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This paper adds to the literature on banking in transition with regard to the comparative efficiency of public, private and foreign banks. We perform stochastic frontier analysis (SFA) of Russian bank-level quarterly data from 2005 to 2013. The method of computation of comparative cost efficiency is amended to control for the effect of the revaluations of foreign currency items in bank balance sheets. All public banks are split into the core and other state-controlled banks. We employ the generalized method of moments to estimate a set of distance functions measuring the observed differences in the SFA scores of banks and bank clusters, depending on the heterogeneity in risk preference and asset structure. These distance functions explain the changes in bank efficiency rankings. Our results on comparative bank efficiency are qualitatively different from those in mainstream papers. The efficiency scores of Russian banks are higher and less volatile, and spreads between the scores of different bank types are narrower than hitherto believed. Foreign banks appear as the least cost-efficient type of market participants, while the core state banks are, on average, nearly as efficient as domestic private banks. We suggest that foreign banks are capable of being more cost efficient than others if they increase loans-to-assets ratios above the sample median level. Core state banks, conversely, lead in terms of cost efficiency if their loans-to-assets ratio falls below the sample median level. Our approach is potentially applicable to the analysis of bank efficiency in other dollarized emerging markets.

Key words: banks, comparative efficiency, SFA, state-controlled banks, Russia

JEL codes: G21, P23, P34, P52

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1. Introduction

Bank efficiency becomes a relevant issue as the Russian economy slows down and the Central Bank of Russia (CBR) tightens its prudential regulation. In order to hold competitive positions, each of the remaining Russian banks needs to optimize their cost structure, but different bank types have different scope for doing so. Their cost efficiency depends on various characteristics including ownership type (public, private, etc.), risk preferences, and assets composition.

In their influential paper, La Porta, López-de-Silanes and Shleifer (2002) argue that government ownership of banks leads to their inefficiency and hinders financial development, although subsequent empirical papers often advocate for a more qualified and nuanced approach (Andrianova, Demetriades, Shortland, 2012; Körner, Schnabel, 2011). Several other authors have approached the subject of comparative bank efficiency in transition countries, shaping the mainstream of empirical findings. Bonin, Hasan and Wachtel (2005a) find foreign-owned banks to be more cost-efficient than other banks in eleven transition economies in 1996-2000. Those banks also provide better service, in particular if they have a strategic foreign owner. However, government-owned banks are not appreciably less efficient than domestic private banks. In a narrower sample of the largest banks in six transition countries (Bulgaria, Croatia, Czech Republic, Hungary, Poland and Romania) the computations support the hypothesis that foreign-owned banks are the most, and government-owned banks the least, efficient (Bonin et al., 2005b).

Fries and Taci (2005) examine the cost efficiency of 289 banks in 15 Eastern European countries and suggest that a higher share of foreign-owned banks in total assets leads to lower costs, although the association between a country's progress in banking reform and cost efficiency is non-linear: initial cost reductions are succeeded by rising costs at more advanced stages. Private banks are more efficient than state-owned banks, but there are differences among private banks. Privatized banks with majority foreign ownership are the most efficient and those with domestic ownership are the least.

Employing Data Envelopment Analysis (DEA) to examine bank-level efficiency in a wide range of transition countries, Grigorian and Manole (2006) discover that foreign ownership with controlling power and enterprise restructuring enhances commercial bank efficiency.

Fries et al. (2006) estimate the margins and marginal costs of banks in transition countries and show that state banks under-perform vis-à-vis private banks in controlling costs and attracting demand throughout the period of observation (1995-2004). In 1995–1998, privatized banks earned higher margins than other banks and had the largest mark-ups, while foreign start-ups had lower marginal costs. In 2002–2004, privatized domestic banks still had the widest margins, but differences among private banks diminished, and foreign banks remained low marginal cost service providers.

The technical efficiency of Russian banks has been researched by Caner and Kontorovich (2004), Golovan (2006), Golovan, Karminsky and Peresetsky (2008), Belousova (2009), Peresetsky (2010), Karas, Schoors and Weil (2010) and Mamonov (2013). Karas et al. (2010) note that while foreign banks are found to be more efficient than domestic private banks, the latter are, unexpectedly, not more efficient than public banks. State-controlled banks might actually be the market leaders in terms of operational efficiency expressed through a cost-to-income ratio (Mamonov, 2013).

Russia remains a special case among transition countries in various senses. The share of foreign banks in total bank assets did not exceed 20%. Unlike Central and Eastern Europe where public banks have become extinct, in Russia they have increased their market share to nearly 60% (Vernikov, 2014). The spontaneous privatization of the 1990s crushed the system of state-owned specialized banks (Schoors, 2003) but it failed to create efficient private ownership.

The reason why we revisit the interplay between bank ownership and cost efficiency in Russia is that one factor has escaped the careful attention of scholars so far, namely the relevance of the revaluations of all foreign currency items on Russian banks' balance sheets (hereinafter *Revals*) to the bank profit-and-loss statements. Russia, just like many other transition and emerging countries, has long remained a dollarized and volatile economy. Previous research on banking in transition employs data that reflect gross bank incomes/costs; therefore the effect of *Revals* may have influenced group efficiency ranks, especially during periods of financial turmoil. *Revals* are a non-core item as they bear little relation to the essence of operating cost efficiency, so we argue that by dropping them one can improve the accuracy of efficiency estimates.

Our key research question relates to the comparative efficiency of Russian banks after we control for the distorting effect of *Revals*. To prove the existence of such a distorting effect we compare the efficiency estimations obtained with *Revals* kept and with *Revals* dropped from the operating costs. Not only do we wish to find out which bank group leads in terms of efficiency and how much room for improvement there is, but also what drives intra-group heterogeneity of banks' ranking on efficiency[3]. Specifically, we are interested in whether the asset composition and risk preference of each bank are responsible for such heterogeneity. This essentially distinguishes us from previous research that analyzed, through the dummy variables approach, the averaged efficiency ranking of various banks groups over the sample period considered. Also, we check the pre-crisis findings of Karas et al. (2010) regarding the efficiency of public banks, in view of their high relevance for Russia, and show how their efficiency ranking have been changing over the 2005-2013 period, i.e. including post-crisis dynamics.

[3] The closely related issue of what drives the changes in bank efficiency rankings over time we leave for future research.

In contrast to other literature on comparative bank efficiency in emerging markets, we:

(1) Show the materiality of *Revals* for Russian banks' financial results and the uneven distribution of *Revals* among banks;

(2) Control for the effect of *Revals* in the stochastic frontier analysis (SFA) of comparative cost efficiency of different bank groups in Russia by performing alternative calculations with *Revals* kept and dropped;

(3) Modify the grouping of Russian banks ownership-wise by differentiating between core state banks and other state-controlled banks and by focusing on the foreign bank subsidiaries within all banks controlled by foreign persons;

(4) Introduce an addition to the regression analysis by distinguishing bank-specific factors that explain the rankings of each bank at each point of observation. In particular, we specify a set of empirical equations to show how average rankings between different banks can vary depending on changes in bank risk preference or asset composition.

We expect the *contribution* of this paper to be two-fold:

(1) Qualitatively different results of comparative bank efficiency when *Revals* are dropped. Efficiency scores become higher and less volatile across the board; spreads between different types of Russian banks shrink. Efficiency ranks of bank groups differ from those in previous research: the group of foreign banks appears as the least efficient type of market participants, while the core state banks are, on average, nearly as efficient as domestic private banks;

(2) Empirical explanation of average ranking of bank groups variation depending on banks' risk preference or assets composition. Foreign banks are capable of being more cost efficient than others if they increase loans-to-assets ratios above the sample median level. Conversely, if the loans-to-assets ratio falls below the sample median level, it ensures the superiority of the core state banks in terms of cost efficiency.

The rest of the paper is organized as follows. Section 2 offers empirical evidence of the polluting effect of currency and securities revaluations on Russian bank revenues and costs. In Section 3 we describe our data, methodology and empirical strategy. Section 4 contains the estimation results and their discussion. Section 5 reports the robustness checks. Section 6 concludes.

2. The revaluations of foreign currencies and securities and their impact on bank profit-and-loss accounts

Quite a large share of Russian banks' operations is denominated in foreign currency, mostly US dollars and euros. Before the 2008 financial crisis, that share was 29.8% in assets and 29.5% in liabilities. It was 35.2% and 31.2%, respectively, two years later (**Table 1**). The mismatch be-

tween those figures reflects the large and positive net foreign currency position of the Russian banking sector. After the crisis subsided, the share of foreign currency items in balance sheets gradually declined to 22.1% of all assets and 21.2% of liabilities at the end of 2013 but remains economically significant. From 2014 onward, data are likely to demonstrate a new upward trend.

The financial crisis of 2008 brought about a flight to quality expressed through a conversion of ruble holdings and the related bank assets and liabilities into foreign currency. The ruble depreciated cumulatively by 28% against the US dollar and by 21% against the euro, thus generating *Revals* of foreign currency-denominated items on bank balance sheets. During 2008-2009, the ratio of positive *Revals* to total assets of the banking system increased sharply from 11.7% to 68.4%, while the ratio of negative *Revals* rose identically from 11.8% to 68.5%. That compares to the ratios of interest income to total assets of just 9.3% or interest expenses to total assets of 5.1% in 2009 (**Table 1**). By the end of the sample period (2013 Q4), the ratios of positive and negative *Revals* to assets declined to 26.8% and 26.7%, respectively, remaining at double the pre-crisis level.

Positive *Revals* and negative *Revals* are by far the largest item of Russian banks' total income and total costs, respectively. However, the net effect of *Revals* is very small at between -0.1% and 0.1% of total assets, *Revals* would not matter at all if they were uniformly distributed among banks in the sample, i.e. if all or the majority of banks displayed the same share of *Revals* in their total costs at each point of time. In that case, *Revals* would not affect the results of estimation in terms of bank ranking by cost efficiency. However, this is not the case with Russian banks. The distribution of *Revals*' share in costs is not uniform both in terms of the number of banks (**Fig. 1.a**) and their shares in total banking system assets before, during and after the 2008 crisis ranges from almost 0% to 95% (**Fig. 1.b**). **Fig. 2.a** additionally illustrates how the *Revals* evolved over time in different percentiles of banks' distribution.

We observe a sharp increase of *Revals* during the crisis of 2008-2009 in almost every percentile of the distribution; after the crisis, the *Revals* remain rather high. At the same time, just a small minority of banks gains economically significant profits from net *Revals* (**Fig. 2.b**).

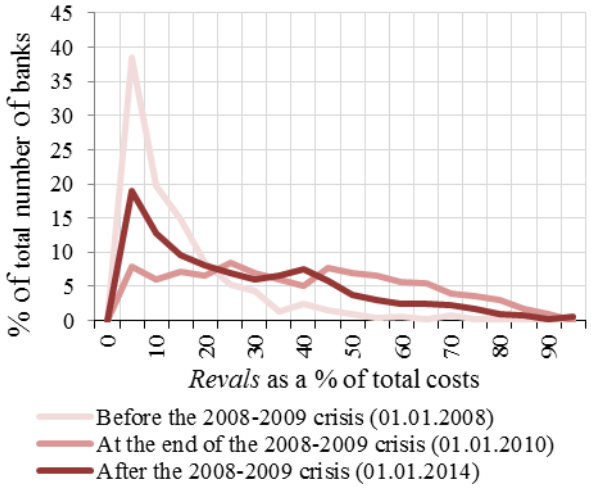
While the currency composition of bank assets is a management choice and an operative decision, *Revals* bear little relation, if any, to the essence of bank cost efficiency that presumably should be within the control of management. *Revals* instead reflect the action of an exogenous factor, namely the exchange rate of the national currency. Currency *Revals* may substantially fluctuate depending on national currency exchange rate dynamics, especially in a dollarized commodity economy like Russia's. In a similar fashion, the revaluation of securities, despite being economically meaningful, is also alien to the operating efficiency concept. The distorting potential of *Revals* increases during periods of financial turmoil (**Fig. 2.a**).

Table 1

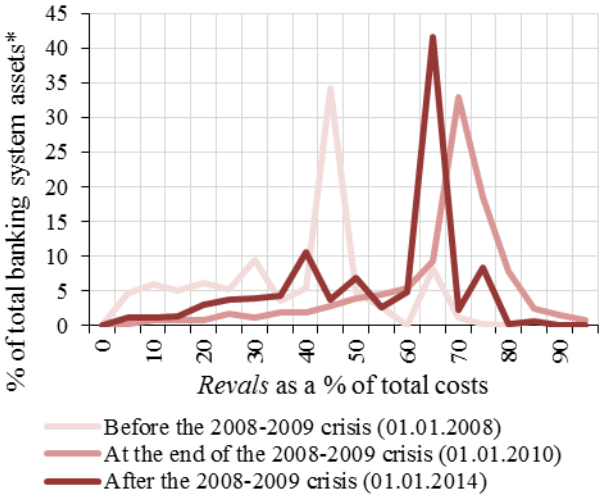
The breakdown of profits and losses of the Russian banking system (as a ratio of total assets, in %)

	The 2008-2009 crisis			
	before	during	after	
	2007Q4	2009Q4	2011Q4	2013Q4
Total income	*40.7*	*105.4*	*65.7*	*53.9*
Interest income	6.9	9.3	6.7	7.7
Income from operations with securities	2.7	2.7	1.4	2.5
Positive securities revaluation	1.0	0.3	0.4	0.1
Income from operations in foreign currency	15.0	76.9	43.3	30.9
Income from positive revaluation of assets and negative revaluation of liabilities both denominated in foreign currency	11.7	68.4	37.5	26.8
Fee and commission income	1.8	1.6	1.4	1.4
Income from decreasing of loan loss provisions (+LLP)	10.7	12.2	9.6	8.4
Other income	3.6	2.8	3.5	2.9
Total costs	*38.4*	*104.9*	*64.1*	*52.5*
Interest expenses	3.2	5.1	3.1	3.8
Expenses due to operations with securities	2.1	2.1	1.3	2.4
Negative securities revaluation	0.4	0.2	0.5	0.1
Expenses due to operations in foreign currency	14.8	76.7	43.1	30.8
Expenses due to negative revaluation of assets and positive revaluation of liabilities both denominated in foreign currency	11.8	68.5	37.5	26.7
Fee & commission expenses	0.2	0.2	0.2	0.3
Expenses due to increasing of loan loss provisions (-LLP)	11.5	15.4	9.8	9.5
Personnel expenses	1.9	1.5	1.6	1.5
Other expenses	4.8	4.0	5.0	4.3
Profit (after LLP and taxation)	*2.3*	*0.4*	*1.7*	*1.4*
Net interest income	3.4	3.7	3.0	3.4
Net income from operations with securities	0.9	1.2	0.7	0.6
Net securities revaluation	0.7	0.5	0.0	0.0
Net income from operations in foreign currency	0.2	0.2	0.2	0.2
Net foreign currency revaluation	–0.1	–0.1	0.1	0.1
Net fee & commission income	1.7	1.4	1.2	1.1
Net income from decreasing of loan loss provisions	–0.8	–3.3	–0.3	–1.1
Personnel expenses (with "-" sign)	–1.9	–1.5	–1.6	–1.5
Net other income	–1.2	–1.2	–1.6	–1.4
Net foreign currency position	*0.3*	*4.0*	*2.9*	*0.9*
Assets in foreign currency	29.8	35.2	30.3	22.1
Liabilities in foreign currency	29.5	31.2	27.4	21.2

Source: own calculations based on the CBR database of bank balance sheets and profit-and-loss statements



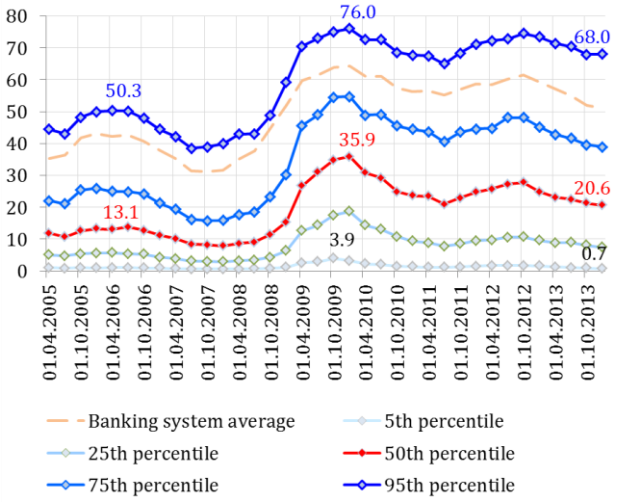
(a) Distribution by the number of banks



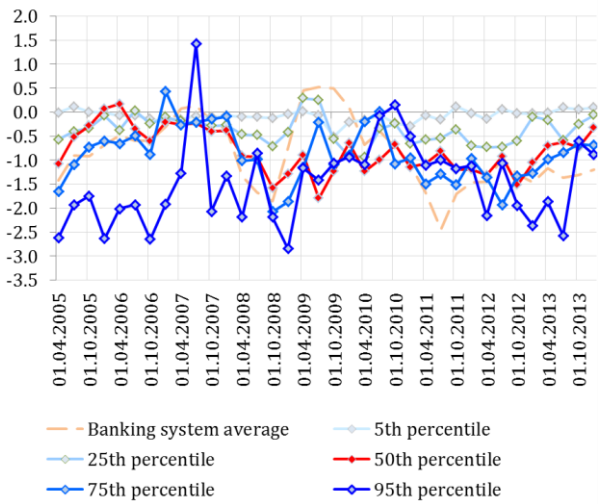
(b) Distribution by the share in total assets of the banking system

Notes: * The peaks correspond to Sberbank that holds about 30% of total banking system assets.

Fig. 1. Frequency distribution of banks according to the materiality of *Revals*



(a) Negative *Revals* as percentage of total costs



(b) Net *Revals* (positive *Revals* minus negative *Revals*) as percentage of total income

Fig. 2. The shares of *Revals* in total costs and revenues in different percentiles of banks distribution

To sum up, *Revals* are economically significant and are not uniformly distributed among Russian banks. We think that by dropping the *Revals* from the total costs we can get closer to the essence of operating costs and perform efficiency estimates more accurately. In Section 4 we show how doing this affects the results.

3. Data and methodology

In this section, we start with the dataset description and then explain our methodology of comparative efficiency analysis: (1) the estimation of cost frontier, (2) computation of bank-level time-varying cost efficiency scores via SFA, (3) regressing these scores on the set of ownership dummies and their interactions with risk preferences and assets composition measures, control-

ling for other bank-specific and macroeconomic variables, and (4) the calculation of the distance function values extracted from the previous step and representing the bank-specific differences between banks from various ownership groups.

3.1. Data

To feature bank-specific factors, we obtain disaggregated bank-level data from Russian bank balance sheets and profit-and-loss (P&L) statements disclosed through the Central Bank of Russia (CBR) website[4]. We use the monthly bank balance sheets (official reporting form No. 101) from March 2004 through December 2013 and the quarterly P&L statements (reporting form No. 102) from 2004 Q1 through 2013 Q4. We combine these two forms into a quarterly panel dataset. While the Form 101 provides stock data, the Form 102 is organized as flow data that builds up cumulatively from one quarter to another within each year. We rearrange these data as moving sums for four consecutive quarters, so we lose observations within 2004 and start our resulting sample period from 2005 Q1. This allows us to interpret factor input prices used in the cost frontier estimations (Section 3.3) as annual rather than quarterly, which is more useful when comparing with interest rates provided by the CBR in its Banking Supervision Reports[5].

The initial sample includes all Russian banks that disclose financial accounts data, i.e. up to 1,248 financial institutions within 2005Q1 - 2013Q4 representing 95% of total Russian banking system assets, on average. It results in a maximum of 36,422 bank-quarter observations in a pooled sample. Disaggregating these pooled data into quarter level, we have statistics on 803 banks as a minimum in 2005Q4 and 1,015 banks as a maximum in 2009Q4. The gap between these two quarterly numbers and the number of banks in the pooled data shows that the sample is quite unstable, i.e. we have many newly created banks along with many banks that left the market during the sample period.

Quarterly based macroeconomic variables were collected from the Federal State Statistics Service website (www.gks.ru) for the same period and include real GDP growth rates (per four moving quarters), real households income growth rate (per four moving quarters), and non-financial firms' profit-to-debt ratio. In addition, we use daily data on the ruble exchange rate to a bi-currency basket (USD 0.55 and EUR 0.45) from the analytical agency Finam (www.finam.ru).

[4] http://www.cbr.ru/credit/forms.asp Data from the same source are used in many studies on Russian banks, e.g.: (Chernykh, Cole, 2011; Anzoátegui et al., 2012; Karas et al., 2013).

[5] http://www.cbr.ru/eng/publ/?PrtId=nadzor

3.2. Bank groups

Using the data described above, this paper breaks down the sample of Russian banks into four categories: core state-controlled banks[6], other state-controlled banks, foreign bank subsidiaries, and all other Russian banks.

Many papers on comparative banking in transition divide the sample into three groups: state-owned banks, domestic private banks and foreign banks. Alternative bank classifications based on the type of ownership have emerged to address a particular research question related to comparative bank efficiency. Bonin et al. (2005a) consider four bank categories – namely, those with majority government ownership, majority domestic private ownership, strategic foreign ownership, and other foreign majority ownership – in the attempt to capture the effect of a particular type of foreign ownership. Fries and Taci (2005) distinguish between privatized banks with majority foreign ownership from those with domestic ownership. Grigorian and Manole (2006) introduce a dummy for foreign ownership (1 if more than 30% owned, 0 otherwise) without specifying within domestically owned banks. Havrylchyk and Jurzyk (2011) distinguish newly established ("greenfield") foreign banks from those who took over existing entities in the host country, in order to assess the importance of the market entry mode by foreign banks.

In countries with a vast public sector, its breakdown into sub-categories may be appropriate. China's 'Big Four' state banks are analyzed separately from the other state-controlled banks (Berger, Hasan, Zhou, 2009). Russia, like China, has a sizable public banking sector consisting of up to 51 banks[7], depending on the point of observation, who jointly possess about 48-60% of all assets. We regard a bank as a state-controlled bank if it is majority-owned by a public entity. In the Russian case, a public entity may vary from the federal government to industrial companies and banks whose equity stems from public funds (Vernikov, 2012). State-controlled banks constitute a heterogeneous group with a broad intra-group variance in size, scope, business model, and governance. While the three largest ones often act as government agents and pursue a combination of financial and non-financial objectives (Vernikov, 2014), many of the smaller state-controlled banks, and particularly the indirectly-owned ones, display market behavior simi-

[6] We prefer the term 'state-controlled banks' over 'state-owned banks' because from a legal viewpoint one party cannot own a joint-stock company but only shares thereof. Importantly, few public banks worldwide remain 100%-owned by the government; many of them have sold sizeable stakes to outside investors including foreign ones. Thus, the term 'state-owned bank' appears to lack accuracy, despite its broad usage in the academic literature.

[7] We use various sources to classify bank owners as state, namely the websites of the banks in question, CBR, Bankscope, Banker's Almanac, etc. Like Bertay, Demirgüç-Kunt and Huizinga (2015), we only include in the sample banks that we can identify to be owned by public entity (-ies) with a 50% or higher ownership share. Moreover, we identify the presence of public institutions among the shareholders of the bank shareholders by screening the information disclosure of bank parent entities. The judgmental element is reduced to the minimum.

lar to that of domestic private institutions and are excused from on-lending public funds to government-supported projects.

Therefore, Russia's state banks are too many, their business models too diverse, and their market share too large (60%) to be treated as a single group. This specific industry structure warrants the introduction of additional sub-categories of state-controlled banks for the sake of a more accurate estimation of comparative efficiency. We introduce the group of core state-controlled banks (*State-1)* and other state-controlled banks (*State-2*), thus enhancing homogeneity within each of the groups. *State-1* comprises the three "national champions" (Sberbank, VTB and Rosselkhozbank) that control between 35% and 43% of the total banking assets in Russia. *State-2* consists of between 28 and 46 banks, depending on the quarter, that jointly own a market share of 19% (**Table A1** in Annex).

The group of foreign-controlled banks (*Foreign*) includes between 27 and 48 entities possessing 8-12% of total banking system assets. We focus on the fully owned foreign bank subsidiaries and the institutions predominantly owned by foreign banks such as Rosbank (Société Générale). We place substance over form and remove the following bank types:

(1) banks whose nominal shareholders are foreign but the final beneficiaries are Russian;
(2) banks controlled by foreign private individuals, institutional investors other than banks, international institutions and national development agencies, because we do not regard them as core strategic investors;
(3) banks controlled by industrial loan corporations, primarily the offspring of the foreign automotive companies (BMW, VW, Daimler, Toyota, PSA Peugeot Citroën, etc.) whose main business is the financing of car sales in the Russian market rather than commercial banking as such; and
(4) banks controlled by foreign investment companies ('investment banks') that mainly conduct financial market operations and do not pursue classical commercial bank business models.

We assume that the performance characteristics of banks controlled by foreign strategic investors shall be more coherent than those within a heterogeneous group that includes diverse bank types. Comparing the performance of foreign bank subsidiaries with that of state-controlled banks and private banks should therefore yield different results than those emerging from the previous studies of aggregated bank categories.

The remaining group of banks privately owned by Russian residents (*Private*) covers between 745 and 920 banks, with a market share ranging from 31% to 42% of all assets.

We revise the composition of each group every quarter to reflect possible migrations.

3.3. Empirical strategy

The literature on banking efficiency provides two alternatives for the estimation of cost (profit) frontier and its determinants: the two-step approach that separates frontier evaluation from the estimation of inefficiency covariates, and the one-step approach that determines and estimates both frontier and inefficiency covariates simultaneously[8]. Wang and Schmidt (2002) show that the two-step approach may lead to biased estimates because normally the inefficiency term is treated as a one-sided (positive) disturbance at the first step and as a two-sided disturbance at the second step. This has encouraged several authors to follow the simultaneous approach (Bonin et al., 2005; Karas et al., 2010). In spite of that, the use of the one-step approach becomes quite limited if a broader set of covariates is taken into account, i.e. not only dummies on bank groups, but also bank-specific characteristics like market power. Bank-level estimates of market power are usually based on the estimates of marginal costs (Lerner index or Boone indicator) that are obtained after the frontier is evaluated; hence, one cannot estimate the effect of market power on efficiency using the one-step approach. Although our focus is different, we are reluctant to omit the market power estimates from the list of bank-specific controls in our comparative efficiency analysis given the large body of literature on market power-efficiency nexus stating that market power is among the major factors determining efficiency (Maudos and Fernández de Guevara, 2007; Solís and Maudos, 2008; Turk Ariss, 2010). This literature follows the two-step approach, as do some papers within the comparative efficiency literature. For example, the above mentioned study on Chinese banks by Berger et al. (2009) follows the two-step approach, although it does not employ market power estimates at the second step. Thus, we follow the two-step approach, leaving the one-step alternative for a robustness check.

(1) *The specification of the empirical cost function*

We use stochastic frontier technique to compute time-specific rankings in bank cost efficiency. We specify the empirical cost function on the bank level within production approach taking into account prices of inputs, quantities of outputs and the equity netputs to control for banks differences in risk preferences (Turk Ariss, 2010; Fiordelisi, Marques-Ibanes and Molyneux, 2011). We prefer the production approach over intermediation approach for two main reasons: (a) to avoid possible bias of efficiency estimates due to incomplete assets and liabilities coverage in the intermediation approach (Fortin, Leclerc, 2007); and (b) to account for the fact that loans are funded not only by deposits but also by other sources such as inter-bank deposits, foreign liabilities, loans from the central bank, debt securities issued by banks, etc. When specifying the cost

[8] See a recent overview by Belotti et al. (2013) who discuss and implement various models within both one-step and two-step approaches into the Stata software.

function we take into account possible non-linear and non-neutral features of technical progress in the banking industry (Berger and DeYoung, 1997; Maudos and Fernández de Guevara, 2007; Turk Ariss, 2010; Fiordelisi et al., 2011).

Our key distinction from previous research is the treatment of *Revals*. We analyze the potentially distortive role of *Revals* in bank performance analysis by specifying two alternative empirical cost functions: (a) total costs minus interest expenses as a dependent variable; (b) the same as (a) minus *Revals*. We deduct interest expenses from total costs on the assumption that interest expenses reflect bank market power rather than its efficiency, following Berger and DeYoung (1997), Maudos and Fernández de Guevara (2007) and Solis and Maudos (2008). Our two alternatives for empirical cost function take the following (translog) form:

$$\ln OC_{it}^{(alt)} = \beta_0 + \sum_{j=1}^{3}\beta_j \cdot \ln Y_{j,it} + \frac{1}{2}\sum_{k=1}^{3}\sum_{j=1}^{3}\beta_{kl} \cdot \ln Y_{k,it} \cdot \ln Y_{l,it} + \sum_{m=1}^{3}\gamma_m \cdot \ln P_{m,it} + \frac{1}{2}\sum_{r=1}^{3}\sum_{q=1}^{3}\gamma_{rq} \cdot \ln P_{r,it} \cdot \ln P_{q,it} + \quad (1)$$

$$+ \sum_{s=1}^{3}\sum_{u=1}^{3}\delta_{su} \cdot \ln Y_{s,it} \cdot \ln P_{u,it} + \sum_{j=1}^{3}\varphi_j \cdot \ln Y_{j,it} \cdot T + \sum_{m=1}^{3}\psi_m \cdot \ln P_{p,it} \cdot T + \alpha_1 \cdot T + \alpha_2 \cdot T^2 + \mu_1 \cdot \ln EQ_{it} +$$

$$+ \mu_2 \cdot (\ln EQ_{it})^2 + \sum_{j=1}^{3}\rho_j \cdot \ln Y_{j,it} \cdot \ln EQ_{it} + \sum_{m=1}^{3}\xi_m \cdot \ln P_{m,it} \cdot \ln EQ_{it} + \eta \cdot T \cdot \ln EQ_{it} + v_{it} + u_{it}$$

where alt stands for two alternative compositions of cost so that $alt=1$ for operating costs with *Revals* kept, while $alt=2$ when *Revals* are dropped from the operating costs. Next, for bank i at time t $OC_{it}^{(alt)}$ are operating costs with *Revals* ($alt=1$) and without *Revals* ($alt=2$). $Y_{j,it}$ is a j-th output: loans to households and nonfinancial firms ($j=1$), retail and corporate deposits (without government and inter-bank accounts, $j=2$), fee and commission income as a proxy for noninterest-based output ($j=3$). $P_{m,it}$ is an m-th factor input price: average funding rate as a price of funds ($m=1$), personnel expenses to total assets ratio as a price for labor ($m=2$) and other non-interest and non-personnel expenses to total assets ratio as a proxy for the price of physical capital ($m=3$). EQ_{it} is equity capital as a netput factor reflecting differences in managers' risk preferences. T is the time trend. $v_{it}+u_{it}$ is a composite error term where $v_{it} \sim N(0,\sigma_v^2)$ is a random error that follows symmetric normal distribution (by assumption). $u_{it} \sim N^{+}(u,\sigma_u^2)$ captures cost inefficiency and is set to follow (positive) half-normal[9] distribution. In estimating empirical cost function we impose, standardly, linear homogeneity conditions on factor input prices as well as symmetry conditions.

[9] We also tested (positive) truncated form for the distribution of inefficiency term within Battese and Coelli (1995) model. Our key results remain qualitatively unchanged.

We estimate Eq.(1) over the 40 quarters of 2005-2013, which is quite a long period consisting of three sub-periods, i.e. the phases of pre-, during and post-crisis of 2008-2009. Although some changes in the underlying cost function may have occurred due to the destructive nature of the crisis, in our basic version we do not separate the estimations for these three sub-periods, for two reasons. Firstly, the 2008-2009 crisis was expeditiously tackled by the Russian government who (1) granted RUB 1,080 bln (3% of GDP in 2009) as subordinated loans or SPO to support systemically important banks and (2) developed more flexible instruments of liquidity support. As argued in Solntsev, Pestova, and Mamonov (2010), these measures softened the banking crisis in Russia eliminating its most destructive effects. The second reason is that the more flexible translog form of cost frontier implies time- and bank-specific relationships between costs and key explanatory variables; hence, the influence of the crisis may have already been accounted for[10].

Having estimated two alternative sets of parameters of cost function, we compute two versions of cost efficiency scores for bank i at time t:

$$SFA_{it}^{(alt)} = \exp\{-\hat{u}_{it}^{(alt)}\} \qquad (2)$$

where $\hat{u}_{it}^{(alt)}$ is an estimate of inefficiency term with *Revals* kept ($alt=1$) and with *Revals* dropped ($alt=2$).

(2) *The aggregation of bank-level cost efficiency scores into group-level characteristics*

The bank-level cost efficiency scores obtained at the previous step are aggregated into group-level scores. We break the entire sample into four groups (*State-1*, *State-2*, *Foreign* and *Private*), as explained in the Section 3.2. The purpose is to compare the performance of Russian banks with regard to their ownership status. We aggregate individual (bank-level) SFA scores for both alternatives, i.e. with *Revals* kept and dropped, in order to arrive at group-level characteristics that would reflect the same two alternatives. We take a simple arithmetic average and a weighted average (with the weights equal to bank share in total banking system assets). We regard the arithmetic average as the basic approach because it provides equal weights to all banks within a particular group irrespectively to their scale and thus better reflects average movements. We complete this step by comparing group-level SFA scores for groups of banks as period averages and in dynamics.

[10] As a robustness check we re-estimated our cost function on the post-crisis sub-periods and found no qualitative changes of our baseline results.

(3) *The estimation of bank-level sources of efficiency heterogeneity*

Finally, we proceed with the heterogeneity analysis in order to explain the observable differences in cost efficiency levels, e.g. SFA scores from Eq.(2), both within a particular group of banks (the core- and the rest of state-controlled banks and foreign-controlled banks) and between them. The motivation is that efficiency ranking may depend on bank-specific factors and thus some banks from one group can be more cost efficient than banks in another group even if on the group level the average ranking is different. It is important to find out why and when some banks from a less efficient group can be more efficient than banks with similar characteristics from a more efficient group. We use bank-specific factors such as the loans-to-assets ratio to catch differences in funds allocation between interest-generating and noninterest-based activities, and the equity-to-assets ratio to manage the variation in risk tolerance. Following Solís and Maudos (2008), Maudos and Fernández de Guevara (2007) and Turk Ariss (2010), we specify the following set of empirical equations under a static panel framework[11] :

$$SFA_{it}^{(alt)} = \alpha_{h,i} + \sum_{j=1}^{3} \beta_{hj} GROUP_j + \sum_{j=1}^{3} \gamma_{hj} GROUP_j X_{h,it} + \gamma_h X_{h,it} + \qquad (3)$$

$$+ \sum_{k=1}^{K} \delta_{hk} BSF_{k,it} + \sum_{m=1}^{M} \varphi_{hm} MACRO_m + \varepsilon_{h,it}$$

where for the bank i at time t, $SFA_{it}^{(alt)}$ is the cost efficiency score from Eq.(2) computed with *Revals* ($alt=1$) and without *Revals* ($alt=2$). $X_{h,it}$ is h-th potential candidate for efficiency heterogeneity factors. We consider more general bank-specific characteristics for $X_{h,it}$: equity-to-assets ratios ($h=1$) and loans-to-assets ratios ($h=2$) that are assumedly responsible for bank-level heterogeneity of SFA scores within a particular $GROUP_j$ as well as between all three groups considered: the core state-controlled banks ($j=1$), the rest of the state-controlled banks ($j=2$) and foreign-controlled banks ($j=3$), while private domestic banks are treated as the reference group. $BSF_{k,it}$ is k-th bank-specific factor that may affect cost efficiency: size, share of retail loans in total loans, loans dynamics, loans-to-deposits ratio, and market power (price mark-up as measured by the Lerner index adjusted for both banks' cost inefficiencies, as in Koetter et al. (2012), and banks' funding rates, similar to Solís and Maudos, 2008). $MACRO_m$ is m-th macroeconomic factor to control for business-cycle, ruble volatility and borrowers' creditworthiness.

[11] Exploring possible persistency in the behavior of operating costs under the dynamic panel framework remains beyond the scope of this paper and the mentioned studies.

As a basic estimator of Eq.(3), we exploit 2-step GMM to address possible endogeneity and heteroscedasticity concerns. As instruments, we use the two first lags of all endogenous, i.e. bank-level, variables.

Our main hypotheses regarding chosen heterogeneity factors $X_{h,it}$ are as follows.

First, larger equity relative to assets provides the potential for maintaining and expanding commercial loans that are among the three outputs included into our cost function. The higher equity-to-assets ratio a bank has, the greater its outputs could be with the same volume of costs. Thus, it implies higher SFA scores. So, if j-th banks group ($GROUP_j$) is on average less efficient compared to the reference group (privately-owned banks), then we would expect that increasing such banks equity-to-assets ratios would reduce their distance to the reference group and, probably, overcome it. This is in line with Berger and Mester (1997) who claim that more prudent banks could be those with higher efficiency levels. On the other hand, holding more capital could be costly as it implies lower lending activities in the current period (Koetter, Poghosyan, 2009; Williams, 2012). We wish to investigate which of these competing effects are predominant in the Russian banking system and for each $GROUP_j$. We include equity capital at both steps, i.e. in the cost frontier and in the efficiency equation. By doing so, we do not treat a bank as inefficient in case it becomes more risk-averse, but at the same time we understand that risk aversion may require additional costs and/or provide some benefits through the prudent-efficient hypothesis of Berger and Mester (1997).

Second, intensifying lending activities may facilitate economy of scale effects so that increasing the loans-to-assets ratio may positively affect cost efficiency (SFA score) (Solís and Maudos, 2008; Williams, 2012). Similarly to the previous case, j-th banks group ($GROUP_j$) could shorten the distance between them and the reference group by increasing the loans-to-assets ratio. At the same time, increasing loans requires more costs for borrowers screening which could lower cost efficiency (Williams, 2012). As in the previous case, we are to define empirically the prevailing effect in the Russian banking system.

On the basis of Eq.(3), we then determine the distances between each $GROUP_j$ and the referent group in terms of SFA scores. We refer to that as distance functions and apply them to answering the question how the groups' efficiency ranking may depend on bank-specific factors $X_{h,it}$. These functions can be represented as follows:

$$\Delta SFA_{j,it}^{(alt)} = \beta_{hj} + \gamma_{hj} X_{h,it} \qquad (4)$$

For each bank i from $GROUP_j$, $\Delta SFA_{j,it}^{(alt)} < 0$ ($\Delta SFA_{j,it}^{(alt)} > 0$) implies that this bank is less (more) cost efficient as compared to the average privately-owned bank.

Typically, previous research analyzed only the first components of the right hand side of Eq.(4), i.e. β_{hj}, which are time-invariant (Bonin et al., 2005; Karas et al., 2010).

Before estimating Eq.(1)-Eq.(4), we employ common filtering procedures to our panel dataset in order to deal with outliers. First, we exclude the data below the 1st and above the 99th percentiles of the initial sample. That applies to data on relative indicators including factor input prices in Eq.(1) and all bank-specific variables in Eq.(3) with the exception of bank size in order not to drop the largest banks such as Sberbank or VTB. Further, we drop the observations with loans-to-assets ratio smaller than 10% in order to focus on banks providing credit to the economy and to eliminate entities that do not function as genuine banks (Schoors, 2000; Karas, Schoors, 2010). After these filtering procedures we have an unbalanced panel data on 1,038-1,196 entities, and the number of observations ranges from 17,401-20,319 in Eq.(3) to 29,082-29,146 in Eq.(1).

4. Estimation results and discussion

In this section, we present and discuss our empirical results obtained from cost frontier estimations (Section 4.1), the aggregation of bank-level SFA scores into group-level (Section 4.2) and the analysis of bank-level and group-level heterogeneity of estimated SFA scores tracing the changes in efficiency ranking of different groups of banks (Section 4.3).

4.1. Bank-level cost efficiency

Descriptive statistics of variables included in the empirical cost functions appear in **Table A2** in the Annex, and the estimation results of the cost functions are in **Table A3** in the Annex. In **Table 2,** we present SFA scores calculated for three distinct percentiles of the distribution – 25th, 50th, and 75th – and then averaged within the whole sample period (2005Q1 – 2013Q4). These values allow us to reveal the scope of differences between less efficient (p25) and more efficient (p75) banks in both alternatives of SFA score computation, i.e. with *Revals* kept and dropped. We also complement the analysis by the SFA scores averaged within two sub-periods: before and after the crisis of 2008-2009, to account for possible changes that occurred during the crisis.

Irrespectively of the phase of the business cycle, the average SFA scores calculated with *Revals* dropped ($alt=2$) are greater than the scores with *Revals* kept ($alt=1$) – 83.9% and 68.3%, respectively, in the 50th percentile for the whole period. When we keep *Revals*, the average SFA score deteriorates from 72.8% before the crisis to 66.0% after it, which is hard to interpret. By contrast, if *Revals* are dropped, the average SFA score grows slightly from 83.6% before the crisis to 84.1% after the crisis. On the one hand, these are technical results: when we exclude one element, such as negative *Revals*, from total costs and leave the same factor input prices, outputs and netputs, the resulting cost efficiency level must be higher. On the other hand, the

magnitude of this effect matters. If the resulting SFA score increase is small, then the necessity of dropping *Revals* is doubtful. However, such an increase turns out to be economically significant ranging from 8.5 to 27.6 percentage points (**Table 2**), despite the downward trend as we move from lower to higher percentiles of the SFA distribution.

Table 2

Bank-level operating cost efficiency (SFA scores, production approach) for different percentiles of bank distribution and within various time periods

	Whole period (2005Q1– 2013Q4)			Before the crisis of 2008-2009 (2005Q1– 2008Q2)			After the crisis of 2008-2009 (2010Q1– 2013Q4)		
	p25	p50	p75	p25	p50	p75	p25	p50	p75
(A) With *Revals* kept	50.9	68.3	82.0	59.3	72.8	83.3	46.9	66.0	81.8
(B) With *Revals* dropped	74.3	83.9	90.5	73.7	83.6	90.6	74.6	84.1	90.3
(B) less (A)	23.4	15.6	8.5	14.4	10.8	7.3	27.6	18.1	8.5

We also present the distributions of SFA scores in both alternatives as 2005 Q1 – 2013 Q4 averages (**Fig.3**). If we keep *Revals*, the peaks in the distribution range from 74 to 89% covering 30% of all bank-quarter observations, and the distribution is uniform. If we drop *Revals*, the majority of Russian banks are located within approximately 78-95% range of the SFA score. The peak of the distribution is reached at SFA scores between 90 and 95% covering about 22% of all bank-quarter observations, and the distribution is quite skewed to the right.

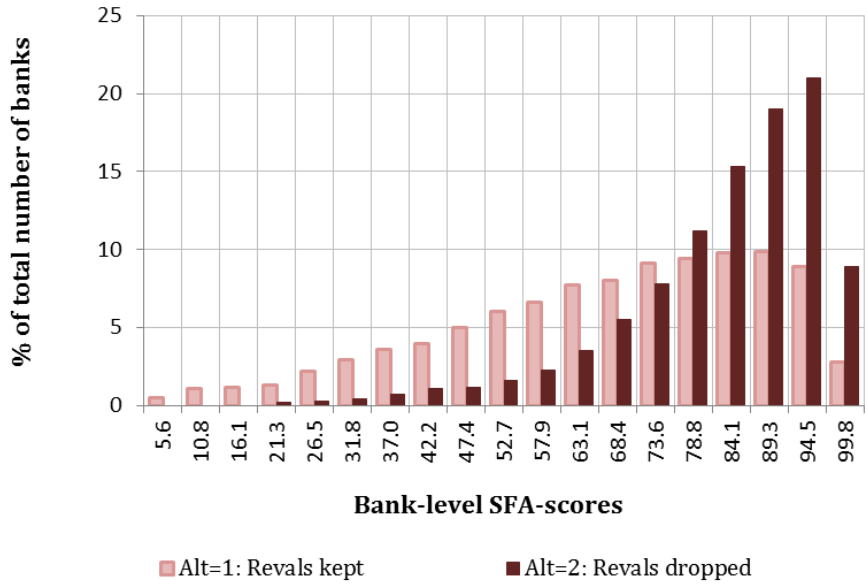


Fig. 3. Frequency distribution of banks' SFA scores as average of 2005Q1-2013Q4 (production approach)

Our estimated SFA scores (with *Revals* kept) are lower than those produced by some other authors. Turk Ariss (2010) estimates Russian banks SFA score to be 83% on average. Kumbhakar and Peresetsky (2013) arrive at an estimated average SFA score of 81% when comparing cost

efficiency of Russian banks to that of banks in Kazakhstan. The period and the scope might explain these differences. Turk Ariss builds a panel of 821 banks from 60 different countries including Russia; Kumbhakar and Peresetsky consider only 78 Russian banks, which is nearly one-tenth of the size of our sample. The period of observations of Turk Ariss is 1999-2005, and that of Kumbhakar and Peresetsky is 2002-2006, of which only two years (2005 and 2006) overlap with our sample period (from 2005 through 2013). We use quarterly data, whereas Kumbhakar and Peresetsky use annual data. Given that Russia is an emerging economy and the Russian banks were still advancing in the mid-2000s, SFA scores above 80% appear to be on the high side because they imply limited room for improvement in cost efficiency.[12] Our estimated average SFA level of 68% (with *Revals* kept, for comparability sake) might therefore look more credible.

4.2. Group-level cost efficiency

We proceed with the comparative analysis of cost efficiency levels of the four groups of banks for the whole sample period first and then in dynamics.

Estimation results for the group-level operating cost efficiency are SFA scores averaged across all banks constituting a particular group (**Table 3**). In Panel 1 and Panel 2 of this table, we put the descriptive statistics of SFA scores computed with *Revals* kept and dropped, respectively.

Table 3
Group-level operating cost efficiency (SFA scores, production approach) as averages of 2005Q1-2013Q4

Bank group	SFA score		Standard deviation	Min	Max	Obs.	No. of banks
	%	rank					
Panel 1: With *Revals* kept							
All groups	64.5		21.7	0.4	99.4	29113	1139
State-1	50.8	3	25.9	12.0	97.8	108	3
State-2	67.1	1	21.9	4.3	98.5	1204	61
Foreign	29.2	4	21.9	1.0	98.4	1177	49
Private	66.1	2	20.2	0.4	99.4	26624	1065
Panel 2: With *Revals* dropped							
All groups	80.1		14.1	2.1	99.8	29113	1139
State-1	75.5	3	18.6	34.9	98.0	108	3
State-2	78.2	2	15.2	20.8	98.7	1204	61
Foreign	60.3	4	19.9	6.9	97.9	1177	49
Private	81.1	1	13.1	2.1	99.8	26624	1065

Revals substantially affect the levels of cost efficiency of all four groups and their rankings, so it matters whether *Revals* are kept or dropped. Average SFA scores rise substantially from Panel 1 to Panel 2 for each particular group. Again, as in the previous section, we observe that these SFA

[12] Schaeck and Cihák (2014) estimate average EU banking system SFA score to be 88% for 1995-2005.

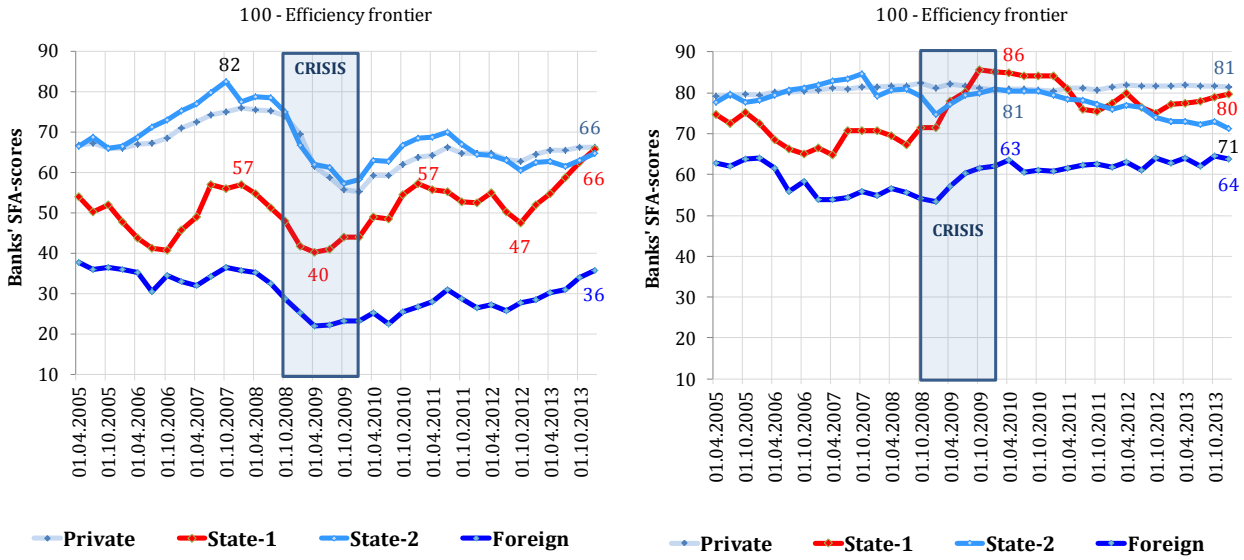
scores become less volatile when *Revals* are dropped. Next, the data in Panel 1 indicate that when *Revals* are kept, the highest SFA score (67.1%) belongs to non-core state-controlled banks (*State-2*) followed by domestic privately owned banks (66.1%), core state-controlled banks (50.8%) and foreign subsidiary banks (29.2%). Dropping the *Revals* upsets that ranking (Panel 2): the leading position goes to domestic private banks (81.1%), followed by non-core state banks (78.2%), core state banks (75.5%) and foreign banks (60.3%). SFA scores of *State-1*, *State-2* and private banks become closer. Foreign banks benefit the most from the procedure of dropping the *Revals*; although they remain at the bottom of the ranking, their average SFA score more than doubles.

The empirical result for foreign banks as the least efficient group of Russian market participants goes contrary to the mainstream of literature on banking in transition (Bonin et al., 2005a; 2005b; Fries, Taci, 2006; Grigorian, Manole, 2006; Fries et al., 2006; Karas et al., 2010). This result requires some interpretation. As shown theoretically by Mian (2006) and empirically by Lensink, Meesters and Naaborg (2008), substantial institutional differences between home and host countries – i.e. developed and transition ones in our case – can cause a negative impact of foreign ownership on banking efficiency, resulting from additional costs borne by foreign banks as compared to domestic banks. There are two alternative explanations for the lesser cost efficiency of foreign banks in Russia: (a) excessive capital adequacy and the relatively small loan portfolio of foreign banks at the initial period of penetration into the Russian market, impeding the exploitation of economies of scale; and (b) the risk aversion of foreign banks in the volatile Russian market with poor protection of property rights. The matter remains a direction for our future research.

The 2008 financial crisis may have produced structural changes, so we test it by performing the comparisons in dynamics and break down the observation period into different subperiods: pre-crisis, crisis and post-crisis, separately for *Revals* kept and dropped (**Fig. 4**).

The immediate finding is that after dropping the *Revals* we observe the spreads between different groups of banks in terms of efficiency shrink. It is consistent with the hypothesis that all players within a banking system are exposed potentially to the best available technology, so the status of banks (state-controlled or private) does not preclude them from approaching the best practice[13]. The inclusion of *Revals* in the bank financial results has blurred this effect hitherto.

[13] Altunbas, Evans and Molyneux (2001) compare different groups of banks within the German banking system and find small spreads in efficiency levels between government- and privately owned banks.



(a) With *Revals* kept (b) With *Revals* dropped

Fig. 4. SFA scores for different bank groups (arithmetic averages within each group; ranging from 0 for the least efficient to 100 for the most efficient)

Our second finding is that the ranking of bank groups is not constant over the period of observations, and the elimination of *Revals* affects the rankings, albeit in a different fashion than in **Table 3**. More specifically, if we keep *Revals*, then *State-2* is the most efficient group most of the time (**Fig. 4.a**). Without *Revals*, however, the leadership of any particular group in terms of cost efficiency is only temporary. Before the 2008 crisis, *State-2* and private banks were co-leading with SFA scores around 80% (**Fig. 4.b**). During the crisis (2008 Q4 – 2010 Q1), the SFA score of *State-1* jumped to 86% and ensured the lead for this group. This phenomenon may be due to the anti-crisis policies of the Russian government and an erosion of confidence in private banks, combined with aggressive marketing by the core state banks. In the post-crisis period, the core state-controlled banks were more efficient than the other state-controlled banks and nearly as efficient as domestic private banks. During this period, the *State-1* group had lost up to 9 percentage points of the SFA score (to 75% in mid-2011) and gradually yielded the top rank to the domestic private banks. These could be a consequence of increasing wages that were lowered by the core state-controlled banks during the crisis as compared to the wages offered in privately-owned banks[14]. But, having reached the floor of 75%, the SFA score of the *State-1* group turned to increase again and achieved 80% at the end of the sample period. This is qualitatively the

[14] Banks are not required to disclose the number of employees, so we can compare banks only in terms of the personnel expenses to total assets ratio. In the *State-1* group the ratio was 1.4% before the crisis, 1.2% during and 1.3% after the crisis. Respective values for private banks were 3.3%, 3.9%, and 3.3%. The rise of the indicator for private banks during the crisis is the result of sharp decrease of total assets and much lesser reduction of staff costs. Nevertheless, the wide gap between these two groups of banks is a feature of the Russian banking industry and reflects the dominance of state-controlled banks. In order to stay competitive with them, privately-owned banks are forced to overpay the staff.

same level that the privately-owned banks had in the same period (81%). The *State-2* group, in contrast to the *State-1* group, could not break the decreasing trend of cost efficiency so that toward the end of the sample period their SFA score was approximately 9 percentage points less than that of *State-1* banks.

Thirdly, **Fig. 4.a** suggests that during financial turmoil the efficiency of banks declines as compared opposed to normal circumstances. **Fig. 4.b**, conversely, shows that bank efficiency grows during the period of the crisis, which is in line with the concept that an economic crisis can discipline economic agents by forcing them to eliminate unnecessary costs accumulated in previous periods. We would not be able to capture this important effect had we kept the *Revals*.

4.3. The distance functions: how does the group ranking depend on bank-specific factors?

Descriptive statistics and pairwise correlations of variables employed in the regression analysis appear respectively in **Table A4** and **Table A5** in the Annex. In this section, we present the estimation results on the distance functions (Eq.4) obtained using 2-step GMM; all the underlying coefficients from Eq.(3) are in **Table A6** in Annex.

Table A6 is organized as follows. In columns I-III we provide the estimation results with *Revals* kept; in columns IV-VI the *Revals* are dropped. Estimated equations within each pair of columns I and IV, II and V, and III and VI has the same explanatory variables; the only difference is keeping or dropping *Revals* from the dependent variable, i.e. SFA score. In the first pair of models (I and IV), we simply regress SFA scores on the four groups dummies without interacting them with other bank-specific factors, as in previous studies. In the second pair of models (II and V), we include all dummies and their interaction terms with the bank-level equity-to-assets ratios measuring banks risk tolerances. In the third pair of models (III and VI), we include all dummies and their interaction terms with the bank-level loans-to-assets ratios as a measure of assets composition.

From a technical viewpoint, all six presented models satisfy the necessary requirements. The sets of instruments employed at the first stage of regressions are valid according to the Hansen test as none of the P-values are below the 10% threshold. These sets of instruments are exogenous as predicted by the Kleibergen-Paap LM statistics in respective regressions (P-values are below the 1% level). We obtained quite large values for the centered R^2, namely 34%-37% in the models with *Revals* kept and 55-56% with *Revals* dropped. Hence, the removal of *Revals* improves the goodness-of-fit. Most of the estimated coefficients correspond to respective pairwise correlations.

Next, we interpret the estimation results obtained from the models with our proposed procedure of dropping *Revals*, i.e. IV-VI, and analyze how these results would change in respective cases of keeping *Revals*, i.e I-III.

(1) *Homogenous relations: findings from previous research revisited*

We start with the first pair of models, Model I and Model IV in **Table A6**, representing the average ranking of the four bank groups over the sample period.

The core state banks (*State-1*) are found to be slightly more cost efficient than the private banks, as the estimated coefficient before the respective dummy is positive and marginally significant, see column IV. The estimated difference between the two groups is only 2.7 p.p. in terms of SFA scores. Keeping *Revals* leads to almost the same estimated difference, but it turns out to be insignificant, see column I. These results support the findings of Karas et al. (2010) and demonstrate that the core state banks are not less cost efficient as compared to the private banks in Russia[15].

The other state-controlled banks (*State-2*) seem to be more cost efficient as compared to the private banks, see column IV. The estimated difference is very significant but quite small – only 1.7 p.p. in terms of SFA scores, which is even smaller than the difference between *State-1* and private banks discussed above. If we keep *Revals* (column I), the estimated coefficient would be much higher, 8.6 p.p., that might bring us to a misleading conclusion, i.e. that the *State-2* banks outperforms all the three other groups[16].

Foreign banks have on average no differences with the private banks in terms of cost efficiency – the estimated coefficient is negative but insignificant (column IV). Keeping *Revals* (column I) would lead us to the qualitatively opposite conclusion as in this case the estimated coefficient is –16.2 and highly significant, implying an extraordinarily inefficient performance of foreign banks in Russia, as discussed in Section 4.2. These findings contradict those of Karas et al. (2010), who stressed that foreign banks outperformed all the other groups in Russia before the 2008-2009 crisis.[17]

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[15] These findings imply that even quite large observed differences in the average efficiency scores outlined in the previous section (SFA score at 50% for *State-1* vs 65% for Private when *Revals* are kept, and 75% vs 81% otherwise) can disappear when we take into account internal specifics of these groups' risk preferences, assets compositions, market powers and other bank-level characteristics unrelated to costs. The core state banks possess greater market power than private banks (Anzoátegui et al., 2012) and are in fact no less cost efficient than private banks in spite of the formally lower efficiency score.

[16] Obtained estimates, 8.6 and 1.7 p.p., reflect one of our previous results concerning the shrinking effect that elimination of *Revals* has on the spread of efficiency scores of different groups (Section 4.2)

[17] Our findings can stem form a higher dependence of foreign banks on cross-border operations, mostly with parent banks in home countries, resulting in that the period-average share of negative *Revals* in total expenses is 58%, as compared to only 23% for the other groups.

(2) *Heterogeneous relations based on differences in risk preferences*

We follow with the second pair of models, Model II and Model V in **Table A6**. The interpretation of respective coefficients provides little information on the ranking of banks, so that we move to analyzing the underlying distance functions (Eq.4). For that reason, for each bank group, we generate the distribution of values obtained from respective distance functions depending on banks' equity-to-assets ratios (ETA), and then extract the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles from these distributions for further analysis. Results appear in **Table 4** (Panels 1-3).

The core state banks (*State-1*) mainly functioned with ETA ratios ranging from 8.8% (p10) to 21.2% (p90) during the sample period (see Panel 3 of **Table 4**). Up to 15.3% (p75) in this range, we found no statistical difference between *State-1* and *Private* banks in terms of cost efficiency (Panel 2). But such differences emerge and grow after p75 so that the *State-1* outperforms all the other three groups. That is, a *State-1* bank with an ETA ratio of 15.3% (21.2%) is 4.3 p.p. (6.7 p.p.) more cost efficient than the average *Private* bank for whom the estimated SFA score was 81% (**Table 3**). Keeping *Revals* leads to a similar conclusion, that is, they are still more cost efficient than *Private* and *Foreign* banks if they possess ETA ratios above p75; but they are less cost efficient as compared to the other state banks, *State-2* (see Panel 1 of **Table 4**).

Foreign banks appear to be the least cost efficient group only when they operate with ETA ratios below the p50; that is, a foreign bank with an ETA ratio of 8.2% (11.1%), which corresponds to p10 (p25), is 2.5 p.p. (1.8 p.p.) less cost efficient than the average *Private* bank. Decreasing leverage by increasing ETA ratio above p50 allows *Foreign* banks to outperform *Private* banks and, above p75, even *State-2* banks. For example, a *Foreign* bank with ETA ratio of 41.5% (p90) is 5.5 p.p. more cost efficient as compared to an average *Private* bank, although it makes little sense to maintain such a high ETA ratio at 3.5 times the banking system average because it substantially restrains profitability. If we keep *Revals*, the distance would turn from 5.5 to –26.7 p.p., demonstrating the materiality of *Revals*, especially for this group of banks.

Results for the *State-1* and *Foreign* banks follow the prudent-efficient hypothesis of Berger and Mester (1997).

(3) *Heterogeneous relations based on differences in asset composition*

At last, we consider the third pair of models, III and VI from **Table A6**. As in the previous case, for each bank group, we analyze the extractions from the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles of the distributions of values calculated from respective distance functions, each of which depends now on the banks' loans-to-assets ratios (LTA). Results appear in **Table 4** (Panels 4-6).

Table 4

GMM post-estimation results: Distances between groups of banks in terms of cost efficiency (p.p. of SFA scores) determined on the basis of observable heterogeneity in risk preferences or assets compositions, averages of 2005Q1-2013Q4

Percentile [a]	p10	p25	p50	p75	p90
Distances as a function of risk preferences (equity-to-assets ratios, ETA)					
Panel 1: *Revals* kept (on the basis of model II from Table A6 in Annex)					
State-1	1.807	2.331	3.153	4.343*	6.592**
State-2	7.993***	8.176***	8.417***	9.018***	10.115***
Foreign	–11.670***	–12.967***	–14.981***	–19.120***	–26.742***
Panel 2: *Revals* dropped (on the basis of model V from Table A6 in Annex)					
State-1	–0.370	0.403	1.614	3.368**	6.679***
State-2	1.753***	1.711***	1.654***	1.514***	1.258***
Foreign	–2.471***	–1.781**	–0.709	1.493*	5.548***
Panel 3: Percentiles of ETA distributions within particular group of banks					
State-1	8.8	10.1	12.3	15.3	21.2
State-2	6.7	8.8	11.5	18.1	30.3
Foreign	8.2	11.1	15.6	24.7	41.5
Private	8.2	11.0	16.5	27.1	44.3
Distances as a function of assets composition (loans-to-assets ratios, LTA)					
Panel 4: *Revals* kept (on the basis of model III from Table A6 in Annex)					
State-1	–0.453	0.286	2.141	2.702	3.224
State-2	7.568***	7.975***	8.262***	8.488***	8.695***
Foreign	–27.380***	–23.573***	–18.699***	–15.599***	–13.536***
Panel 5: *Revals* dropped (on the basis of model VI from Table A6 in Annex)					
State-1	6.140***	4.454**	0.223	–1.058	–2.247
State-2	4.006***	2.708***	1.793***	1.072***	0.410
Foreign	–18.552***	–11.989***	–3.586***	1.758**	5.316***
Panel 6: Percentiles of LTA distributions within particular group of banks					
State-1	36.8	43.7	61.1	66.3	71.2
State-2	22.0	39.4	51.7	61.4	70.3
Foreign	6.4	24.1	46.7	61.1	70.7
Private	23.3	39.4	54.8	66.7	75.8

Notes: ***, ** and * – an estimate is significant at the 1%, 5% and 10%, respectively. Robust standard errors are not provided for reasons of space.

[a] The number of bank-quarter observations employed to calculate the values of the distance functions are: 108 for the State-1 banks; 1204 for the State-2 banks; 1177 for the Foreign banks. The referent group (Private banks) accounts for 26624 observations.

State-1 banks operate with one of the largest LTA ratios in the Russian banking system whereas Foreign banks are less specialized in allocating loans to the economy than all the other groups, as can be inferred from Panel 6 of **Table 4**. That is, within the p10-p90 of respective distributions, the *State-1* banks' LTA ratios ranges from 36.8% to 71.2% while Foreign banks' LTA ratios are only 6.4% in p10 and 70.7% in p90. Here, our estimations on efficiency distance functions yield an important result: *State-1* banks become the most cost efficient group if they lend less to the

economy; on the contrary, Foreign banks tend to be the most cost efficient group if they lend more to the economy (Panel 5)[18]. In p10, the SFA score of a *State-1* bank is 6.1 p.p. higher than that of an average *Private* bank; the SFA score of *Foreign* bank is 18.6 p.p. lower relative to an average *Private* bank. In p90, the opposite is true. Importantly, these results are entirely upset if *Revals* are kept (Panel 4).

Another notable result comes from the comparison of *State-1* and *State-2* banks. As our estimations have shown, the latter are more cost efficient than the former within the p50-p75 range of LTA ratios. This might reflect a lesser degree of political interference into bank decision-making. Unlike in the case of *State-1* banks, the government would not force the *State-2* banks to finance government-approved projects. Had we relied on keeping *Revals* (Panel 4), we would claim that *State-2* banks are always – not only within the p50-p75 range of LTS distribution – more cost efficient than *State-1* banks.

(4) *Additional estimation results*

The set of control variables employed in the estimation of efficiency regression Eq.(3) encompasses both bank-specific and macroeconomic variables (**Table A6** in the Annex).

From the bank-specific side, we found that the loans-to-deposits ratio negatively and statistically significantly (at 1% level) affects cost efficiency, irrespective of keeping or dropping *Revals*. It might be the case that a growing mismatch between assets and liabilities requires additional funds to manage it, e.g. through increasing the costs of screening and monitoring of borrowers quality. Next, we revealed positive and very significant impact of the share of retail loans in a total loan portfolio on a bank's cost efficiency. It implies that focusing more on retail lending models brings a benefit of lower costs per output (loans) and this is not caused by scale economies as we included bank size in the models as well. Though the significance in this case does not depend on the treatment of *Revals*, their dropping leads to a decrease in the coefficient magnitude by 7-8 times. Regarding the bank size, we found it to have a positive impact on cost efficiency as in Maudos and Fernández de Guevara (2007) and Turk Ariss (2010), but it is true

[18] We suppose that the growing efficiency of foreign subsidiary banks as they lend more is quite logical. Economy of scale makes sense, especially if we examine traditional commercial banks geared towards lending and other core banking business. Our finding proves that the subsidiaries of foreign commercial banks, as opposed to other types of foreign-controlled banking entities, are 'normal' commercial banks pursuing healthy business models. What is unusual is the decreasing efficiency of core state banks in dynamics. We do not interpret it as a depressing effect of loans on bank efficiency. We might be actually looking at banks pursuing different business models. For instance, an expansion of retail/consumer/mortgage lending might require additional costs reflecting investments in technology and infrastructure, at least for a certain period. On the other hand, for systemically important state banks a surge in policy lending might constrain the growth of profitability. Another possible explanation would be that in the case of large state banks, a lesser share of commercial loans in assets corresponds to a larger, than average, share of financial instruments and other asset classes typical of investment banking that bring higher returns. That puts those banks at an advantage before others in terms of efficiency. Finally, state banks can be prone to corruption in the lending process in the form of kick-backs and/or related lending to a greater degree than peer banks.

only if *Revals* are dropped. Keeping them breaks this intuitive relationship and we treat it as additional support to the idea of dropping *Revals*. A similar situation arises with the Lerner index, i.e. it is significant only when are *Revals* are dropped. We found that market power as measured by the Lerner index is positively related to cost efficiency rejecting the so-called Quiet life hypothesis (Berger, Hannan, 1998) for the credit market within the Russian banking sector. The same results were achieved by Maudos and Fernández de Guevara (2007) for the credit markets in EU-15 and for different banking sectors in a multi-country study by Turk Ariss (2010).

From the macroeconomic side, we found that the impact of ruble exchange rate volatility on bank cost efficiency depends on the treatment of *Revals*. If they are kept, the effect is very significant (at 1% level) and negative, which can reflect a sort of predetermined results as *Revals* grow when the ruble is instable, causing bank costs to rise and cost efficiency, thus, to decline. If *Revals* are dropped, the statistically significant effect disappears. Next, we found that cost efficiency is very procyclical as it is positively related to the state of the economy as measured by the GDP growth ratio. During the periods of positive growth, Russian banks benefit from expanding loan portfolios and decreasing interest rates on deposits, which results in higher interest income and lower interest expenses, relative to respective outputs. The opposite is true when the Russian economy suffers from negative dynamic of its GDP. The most interesting outcome from this analysis is that, as we expected, dropping *Revals* indeed leads to a substantial decrease in the magnitude of major macroeconomic controls such as ruble exchange rate and GDP growth. It implies that managerial efficiency is much more affected by bank-specific factors than macroeconomic conditions. We also have tested the simultaneous effects of the two specific proxies of borrowers' creditworthiness – one for households and the other one for non-financial firms – on bank cost efficiency. We found that increases in households' income caused drops in banks cost efficiency levels during the sample period. At first sight, it might seem counterintuitive as banks should extract higher profits from retail lending when household income grows. But in fact the market for retail loans was quite underdeveloped in Russia during that time (the ratio of retail loans to GDP was only 2% in the beginning of the sample period reaching up to 16% at the end of 2013) so that the banks-customers relationships were very young and, thus, not intensive. These relationships rapidly developed during the sample period as household demand for loans, stimulated by growing income, increased substantially. Undoubtedly, banks were forced to bear significant costs on retail borrowers screening and further monitoring of creditworthiness. Concerning the creditworthiness of non-financial firms, we found no evidence favoring their positive or negative impact on cost efficiency when *Revals* are dropped. It can be attributed to the non-market mechanisms of setting interest rates on corporate loans in Russia (this specific issue requires an additional investigation in future research).

5. Robustness check

We re-estimate Eq.(1)-Eq.(4) by either replacing the production approach by the intermediation approach or by applying Tobit instead of GMM estimators. Then we include additional outputs in our translog cost function, Eq.(1), and drop all but one macroeconomic controls, namely the GDP growth rate, from Eq.(4) to address possible multicollinearity concerns.

First, staying within the production approach, we re-estimate Eq.(3) using the Tobit estimation technique rather than the GMM procedure to account for the censored nature of SFA scores, i.e. their lower and upper bounds that are, by construction, 0 and 100, respectively[19]. The results of this exercise are presented in **Table A7** in the Annex. Comparing them with respective GMM estimation results from **Table A6** in the Annex, we observe no qualitative differences as the coefficients change only slightly. Consequently, no qualitative changes occur with the efficiency distance functions measured using either risk preferences or assets composition. That can be verified by comparing **Table A8** in the Annex with **Table 4**. As a result, we still claim that the core state banks can be the most cost efficient group if they gradually replace loans with other types of assets and that the foreign subsidiary banks can outperform the other three groups if they lend more to the economy.

Second, we re-estimate the translog cost function under the intermediation approach by dropping deposits and fees variables from the list of regressors, but keeping the average funding rate as an explanatory variable[20]. Results are reported in **Table A3** in the Annex. We find that the majority of the coefficients remain qualitatively the same with few exceptions concerning three interaction terms, i.e. price of physical capital and time trend, equity capital and each of the first two input prices. Expectedly, the goodness-of-fit decreases dramatically as can be seen from the much lower values of likelihood function.

Third, we re-calculate SFA scores under the intermediation approach and aggregate them into group-averages (**Table A9** in the Annex). Comparing these with what we have achieved under the production approach (**Table 3**), we conclude that, on average, *Foreign* banks remain the least cost efficient group regardless of whether *Reveals* are kept or dropped. The core state banks hold the 1st position rather than the 3rd position after *State-2* and *Private* as previously estimated under the production approach. Average SFA scores for all three groups exhibit unstable patterns

[19] For that purpose, we employ the minimum chi-squared estimator proposed in Newey (1987).

[20] It might be reasonable to suggest that operating costs are indirectly affected by the price of deposits through the adverse selection problem. In other words, when the price of deposits rises banks are tending to increase the price of loans. The latter usually decreases the stimulus of borrowers with good creditworthiness to take new loans so that banks are forced to soften their lending standards to find new borrowers. It might well lead to decrease in their screening costs in the short run; but in the longer term it might require to make additional costs in order to stop growing bad debts.

in dynamics causing several reshufflings of the ranking. It might be caused by a dramatic drop in goodness-of-fit observed within the intermediation approach.

Fourth, we again re-estimate Eq.(3) replacing the SFA scores from production approach by SFA scores from intermediation approach. We employ only GMM because no qualitative changes are revealed when we use the Tobit technique. Estimation results are reported in **Table A10** in the Annex where those newly estimated coefficients that are qualitatively different from the respective baseline results from **Table A6** are bolded for the sake of convenience. About one-half of these coefficients before the variables of interest display changes in either significance or sign. We do not analyze every such change but trace its impact on our basic findings. For that purpose, in Panels 1-3 of **Table A11** in the Annex, we report the values of efficiency distance functions measured in terms of risk preferences, and in Panels 4-6 of **Table A11** such distance functions are measured based on assets composition. Comparing **Table A11** with **Table 4**, we observe that the core state banks can still be the most efficient group if they maintain higher capital adequacy or decrease the loans-to-assets ratio below the median in the sample. What we do not observe anymore is that foreign banks can be more cost efficient than the other groups if they rely more on equity capital than on attracted funds[21]. This makes us interpret the finding with caution as it is not robust to the change in approach to estimating cost function. However, the conclusion that foreign banks can increase their cost efficiency and even outperform other groups if they lend more to the economy remains unchanged.

Fifth, we address possible multicollinearity concerns given that the pairwise correlations between different macroeconomic controls (GDP and households income growth rates, firms' profit-to-debt ratio, and ruble volatility) are quite high, ranging from –0.59 to 0.68 (**Table A5**). We dropped all but GDP growth rate from Eq.(3) and re-estimated Eq.(4) within both the intermediation and production approaches and employing both the 2-Step GMM and IV Tobit estimators. Our baseline results did not suffer qualitative changes.

Sixth, we re-configure our translog cost function by adding more outputs or replacing operating costs with total costs (only with *Revals* dropped). We include securities, both private and government, as the fourth output into Eq.(1) given that this class of assets may be important for banks that are less geared towards lending to the economy. As we have shown in Panel 6 of **Table 4**, this is the case of foreign banks in Russia. Next, we include foreign assets (loans to and securities of non-residents) into Eq.(1) as the fifth output to account for the fact that Russian banks rely on this class of assets more than on loans to residents in periods of ruble instability.

[21] This is caused by the change of signs of the coefficients before the interaction terms in respective distance function, i.e. within the intermediation approach the distance function for foreign banks is positively – and not negatively as in the case of production approach – determined by equity-to-assets ratios.

Lastly, we replace operating costs with total costs within the basic specification of Eq.(1), i.e. with only three outputs. The estimation results for each of the three cases are presented in Annex **Fig. A1**. Comparing the latter with the **Fig. 4.b** in Section 4, we can infer that our baseline results remain unchanged, though we observe that including more outputs decreases the distances between *Foreign* banks and the other three groups of banks. We found support for the theoretical predictions of Mian (2006) and empirical results of Lensink et al. (2008) regarding the lower efficiency of foreign banks as compared to domestic financial institutions.

Finally, we omit the Lerner index from the list of inefficiency covariates and re-estimate Eq.(1) and Eq.(3) simultaneously, i.e. within the one-step approach, taking into account bank-level fixed-effects and replacing (positive) the half-normal distribution of the inefficiency term with the (positive) truncated-normal alternative. For this purpose, and similarly to Karas et al. (2010), we employ the model of Battese and Coelli (1995). Our basic results on comparative efficiency appear to be robust to such a methodological change.

6. Conclusion

In this paper, we introduced three amendments into the SFA computation of comparative bank efficiency in Russia. Firstly, we showed that the effects of the revaluations of all foreign currency items on Russian banks' balance sheets (*Revals*) are unevenly distributed among banks, so they do matter for bank efficiency rankings. We demonstrated their distorting effects by performing alternative calculations with *Revals* kept and dropped. Secondly, we analyzed the performance of the core state-controlled banks separately from that of the rest of the state-controlled banks. Thirdly, within the group of foreign banks we focused on those controlled by strategic foreign investors, i.e. the subsidiaries of foreign banks, and not just any foreign investors.

Our empirical results shed new light on the issue of comparative bank efficiency in Russia. A refined definition of bank revenue that controls for the effect of currency and securities revaluation suggests that:

(1) efficiency scores become higher and less volatile across the board;

(2) the spreads between different types of banks in terms of efficiency shrink;

(3) during financial turmoil the efficiency of banks grows as compared to normal circumstances;

(4) foreign-controlled banks appear to be the least efficient market participants, on average;

(5) the core state-controlled banks are more efficient than other state-controlled banks and nearly as efficient as domestic private banks which is true starting from the crisis of 2008-2009;

(6) based on our estimated distance functions we argue that foreign-controlled banks are able to be more cost efficient than others when they increase loans-to-assets ratios above the sample

median level. Conversely, when the loans-to-assets ratio falls below the sample median level, it ensures the superiority of the core state-controlled banks in terms of cost efficiency.

Some of the results are consistent with previous research (Karas et al., 2010). Others challenge the conventional wisdom with regard to the general level of Russian bank efficiency, the performance of foreign-controlled banks (Bonin et al., 2005a; Fries, Taci, 2005; Grigorian, Manole, 2006) and bank behavior during crises. The most striking finding is the inferior efficiency performance of banks controlled by strategic foreign investors. This result might be attributable to institutional differences between Russia and the home countries of some of the foreign banks present in Russia (Mian, 2006; Lensink et al., 2008), as well as the inability of foreign banks to enjoy the economies of scale. This issue requires further research.

Another important finding is that large state-controlled banks are not necessarily poor performers.

Our empirical findings might have research and policy implications. From a research perspective, this paper offers evidence that bank rankings in terms of efficiency might be upset unless the effects of revaluation of foreign currency and securities are neutralized. Hopefully, subsequent estimations of comparative performance and efficiency estimations will use refined bank revenue data.

From a policy perspective, our empirical results might invite regulators to adjust industrial policies with regard to banks. Both the prejudice against state banks and the bias in favor of foreign banks should give way to a more balanced industrial policy aimed at a better performance of all national banks. However, there might be less room for the improvement of cost efficiency than is widely believed.

Last but not least, we think that our approach is potentially applicable to other dollarized emerging markets. Checking this remains a research task for the future.

References

Altunbas Y., Evans L., Molyneux P. (2001), Bank ownership and efficiency, *Journal of Money, Credit and Banking* **33**(4): 926-954.

Andrianova S., Demetriades P., Shortland A. (2012), Government ownership of banks, institutions and economic growth, *Economica* **79**(315): 449–469.

Battese G., Coelli T. (1995), A model for technical inefficiency effects in a stochastic frontier production for panel data, *Empirical Economics* **20**(2): 325-332.

Belotti F., Daidone S., Ilardi G., Atella V. (2013), Stochastic frontier analysis using Stata, *STATA Journal* **13**(4): 719-758.

Belousova V. (2009), Effektovnost izderzhek odnorodnykh rossiyskikh kommercheskikh bankov: obzor problemy i noviye rezultaty [Cost efficiency of similar Russian commercial banks: A survey and new evidence], *Economic Journal of the Higher School of Economics* **13**(4): 489-519. [in Russian]

Berger A., DeYoung R. (1997), Problem loans and cost efficiency in commercial banks, *Journal of Bank-*

ing and Finance **21**(6): 849-870.

Berger A., Hannan T.H. (1998), The efficiency cost of market power in the banking industry: A test of the 'quiet life' and related hypotheses, *Review of Economics and Statistics* **8**(3): 454–465.

Berger A., Hasan I., Zhou Mingming (2009), Bank ownership and efficiency in China: What will happen in the world's largest nation? *Journal of Banking and Finance* **33**(1): 113-130.

Berger A., Mester L. (1997), Inside the black box: What explains differences in the efficiencies of financial institutions? *Journal of Banking and Finance* **21**(7): 895–947.

Bertay A., Demirgüç-Kunt A., Huizinga H. (2015), Bank ownership and credit over the business cycle: Is lending by state banks less procyclical? *Journal of Banking and Finance* **50**: 326-339.

Bonin J., Hasan I., Wachtel P. (2005a), Bank performance, efficiency and ownership in transition countries, *Journal of Banking and Finance* **29**(1): 31–53.

Bonin J., Hasan I., Wachtel P. (2005b), Privatization matters: Bank efficiency in transition countries, *Journal of Banking and Finance* **29**(8-9): 2155–2178.

Caner S., Kontorovich V. (2004), Efficiency of the banking sector in the Russian Federation with international comparison, *Economic Journal of the Higher School of Economics* **8**(3): 357-375.

CBR (2014), *Banking Supervision Report in 2013*. Moscow: Central Bank of Russia.

Chernykh L., Cole R. (2011), Does deposit insurance improve financial intermediation? Evidence from the Russian experiment, *Journal of Banking and Finance* **35**(2): 388-402.

Claessens S., van Horen N. (2012), Being a foreigner among domestic banks: Asset or liability? *Journal of Banking and Finance* **36**(5), 1276–1290.

Fiordelisi F., Marques-Ibanez D., Molyneux P. (2011), Efficiency and risk in European banking, *Journal of Banking and Finance* **35**(5): 1315-1326.

Fortin M., Leclerc A. (2007), Should we abandon the intermediation approach for analyzing banking performance? // Working Paper 07-01, Université de Sherbrooke.

Fries S., Taci A. (2005), Cost efficiency of banks in transition: Evidence from 289 banks in 15 post-communist countries, *Journal of Banking and Finance* **29**(1): 55–81.

Fries S., Neven D., Seabright P., Taci A. (2006), Market entry, privatisation and bank performance in transition, *Economics of Transition* **14** (3): 579-610.

Golovan S. (2006), Faktory, vliyayuschie na effektivnost rossiyskikh bankov [Factors influencing the efficiency of Russian bank performance], *Applied Econometrics* **2**(2): 3-17. [in Russian].

Golovan S., Karminsky A., Peresetsky A. (2008), Cost efficiency of Russian banks. Models with risk factors, *Ekonomika i matematicheskiye metody* **44**(4): 28-38.[in Russian].

Grigorian D., Manole V. (2006), Determinants of commercial bank performance in transition: An application of data envelopment analysis, *Comparative Economic Studies* **48**(3): 497-522.

Havrylchyk O., Jurzyk E. (2011), Inherited or earned? Performance of foreign banks in Central and Eastern Europe, *Journal of Banking and Finance* **35**(5): 1291-1302.

Jiang Chunxia, Yao Shujie, Feng Genfu (2013), Bank ownership, privatization, and performance: Evidence from a transition country, *Journal of Banking and Finance* **37**(9): 3364-3372.

Karas A., Schoors K., Weill L. (2010), Are private banks more efficient than public banks? Evidence from Russia, *Economics of Transition* **18** (1): 209 – 244.

Karas A., Schoors K. (2010), A guide to Russian bank data // SSRN Working Paper Series No 1658468.

Karas A., Pyle W., Schoors K. (2012), Deposit insurance, banking crises, and market discipline: Evidence from a natural experiment on deposit flows and rates, *J. of Money, Credit and Banking* **45**(1): 179-200.

Körner T., Schnabel I. (2011), Public ownership of banks and economic growth: The impact of country heterogeneity, *Economics of Transition* **19**(3): 407–441.

Kumbhakar S., Peresetsky A. (2013), Cost efficiency of Kazakhstan and Russian banks: results from competing panel data models, *Macroeconomics & Finance in Emerging Market Economies* **6**(1): 88-113.

La Porta R., López-de-Silanes F., Shleifer A. (2002), Government ownership of banks, *Journal of Finance* **57**(1): 265–301.

Lensink R., Meesters A., Naaborg I. (2008), Bank efficiency and foreign ownership: Do good institutions matter? *Journal of Banking and Finance* **32**(5): 834-844.

Mamonov M. (2013), Gosbanki vs chastny bankovsky sector: kto effektivneye? [State banks vs the private banking sector: Who is more efficient?], *Bankovskoye delo* 5: 23-30. [in Russian]

Maudos J., Fernández de Guevara J. (2007), The cost of market power in banking: Social welfare loss vs. cost inefficiency, *Journal of Banking and Finance* **31**(7): 2103–2125.

Mian A. (2006), Distance constraints: The limits of foreign lending in poor countries, *Journal of Finance* **61**(3): 1465-1505.

Newey W. (1987), Efficient estimation of limited dependent variable models with endogenous explanatory variables, *Journal of Econometrics* **36**(3): 231–250.

Peresetsky A. (2010), Bank cost efficiency in Kazakhstan and Russia // BOFIT Discussion Papers 1/2010, Bank of Finland, Institute for Economies in Transition.

Schaeck K., *Cihák* M. (2014), Competition, efficiency, and stability in banking, *Financial Management* **43**(1): 215-241.

Schoors K. (2000), A note on building a database on Russian banks: Fieldwork against the odds, *Post-Communist Economies*, **12**(2): 241–249.

Schoors K. (2003), The fate of Russia's former state banks: Chronicle of a restructuring postponed and a crisis foretold, *Europe-Asia Studies* **55**(1): 75-100.

Solís L., Maudos J. (2008), The social costs of bank market power: Evidence from Mexico, *Journal of Comparative Economics*, **36**(3): 467-488.

Solntsev O., Pestova A., Mamonov M. (2010), Stress test: Will Russian banks need new government support? *Problems of Economic Transition* **54**(8): 68-94.

Turk Ariss R. (2010), On the implications of market power in banking: Evidence from developing countries, *Journal of Banking and Finance* **34**(4): 765-775.

Vernikov A. (2012), Impact of state-controlled banks on the Russian banking sector, *Eurasian Geography and Economics* **53**(2): 250-266.

Vernikov A. (2014), «National champions» in Russia's banking services market, *Problems of Economic Transition* **57**(4): 3-25.

Wang H., Schmidt P. (2002), One-step and two-step estimation of the effects of exogenous variables on technical efficiency levels, *Journal of Productivity Analysis* **18**(2): 289-296.

Annex

Table A1

The breakdown of the sample of banks

Period	Core state-controlled banks (*State-1*)		Other state-controlled banks (*State-2*)		Domestic privately-owned banks (*Private*)		Foreign subsidiary banks (*Foreign*)		Total	
	No.	%*	No.	%*	No.	%*	No.	%*	No.	%*
4Q2005	3	36.8	28	11.7	745	41.7	27	9.8	803	100.0
4Q2006	3	35.0	30	12.7	865	42.5	27	9.8	925	100.0
4Q2007	3	36.7	33	12.0	891	39.9	34	11.4	961	100.0
4Q2008	3	38.3	45	17.7	871	32.1	37	11.9	956	100.0
4Q2009	3	39.8	46	18.5	920	31.3	46	10.4	1015	100.0
4Q2010	3	39.4	41	17.4	908	33.1	48	10.1	1000	100.0
4Q2011	3	40.8	37	17.5	880	32.0	45	9.7	965	100.0
4Q2012	3	41.5	36	17.0	857	32.4	43	9.1	939	100.0
4Q2013	3	42.6	36	17.7	820	31.7	42	8.0	901	100.0

* The group's share in total assets of the sample in the respective quarter

Table A2

Descriptive statistics of variables in the cost function (2005 Q1 – 2013 Q4)

	Unit	Symbol	Mean	St.Dev	Min	Max	Obs	Banks
Dependent Variables								
Total costs minus interest expenses minus *Revals**	RUB bn	$OC_{it}^{(1)}$	7.7	69.8	0.0	2904.0	30784	1196
Total costs minus interest expenses	RUB bn	$OC_{it}^{(2)}$	19.2	207.2	0.0	8885.6	30753	1196
Explanatory Variables								
Loans to households and nonfinancial firms	RUB bn	$Y_{1,it}$	18.2	206.7	0.0	10015.4	30045	1159
Retail and corporate accounts and deposits	RUB bn	$Y_{2,it}$	16.6	205.1	0.0	10374.8	30635	1191
Fee and commission income	RUB bn	$Y_{3,it}$	0.5	5.0	0.0	220.6	30635	1189
Average funding rate	%	$P_{1,it}$	4.9	2.8	0.0	50.1	29365	1152
Price for personnel expense	%	$P_{2,it}$	4.1	3.3	0.1	49.5	30784	1196
Price of physical capital	%	$P_{3,it}$	23.7	22.4	0.2	180.0	30784	1196
Equity capital	RUB bn	EQ_{it}	3.8	40.8	0.0	1954.2	30745	1196

Table A3

Empirical cost functions under stochastic frontier analysis: estimation results (2005Q1-2013Q4)

Approach		Production (basic)		Intermediation	
Revals kept		Yes	No	Yes	No
Explanatory variables, in logs	Symbol	I	II	III	IV
Loans to households and nonfinancial firms (*LNS*)	$\ln Y_{1,it}$	0.136*** (0.012)	0.247*** (0.007)	0.506*** (0.007)	0.606*** (0.008)
Retail and corporate accounts and deposits (*DEP*)	$\ln Y_{2,it}$	0.378*** (0.011)	0.303*** (0.006)		
Fee and commission income (*FEE*)	$\ln Y_{3,it}$	0.049*** (0.009)	0.079*** (0.005)		
Average funding rate (*AFR*)	$\ln P_{1,it}$	0.003 (0.009)	–0.039*** (0.005)	0.025** (0.012)	–0.067*** (0.008)
Price for personnel expense (*PPE*)	$\ln P_{2,it}$	0.369*** (0.011)	0.388*** (0.006)	0.339*** (0.016)	0.385*** (0.011)
Price of physical capital (*PPC*)	$\ln P_{3,it}$	0.628*** (0.010)	0.651*** (0.006)	0.637*** (0.014)	0.682*** (0.010)
LNS^2	$(\ln Y_{1,it})^2$	0.019*** (0.008)	0.018*** (0.000)	0.076*** (0.001)	0.068*** (0.001)
LNS×*DEP*	$\ln Y_{1,it} \ln Y_{2,it}$	–0.011*** (0.002)	–0.012*** (0.001)		
LNS×*FEE*	$\ln Y_{1,it} \ln Y_{3,it}$	–0.006*** (0.001)	0.006*** (0.001)		
DEP^2	$(\ln Y_{2,it})^2$	0.074*** (0.001)	0.071*** (0.001)		
DEP×*FEE*	$\ln Y_{2,it} \ln Y_{3,it}$	–0.008*** (0.001)	–0.013*** (0.001)		
FEE^2	$(\ln Y_{3,it})^2$	0.007*** (0.001)	0.011*** (0.001)		
AFR^2	$(\ln P_{1,it})^2$	–0.010*** (0.001)	–0.006*** (0.001)	–0.023*** (0.002)	–0.019*** (0.001)
AFR×*PPE*	$\ln P_{1,it} \ln P_{2,it}$	0.014*** (0.003)	0.011*** (0.002)	0.053*** (0.004)	0.045*** (0.003)
AFR×*PCE*	$\ln P_{1,it} \ln P_{3,it}$	0.006*** (0.002)	0.000 (0.001)	–0.0075** (0.0032)	–0.0070** (0.0022)
PPE^2	$(\ln P_{2,it})^2$	0.051*** (0.002)	0.053*** (0.001)	0.0070** (0.0031)	0.021*** (0.002)
PPE×*PCE*	$\ln P_{2,it} \ln P_{3,it}$	–0.116*** (0.003)	–0.117*** (0.002)	–0.067*** (0.004)	–0.087*** (0.003)
PCE^2	$(\ln P_{3,it})^2$	0.055*** (0.001)	0.058*** (0.001)	0.037*** (0.002)	0.046*** (0.002)
LNS×*AFR*	$\ln Y_{1,it} \ln P_{1,it}$	0.000 (0.002)	0.011*** (0.001)	0.059*** (0.003)	0.057*** (0.002)
LNS×*PPE*	$\ln Y_{1,it} \ln P_{2,it}$	0.002 (0.002)	–0.004** (0.002)	–0.077** (0.003)	–0.057** (0.002)
LNS×*PCE*	$\ln Y_{1,it} \ln P_{3,it}$	–0.002 (0.002)	–0.007*** (0.002)	–0.017*** (0.003)	–0.000 (0.002)
DEP×*AFR*	$\ln Y_{2,it} \ln P_{1,it}$	0.008*** (0.002)	–0.001 (0.001)		
DEP×*PPE*	$\ln Y_{2,it} \ln P_{2,it}$	–0.017*** (0.003)	–0.012*** (0.002)		
DEP×*PCE*	$\ln Y_{2,it} \ln P_{3,it}$	0.008*** (0.002)	0.014*** (0.001)		
FEE×*AFR*	$\ln Y_{3,it} \ln P_{1,it}$	–0.006*** (0.002)	–0.006*** (0.001)		

Approach		Production (basic)		Intermediation	
Revals kept		Yes	No	Yes	No
Explanatory variables, in logs	Symbol	I	II	III	IV
FEE×*PPE*	$\ln Y_{3,it} \ln P_{2,it}$	0.000 (0.002)	0.003*** (0.001)		
FEE×*PCE*	$\ln Y_{3,it} \ln P_{3,it}$	0.006*** (0.002)	0.002** (0.001)		
Trend	T	0.0038*** (0.0012)	–0.0007 (0.0006)	0.016*** (0.002)	0.0054*** (0.0012)
Trend^2	T^2	–0.0001*** (0.0000)	0.0000* (0.0000)	–0.0002*** (0.0000)	–0.0000 (0.0002)
Trend×*AFR*	$T \ln P_{1,it}$	–0.0009*** (0.0002)	0.0007*** (0.0001)	–0.000 (0.000)	0.0019*** (0.0002)
Trend×*PPE*	$T \ln P_{2,it}$	0.0002 (0.0002)	–0.0010*** (0.0001)	0.001 (0.000)	–0.0013*** (0.0003)
Trend×*PCE*	$T \ln P_{3,it}$	0.0008*** (0.0002)	0.0004*** (0.0001)	–0.000 (0.000)	–0.0006*** (0.0002)
Trend×*LNS*	$T \ln Y_{1,it}$	–0.001*** (0.000)	–0.0024*** (0.0002)	–0.000 (0.000)	–0.0029*** (0.0002)
Trend×*DEP*	$T \ln Y_{2,it}$	0.0010*** (0.0003)	0.0006*** (0.0001)		
Trend×*FEE*	$T \ln Y_{3,it}$	–0.0005*** (0.0002)	–0.0000 (0.0001)		
Equity capital (EQ)	$\ln EQ_{it}$	0.542*** (0.012)	0.413*** (0.006)	0.571*** (0.016)	0.388*** (0.011)
EQ^2	$(\ln EQ_{it})^2$	0.094*** (0.002)	0.086*** (0.001)	0.105*** (0.003)	0.081*** (0.002)
EQ×*AFR*	$\ln EQ_{it} \ln P_{1,it}$	0.021*** (0.002)	0.006*** (0.001)	–0.009** (0.004)	–0.030*** (0.003)
EQ×*PPE*	$\ln EQ_{it} \ln P_{2,it}$	–0.005* (0.003)	–0.006*** (0.002)	0.028*** (0.004)	0.018*** (0.003)
EQ×*PCE*	$\ln EQ_{it} \ln P_{3,it}$	–0.015*** (0.003)	0.000 (0.002)	–0.019*** (0.004)	0.012*** (0.003)
EQ×*LNS*	$\ln EQ_{it} \ln Y_{1,it}$	–0.007** (0.003)	–0.005*** (0.002)	0.002*** (0.000)	–0.152*** (0.002)
EQ×*DEP*	$\ln EQ_{it} \ln Y_{2,it}$	–0.166*** (0.002)	–0.158*** (0.001)		
EQ×*FEE*	$\ln EQ_{it} \ln Y_{3,it}$	0.006*** (0.002)	0.005*** (0.002)		
EQ×*Trend*	$\ln EQ_{it} T$	0.0023*** (0.0003)	0.0025*** (0.0001)	0.0022*** (0.0004)	0.0035*** (0.0003)
Intercept		–3.036*** (0.029)	–3.073*** (0.016)	–3.258*** (0.031)	–3.401*** (0.022)
Obs.		29082	29082	29146	29146
Log *L*		–13683.328	7620.759	–22793.544	–10954.861
Convergence achieved		yes	yes	yes	yes
St.dev of the inefficiency term, the rest of the error		0.730, 0.061	0.334, 0.049	0.873, 0.208	0.536, 0.177

Notes: ***, ** and * – an estimate is significant at the 1%, 5% and 10%, respectively. Robust standard errors are provided in parentheses under the coefficients.

Table A4

Descriptive statistics of variables in cost efficiency equations (2005Q1-2013Q4), %

	Mean	St.Dev	Min	Max	Obs	Banks
*Bank-specific factors**						
Equity-to-assets ratio	18.6	12.0	1.9	79.8	22629	1038
Loans-to-assets ratio	55.1	16.7	10.0	96.0	22629	1038
Loans-to-deposits ratio	107.3	83.0	10.5	996.0	22629	1038
Share of retail loans in total loans	31.8	23.5	0.0	100.0	22629	1038
Bank size (in terms of assets)	0.1	1.1	0.0	31.6	22629	1038
Funding- and efficiency adjusted Lerner index of market power**	17.0	37.3	–96.8	94.9	22316	1033
Macroeconomic controls						
3-month Ruble volatility	0.6	0.5	0.1	2.2	36	
GDP (annual growth rate)	3.4	4.9	–11.2	8.6	36	
Real households income (annual growth rate)	6.1	4.9	–4.9	15.4	36	
Firms' profit-to-debt ratio	4.7	2.1	–1.7	10.4	36	

Notes:

* All values reported in this Table are those obtained through applying the filtering procedures to our sample, see Section 3.3 for details.

** Negative values of the Lerner index for some banks in our sample may reflect either the cross-subsidy strategies in order to gain higher market shares (Solís and Maudos, 2008) or greater inefficiencies of small banks, i.e. those players who cannot dictate prices for their loans and suffer from negative margins. Notably, as shown by Solís and Maudos (2008), the Lerner index averaged across all banks operating within the market for loans in the Mexican banking system achieved quite huge negative values, e.g. –0.41 in 2003. The cross-subsiding strategy implies covering such negative margins in one market by positive margins in others. For example, in 2003, the Lerner index for deposits market in Mexico was about +0.48. We suppose that the similar patterns can be observed within the Russian banking markets.

Table A5

Pairwise correlations of variables in cost efficiency equations (2005Q1-2013Q4)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. SFA with *Revals* kept	1.00														
2. SFA with *Revals* dropped	0.66	1.00													
3. State-1	–0.03	–0.03	1.00												
4. State-2	0.06	0.01	–0.01	1.00											
5. Foreign	–0.30	–0.27	–0.01	–0.04	1.00										
6. Equity-to-assets ratio	0.18	0.19	–0.03	–0.08	–0.01	1.00									
7. Loans-to-assets ratio	0.26	0.32	0.01	–0.01	–0.02	–0.05	1.00								
8. Loans-to-deposits ratio	–0.19	–0.33	0.08	–0.03	0.33	0.32	0.39	1.00							
9. Share of retail loans in total loans	0.11	0.07	–0.04	0.05	0.00	0.02	–0.01	–0.04	1.00						
10. Bank size (in terms of assets)	–0.01	0.01	0.73	0.05	0.03	–0.06	0.02	0.02	–0.02	1.00					
11. Lerner index of market power	0.18	0.25	–0.06	–0.04	–0.08	0.26	0.06	–0.08	0.22	–0.12	1.00				
12. 3-month Ruble volatility	–0.11	0.02	0.00	0.01	0.01	0.05	0.00	0.01	0.01	0.00	–0.06	1.00			
13. GDP (y-o-y)	0.19	0.00	0.00	–0.01	–0.01	–0.07	0.02	–0.01	0.00	0.00	0.07	–0.56	1.00		
14. Real households income (y-o-y)	0.08	–0.03	0.01	0.00	–0.02	–0.03	0.04	0.03	–0.02	0.00	0.06	–0.49	0.51	1.00	
15. Firms' profit-to-debt ratio	0.12	–0.01	0.00	–0.01	–0.01	–0.04	0.03	0.01	–0.01	0.00	0.07	–0.59	0.59	0.68	1.00

Table A6

GMM estimation results: The determinants of within- and between-group heterogeneity of cost efficiency (2005Q1-2013Q4; dep. variable: bank-level SFA score with *Reveals* kept or dropped)

Reveals kept	Yes			No		
	I	II	III	IV	V	VI
Dummy variables for bank ownership status						
State-1	2.780 (2.649)	–1.584 (4.639)	–4.390 (6.869)	2.704* (1.406)	–5.365** (2.648)	15.123*** (4.984)
State-2	8.559*** (0.525)	7.387*** (1.120)	7.055** (2.765)	1.672*** (0.241)	1.895*** (0.572)	5.643*** (1.223)
Foreign	–16.222*** (0.996)	–7.939*** (1.704)	–28.756*** (3.165)	–0.021 (0.693)	–4.456*** (1.159)	–20.925*** (1.892)
Bank-specific factors						
Equity-to-assets ratio (ETA)	0.661*** (0.018)	0.676*** (0.018)	0.638*** (0.018)	0.426*** (0.011)	0.417*** (0.011)	0.419*** (0.011)
ETA × State-1		0.386 (0.254)			0.569*** (0.166)	
ETA × State-2		0.090 (0.063)			–0.021 (0.035)	
ETA × Foreign		–0.453*** (0.083)			0.241*** (0.059)	
Loans-to-assets ratio (LTA)	0.607*** (0.012)	0.606*** (0.013)	0.589*** (0.012)	0.439*** (0.008)	0.439*** (0.008)	0.428*** (0.008)
LTA × State-1			0.107 (0.139)			–0.244*** (0.085)
LTA × State-2			0.023 (0.048)			–0.074*** (0.022)
LTA × Foreign			0.215*** (0.061)			0.371*** (0.037)
Loans-to-deposits ratio	–0.114*** (0.005)	–0.115*** (0.005)	–0.107*** (0.005)	–0.106*** (0.003)	–0.106*** (0.004)	–0.101*** (0.004)
Share of retail loans in total loans	0.077*** (0.006)	0.076*** (0.006)	0.074*** (0.006)	0.009*** (0.003)	0.011*** (0.003)	0.009*** (0.003)
Bank size	0.206 (0.167)	0.157 (0.171)	0.229 (0.178)	0.483*** (0.064)	0.513*** (0.063)	0.533*** (0.066)
Funding- and efficiency adjusted Lerner index of market power [a]	–0.007 (0.006)	–0.007 (0.006)	–0.003 (0.006)	0.012*** (0.003)	0.012*** (0.003)	0.013*** (0.003)
Macroeconomic factors						
3-Month Ruble volatility	–1.068*** (0.361)	–1.090*** (0.360)	–0.915*** (0.351)	0.202 (0.160)	0.205 (0.159)	0.177 (0.158)
GDP (annual growth rate)	0.873*** (0.034)	0.874*** (0.034)	0.848*** (0.033)	0.053*** (0.015)	0.053*** (0.014)	0.050*** (0.014)
Real households income (annual growth rate)	–0.203*** (0.036)	–0.204*** (0.036)	–0.184*** (0.036)	–0.066*** (0.017)	–0.066*** (0.017)	–0.059*** (0.017)
Firms' profit-to-debt ratio	0.204** (0.096)	0.207** (0.095)	0.167* (0.100)	0.028 (0.046)	0.029 (0.046)	0.018 (0.049)
Intercept	28.297*** (0.763)	28.196*** (0.761)	29.276*** (0.780)	61.283*** (0.396)	61.361*** (0.395)	61.552*** (0.412)
No. of obs. (banks)	19546 (967)	19546 (967)	20319 (978)	19573 (967)	19573 (967)	20319 (978)
Centered R^2	0.337	0.369	0.352	0.557	0.559	0.549
No. of endog. vars., excl. instr.	6, 12	9, 15	9, 15	6, 12	9, 15	9, 15
P-val for Hansen J-stat	0.558	0.566	0.719	0.143	0.221	0.167
P-val for Kleibergen-Paap LM stat	0.000	0.000	0.000	0.000	0.000	0.000

Notes: ***, ** and * – an estimate is significant at the 1%, 5% and 10%, respectively. Robust standard errors are provided in parentheses under the coefficients.

Domestic privately-owned banks are the referent group. SFA scores are defined within production approach.

[a] Cumulative effect of 4 quarters (0, –1, –2, and –3)

Table A7

Tobit estimation results: The determinants of within- and between-group heterogeneity of cost efficiency (2005Q1-2013Q4; dep. variable: bank-level SFA score with *Revals* kept or dropped)

Revals kept	Yes			No		
	I	II	III	IV	V	VI
Dummy variables for bank ownership status						
State-1	2.387	–1.553	–4.621	2.308*	–6.132**	13.856***
	(2.781)	(6.269)	(9.904)	(1.285)	(2.891)	(4.620)
State-2	8.583***	7.239***	7.028**	1.692***	1.718***	5.739***
	(0.608)	(1.328)	(2.995)	(0.281)	(0.613)	(1.397)
Foreign	–16.336***	–8.034***	–28.534***	–0.206	–4.598***	–20.728***
	(0.785)	(1.374)	(2.738)	(0.363)	(0.634)	(1.278)
Bank-specific factors						
Equity-to-assets ratio (ETA)	0.659***	0.672***	0.636***	0.422***	0.413***	0.416***
	(0.016)	(0.016)	(0.016)	(0.007)	(0.007)	(0.007)
ETA × State-1		0.353			0.621***	
		(0.433)			(0.200)	
ETA × State-2		0.101			–0.006	
		(0.082)			(0.038)	
ETA × Foreign		–0.455***			0.238***	
		(0.063)			(0.029)	
Loans-to-assets ratio (LTA)	0.605***	0.605***	0.589***	0.438***	0.437***	0.428***
	(0.010)	(0.010)	(0.010)	(0.005)	(0.005)	(0.004)
LTA × State-1			0.105			–0.226***
			(0.180)			(0.084)
LTA × State-2			0.024			–0.075***
			(0.054)			(0.025)
LTA × Foreign			0.211***			0.368***
			(0.051)			(0.024)
Loans-to-deposits ratio	–0.113***	–0.113***	–0.106***	–0.105***	–0.104***	–0.101***
	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)
Share of retail loans in total loans	0.077***	0.075***	0.074***	0.009***	0.011***	0.008***
	(0.006)	(0.006)	(0.006)	(0.003)	(0.003)	(0.003)
Bank size	0.224	0.173	0.242	0.498***	0.519***	0.543***
	(0.178)	(0.178)	(0.185)	(0.082)	(0.082)	(0.087)
Funding- and efficiency adjusted Lerner index of market power [a]	–0.006	–0.006	–0.002	0.013***	0.013***	0.014***
	(0.006)	(0.006)	(0.005)	(0.003)	(0.003)	(0.003)
Macroeconomic factors						
3-Month Ruble volatility	–1.066***	–1.080***	–0.904***	0.203	0.203	0.185
	(0.346)	(0.345)	(0.334)	(0.160)	(0.159)	(0.156)
GDP (annual growth rate)	0.873***	0.873***	0.848***	0.054***	0.053***	0.052***
	(0.031)	(0.031)	(0.030)	(0.014)	(0.014)	(0.014)
Real households income (annual growth rate)	–0.202***	–0.205***	–0.183***	–0.064***	–0.063***	–0.053***
	(0.037)	(0.036)	(0.036)	(0.017)	(0.017)	(0.017)
Firms' profit-to-debt ratio	0.200**	0.205**	0.159	0.019	0.019	–0.003
	(0.099)	(0.098)	(0.101)	(0.046)	(0.045)	(0.047)
Intercept	28.334***	28.225***	29.310***	61.349***	61.443***	61.654***
	(0.725)	(0.725)	(0.747)	(0.335)	(0.395)	(0.349)
No. of obs.	19546	19546	20319	19573	19573	20319
(banks)	(967)	(967)	(978)	(967)	(967)	(978)
No. of endog. vars., excl. instr.	6, 12	9, 15	9, 15	6, 12	9, 15	9, 15
P-val for Wald test of exogeneity	0.000	0.000	0.000	0.001	0.000	0.000

Notes: ***, ** and * – an estimate is significant at the 1%, 5% and 10%, respectively. Robust standard errors are provided in parentheses under the coefficients.

Domestic privately-owned banks are the referent group. SFA scores are defined within production approach.

[a] Cumulative effect of 4 quarters (0, –1, –2, and –3)

Table A8

Tobit post-estimation results: Distances between groups of banks in terms of cost efficiency (p.p. of SFA scores) determined on the basis of observable heterogeneity in risk preferences or assets compositions, averages of 2005Q1-2013Q4

Percentile	p10	p25	p50	p75	p90
Distances as a function of risk preferences (equity-to-assets ratios, ETA)					
Panel 1: *Revals* kept (on the basis of model II from Table A7 in Annex)					
State-1	1.548	2.028	2.780	3.869	5.924
State-2	7.921***	8.128***	8.400***	9.078***	10.314***
Foreign	–11.785***	–13.090***	–15.116***	–19.278***	–26.942***
Panel 2: *Revals* dropped (on the basis of model V from Table A7 in Annex)					
State-1	–0.678	0.165	1.488	3.403**	7.018***
State-2	1.677***	1.665***	1.648***	1.608***	1.534**
Foreign	–2.635***	–1.952**	–0.892**	1.286**	5.297***
Panel 3: Percentiles of ETA distributions within particular group of banks					
State-1	8.8	10.1	12.3	15.3	21.2
State-2	6.7	8.8	11.5	18.1	30.3
Foreign	8.2	11.1	15.6	24.7	41.5
Private	8.2	11.0	16.5	27.1	44.3
Distances as a function of assets composition (loans-to-assets ratios, LTA)					
Panel 4: *Revals* kept (on the basis of model III from Table A7 in Annex)					
State-1	–0.739	–0.010	1.818	2.371	2.885
State-2	7.563***	7.987***	8.286***	8.522***	8.738***
Foreign	–27.188***	–23.466***	–18.699***	–15.668***	–13.650***
Panel 5: *Revals* dropped (on the basis of model VI from Table A7 in Annex)					
State-1	5.517***	3.951***	0.023	–1.166	–2.270
State-2	4.079***	2.764***	1.836***	1.106***	0.435
Foreign	–18.378***	–11.881***	–3.561***	1.729***	5.252***
Panel 6: Percentiles of LTA distributions within particular group of banks					
State-1	36.8	43.7	61.1	66.3	71.2
State-2	22.0	39.4	51.7	61.4	70.3
Foreign	6.4	24.1	46.7	61.1	70.7
Private	23.3	39.4	54.8	66.7	75.8

Notes: ***, ** and * – an estimate is significant at the 1%, 5% and 10%, respectively. Robust standard errors are not provided for reasons of space.

Domestic privately-owned banks are the referent group. SFA scores are defined within production approach.

Table A9

Group-level operating cost efficiency (SFA scores, intermediation approach) as averages of 2005 Q1 – 2013 Q4

Bank group	SFA score		Standard deviation	Min	Max	Obs.	No. of banks
	%	rank					
Panel 1: With *Revals* kept							
All groups	55.5		21.0	0.2	97.3	29146	1142
State-1	58.7	1	16.6	25.3	86.4	108	3
State-2	57.5	2	20.3	8.4	95.8	1204	61
Foreign	33.0	4	21.4	1.0	97.3	1179	49
Private	56.3	3	20.5	0.2	96.3	26655	1068
Panel 2: With *Revals* dropped							
All groups	67.8		16.4	1.5	97.3	29177	1142
State-1	78.2	1	6.7	60.2	89.4	108	3
State-2	65.4	3	16.2	10.6	97.3	1204	61
Foreign	63.4	4	19.4	8.4	97.3	1179	49
Private	68.1	2	16.2	1.5	97.0	26686	1068

Table A10

Intermediation approach instead of production approach. GMM estimation results: The determinants of within- and between-group heterogeneity of cost efficiency (2005 Q1 – 2013 Q4; dep. variable: bank-level SFA score with *Reavals* kept or dropped)

Reavals kept	Yes			No		
	I	II	III	IV	V	VI
Dummy variables for bank ownership status						
State-1	2.519 (3.887)	–8.751 (8.757)	26.178 (20.685)	7.366*** (1.013)	**0.478** **(2.062)**	28.066*** (4.218)
State-2	7.976*** (1.239)	9.013*** (3.466)	**2.742** **(4.479)**	1.842*** (0.194)	1.766*** (0.441)	**–2.704***** **(0.945)**
Foreign	–14.703*** (1.395)	**–2.096** **(2.902)**	–18.175*** (5.059)	**3.389***** **(0.253)**	**5.130***** **(0.465)**	–3.334*** (0.960)
Bank-specific factors						
Equity-to-assets ratio (ETA)	0.742*** (0.068)	0.767*** (0.052)	0.741*** (0.067)	0.581*** (0.008)	0.584*** (0.007)	0.582*** (0.008)
ETA × State-1		0.948* (0.519)			0.544*** (0.160)	
ETA × State-2		–0.058 (0.158)			0.007 (0.024)	
ETA × Foreign		–0.695*** (0.179)			**–0.097***** **(0.026)**	
Loans-to-assets ratio (LTA)	0.970*** (0.037)	0.970*** (0.038)	0.965*** (0.037)	0.739*** (0.004)	0.738*** (0.004)	0.734*** (0.004)
LTA × State-1			–0.442 (0.425)			–0.383*** (0.077)
LTA × State-2			0.096 (0.072)			**0.083***** **(0.017)**
LTA × Foreign			**0.062** **(0.059)**			0.122*** (0.018)
Loans-to-deposits ratio	–0.022* (0.012)	–0.021* (0.012)	–0.022** (0.012)	–0.006*** (0.001)	–0.006*** (0.001)	–0.007*** (0.001)
Share of retail loans in total loans	0.050 (0.032)	0.045 (0.034)	0.049 (0.031)	–0.008*** (0.003)	–0.009*** (0.002)	–0.009*** (0.003)
Bank size	0.421 (0.278)	0.333 (0.253)	0.508 (0.342)	0.389*** (0.095)	0.370*** (0.091)	0.452*** (0.086)
Funding- and efficiency adjusted Lerner index of market power [a]	–0.017 (0.034)	–0.013 (0.036)	–0.016 (0.034)	–0.009*** (0.003)	–0.009*** (0.003)	0.010*** (0.003)
Macroeconomic factors						
3-Month Ruble volatility	–0.697 (0.900)	–0.671 (0.929)	–0.708 (0.873)	–0.295*** (0.114)	–0.301*** (0.113)	–0.321*** (0.111)
GDP (annual growth rate)	0.617*** (0.056)	0.618*** (0.058)	0.615*** (0.055)	–0.023** (0.009)	–0.024** (0.009)	–0.026*** (0.009)
Real households income (annual growth rate)	–0.058 (0.120)	–0.056 (0.124)	–0.057 (0.116)	–0.012 (0.013)	–0.014 (0.013)	–0.012 (0.013)
Firms' profit-to-debt ratio	–0.405 (0.463)	–0.425 (0.481)	–0.402 (0.451)	–0.105** (0.044)	–0.102** (0.043)	–0.096** (0.042)
Intercept	–8.266*** (1.027)	–8.504*** (1.061)	–7.980*** (1.022)	19.867*** (0.241)	19.845*** (0.241)	20.193*** (0.241)
No. of obs.	17057	17057	17057	17084	17084	17084
(banks)	(890)	(890)	(890)	(890)	(890)	(890)
Centered R^2	0.333	0.303	0.339	0.901	0.902	0.904
No. of endog. vars., excl. instr.	6, 9	9, 12	9, 12	6, 9	9, 12	9, 12
P-val for Hansen J-stat	0.744	0.811	0.744	0.941	0.937	0.898
P-val for Kleibergen-Paap LM stat	0.000	0.000	0.000	0.018	0.016	0.019

Notes: ***, ** and * – an estimate is significant at the 1%, 5% and 10%, respectively. Robust standard errors are provided in parentheses under the coefficients.

Domestic privately-owned banks are the referent group. Coefficients on the group dummies and their interactions with ETA or LTA that are qualitatively different from respective baseline results in **Table A6** are bolded.

[a] Cumulative effect of 4 quarters (0, –1, –2, and –3)

Table A11

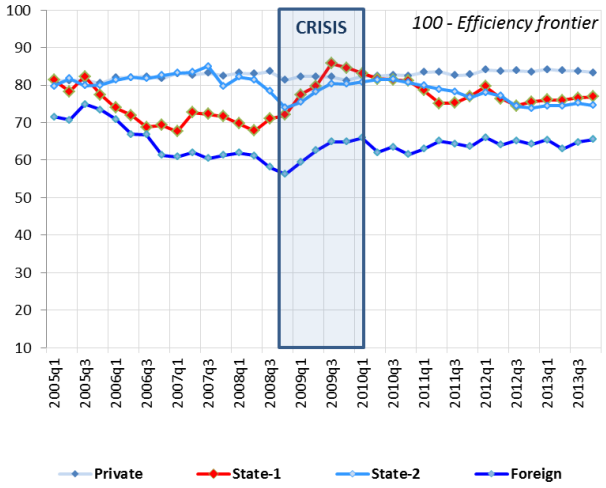
GMM post-estimation results under the intermediation approach: Distances between groups of banks in terms of cost efficiency (p.p. of SFA scores) determined on the basis of observable heterogeneity in risk preferences or assets compositions, averages of 2005Q1-2013Q4

Percentile	p10	p25	p50	p75	p90
Distances as a function of risk preferences (equity-to-assets ratios, ETA)					
Panel 1: *Revals* kept (on the basis of model II from Table A10 in Annex)					
State-1	–0.424	0.863	2.883	5.807*	11.326**
State-2	8.620***	8.501***	8.344***	7.955***	**7.244*** **
Foreign	–7.828***	–9.821***	–12.916***	–19.276***	–30.987***
Panel 2: *Revals* dropped (on the basis of model V from Table A10 in Annex)					
State-1	**5.251*** **	**5.989*** **	**7.146*** **	8.822***	11.985***
State-2	1.810***	1.823***	1.841***	1.885***	1.965***
Foreign	**4.330*** **	**4.051*** **	**3.619*** **	**2.731*** **	1.096
Panel 3: Percentiles of ETA distributions within particular group of banks					
State-1	8.8	10.1	12.3	15.3	21.2
State-2	6.7	8.8	11.5	18.1	30.3
Foreign	8.2	11.1	15.6	24.7	41.5
Private	8.2	11.0	16.5	27.1	44.3
Distances as a function of assets composition (loans-to-assets ratios, LTA)					
Panel 1: *Revals* kept (on the basis of model III from Table A10 in Annex)					
State-1	**9.915***	**6.862***	–0.798	–3.116	–5.270
State-2	**4.844***	**6.510*** **	7.686***	8.611***	9.461***
Foreign	–17.775***	–16.671***	–15.256***	–14.357***	–13.758***
Panel 2: *Revals* dropped (on the basis of model VI from Table A10 in Annex)					
State-1	13.956***	11.307***	**4.661*** **	**2.649***	0.781
State-2	**–0.879**	**0.568***	**1.588*** **	**2.392*** **	**3.130*** **
Foreign	–2.551***	–0.386	2.387***	4.150***	5.324***
Panel 3: Percentiles of LTA distributions within particular group of banks					
State-1	36.8	43.7	61.1	66.3	71.2
State-2	22.0	39.4	51.7	61.4	70.3
Foreign	6.4	24.1	46.7	61.1	70.7
Private	23.3	39.4	54.8	66.7	75.8

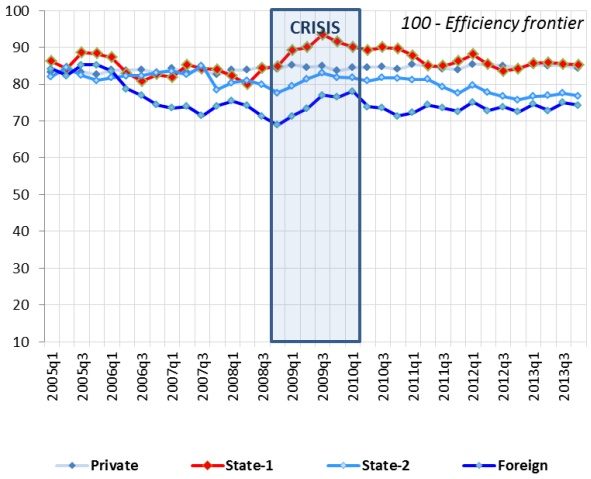
Notes: ***, ** and * – an estimate is significant at the 1%, 5% and 10%, respectively. Robust standard errors are not provided for reasons of space.

Domestic privately-owned banks are the referent group.

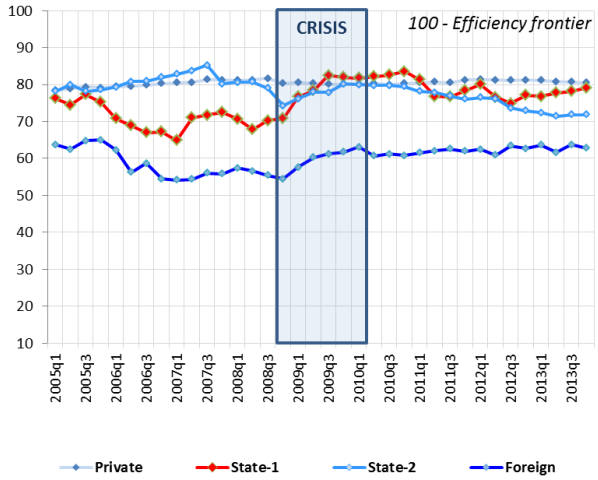
Coefficients that are qualitatively different from respective baseline results in **Table A6** are bolded. SFA scores are defined within intermediation approach.



1. securities are included as the fourth output into the translog cost function



2. foreign assets are included as the fifth output into the translog cost function



3. operating costs are replaced by total costs in the three-output version of translog cost function

Fig. A1. SFA scores for different bank groups (arithmetic averages within each group; *Revals* dropped)

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