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Bank Portfolio Allocation Strategy and Its Probability of Failure: Case of the Russian Banking Sector Purge

Victor Krakovich

PhD, Associate Professor, Department of Finance, St. Petersburg School of Economics and Management, HSE University, St. Petersburg, Russia, vkraiovich@hse.ru, [ORCID](#)

Daria Udaltsova

Operations Team Lead, “Software development” LLC, St. Petersburg Russia, udaltsova98@mail.ru, [ORCID](#)

Abstract

This paper aims to discover portfolio allocation strategies that facilitate a bank's stability. The paper examines the phenomenon of massive failures of Russian banks in the period from 2013 to 2019, in order to identify which of the banks' strategic decisions regarding assets and liabilities, as well as portfolio structure, lead to higher stability. The dataset contains financial indicators and prudential ratios of 895 commercial banks operating in Russia during that period. 507 banks, or 57% of all banks, lost their license during the considered period. Cases of bank failures were classified depending on whether the Central Bank identified any illegal activities conducted by the failed bank. The high failure rate provides an opportunity to study the differences between failed and non-failed banks in order to determine the factors associated with lower failure probability. Following the approach applied in most of the previous studies, we use a logistic regression to model the effect of different asset and liability portfolio structure on the failure probability. The hypothesis that failure probability of a bank is affected by its strategic focus of forming an assets and liabilities portfolio was statistically confirmed. We found that the focus of a bank's activity on providing loans to individuals and attracting deposits from companies leads to lower failure probability, confirming the results of previous studies. Also, we found that more active cooperation with other banks in terms of both borrowing and lending is associated with lower failure probability. Furthermore, we found that banks are less likely to borrow from or lend money to their fellow banks that later fail with illegal activity accusations. Finally, we found that unlike the EU banks, Russian banks with higher profitability ratios are more stable. The results are relevant for industry practitioners in facilitating the development of a more resilient bank strategy, as well as for regulators for incorporation in early warning models.

Keywords: banks, bank strategy, bank failure, bank management, bank portfolio allocation, bank profitability

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Introduction

When the new chairman of the Russian Central Bank, Elvira Nabiullina, took up the position in 2013, the radical changes in the approach of interacting with inefficient banks were subsequently implemented [1]. This period can be referred to as the “banking sector purge”. In 2016 alone, 15% of all the Russian banks lost their license. Such numerous license revocations were unprecedented in Russia’s modern economic history (Figure 1) [2].

Overall, the banking sector purge initiated by the Central Bank seems to have had a positive effect on the economy. This purge resulted in revealing a plethora of banks engaged in shady activity or earning management [1]. This also led to some negative consequences, such as a reallocation of assets to bigger banks [3; 4]. For many small and medium-sized banks, the question of survival has emerged. In such circumstances, it is worth studying the comparative resilience of different banks.

There are multiple outcomes that can be considered a failure for banks. It can be bankruptcy, according to national legislation [5], voluntary liquidation [6], or supervisory merger [7]. All of these outcomes lead to a bank’s inability to continue its operations as an independent entity and loss of license, i.e. a failure of its strategy. In this study, we do not distinguish between these outcomes and use the term ‘failure’ to refer to all cases of license revocation.

The main argument for initiating the banking sector purge was the involvement of many Russian banks in shady activities and the fact that they did not really serve the economy. This argument can be supported with the data. Among the 507 bank failures registered during the period in question, 264 occurred due to illegal activities. The reasons for the failure of law abiding and misbehaving banks may be different. Therefore, we conducted separate analyses for these two groups.

The Russian banking industry is a unique example of an emerging market that has experienced a large number of

bank failures during the last decade, and experienced an impressive economic and banking sector growth in recent years [8]. The assets of the Russian banking sector are highly concentrated. On June 1st 2020, 70% of total assets belonged to the 11 biggest banks [9, p. 5]. This puts the rest of the small and medium banks (which numbered 417 as of June 1st 2020 [9]) in danger of being unable to compete with the market leaders. Such a vulnerable position of the majority of banks indicates the fragility of the whole banking sector [10].

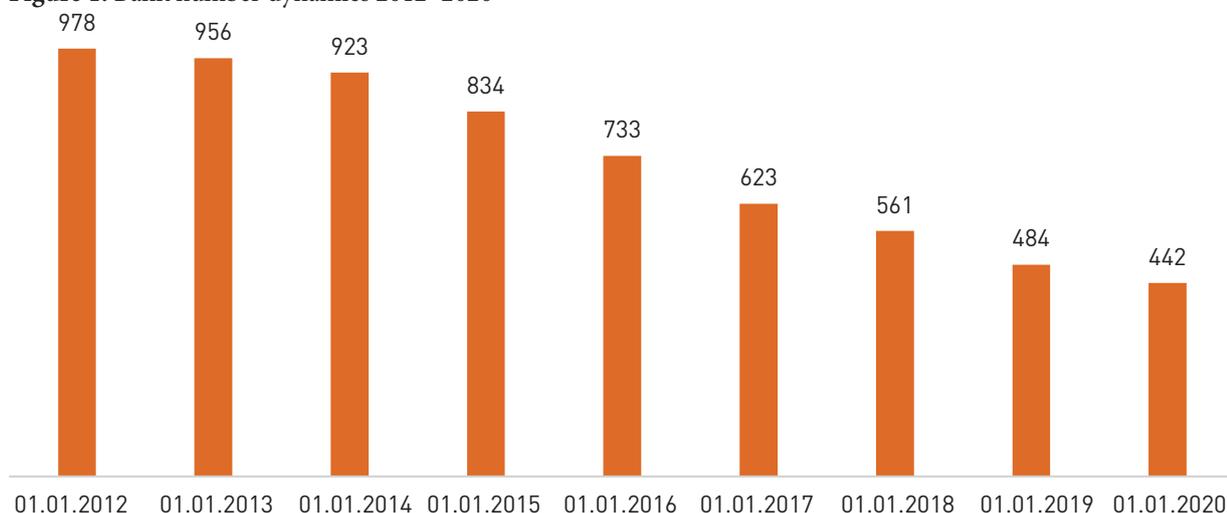
Ensuring financial stability is one of the main functions of the Central Bank. Much has been done to this end: the adoption of Basel I, II, and the current adoption of Basel III regulatory frameworks, adoption of new technologies, and implementation of the daily monitoring of banks’ prudential ratios. The Central Bank also tries to mitigate external risks, such as global financial crises and natural resource price fluctuations, which can be very dangerous for the banking system [11; 12]. If necessary, the government can provide additional support to systemically important banks, like it did in the 2008–2009 global financial crises [13, p. 33].

The Central Bank has to conduct all its regulatory interventions against commercial banks non-publicly. Otherwise, the information about such interventions will substantially worsen the situation in a bank due to a potential bank run. The Central Bank reveals information only when serious intervention is necessary. Such intervention usually means a bank failure [4]. It is important for the public to find reliable failure risk estimation methods.

The possibility for an external observer to predict a forthcoming bank failure has been a relevant issue for many years. It seems rather challenging to identify the fine line between a problem bank and a bank in crisis, or a stable bank and a bank with insignificant current difficulties [12].

There are multiple bank rating systems utilized by central banks around the world. One of the best-known ones is CAMELS (capital adequacy, asset quality, management,

Figure 1. Bank number dynamics 2012–2020



Source: The official website of the Central Bank of the Russian Federation.

earnings, liquidity, sensitivity) which is implemented in the US [14]. In order to use a system that is better fit for national peculiarities, many countries have developed their own. For instance, Germany uses BAKIS, a coefficient analysis method based on a system of 47 indicators that comprehensively assess credit risk, market risk, liquidity and profitability. In the UK there is the RATE system, which is based on measuring the effectiveness of risk assessment instruments. Russia, in turn, focuses on the conditions of a bank's financial stability, owned capital, assets, profitability, liquidity, interest rate risk, quality of management, and transparency of ownership structure [15]. Russian Central Bank monitors the commercial bank ratio set daily. The ratios are described in the Central Bank instructions No. 199-I issued on 29.11.2019 [16]. We use these ratios in our research as control variables.

As state regulators do not reveal their bank rating grades, the public usually uses the ratings issued by private rating agencies. There are 4 national rating agencies accredited by the Central Bank of Russia. It is a very convenient tool, since all the information about bank stability is compressed into a single rating grade [17]. In spite of the popularity of credit ratings, they have some drawbacks, which are particularly relevant for Russia. The main one is that rating agencies, both Russian and global, are usually slow in updating their grades, and banks with an investment grade sometimes lose their license. Ferri et al. [18] found that credit ratings alone are not sufficient to reliably predict bank failures. Karminsky and Kostrov [19] produced similar results for the Russian banking sector.

Bank management influences its failure probability [20]. A bank's strategy can be identified as a combination of its asset and liability management strategies. To be more precise, the strategy of attracting deposits and allocating loans are the most informative [21]. Therefore, variables that describe them should be good predictors of a bank's failure probability [22].

Literature review

The issues of bank stability have been of interest to researchers and practitioners for many years. Developing the ideas of Altman [23], Sinkey [24] suggested using the discriminant analysis to model the banks' failure probability. Subsequently, Martin [25] introduced logit regression for bank failure prediction. Since then, different models were applied to address the same problem: survival analysis models [20; 26], trait recognition models [5], and neural networks [27]. However, the logit remains the most popular model in the field, due to its simplicity and ease of interpretation [5; 10; 11; 15; 18; 27–30].

Management quality is a crucial factor affecting a bank's stability, but its adequate estimation is problematic. In traditional CAMELS, rating system management quality is estimated by on-site bank examinations. External stakeholders are unable to conduct such examinations. Moreover, a CAMELS rating calculated by the regulator is kept secret in order to prevent a bank run following a downgrade. So, the public needs other ways to estimate bank stability.

However, today, banks publish their financial statements in many countries, including Russia. Financial information can be used to identify a bank's strategy and management quality. Wheelock and Wilson [20] suggested measuring management quality by cost inefficiency and input and output technical inefficiencies using a bank's financial information.

The banks generate cash flows through a variety of different activities. When researchers model a bank's activity, they have to simplify it and reduce it to a limited number of functions. As investment banking in Russia is less developed than commercial banking, for most banks the main cash flow generating activity is attracting deposits and allocating them to loans. For this reason, in our study we focus on these types of banking activities.

Mamonov [1] reported that in failed banks population those who had higher proportion of deposits from individuals and loans to firms tend to have higher "holes" (negative capital) after the failure. Karminsky and Kostrov [19] have arrived at similar conclusions. They found that a larger share of loans to individuals and a lower share of deposits from individuals reduce the failure probability for banks with negative capital. Deposits from individuals, despite typically being cheaper than other sources of financing like interbank borrowing, have their own risks. A higher proportion of deposits from individuals increases operational costs and makes a bank more vulnerable to liquidity risk after a bank run. Loans to individuals are more diversified and transparent than company loans. Their prevalence in the loan portfolio should make banks more stable.

Another group of relevant data is associated with the interbank market. Theory suggests that banks are better informed of the actual state of affairs in other banks than the general public or the regulator [31]. There is evidence that interbank market data can be useful in bank failure prediction [32]. It can be expressed through interbank market decisions when potentially problematic banks struggle to attract financing or allocate their resources on the interbank market.

Since 2017, when the above-mentioned studies were conducted, the "banking sector purge" in Russia hasn't ended yet. Thus, it may be interesting to check the earlier findings on the updated dataset. Furthermore, those studies are focused on the factors affecting a bank's negative capital after failure, while in our study we are more interested in bank strategies in regard to deposits and loan allocation that facilitate its resilience.

We will use the following research hypotheses.

More specific findings will be revealed below, which currently enables us to propose narrower hypotheses corresponding with the research direction.

H1.1: A bank's focus on issuing loans to individuals is likely to reduce its failure probability, while issuing more commercial loans increases failure probability.

H1.2: A bank's focus on attracting commercial deposits is likely to reduce failure probability, while attracting more deposits from individuals increases failure probability.

H1.3: The banks that fail due to illegal activities are less involved in interbank borrowing and lending.

The proposal of these hypotheses is driven by the related studies of Lanine and Vennet [5], Fungacova and Weill [10] and Zakirova et al. [15]. In addition, other findings are yet to emerge.

The study is unique in several ways. It encompasses an extensive time period known as the second wave of Russian banks' failure. Furthermore, it distinctly emphasizes the role of different financial indicators in portfolio allocation, as well as prudential ratios. Lastly, the research scale is massive, which is illustrative and relevant when discussing the Russian banking system phenomenon.

Data and methodology

The dataset contains monthly information on 895 commercial banks operating in Russia from 2012 to 2019. Elvira Nabiullina was appointed as the head of the Russian Central Bank in June 2013. With her appointment, the

Central Bank shifted its policy to purging the banking sector, actively revoking the licenses of problem banks. So, we included one full year before this policy shift in the sample. All the data is structured as a panel dataset, where all the indicators included in the forthcoming analysis are captured on a monthly basis. For each bank, the periods are numbered from 1 to 96, where the first period is January 2012 and the 96th period is December 2019. This enables us to conveniently follow bank number dynamics within the time period when the Central Bank was implementing its radical policy in relation to inefficient banks and revoked licenses. In other words, if the cells containing some data in a previous month become blank in the following month, it means that a bank has defaulted (Appendix 1).

We use the binary variable "failure" as a dependent variable, which is equal to 1 if a bank fails during the analyzed period, and 0 if it continues its operations.

The independent variables are divided into 2 groups. The first group includes 11 financial indicators reflecting bank performance and loan/deposit portfolio composition (Table 1).

Table 1. Description of financial indicators

Financial Indicator	Description and gathering method
<i>Loans to individuals</i>	Include loans to individuals for 180 days, from 181 days to 1 year, from 1 to 3 years, more than 3 years, overdrafts and past-due debt
<i>Loans to companies</i>	Include loans to legal entities for 180 days, from 181 days to 1 year, from 1 to 3 years, more than 3 years, overdrafts and past-due debt
<i>Issued Interbank Loans</i>	Include loans issued to other banks that are incorporated in the CB and total turnover
<i>Individual deposits</i>	Include deposits of individual clients for 180 days, from 181 days to 1 year, from 1 to 3 years, more than 3 years and their turnover
<i>Company deposits</i>	Include deposits of legal entities for 180 days, from 181 days to 1 year, from 1 to 3 years, more than 3 years and their turnover
<i>Interbank Loans Raised</i>	Include loans raised from other banks, the CB, all turnovers and Loro correspondent accounts
<i>Total Assets</i>	Include high-liquid assets [cash, Nostro correspondent accounts], issued interbank loans, investments in securities [stocks, bonds, bills of credit], investments in other legal entities' equity, loans to individuals, loans to legal entities, past due debt in credit portfolio, fixed, intangible and other assets
<i>Net Income</i>	Calculated as net difference between a bank's total revenue and its costs in a particular period
<i>Return on Assets [ROA]</i>	The indicator measures a bank's profitability in relation to its assets. Calculated as a ratio of net income to net assets
<i>Bank Capital</i>	The difference between a bank's assets and liabilities. The amount of a bank's own funds that constitutes the financial basis of its activity. The information is extracted from the 123 reporting form
<i>Total Liabilities</i>	Total amount of funds that are paid or will become due for payment by a bank to its customers. Calculated as the difference between Net Assets and Bank Capital

The data was extracted from Banki.ru [33], a website that contains all the relevant information about Russian credit organizations. Its reliability is additionally supported by the usage of this source in related papers [10; 15; 19].

Table 2. Description of bank normatives

Normative	Description
<i>N1: Capital Adequacy Ratio</i>	Regulates risks of insolvency and establishes the minimum value requirement (10 percent) of a bank's capital needed to cover credit, operational and market risks
<i>N2: Quick Liquidity Ratio</i>	Regulates liquidity loss risks within one working day. The minimum value is 15 per cent
<i>N3: Current Liquidity Ratio</i>	Regulates liquidity loss risks within 30 days immediately following the date of its calculation. The minimum value is 50 per cent
<i>N4: Long-term Liquidity Ratio</i>	Regulates liquidity loss risks resulting from investments in long-term assets (more than 365 calendar days). The maximum value is 120 per cent
<i>N7: Maximum Volume of Large Credit Risks Ratio</i>	Regulates total volume of large credit risks and establishes the maximum ratio (800 per cent) of the volume of large credit risks to a bank's capital
<i>N12: Ratio of Using Bank's Capital For Purchasing of Shares of Other Legal Entities</i>	Establishes the maximum ratio (25 per cent) of funds invested in share purchasing to the bank's capital

These indicators are highly significant, as they help identify the general strategy of credit organizations in terms of their assets and liabilities portfolio structure. For this purpose, six additional variables were created, representing the share of each loan and deposit type in a bank's portfolio:

In order to identify a bank's strategy in loan and deposit allocation, we use 6 relational ratios.

- 1) *Share of Loans to individuals = Loans to individuals / Total Assets [il_to_ta].*
- 2) *Share of Loans to companies = Loans to Legal Entities / Total Assets [cl_to_ta].*
- 3) *Share of Interbank Loans = Issued Interbank Loans / Total Assets [ib_to_ta].*
- 4) *Share of Deposits from individuals = Deposits from individuals / Total Liabilities [id_to_tl].*
- 5) *Share of Deposits from companies = Deposits of Legal Entities / Total Liabilities [cd_to_tl].*
- 6) *Share of Interbank Loans Raised = Interbank Loans Raised / Total Liabilities [ib_to_tl].*

The second group of variables consists of six prudential ratios, which are monitored by the Central Bank on a daily basis (Table 2). They characterize the risk of the bank. The closer the ratio value to the minimum or maximum threshold set by the Central Bank, the more risks a bank has. The data is collected from the Central Bank website [34].

The study involves 895 Russian commercial banks. Between 2012 and 2019, 507 of them lost their license.

Such a high failure rate (57%) points at the banking sector purge process and enables researchers to investigate the differences between failed and non-failed banks. One important factor to consider in analyzing failure reasons is the criminal status of a failed bank. We merged our data with the dataset provided by A. Karas [35] in order to identify whether the Central Bank mentioned that the bank was involved in illegal activities in its bank license revocation press release. Illegal activities include captive and dubious activities, asset tunneling, fraud, and violation of anti-money laundering laws [35]¹. Table 3 reveals that more than half of the failed banks were accused of violating federal laws. As the Central Bank reveals such information only simultaneously or after the license revocation announcement, there are no observations of surviving banks involved in illegal activities (Table 3).

Also, we considered the ownership structure of the banks, particularly, state ownership (including regions, municipal and state companies), and foreign ownership. We extracted bank ownership data from [36]. We found that cases of failure in such banks are very scarce. Support from the state or international enterprises makes them intrinsically different from other banks. Therefore, we decided to exclude them from the sample. Table 3 shows the difference between the two samples. The second sample is smaller by 46 observations. Only five of them are failed banks. This proportion differs from that observed in the entire sample.

¹ We took all the reasons that start with "M" in [35]. There is also a set of failure reasons starting with "R" devoted to different regulation violations. Such violations are not always due to the bad intentions of bankers. They might be due to other reasons, i.e. insufficiency of funds or operational mistakes. Therefore, we did not take this set of failure reasons.

Table 3. Failure / Survival statistics for all banks (left) and for private domestic banks (right)

Illegal				Illegal			
Bfail	0	1	Total	Bfail	0	1	Total
0	388	0	388	0	347	0	347
1	243	264	507	1	239	263	502
Total	631	264	895	Total	586	263	849

Table 4 contains descriptive statistics of independent variables. We can see that banks have different strategies in deposit and loan allocation. The counterparts of deposit or loan allocation, such as corporate clients, individual clients or other banks can be dominant or negligible for different banks. Regulatory ratios vary significantly as well, indicating different risk profiles of the banks.

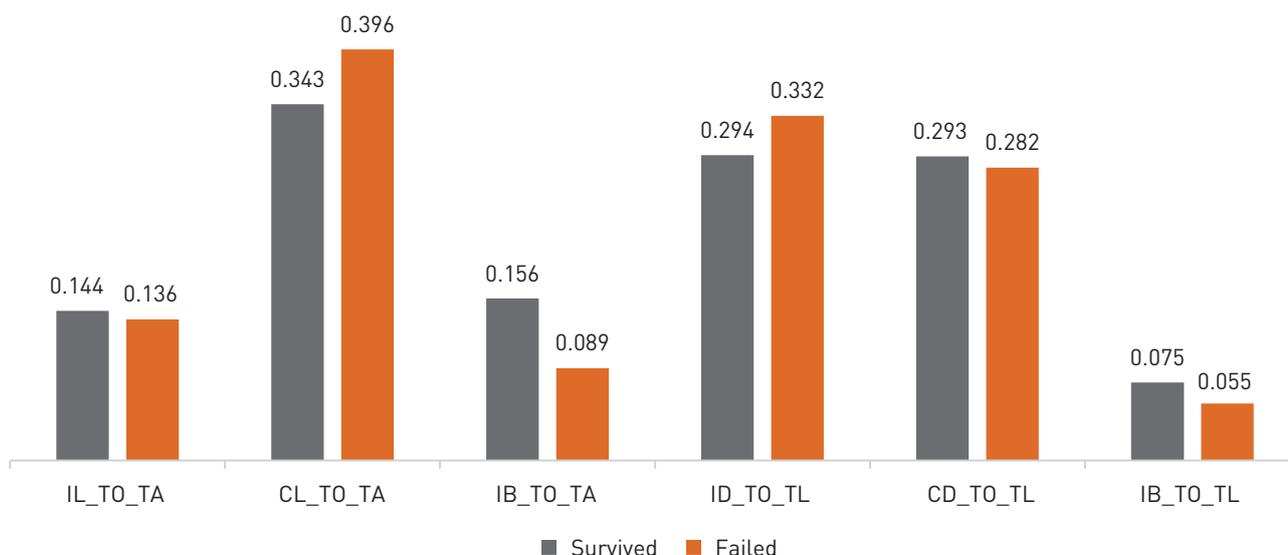
Table 4. Descriptive statistics of independent variables

Variable	Obs	Mean	Std. dev.	Min	Max
il_to_ta	58,982	.1364998	.1535784	0	.969
cl_to_ta	58,974	.3683424	.2104017	0	.994
ib_to_ta	58,982	.1245544	.1641695	0	2.453
id_to_tl	58,999	.3194003	.2202368	0	1.945
cd_to_tl	58,999	.2890019	.1712651	0	1.318
ib_to_tl	58,910	.0590109	.1233367	0	1.397
roa	58,982	.0042499	.0335985	-2.963981	.575944
n1	57,642	28.0498	31.87949	-2.76	2232.73
n2	56,202	435.8618	16904.78	0	1843406
n3	57,430	221.1897	2581.701	0	456271.9
n4	56,038	48.00565	31.06678	0	708.6
n7	56,002	257.0356	8049.571	-2641.06	1902056
n12	54,811	1.336668	9.429133	0	1389.1

In addition, the VIF test was conducted in order to reveal possible multicollinearity issues (Table 5). VIF values indicate that multicollinearity is not an issue in our sample.

Table 5. VIF test

VIF		VIF	
il_to_ta	1.76	n1	1.39
cl_to_ta	1.69	n2	1.03
ib_to_ta	1.38	n3	1.04
id_to_tl	2.14	n4	1.49
cd_to_tl	1.76	n7	1.08
ib_to_tl	1.44	n12	1.09
roa	1.01	Mean VIF	1.41

Figure 2. Average shares of strategies followed by failed and survived banks

Source: Based on Banki.ru.

Figure 2 illustrates the descriptive statistics of the loan and portfolio structure for failed and non-failed banks. We can see statistically significant differences in values between the two groups of banks.

The model we chose is the panel logit regression with random effects due to the binary nature of the dependent variable, as well as the ease of regression coefficients' interpretation. A fixed effects model does not calculate the probability of the outcome (i.e. failure). Instead, the model estimates the probability of having a non-zero outcome among all the observations of the particular panel unit (i.e., bank). Moreover, variable changes across time are small (from approximately one thousandth to one hundredth). This makes the application of fixed effects regression rather complicated or even impossible. Thus, the random effects model is popular in research on related topics [5; 10; 15; 28; 37].

Results and discussion

Table 6 displays the coefficients and marginal effects of the model. We ran separate logit regressions for the two samples, i.e., the banks that had failed without accusations of illegal activities, and banks that were accused of conducting such activities. The set of surviving banks is the same for both samples. The change in the log-odds does not provide a clear understanding of their actual influence on the

probability of bank failure. In order to make the interpretation of model results easier, we also estimated marginal effects. Since all the variables are continuous, marginal effects measure the instantaneous rate of change, i.e. how the probability of bank failure will change if the independent variable value changes by one unit. These effects are more convenient, since they enable us to interpret the results in the same way as in the usual linear regression model.

The regression results are presented in Table 6. As the samples are different in size, we cannot compare the coefficients and marginal effects. What we can compare are their sign and significance. We can see that results are generally consistent for both samples. The signs of coefficients and marginal effects are mostly similar for both samples except for the share of interbank deposits in total liabilities. It might be due to the fact that the general public is not informed about a bank's potential misconduct, while other banks may have more information and prefer not to keep their assets in potentially criminal banks. An alternative explanation may be that shady banks, unlike their law-abiding competitors, do not need additional financing due to the nature of their operations.

Although we use a random effect model, the month dummies are still included in order to specify all the financial indicators for each of the 96 periods. Overall, 58,535 observations are included in the model that are clustered in 895 groups according to the number of banks.

Table 6. Results of the panel logit regression and marginal effects

Bank Failure	No illegal activities identified		Illegal activities identified	
	Regression Model Coefficients /Std. Err.	Marginal effects dy/dx /Std. Err.	Regression Model Coefficients /Std. Err.	Marginal effects dy/dx /Std. Err.
IL_to_TA	-0.601*** (0.102)	-0.0875251*** (0.0153178)	-1.210*** (0.105)	-.1748446 (.0171644)

Bank Failure	No illegal activities identified		Illegal activities identified	
	Regression Model Coefficients /Std. Err.	Marginal effects dy/dx /Std. Err.	Regression Model Coefficients /Std. Err.	Marginal effects dy/dx /Std. Err.
CL_to_TA	0.447*** (0.0745)	0.0650521*** (0.0112424)	0.312*** (0.0714)	.0450795 (.0105346)
IB_to_TA	-0.236* (0.0977)	-0.0343357* (0.0143247)	-2.352*** (0.107)	-.3398107 (.02224)
ID_to_TL	0.723*** (0.0893)	0.1052427*** (0.0138117)	0.337*** (0.0849)	.0487159 (.0124565)
CD_to_TL	-1.058*** (0.103)	-0.1540473*** (0.0165258)	-0.952*** (0.0970)	-.1374846 (.015323)
IB_to_TL	0.461*** (0.118)	-0.0670916*** (0.0174036)	-2.899*** (0.145)	-.4189232 (.0284712)
ROA	-5.450*** (0.482)	-0.7933378*** (0.078554)	-9.509*** (0.529)	-1.374009 (.0984186)
H1	0.00112 (0.000655)	0.0001637 (0.0000957)	0.00610*** (0.000721)	.0008818 (.000112)
H2	-0.00000238 (0.00000385)	-0.000000346 (0.000000561)	-0.0000190 (0.0000106)	-0.00000274 (0.00000153)
H3	0.0000197 (0.0000150)	0.00000286 (0.00000219)	0.0000218* (0.00000998)	0.00000315 (0.00000145)
H4	-0.00286*** (0.000482)	-0.0004158*** (0.0000725)	-0.00189*** (0.000454)	-.0002729 (.0000666)
H7	0.00000624** (0.00000229)	0.000000908** (0.000000337)	0.000000470 (0.00000163)	0.000000679 0.000000235
H12	-0.0237*** (0.00349)	-0.0034465*** (0.0005315)	-0.00102 (0.00218)	-.000148 .0003152
Constant	-1.395*** (0.142)		-0.767*** (0.161)	
N	41110		43660	
Prob>chi2	0.000		0.000	
Log-likelihood	-21334.24		-23673.55	

*p<0.05, ** p<0.01, *** p<0.001.

The first key variable, IL_to_TA , which stands for the share of loans to individuals in total bank assets, has significant negative coefficients. That means that all else being equal, the strategy of increasing the share of loans to individuals in total bank assets has a positive effect on the bank's performance.

The second variable, CL_to_TA , indicates the strategic focus of increasing the share of loans to companies in a bank's total assets has positive value coefficients. This means that based on the given dataset, banks that were focusing on crediting legal entities experienced more frequent license revocations.

The share of interbank loans in total assets (IB_to_TA) is negatively associated with a bank's failure probability. The results are more significant for the sample with misbehaving banks. It may indicate that banks themselves possess additional information about their fellow banks and prefer not to lend money to banks that may be involved in illegal operations.

The second group of key variables is related to a bank's liability portfolio. Here, the indicators ID_to_TL (share of deposits from individuals in total liabilities) and CD_to_TL (share of deposits from companies in total liabilities) have coefficients with the same signs in both samples. The strategy of attracting personal deposits led to a higher chance of a bank losing its license, thus demonstrating poorer performance. The log-odds of bank failure probability decreases when there is a one-unit increase in the share of deposits from companies, all other things being equal. Our results confirm the findings of Mamonov [1], Karminsky and Kostrov [19], which stated that the strategy of attracting deposits from companies to lend to individuals is more sustainable than the opposite one.

Interestingly, coefficients at variable IB_to_TL (share of in-

terbank deposits in total liabilities) have different signs in the 2 samples. In the sample of law-abiding banks it is associated with higher failure probability, while in the other sample we see that it has a significant negative association with failure probability. It might be due to the fact that it is more difficult to attract funds from other banks for misbehaving banks. It indicates that banks themselves have more information about their competitors and interbank money flow dynamics can be used to identify the banks involved in illegal activities.

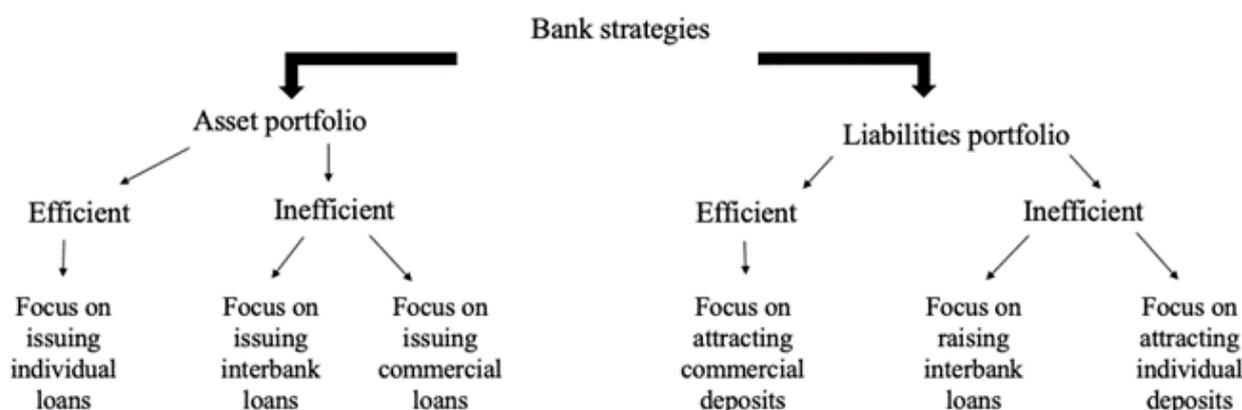
As for control regressors, the Return on Assets (ROA) showed a positive impact on bank performance. This finding contradicts the one by Pessarossi et al. [38] for European banks. This might be due to the different stages of banking sector development in the EU and Russia. It makes sense to reconsider the effect of ROA on bank stability in Russia again later, after the bank purge process is over and the number of banks becomes more stable.

The values of bank normative ratios mostly have little effect on the model and the signs of their coefficients are the same for both models. It is assumed that the changes in these indicators were insignificant for most of the periods except for a few shocks.

Taking into account the $Prob > \chi^2$ value, which equals zero (completely significant) and the statistical significance of four out of six independent variables representing bank strategies, the null hypothesis can be rejected. This means that the way a credit organization structures its assets and liabilities portfolio does affect the probability of default, hence, is capable of influencing bank performance.

The regression results confirm the research hypothesis that bank strategies do affect their probability of failure. Summing up the results of the study, the diagram of analyzed bank strategies is presented (Figure 3).

Figure 3. Efficient and inefficient bank strategies



Conclusion

This research aimed to find efficient strategies of forming the assets and liabilities portfolio of a bank. It examined the eight-year period from 2012 to 2019, when numerous commercial bank licenses were revoked by the Central Bank of Russia. The logit panel regression model demonstrated the statistical significance of the research hypothesis, namely, that a bank's strategy of loans and deposit portfolio allocation between different client segments does affect the probability of its default. The strategy of raising deposits from companies and distributing them as loans to individuals is more resilient than the opposite one. Unlike the EU banks, Russian banks with higher ROA tend to be more stable. Also, information on the interbank market strategy is relevant for failure prediction. The share of interbank deposits in total liabilities has a different effect on law-abiding and misbehaving banks. For the first group it is positively associated with failure probability, while for the second one we identified a strong negative association. This might indicate that banks themselves are reluctant to cooperate with potentially problematic banks, since they have more information about their peers. This finding suggests an avenue for future research and interbank market analysis for the purpose of failure prediction.

These results may be useful for financial experts, investors, and other economic professionals, people who seek to manage their personal assets more rationally, or to expand their general knowledge about commercial credit organizations. Also, the outcomes can be taken into account by the banks themselves in order to adjust their current strategies as a measure of failure prevention and enhancement of financial position. Finally, the financial regulator may use the findings of the study in the development of an early warning system.

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Appendices

Appendix 1. Example of the dataset with the failed bank

IB_TO_TL	0.003	0.003	0	0	0	0	0	0				
CD_TO_TL	0.131	0.123	0.121	0.12	0.118	0.114	0.02					
ID_TO_TL	0.541	0.549	0.563	0.561	0.562	0.563	0.552					
IB_TO_TA	0	0	0	0	0	0	0					
CL_TO_TA	0.794	0.791	0.785	0.804	0.81	0.809	0.758					
IL_TO_TA	0.002	0.001	0.001	0.001	0.001	0.001	0.001					
Bank Failure	1	1	1	1	1	1	1					
No. of period	61	62	63	64	65	66	67	68	69	70	71	72
Date	01.01.2017	01.02.2017	01.03.2017	01.04.2017	01.05.2017	01.06.2017	01.07.2017	01.08.2017	01.09.2017	01.10.2017	01.11.2017	01.12.2017
Bank Name	Yugra											

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