Russian Banking System: Stability Factors In the Wake of 2008-2009 Crisis

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Abstract

This paper discusses different approaches to theoretical and empirical models of bank defaults. Through constructed binary probabilistic models of defaults the paper reveals key factors which have an impact on the viability of Russian banks during the financial crisis of 2008 to 2009. Policy recommendations of the Central Bank of Russia and the banking supervision and regulation aimed at preventing bank defaults in the event of such crises in the future are formulated based on the model results.

JEL classification: E41, E51, E58, G21, G24 G28

Key words: bank default, financial crisis, binary models, policy of the Central Bank of Russia.

Russian Banking System: Stability Factors In the Wake of 2008-2009 Crisis

The Russian banking sector was heavily affected by the crisis of 2008-2009. There was a sharp decrease in assets quality and liquidity deterioration. An outflow of deposits was accompanied with an increase in rates on the interbank market. The situation required some active actions from the Central Bank of Russia, in particular large-scale lending to the banking sector.

The Central Bank of Russia managed to avoid a large number of defaults among major Russian banks with the help of its active policy. However, even separate bank defaults had a negative impact on the economy and, in particular, on the banking sector.

The crisis of 2008-2009 affected primarily the financial sector of the Russian economy. A decrease in bank stability is largely determined by changes in the macroeconomic environment and the global financial crisis. However, the most important factors in the stability of the bank (even in a case of systemic crisis) are the features of management and quality of the financial policies of each individual bank. On the one hand, the crisis reveals errors in the management of the banks made in the period of economic growth, not allowing them to hide this mistakes through continued expansion and higher incomes. On the other hand, a large support of the banking sector from the Central Bank of Russia's has enabled many banks to overcome the times of trouble.

The purpose of this paper is to distinguish the major factors determining the occurrence of problems in Russian banks during the crisis in 2008. This problem is solved using binary probabilistic models estimated on data from bank statements and macroeconomic statistics.

The structure of the paper is organized as follows. The first part is a review of theoretical and empirical studies of bank defaults. The second part of the paper describes the problem and the available data. The final part consists of the results based on estimated models and conclusions.

Literature review of bank default models

Classical theoretical study on modeling of banking crises is the work (Diamond DW, Dybvig PH, 1983). This paper considers three period models describing the appearance of possible equilibria among investors, including banking panic.

The authors show that, despite the existence of a Pareto-dominant "good" (no bank run) equilibria, the model can result in a "bank run". An introduction of National Insurance contributions allows to achieve a favorable ebuilibria.

A series of subsequent theoretical research provides an understanding of what factors are important in describing the crisis in the banking sector. Thus, in the paper (Ennis, Keister, 2009) it is shown that the announcement of the bank's commitment to "tough" policy in the case of a run helps prevent bank panics. The more recent work by the same authors (Ennis, Keister, 2010) concludes that the bank pursuing ex post efficient policy payments on deposits can generate intentions of investors to participate in the bank run. The importance of such factors as concentration of the banking system in reducing the probability of "bank runs" was noted in (Temzelides, 1997).[1]

Empirical studies of bank defaults often try to identify the cause of the problem situations with the help of various indicators resulting from the bank statements, macroeconomic and institutional variables. Most of these studies use binary model (probit and logit) specifications.

In the early empirical work (Martin, 1977), the probabilistic model of bank defaults in the U.S. in the 1970s is considered. On the basis of the constructed models, the author concluded that the ratio of net income to bank assets and the ratio of capital to risk assets have a negative impact on the probability of default. The share of commercial loans and the ratio of written-off assets to operating income positively affect the likelihood of default.

Hwang in his study (Hwang et al., 1997) considers bank defaults in the U.S. in late 1980s. The main result is that more profitable banks and banks with high net worth were more stable, along with banks with a high proportion of liquid assets.

Banking crises in East Asia and Latin America are considered in the work (Arena, 2007). Based on cross-section logistic regressions, the author concluded that the high value of the ratio of liquid assets to liabilities and interest income to assets reduced the probability of bank default, while a large share of loans in total assets increased this likelihood.

The work (Demirguc-Kunt, E.Detragiache, 1998) concerns cross-country studies of banking crises. One of the important results is the negative effect of presence of a system of deposit insurance on the stability of the banking system due to moral hazard. This result goes into contrary to those of the studies listed above by Diamond and Dybvig.

A number of articles by Russian authors is devoted to the crisis of 1998 that strongly affected the banking system and the economy as a whole. Styrin in his paper (Styrin, 2005) considered 250 largest Russian banks during the crisis in the framework of binary models. The

[1] Theoretical models of bank defaults were also investigated in (Goldstein, Pauzner, 2005), (Peck, Shell, 2003), (Green, Lin, 2000).

author found out that the share of deposits in liabilities and the share of other financial assets in all assets significantly increased the probability of bank default, while the share of foreign liabilities in all the bank's liabilities was prejudicial to the probability of default. The author also noted that the largest banks were more resilient to the crisis.

It is worth to mention the paper (Peresetsky et al., 2004), devoted to crisis of 1998 in Russia, in which the authors used a different technique of constructing the dependent variable in the binary model, responsible for the bank's default. According to estimated models, the authors concluded that the ratio of equity to assets, the share of liquid assets in the total assets and the share of loans to non-financial organizations enhanced the viability of the bank, while the ratio of reserves to assets and the share of long-term assets had a negative impact on the banks viability. A large share of corporate securities in assets increased the probability of bank default. It is also noted that the inclusion in the model of various macroeconomic variables improved the quality of the models.

Drobyshevsky in his work (Drobyshevsky, 2000) identified factors that caused problems in the Russian banks in 1997-1998. With the logistic model, the author found that the proportion of funds in foreign accounts had a positive effect on the probability of survival of the bank, while the ratio of foreign liabilities to assets, the share of deposits in the liabilities of the bank and the quarter growth rate of loans to non-financial sector had a negative effects on the viability of the bank.[2]

Problem statement and data description

Analysis of the theoretical and empirical works on bank defaults and macroeconomic environment in the country during the crisis helped to make assumptions about the impact of different variables on the viability of banks in 2008-2009.

First, we should highlight the importance of the amount of liquid assets in the banking sector. The lack of liquidity in the banking system during the crisis period (the second half of 2008) was offset by the issuance by the Bank of Russia of a large volume of loans to commercial banks, so the possible negative impact of the liquidity ratio on probability of bank default could be offset by this liquidity provision.

The bank's equity, which characterizes bank’s stability in the case of increasing the share of pour quality assets, also could be an important indicator for bank default probability.

[2] Extensive review of the empirical literature on bank defaults, and a summary table of areas of influence of different variables on the viability of the bank by source can be found in "The factors of stability of Russian banks in 2007-2009" / S. Drobyshevsky A. Zubarev - Moscow Gaidar Institute, 2011.

The structure of loan portfolio, along with the value of reserves for possible losses that banks accumulated based on the riskiness of their portfolio, also should be considered as important factors for bank viability.

Liability structure could also have a significant impact on the stability of the bank. First of all, we should pay attention to public deposits and foreign liabilities, but the variables responsible for the creation of market debt through the issuance of bonds or notes, too, could have an impact on the bank performance.

In addition to balance sheet variables, we should consider various measures of macroeconomic environment, which could also have an impact on the viability of banks.

The purpose of this paper is an empirical identification of factors, which had an impact on the viability of Russian banks during the crisis of 2008-2009.

We used quarterly bank statements for the period from 2006 to 2009 provided by the Center for Economic Analysis by Interfax. These statements include the balance sheet indicators of the structure of assets and liabilities of the bank, the data on profit and loss account, capital adequacy and liquidity. Data on liquid assets are taken from the base of the Mobile agency. This database is similar to the Interfax base, and differs from it by a set of published indicators (in particular, indicators of liquidity are absent in the Interfax base).

Information on the license withdrawal was taken from the web site of the Central Bank of Russia.

The final set of variables for building econometric models was formed on the basis of a set of data provided by the Interfax agency. Variable selection was made with the logic of the crisis and the previous studies that investigated the bank defaults. Table 1 shows the variables used and their expected impact on the viability of the bank.[3]

Table 1. Variables

Variable name	**Description**	**The expected effect on the probability of bank default**
ln_assets	Logarithm of bank assets	unclear
sk_a	The ratio of bank equity to total assets of the bank	negative
hh_deposits_a	The ratio of deposits to total assets of the bank	negative (possibly insignificant)
nongov_sec_a	The ratio of non-government	unclear

[3] The detailed hypotheses about the direction of the influence of explanatory variables on the probability of bank default can be found in the "Factors stability of Russian banks in 2007-2009" / S. Drobyshevsky A. Zubarev - Moscow Gaidar Institute, 2011.

	securities to total assets of the bank	
gov_sec_a	The ratio of government securities to total assets of the bank	negative (possibly insignificant)
corr_acc_a	The ratio of balances on correspondent accounts with assets of the bank	negative (possibly insignificant)
credit_to_banks_a	The ratio of loans to total assets of the banking system of the bank	unclear
nbs_credit_a	The ratio of loans to non-bank system assets of the bank	unclear
loans_to_hh_a	The ratio of household loans to total assets of the bank	negative
foreighn_liab_a	The ratio of foreign liabilities to total assets of the bank	negative
interbank_loans_a	The ratio of inter-bank loans granted to the assets of the bank	unclear
reserves_loans	The ratio of reserves for possible losses to loans to non-banking sector	positive
liab_bank_ratio	Ratio of liabilities to banks, to all liabilities	unclear
marketdebt_l	The ratio of market debt (bonds and notes) to liabilities of the bank	positive
overdue_liab	The ratio of overdue liabilities to the liabilities of the bank	positive (possibly insignificant)
delayed_nbs_credit	The share of overdue loans to non-bank system in bank loans portfolio	negative
la_a	The ratio of liquid assets to total assets of the bank	negative (possibly insignificant)

As noted in many studies[4], the size in terms of assets may be an important factor affecting the viability of the bank. Therefore we decided to include also the square of the logarithm of the assets, thus trying to check non-linear dependence of the probability of default on the bank's assets. Table 2 shows the mean, standard deviation, and maximum and minimum values of the variables used in the entire data sample. Assets, measured in millions of rubles, are used in logs, the other values are dimensionless.

Table 2. Summary statistics

Variable	Mean	Standard diviation	Min	Max
ln_assets	7.481969	1.840396	0.5738	15.77225
(ln_assets)^2	59.3667	29.47435	0.329247	248.7637
sk_a	0.224503	0.165896	0.30034	1
hh_deposits_a	0.231972	0.192456	0	0.886958
gov_sec_a	0.02047	0.049343	0	0.77391
nongov_sec_a	0.041972	0.083635	0	0.850236
corr_acc_a	0.166408	0.148934	0	0.986744
Credit_to_banks_a	0.099377	0.129073	0	0.974694
nbs_credit_a	0.540694	0.208293	0	0.996433
loans_to_hh_a	0.142067	0.15684	0	0.992703
interbank_loans_a	0.059802	0.093628	0	0.912911
reserves_loans	0.074747	0.091245	0	1
liab_bank_ratio	0.096224	0.172667	0	0.993851
marketdebt_l	0.064713	0.108748	0	0.986287
overdue_liab	0.001969	0.015971	0	0.452135
delayed_nbs_credit	0.025725	0.054867	0	1
foreighn_liab_a	0.067844	0.159645	0	0.994357
la_a	0.345957	0.181737	0	0.997031

The viability of the bank can be determined by various variables. In work by Peresetsky, bank default could be defined as the realization of one of the possible conditions: license withdrawal, the elimination due to a merger with another bank, or go under the ARCO's control (Agency for Restructuring Credit Organizations). In other works, such as (Drobyshevsky, 2000) and (Arena, 2007), some of the "economic" indicators of default are used in addition, associated

[4] See (Peresetsky et al., 2004)

with the value of the share of equity in the assets or shares of overdue payments in the bank's liabilities.

As a definition of bank default in this paper, we consider the fact that at least one of the following conditions holds:

1) the license withdrawal;

2) the transfer of the bank under the control of the DIA (Deposit Insurance Agency);

3) negative equity;

4) the share of overdue payments in the whole volume liabilities is above 3%.

This widened definition of a default can identify ailing banks not only in the event of an actual liquidation or providing them with financial assistance, but also in the more general case of serious financial problems.

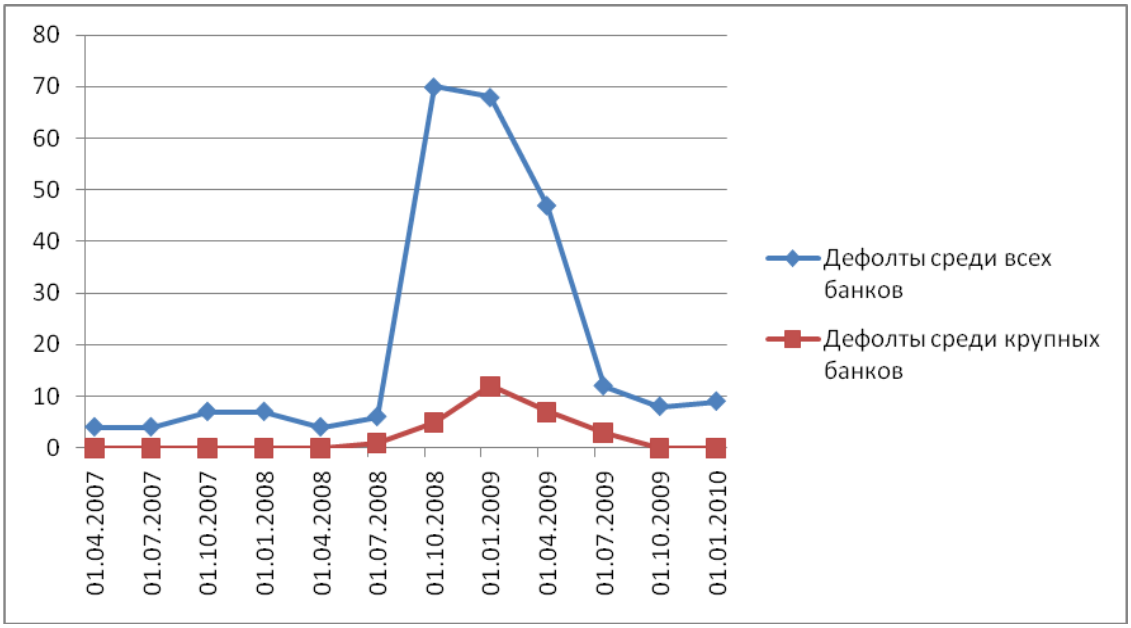
In this work, similar to the work of Peresetsky, the specific pool of data is formed from original unbalanced panel data. It is not reasonable to use all the available observations because of the autocorrelation of the observations for a single bank. The algorithm for creating the final set of data is as follows:

1) For a bank that got insolvent at the time t (on quarterly basis), indicators of bank accounts are taken at time t-4 (one year before the date t), and a binary dependent variable DEATH, characterizing the state of the bank, is set equal to one. Thus, a first point in the generated data set for model estimation is: the dependent variable DEATH = 1, and the explanatory variables match those of the bank at the time of t-4.
2) Next, retreating further than a year ago, at the time of t-8 (provided that this period does not exceed the limits of the available data), for bank performance in this period, the dependent variable DEATH is set equal to zero (the bank is still normal functioning in that time). Thus, it is another observation that corresponds to the bank in the final set of data points: DEATH = 0, and the explanatory variables are indicators of the bank performance at the time of t-8.
3) Then, we repeat the previous step, and the value of the dependent variable DEATH = 0 is attributed to bank statement indicators for the periods t-12 (provided that this period does not exceed the limits of the available data).
4) In case the bank did not go bankrupt in accordance with the definition above by January 1, 2010, then moment t is chosen at random (with equal probability) among the four quarters of 2009. Then, for the indicators of the bank at the time of t-4 DEATH is equal to 0. So it turns out the first point for the survived bank. Further, for this bank DEATH = 0 for indicators at t-8, t-16 (provided that this period does not exceed the limits of the available data).

The idea of considering bank indicators for the year before the actual default is based on the fact that the failed bank issues can be diagnosed early. The very length of 4 quarters is chosen to properly account for various seasonal components. Also note that some banks may be part of the final pool as multiple individual points that are treated at the same time as individual banks.

For the construction of the dependent variable characterizing the viability of the bank in a crisis period, we need to choose the right boundary of the time interval of the data used. The graph in Figure 1 shows that the actual wave of bank defaults connected to the financial crisis started in the 3rd quarter of 2008. So, it was decided to limit the available sampling time and the use of data from only the third quarter of 2007 (according to the definition given above, bank performance indicators are used with annual lag).

Picture 1. Distribution of defaults by quarters (blue: all banks, red: big banks)



The main tool of modeling the probability of bank default is a binary logistic model:

$$P(DEATH_i = 1) = \Lambda(x_i'\beta)$$

where x_i is a vector of parameters of a particular point in the pool. Logistic distribution function has the form:

$$\Lambda(z) = \frac{1}{1+e^{-z}}$$

Vector estimation of this equation is obtained by maximizing the likelihood function. Quality predictive power models will be assessed by a Hosmer–Lemeshow test that shows the degree of difference between the estimated and the actual values of the dependent variable for both groups (binary variable values 0 and 1).

Evaluation of this equation is not only on a sample of all banks, but also on a sample consisting only of the big banks. Such division of banks (large and small) is due to the fact that it is the big banks for the most part in classic banking (lending and deposit taking), while among the small banks there are a lot of captives, who are children of some corporations or holdings. In these small banks, there is often no developed branch network, as there is no need to serve a large number of customers. They are don't issue of loans and deposits. Model for a sample of large banks will be distinguished by the absence of variables characterizing the size of the bank in terms of assets.

Results

This section is devoted to the estimation of models and hypothesis testing. Based on the above binary logistic specification, we built a number of models presented in Table 3.

The first column corresponds to the model that includes all the above variables (Table 1), characterizing the performance of bank statements. The second, third and fourth columns correspond to models with the included macroeconomic variables. The last, fifth, column corresponds to the model derived from the first one, by the sequential removal of all non-significant variables in descending order of insignificance. This algorithm can control the change of joint significance of all variables after the removal of each insignificant variable.

Let's consider the effect of significant variables on the bank default probability in the built models. Different signs and significance of the coefficients of the logarithm of assets (negative) and the square of the logarithm of assets (positive sign) indicates that large and very small banks bankrupt less than medium-sized banks (models 1 and 5). Medium-sized banks were less likely to survive the crisis, other things being equal.

Significant negative coefficient of loans to households in models 1 and 5 indicates that higher values of this variable reduce the probability of bank default. The reason for this is the fact that not all banks are actively lending to the public, and only sufficiently large and healthy banks with an extensive branch network are doing it. These banks tend to have quality management and many have successfully gone through the crisis of 2008, in spite of the problems encountered with the service and return of loans to households.

Large values of the share of foreign liabilities in all the bank's liabilities also significantly increase the viability of the bank in models 1 and 5. Here again, the reason for this is the direction of the influence, probably the fact that only large strong banks with very good reputation hold foreign liabilities in their portfolios. And one can hardly speak of a direct impact of the size of the foreign liabilities on the probability of default.

The negative sign (models 1 and 5) of the share of non-performing loans in loans to non-financial enterprises may seem strange, as they clearly worsen bank performance. The reason is seen especially in how different banks maintain records in their statements. Strong stable banks with a good reputation do not fear to report data on delinquent loans, because this cannot greatly affect the ability of banks to meet its obligations, while banks that are already experiencing problems can restructure outstanding debt of its customers by issuing the repayment of old papers and issuing a new loan in order not to attract too much attention on the part of supervisors. Thus, small banks experiencing problems often publish false information in their reports, and so the share of overdue loans in the loan portfolio of such banks could have a negative effect on the probability of default because of large stable banks true reports.

Only two variables significantly increased the probability of default in models 1 and 5: the share of the market debt liabilities of the bank and the ratio of reserves for possible losses to non-banking sector loans. Market debt consists not only of bonds, but also promissory notes, which are a less reliable payment instrument than bonds. Banks use promissory notes when they do not have the opportunity to issue bonds. Troubled banks used promissory notes to raise their means, which often did not solve their problems. Therefore, a large number of promissory notes accompanied subsequent defaults. One may notice that the big banks in the developed economies almost do not use promissory notes as a way to raise funds.

Consider the variable ratio of reserves for possible losses to non-banking sector loans. The coefficient of this variable is significant and has a positive sign in all five models (see Table 3). Accumulation of reserves, in theory, can contribute to solving the problems of the expected bank run or other problems with liabilities, but this is not always the case. In the crisis of 2008, the banks that created large reserves seemed to experience great difficulties and this reflected in their statements. Accumulation of large reserves for possible losses didn't help to cope with such problems and as a result these banks often failed.

We should note the insignificance of the coefficient of the variable share of liquid assets in all assets of the bank. This suggests that temporary liquidity crisis in the banking sector, which arose with the beginning of the financial and economic crisis, has been overcome by monetary authorities through the provision of loans and gradual devaluation of the ruble, which gave banks the opportunity to invest in the foreign currency, that becoming a profitable asset.

Table 3. Models, sample of all banks

VARIABLES	(1) death	(2) death	(3) death	(4) death	(5) death
ln_assets	0.919**	1.144***	0.951**	0.998**	0.891***

	(0.372)	(0.412)	(0.374)	(0.392)	(0.338)
ln_assets_2	-0.060**	-0.073***	-0.063***	-0.062**	-0.057***
	(0.023)	(0.026)	(0.024)	(0.025)	(0.022)
sk_a	-0.651	-0.552	-0.602	-0.442	
	(0.726)	(0.715)	(0.741)	(0.738)	
hh_deposits_a	-0.595	-0.686	-0.690	-0.730	
	(0.714)	(0.745)	(0.721)	(0.726)	
gov_sec_a	-1.726	-3.182	-2.190	-3.397*	
	(2.056)	(2.212)	(2.175)	(2.063)	
nongov_sec_a	-1.644	-2.046	-1.600	-1.657	
	(1.581)	(1.523)	(1.566)	(1.491)	
corr_acc_a	-1.132	-1.954	-1.436	-1.889	
	(1.377)	(1.417)	(1.400)	(1.392)	
credit_to_banks_a	-0.998	-1.330	-1.079	-1.272	
	(1.320)	(1.268)	(1.295)	(1.316)	
nbs_credit_a	0.119	-0.179	0.235	0.015	
	(1.150)	(1.120)	(1.152)	(1.128)	
loans_to_hh_a	-1.495**	-1.420**	-1.543**	-1.307*	-1.100*
	(0.699)	(0.720)	(0.712)	(0.722)	(0.612)
foreign_liab_l	-2.350**	-2.223*	-2.209*	-2.635**	-2.129**
	(1.126)	(1.201)	(1.142)	(1.179)	(1.020)
interbank_loans_a	0.255	-0.901	-0.211	-0.590	
	(1.499)	(1.606)	(1.549)	(1.592)	
reserves_loans	4.148***	4.477***	4.500***	3.952***	3.570***
	(1.201)	(1.279)	(1.247)	(1.273)	(1.075)
liab_bank_ratio	0.389	0.396	0.340	0.474	
	(0.832)	(0.839)	(0.873)	(0.853)	
marketdebt_l	5.495***	5.464***	5.427***	4.690***	5.680***
	(0.878)	(0.821)	(0.871)	(0.823)	(0.774)
overdue_liab	-0.553	5.025	1.271	7.005	
	(3.850)	(5.841)	(3.978)	(7.921)	
delayed_nbs_credit	-4.297*	-4.477**	-4.694*	-3.258*	-4.129**
	(2.240)	(2.154)	(2.420)	(1.978)	(2.105)
la_a	0.399	0.761	0.516	0.882	
	(1.032)	(1.040)	(1.051)	(1.016)	
delta_exch_rate		0.300***			
		(0.037)			
exp_imp			-3.011***		
			(0.693)		
dep_rate				-59.819***	
				(6.297)	
Constant	-4.953***	-6.177***	-0.431	-0.922	-5.362***
	(1.807)	(1.918)	(2.089)	(1.810)	(1.308)
Observations	1331	1331	1331	1331	1331
Ll	-514.3	-476.4	-504.2	-475.7	-517.6
r2_p	0.111	0.177	0.129	0.178	0.105
Hosmer-Lemeshow(prob.)	0.7353	0.1817	0.2874	0.1558	0.3872

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

We now turn to the results of models based on the sample of the first large 150 banks (by assets), which are presented in Table 4. As noted above, a cluster of large banks may be of great interest, since almost all the banks in this cluster do classic banking.

One difference from the results for the entire sample is the significance of the coefficient of the equity in models 1 and 5 (Table 4). The negative sign indicates that the large values of equity decreased probability of default of the bank during the crisis. This effect is quite logical, since the Central Bank monitors the implementation of standards by banks, including for capital adequacy. Probably, for small banks, Central Bank does this not so carefully, and the impact of this variable on the whole sample vanishes. This corresponds to the insignificance of this indicator in models based on the sample of all banks.

Variable proportion of government securities in the assets is significant at the 10% level in Model 5 and has a negative sign. That is, higher values of this variable reduce the probability of default, other things being equal. This can be explained by the fact that banks with a large share of these securities in its portfolio in the case of problems with could take collateral credit under these securities at the Central Bank that help them ride out the crisis.

The coefficient of the balance on correspondent account is significant and negative in only one model, so this result is not stable. Variable loans to banking system is also weakly significant (with a negative sign) in model 5 and insignificant in model 1.

The effect of the market debt was insignificant. Big banks did not use notes to raise funds, and the effect of the market value of debt on a sample of these banks is not detected.

The influence of other variables is identical to the model built on a sample of all banks. The share of loans to individuals in the entire loan portfolio negatively affects the probability of default. Even among the largest 150 banks in terms of assets, only very stable banks with extensive branch network were involved in active loans.

The presence of a large share of foreign liabilities in the liabilities of the bank went in line with its good reputation and stability was consistent with a negative impact on the probability of bank default.

Accumulation of large reserves for possible losses on loans increased probability of default among the major banks. Explanation of this fact seems to be the same as in the case with the entire sample: banks with large reserves already had problems or were aware of the imminent worsening of the situation.

It should be noted that in all the models a coefficient of the share of liquid assets in the bank's assets turned out to be insignificant. This can be explained as follows. First, at the time of the crisis there was no explicitly banking panic in which the liquidity of the bank is very important. Second, in case of problems with liquidity, banks could always get funds on the

interbank market or take a loan with the Bank of Russia. This situation was different from what it was in 2004, when the Central Bank of Russia was very selective in allocating funds in the debt, and the banks experiencing liquidity problems were likely to cease to exist.

Таблица 4 Models, sample of the 150 biggest banks

VARIABLES	(1) death	(2) death	(3) death	(4) death	(5) death
sk_a	-7.458**	-8.067***	-8.480**	-9.011***	-6.668**
	(3.333)	(3.002)	(3.412)	(3.277)	(2.904)
hh_deposits_a	0.757	-2.557	-0.705	0.183	
	(2.948)	(3.640)	(2.966)	(3.580)	
gov_sec_a	-17.65	-31.66***	-25.24**	-25.37*	-16.09*
	(10.84)	(11.10)	(11.69)	(13.11)	(8.812)
nongov_sec_a	-1.200	-3.124	2.639	-0.350	
	(7.235)	(6.735)	(7.394)	(7.102)	
corr_acc_a	-7.781	-12.88	-7.408	-8.921	-7.560**
	(6.193)	(8.073)	(7.415)	(7.215)	(3.657)
credit_to_banks_a	-10.39	-18.97**	-12.78*	-15.56	-5.418*
	(6.505)	(7.984)	(7.536)	(9.520)	(2.887)
nbs_credit_a	-0.147	-3.330	1.316	-0.755	
	(5.420)	(6.237)	(6.355)	(6.104)	
loans_to_hh_a	-7.556**	-7.391*	-6.945*	-8.482*	-5.785**
	(3.822)	(4.109)	(3.600)	(4.354)	(2.345)
foreign_liab_l	-10.96***	-14.67***	-14.27***	-12.07***	-10.03***
	(3.346)	(4.276)	(4.380)	(3.762)	(2.897)
interbank_loans_a	9.416	11.97	9.566*	13.93	
	(6.183)	(7.762)	(5.446)	(10.37)	
reserves_loans	13.78***	15.03***	17.10***	13.61**	12.14**
	(5.347)	(5.395)	(6.016)	(6.299)	(5.012)
liab_bank_ratio	-1.266	-3.700	-2.351	-0.846	
	(2.064)	(2.355)	(2.082)	(2.139)	
marketdebt_l	1.499	-1.467	-0.433	0.462	
	(3.225)	(3.496)	(4.231)	(3.509)	
delayed_nbs_credit	18.16	30.23	21.32	21.73	
	(19.92)	(24.40)	(21.43)	(23.59)	
la_a	3.539	3.591	4.501	2.905	4.078
	(4.058)	(3.239)	(3.279)	(3.697)	(3.151)
delta_exch_rate		0.490***			
		(0.148)			
exp_imp			-9.551***		
			(2.995)		
dep_rate				-77.62***	
				(24.40)	
Constant	0.545	4.521	14.50	7.827	0.435
	(5.599)	(6.708)	(8.869)	(6.932)	(0.794)
Observations	191	191	191	191	191
Ll	-56.70	-47.26	-48.20	-50.95	-58.41
r2_p	0.271	0.393	0.381	0.345	0.249
Hosmer-Lemeshow(prob.)	0.9933	0.1092	0.0207	0.9525	0.7541

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Let's describe the models with included macroeconomic variables that correspond to columns 2, 3 and 4 in Tables 3 and 4. The tables include a model with the addition of three macroeconomic variables from the above list: the ratio of exports from the Russian Federation to the import, the deposit rate (the average rate on ruble retail deposits with credit institutions for a period of 1 year.) and the change of exchange rate of the ruble against the dollar. The direction of influence of these macroeconomic variables was identical for both samples of banks.

Consider first the deposit rate (model 4). The negative sign means that high rates reduced the value of the probability of default. It does seem plausible, if one compares the situation with the crisis of 1998. In that period, along with rising interest rates banks tried to raise money from the public to be able to discharge obligations. However, in 1998, the public did not believe in the stability of banks (besides, the deposit insurance system did not exist), so the rate increase was not successful in terms of attracting deposits and characterized the intensification of the crisis: the more banks raised their rates, the more default probability grew.

In 2008, the public trusted more in the banking system and government guarantees than in 1998, so the rates growth was not perceived as panic, and raising interest rates on deposits led to the actual inflow of funds into the banks, which increased bank resources and allowed the banks to avoid defaults.

The ratio of the value of exports to imports in the Russian economy is largely characterized by the value of the exported energy resources, which are major export. High values of this variable caused profitability growth in the economy by increasing the monetary base with quasi-fixed exchange rate and, accordingly, reduced the probability of default of the bank. This is consistent with the fact that the majority of defaults just happened in a period of rapid decline in oil prices, and, consequently, the low value of the ratio of exports to imports. A falling exports tended to weaken the exchange rate, which the Central Bank maintained by selling international reserves, resulting in reduced liquidity in the banking sector.

Change of the value of dollar exchange rate also has the expected positive sign?. This means that with the weakening of the ruble, the probability of default increases. Such influence seems logical, since the weakening of the ruble means a sharp increase in foreign exchange risk due to the increased cost of the return of loans made by banks in foreign currency, which could lead to bankruptcy.

As far as the quality of the constructed models is concerned (1-5 in Tables 3 and 4), it is seen that the values of the pseudo-R2 significantly increased with the addition of macroeconomic

variables in the model (for example, the addition of deposit rates increases the pseudo-R2 from 0.111 to 0.178). It can be concluded that the change in the macroeconomic environment had a significant impact on the bank defaults during the crisis of 2008.

At the same time, among models with macroeconomic variables only inclusion of a deposit rate in the model estimated on a sample of large banks provides high level of Hosmer-Lemeshow test p-value (model 4, table 4). This means that the predicted values in this model do not differ from the actual values of the dependent variable DEATH in the case of its values equal to 1 as well as in the case of them being equal to 0. In the model without macro variables for the sample of all banks (Model 1 in Table 3), the highest level of Hosmer-Lemeshow test p-value shows its best predictive power in the two groups of binary variable at a time.

Conclusion

The purpose of this study was to determine the main factors that influenced the bank defaults in Russia during the financial crisis of 2008-2009. To handle this problem, we used logistic models, estimated on a sample of all the banks and on a sample of the 150 largest banks in terms of assets.

According to models that are based on indicators of bank statements, variables such as the ratio of reserves for possible losses to loans to non-banking sector and the ratio of debt-to-market liabilities of the bank had a positive effect on the probability of bank default. This can be explained by the fact that banks accumulated additional reserves if they had already experienced problems with the quality of its loan portfolio. Accumulation of such reserves, despite its ability to reduce liabilities for income tax, in the end could not save the bank. The positive impact of market debt was probably due to the weaker banks, which usually raised they funds with the help of promissory notes, and such additional fundraising also could not significantly improve bank performance.

High values of variables such as the share of loans to households in the bank's assets and the share of foreign liabilities in liabilities of the bank, met a lesser probability of default during the crisis. The reason for this is seen that only large stable banks, which safely went through the crisis, owned foreign liabilities, and, similarly, mainly large stable banks with extensive branch network were engaged in public lending.

On a sample of large banks, a significant variable was the share of government securities in the assets of the bank, which adversely affected the likelihood of default, which can be explained by the opportunity to take collateral loans on government securities.

Insignificance of such variable as a share of liquid assets in all assets of the bank, which were significant in many preceding studies, could be explained by the fact that short-term

liquidity crisis in the banking sector was mitigated by providing loans by the Bank of Russia to the Russian banking sector.

The change in macroeconomic environment was an important factor in the bank defaults. The increase in the ratio of exports to imports was due to higher oil prices and the stabilization of the macroeconomic situation in 2009, and estimated models revealed a negative impact of this variable on the probability of default. The sharp fall in the ruble characterized the crisis period and went in line with a large number of defaults, which corresponds to the positive impact of exchange rate changes on the bank default probability. Raising deposit rates helped to attract money in banks, including some of the problems solved the shortage of funds, which is consistent with the negative effect of interest rates on deposits in the probability of default of the bank identified in the built models.

These results allow us to formulate some policy recommendations to the Central Bank of the Russian Federation and the banking supervision and regulation aimed at preventing bank defaults in the event of such crises in the future:

1. Stricter requirements on the classification of bank assets and the creation of bank reserves for possible losses.

2. Limited edition of promissory notes and other debt by commercial banks.

3. Expansion of the collateral credit list of the Bank of Russia and the easier access to such credits for commercial banks, including medium and small regional banks and the possibility of refinancing with the Central Bank against securities.

4. The need to provide direct access to various tools for providing liquidity by the Bank of Russia for the extended number of banks, as in the case of crisis the market of interbank lending stops working as a transmission channel of liquidity into the banking system through the major banks.

5. The use of good practices of emergency providing liquidity for commercial banks by the Central Bank of the Russian Federation, including the unsecured basis, in case of strong shocks of the banking system.

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