad loans %	Yes	Yes	Yes	Yes
Log-likelihood	-2163.004	-2162.106	-2130.126	-2128.461
Post-generalized deposit insurance (2006)				
Intercept	Yes	Yes	Yes	Yes
Public banks	-2.699***	-1.739***	-5.397**	-2.859***
	(3.85)	(3.67)	(2.47)	(3.46)
Foreign banks	-4.514***	-3.885***	-7.153*	-5.523***
	(3.71)	(3.64)	(1.97)	(3.28)
Household deposits %	Yes	Yes	-	-
Firm deposits %	Yes	Yes	-	-
Household loans %	Yes	Yes	-	-
Firm loans %	Yes	Yes	-	-
Bad loans %	Yes	Yes	Yes	Yes
Log-likelihood	-1226;456	-1165.323	-1230.926	-1143.223

Panel B Public banks defined as banks that receive a high share of interest income from government bodies, production approach

Pre-generalized deposit insurance (2002)				
Frontier characteristics	***(a) environment***	***(b) equity and environment***	***(c) environment and activities***	***(d) equity and environment and activities***
Intercept	Yes	Yes	Yes	Yes
Public banks	-1.348	-1.561	-0.862	-1.137
	(1.24)	(1.58)	(0.95)	(1.53)
Foreign banks	-0.788***	-0.863**	-0.574**	-0.654*
	(2.89)	(2.52)	(2.05)	(1.70)
Household deposits %	Yes	Yes	-	-
Firm deposits %	Yes	Yes	-	-
Household loans %	Yes	Yes	-	-
Firm loans %	Yes	Yes	-	-
Bad loans %	Yes	Yes	Yes	Yes
Log-likelihood	-2163.432	-2162.537	-2130.490	-2128.775
Post-generalized deposit insurance (2006)				
Intercept	Yes	Yes	Yes	Yes
Public banks	-3.329***	-2.766***	-3.602	-2.855***
	(3.37)	(3.87)	(1.18)	(3.17)
Foreign banks	-4.553***	-4.001***	-5.611	-5.627**
	(3.35)	(3.63)	(1.39)	(2.43)
Household deposits %	Yes	Yes	-	-
Firm deposits %	Yes	Yes	-	-
Household loans %	Yes	Yes	-	-
Firm loans %	Yes	Yes	-	-
Bad loans %	Yes	Yes	Yes	Yes
Log-likelihood	-1231.047	-1167.378	-1235.123	-1145.789

Panel C Public banks defined as state-owned banks, intermediation approach

Pre-generalized deposit insurance (2002)				
Frontier characteristics	***(a) environment***	***(b) equity and environment***	***(c) environment and activities***	***(d) equity and environment and activities***
Intercept	Yes	Yes	Yes	Yes
Public banks	-1.285***	-1.259**	-1.471	-1.447*
	(2.31)	(2.36)	(1.58)	(1.93)
Foreign banks	0.005	0.018	-1.609	-0.155
	(0.02)	(0.11)	(0.51)	(0.81)
Household deposits %	Yes	Yes	-	-
Firm deposits %	Yes	Yes	-	-
Household loans %	Yes	Yes	-	-
Firm loans %	Yes	Yes	-	-
Bad loans %	Yes	Yes	Yes	Yes
Log-likelihood	-1917.841	-1916.956	-1917.810	-1917.737
Post-generalized deposit insurance (2006)				
Intercept	Yes	Yes	Yes	Yes
Public banks	-1.957***	-1.857***	-2.244	-2.326***
	(2.57)	(5.08)	(1.60)	(3.88)
Foreign banks	-3.863***	-4.378***	-3.924**	-6.275***
	(2.93)	(10.40)	(2.07)	(3.14)
Household deposits %	Yes	Yes	-	-
Firm deposits %	Yes	Yes	-	-
Household loans %	Yes	Yes	-	-
Firm loans %	Yes	Yes	-	-
Bad loans %	Yes	Yes	Yes	Yes
Log-likelihood	-951.341	-932.902	-998.824	-975.377

Panel D Public banks defined as banks that receive a high share of interest income from the government bodies, intermediation approach

Pre-generalized deposit insurance (2002)				
Frontier characteristics	***(a) environment***	***(b) equity and environment***	***(c) environment and activities***	***(d) equity and environment and activities***
Intercept	Yes	Yes	Yes	Yes
Public banks	-0.967	-0.890	-1.320	-1.267
	(1.53)	(1.47)	(1.10)	(1.17)
Foreign banks	0.054	0.067	-0.125	-0.118
	(0.24)	(0.38)	(0.53)	(0.59)
Household deposits %	Yes	Yes	-	-
Firm deposits %	Yes	Yes	-	-
Household loans %	Yes	Yes	-	-
Firm loans %	Yes	Yes	-	-
Bad loans %	Yes	Yes	Yes	Yes
Log-likelihood	-1919.707	-1918.822	-1919.208	-1919.153
Post-generalized deposit insurance (2006)				
Intercept	Yes	Yes	Yes	Yes
Public banks	-2.670**	-2.824***	-2.518	-2.978***
	(2.28)	(3.98)	(1.36)	(2.81)
Foreign banks	-3.892***	-4.359***	-3.847***	-6.380***
	(2.77)	(3.85)	(2.76)	(2.76)
Household deposits %	Yes	Yes	-	-
Firm deposits %	Yes	Yes	-	-
Household loans %	Yes	Yes	-	-
Firm loans %	Yes	Yes	-	-
Bad loans %	Yes	Yes	Yes	Yes
Log-likelihood	-953.868	-934.310	-1000.718	-976.560

Table 7 Size-matched results

Panel A Public banks defined as state-owned banks, production approach

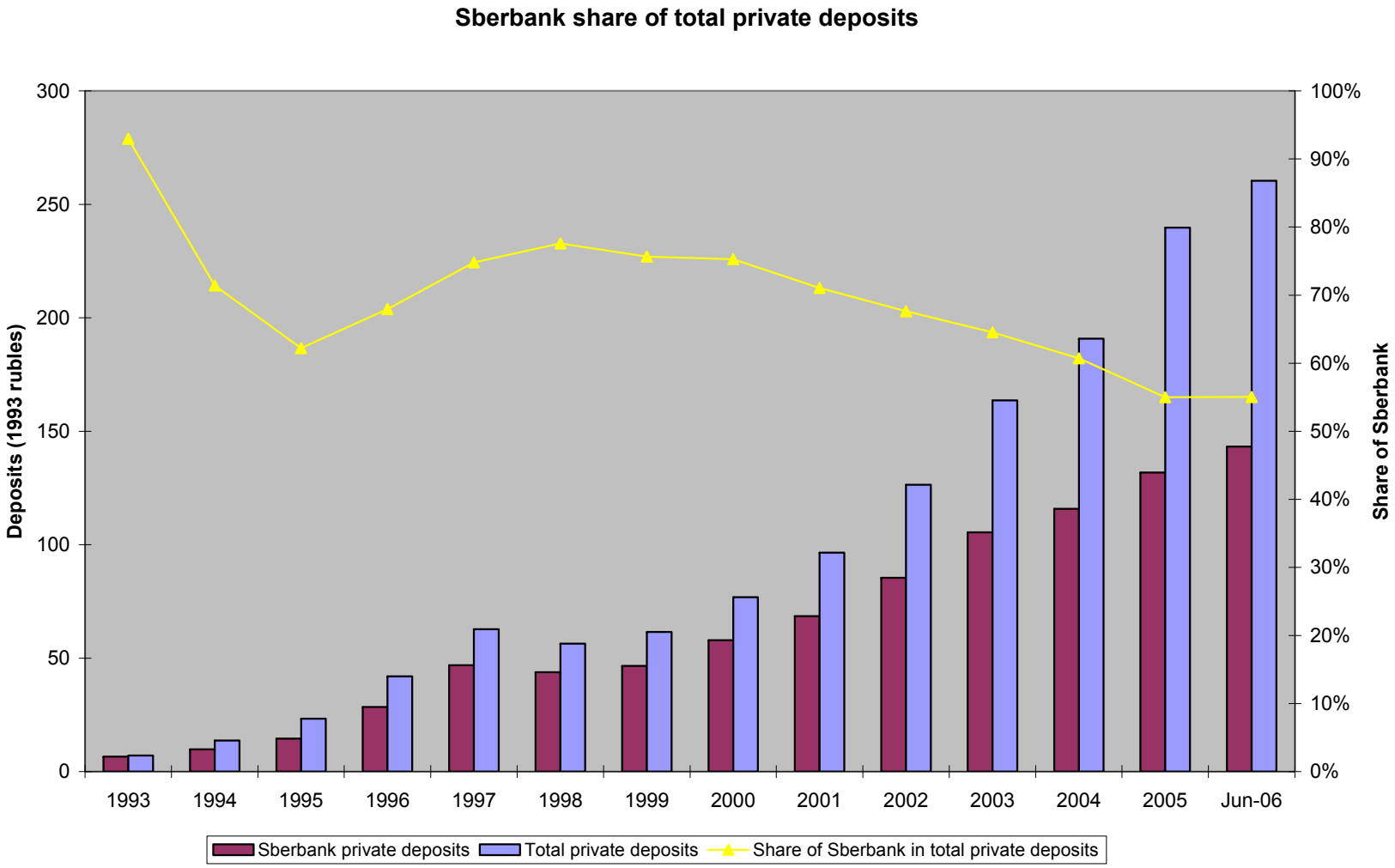
Pre-generalized deposit insurance (2002)				
Frontier characteristics	***(a) environment***	***(b) equity and environment***	***(c) environment and activities***	***(d) equity and environment and activities***
Intercept	Yes	Yes	Yes	Yes
Public banks	-2.130	-2.153***	-0.226	-0.244
	(1.14)	(2.73)	(0.66)	(0.57)
Foreign banks	0.412	0.384	0.039	0.012
	(0.64)	(1.32)	(0.11)	(0.04)
Household deposits %	1.594	1.035	-	-
	(0.71)	(1.46)		
Firm deposits %	6.439	6.175***	-	-
	(1.23)	(3.26)		
Household loans %	2.130	2.681*	-	-
	(1.17)	(1.92)		
Firm loans %	2.226	2.639**	-	-
	(1.36)	(2.23)		
Bad loans %	11.841	15.918**	6.168	6.742
	(1.47)	(2.53)	(1.62)	(1.22)
Log-likelihood	-397.439	-397.026	-390.969	-390.955
Post-generalized deposit insurance (2006)				
Intercept	Yes	Yes	Yes	Yes
Public banks	-0.331*	-0.190**	-1.406**	-1.280**
	(1.95)	(1.96)	(2.06)	(2.27)
Foreign banks	-1.433***	-0.907***	-2.660*	-1.987**
	(6.74)	(11.58)	(1.94)	(2.36)
Household deposits %	-0.815***	0.030	-	-
	(3.60)	(0.36)		
Firm deposits %	-0.222	0.154**	-	-
	(1.16)	(2.48)		
Household loans %	0.718***	0.293	-	-
	(2.69)	(1.64)		
Firm loans %	0.813***	0.416***	-	-
	(3.57)	(3.69)		
Bad loans %	0.018	0.207	-3.215	-4.126
	(0.03)	(1.08)	(0.89)	(1.06)
Log-likelihood	-360.661	-332.218	-349.916	-339.517

Table 8 Robustness to other econometric techniques: DEA

Panel A: Public banks defined as state-owned banks, full sample						
	Before generalised deposit insurance (2002)			***After generalised deposit insurance (2006)***		
Frontier characteristics	***(a)***	***(b)***	***(c)***	***(d)***	***(e)***	***(f)***
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Public banks	-0.007	-0.0233	-0.021	0.014	0.013	0.013
	(0.32)	(1.16)	(1.07)	(0.68)	(0.63)	(0.61)
Foreign banks	0.055***	0.008	0.008	0.145***	0.135***	0.135***
	(3.03)	(0.44)	(0.45)	(8.00)	(6.66)	(6.67)
Activities	-	Yes	Yes	-	Yes	Yes
Bad loans	-	-	Yes	-	-	Yes
Log-likelihood	733.983	776.945	785.229	525.603	538.238	538.296
Panel B: Public banks defined as state-owned banks, size-matched sample						
Intercept	Yes	Yes	Yes	Yes	Yes	Yes
Public banks	-0.023	-0.034	-0.033	0.024	0.018	0.017
	(0.68)	(1.01)	(1.00)	(0.78)	(0.63)	(0.60)
Foreign banks	0.055*	0.005	0.004	0.152***	0.128***	0.112***
	(1.90)	(0.18)	(0.12)	(6.11)	(4.31)	(3.70)
Activities	-	Yes	Yes	-	Yes	Yes
Bad loans	-	-	Yes	-	-	Yes
Log-likelihood	85.342	93.296	94.764	130.483	147.455	149.411

'Environment' means that regional dummies are included in the estimation of the cost frontier. 'Equity' refers to the inclusion of the bank's equity in the estimation of the cost frontier. N=747 for the first period, N=471 for the second period. Absolute t-statistics in parentheses, *, **, *** denote an estimate significantly different from zero at the 10%, 5% or 1% level

Figure 1 Sberbank's dominance in personal deposit market



Source: own calculations based on CBR Bulletin of Bank Statistics and Sberbank

ANNEX

Table A.1 Means of key variables for private and public banks, size-matched sample

	2002		2006	
	Private banks	**Public banks**	**Private banks**	**Public banks**
Characteristics				
Total assets	5,151.91	7,401.68	8,121.43	32,322.32
Total costs (production)	203.89	281.03	388.71	1,108.36
Total costs (intermediation)	240.25	339.56	459.19	1,352.25
Loans	3,911.10	4,898.84	6,058.27	23,751.46
Deposits	3,763.33	5,315.51	6,332.80	25,765.57
Investment assets	325.33	915.25	1,143.52	5,345.11
Price of labor	0.0083	0.0112	0.0087	0.0087
Price of physical capital	2.4495	1.2885	2.1035	1.5660
Price of borrowed funds	0.0105	0.0086	0.0125	0.0111
Equity/total assets	0.2149	0.2313	0.1448	0.1341
Bad loans / loans	0.0207	0.0229	0.0203	0.0107
Loan activities				
Household loans / loans	0.0495	0.0248	0.1632	0.1591
Firm loans / loans	0.6163	0.6586	0.6431	0.6606
Government loans / loans	0.0099	0.0111	0.0074	0.0189
Bank loans / loans	0.3243	0.3055	0.1862	0.1614
Deposit activities				
Household dep./ deposits	0.1977	0.1204	0.3755	0.3561
Firm deposits / deposits	0.5180	0.5858	0.4606	0.3872
Government dep. /deposits	0.0359	0.1438	0.0186	0.1452
Bank dep. / deposits	0.2484	0.1501	0.1454	0.1115
Environment				
Moscow area	0.6016	0.5882	0.5106	0.4167
Number of observations	492	68	564	48

Table A.2 Further size-matched results

Panel B *Public banks defined as banks that receive a high share of interest income from government bodies,* production approach

Pre-generalized deposit insurance (2002)				
Frontier characteristics	***(a) environment***	***(b) equity and environment***	***(c) environment and activities***	***(d) equity and environment and activities***
Intercept	Yes	Yes	Yes	Yes
Public banks	-2.934	-3.236**	-0.993	-0.994
	(1.40)	(2.03)	(0.43)	(0.45)
Foreign banks	0.655	1.050	0.065	0.045
	(1.01)	(1.62)	(0.26)	(0.12)
Household deposits %	2.451	3.363**	-	-
	(1.28)	(1.97)		
Firm deposits %	7.025*	7.719***	-	-
	(1.80)	(2.62)		
Household loans %	2.563	3.115**	-	-
	(1.47)	(2.19)		
Firm loans %	2.356*	2.064	-	-
	(1.83)	(2.43)		
Bad loans %	13.430***	7.458	6.477	6.806
	(2.14)	(4.39)	(1.50)	(1.15)
Log-likelihood	-399.040	-397.810	-390.961	-390.958
Post-generalized deposit insurance (2006)				
Intercept	Yes	Yes	Yes	Yes
Public banks	-0.386	-0.232	-3.680*	-2.779*
	(0.93)	(0.93)	(1.91)	(1.70)
Foreign banks	-1.221***	-0.940***	-1.943**	-1.490**
	(6.42)	(18.57)	(2.41)	(2.27)
Household deposits %	-0.586**	-0.036	-	-
	(2.23)	(0.95)		
Firm deposits %	-0.049	0.107***	-	-
	(0.27)	(2.72)		
Household loans %	0.718***	0.665***	-	-
	(2.81)	(4.11)		
Firm loans %	0.808***	0.329***	-	-
	(3.72)	(5.13)		
Bad loans %	-0.251	0.881***	-4.794	-5.458
	(0.24)	(4.89)	(0.93)	(0.77)
Log-likelihood	-365.493	-320.609	-350.452	-340.378

Panel C Public banks defined as state-owned banks, intermediation approach

Pre-generalized deposit insurance (2002)				
Frontier characteristics	***(a) environment***	***(b) equity and environment***	***(c) environment and activities***	***(d) equity and environment and activities***
Intercept	Yes	Yes	Yes	Yes
Public banks	-2.431	-3.593	-5.097	-5.466**
	(1.36)	(1.19)	(0.60)	(2.06)
Foreign banks	-0.008	0.158	0.503	1.609*
	(0.02)	(0.51)	(0.33)	(1.65)
Household deposits %	-0.407	0.126	-	-
	(0.36)	(0.07)		
Firm deposits %	0.045*	6.680	-	-
	(1.76)	(1.48)		
Household loans %	-1.657	-2.028	-	-
	(0.74)	(1.58)		
Firm loans %	0.527	0.241	-	-
	(0.93)	(0.32)		
Bad loans %	9.552**	7.142	17.085	-0.539
	(2.10)	(1.56)	(0.79)	(0.14)
Log-likelihood	-327.203	-326.982	-333.275	-331.822
Post-generalized deposit insurance (2006)				
Intercept	Yes	Yes	Yes	Yes
Public banks	-1.304	-1.393*	-1.478	-1.619
	(1.62)	(1.87)	(0.68)	(1.20)
Foreign banks	-2.031**	-2.080*	-2.760	-2.668
	(2.03)	(1.85)	(0.82)	(1.25)
Household deposits %	-4.213**	-4.195**	-	-
	(2.34)	(2.11)		
Firm deposits %	0.181	0.255	-	-
	(0.35)	(0.69)		
Household loans %	1.548**	1.606*	-	-
	(1.99)	(1.94)		
Firm loans %	1.538*	1.450**	-	-
	(1.91)	(2.19)		
Bad loans %	0.404	0.242	-4.044	-4.117
	(0.15)	(0.15)	(0.63)	(0.90)
Log-likelihood	-220.328	-218.397	-205.273	-200.991

Panel D *Public banks defined as banks that receive a high share of interest income from government bodies,* intermediation approach

Pre-generalized deposit insurance (2002)				
Frontier characteristics	***(a) environment***	***(b) equity and environment***	***(c) environment and activities***	***(d) equity and environment and activities***
Intercept	Yes	Yes	Yes	Yes
Public banks	-3.323	-4.430	-13.875	-13.125***
	(1.34)	(0.66)	(1.21)	(2.57)
Foreign banks	0.127	0.353	0.685	1.840*
	(0.42)	(0.35)	(1.06)	(1.93)
Household deposits %	0.276	0.846	-	-
	(0.23)	(0.29)		
Firm deposits %	4.403*	6.259	-	-
	(1.72)	(0.67)		
Household loans %	-1.394	-1.884	-	-
	(0.85)	(0.55)		
Firm loans %	0.422	0.212	-	-
	(1.09)	(0.30)		
Bad loans %	9.870**	8.760	15.098	1.318
	(2.02)	(1.09)	(1.54)	(0.53)
Log-likelihood	-331.408	-331.208	-334.246	-332.787
Post-generalized deposit insurance (2006)				
Intercept	Yes	Yes	Yes	Yes
Public banks	-1.464	-1.382	-2.555	-1.690
	(0.93)	(0.98)	(0.54)	(1.28)
Foreign banks	-1.775*	-1.832*	-2.449	-2.392
	(1.91)	(1.68)	(0.80)	(1.52)
Household deposits %	-3.826**	-3.849**	-	-
	(2.39)	(2.26)		
Firm deposits %	0.674	0.791	-	-
	(1.50)	(1.37)		
Household loans %	1.539*	1.622*	-	-
	(1.90)	(1.94)		
Firm loans %	1.686**	1.634**	-	-
	(2.41)	(2.06)		
Bad loans %	0.191	0.033	-4.504	-4.400
	(0.09)	(0.01)	(0.48)	(1.21)
Log-likelihood	-223.653	-222.113	-205.615	-201.543

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