Relationship between the Operational Risk, Operations and Information Management in Russian Banking Sector

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Abstract— **The paper considers the issue of operational risk management in Russian commercial banks. The correlation and regression analysis also revealed the dependence of the operational risk level on liquidity risks (current and long-term liquidity ratios) and crediting risks (the amount of overdue debt, the aggregate risk for bank insiders, and reserves for possible losses on loans and equivalent debt). It has been proved that with the growth of current and long-term liquidity ratios, overdue debts and reserves for possible losses on a loan, loan debt and its equivalent ratios, the operational risks of credit organizations in Russia grow, whereas with an increase in the aggregate risk for bank insiders (H10.1), the level of operational risks of the banking sector is reduced. The values of operational risk in the banking sector of the Russian Federation are predicted on the basis of the scenario approach for 2019-2020. As part of the pessimistic and moderate growth scenario, an increase in the level of operational risks is predicted, which makes it necessary to implement new approaches to managing this type of risk in credit institutions and introduce new methods of managing operational risk by the Central Bank of the Russian Federation.**

Keywords— *banking sector, banking risks, operation and information management, operational risk, credit risk, liquidity risk, market risk*

1.   Introduction

As banking operations become more complex and their volumes increase, accompanied by the consolidation of the banking sector and extension of credit institutions, many banks face serious problems associated with the emergence of operational risks [1-5]. This means the likelihood of losses arising from the occurrence of events associated with erroneous or unlawful actions of employees and third parties; technical and professional imperfections in the support of banking processes; factors acting as part of the banking business systems, and also external events [6-12]. Operational risks are unpredictable and are characterized by greater uncertainty than other banking risks [1, 13-18] since they do not depend on market conditions, economic processes, political stability, etc.

Unlike the main typical banking risks, the occurrence of operational risk does not always depend on the performance of traditional banking operations. At the same time, banking risks are closely interrelated; their mutual influence can significantly affect the risk of the banking portfolio as a whole, which makes it necessary to analyze the relationship of operational risk with other typical banking risks in order to obtain a tool for managing them in credit institutions [19-24].

2.   Methods

In order to establish the dependence of the level of operational risk on typical banking risks and the degree of their influence on the resulting component, the methods of correlation and regression analysis were used.

3.   Results

Initially, a system of typical banking risks was determined for econometric analysis. One of the conditions for the use of correlation and regression analysis is the availability of digital data in the analytical reports of the Bank of Russia on the parameters included in the model. In addition to operational risk which is reflected in such statistical surveys, the Bank of Russia publishes information on market risk, including its components (interest rate, equity, currency and commodity risks), on liquidity ratios (instant (H2), current (H3) and long-term (H4) liquidity), on the crediting risks (the amount of overdue debt, the amount of loan loss provision, loan indebtedness and similar debts (hereinafter - LLP), compliance with mandatory credit risk standards (maximum size of large credit risks (H7), aggregate risk value for insiders of a bank (H10.1)). Product risk was excluded from this set due to insufficient statistical data since this indicator began to be calculated by Russian banks from the beginning of 2016.

898

Int. J Sup. Chain. Mgt   Vol. 8, No. 5, August 2019

In addition, when forming the system of factors, the key principle of correlation and regression analysis was taken into account: the number of factors taken into account in the model (without taking into account the resulting indicator) should be 6-7 times lower than the number of parameters in a representative sample. In this study, monthly parameters were used from 01/01/2013 to 01/01/2019; a total is 72 points for analysis by 10

regressors, the excess is 7.2 times, which indicates compliance with this principle.

For the purpose of eliminating the problem of factor multicollinearity, an analysis of paired correlations between selected indicators was carried out (Table 1). The analytical information source was analytical reports of the Bank of Russia, posted on the website www.cbr.ru [2]. All calculations were made using Excel software.

Table 1. Checking the factors for multicollinearity

Correlation	Operational risk	Overdue debt	LLP	H2	H3	H4	H7	H 10.1	Interest risk	Currency risk	Stock risk
Operational risk	1.00										
Overdue debt	0.9522	1.00									
LLP	0.9700	0.456	1.00								
H2	0.8886	0.145	0.245	1.0							
H3	0.8933	0.256	0.417	0.858	1.0						
H4	-0,8751	0.475	0.236	0.758	0.245	1.0					
H7	0.2664	0.348	0.485	0.471	0.380	0.623	1.0				
H10.1	-0,9118	0.356	0.365	0.015	0.596	0.254	0.456	1.0			
Interest risk	0,6038	0.445	0.251	0.154	0.123	0.254	0.342	0.321	1.0		
Currency risk	0.3515	0,359	0.336	0.196	0.214	0.145	0.125	0.248	0.445	1.0	
Stock risk	0.0916	0.182	0.463	0,295	0.025	0.175	0.241	0.236	0.378	0.283	1.0

To conduct a regression analysis, it is advisable to leave in the consideration the factors for which a high relationship was found on the Chaddock scale, that is if the correlation coefficient exceeds 0.7. All other factors that do not satisfy this condition are excluded. In addition, there is a strong relationship between the factors of instant liquidity (H2) and current liquidity (H3), as well as long-term liquidity (H4). This necessitates excluding the N2 ratio from further research. Therefore, the current liquidity ratio (X_1), the long-term liquidity ratio (X_2), the amount of overdue debt (X_3), the aggregate amount of risk on bank insiders (X_4), and LLP (X_5) are subject to inclusion in the model.

To identify the relationship between operational risk and the above factors, the Regression tool of the Data Analysis package in MS Excel was used. As a result, the following equation was obtained:

$$Y = -6352.2 + 21.75 * X1 + 75.06 * X2 + 1.02 * X3 + 0.77 * X5 – 2389.4 * X4, (1)$$

According to this equation, it is possible to determine the direction of the relationship between factors and the resulting indicator. If the sign in front of the desired parameter is positive then the relationship is direct, if negative, then it is the inverse one [3, p.25]. Consequently, with an increase in current and long-term liquidity ratios, overdue debts and LLP, the operational risks of

credit institutions in Russia will also progress, while with an increase in the aggregate amount of risk on bank insiders (H10.1), the operational risks of the banking sector will decrease.

In order to assess the quality of the obtained regression line, the coefficient R^2 and the multiple correlation coefficient R were calculated. According to the analysis results, the value of R^2 is close to 1 and is 0.9691, i.e. all factors are taken into account in this model are responsible for 96.91% of the analyzed function variation. The rest may be due to the influence of other factors that are unrecorded. According to the results of calculations, the coefficient of multiple correlation R is 0.9844, which also confirms that the constructed model is significant.

To determine the influence of specific factors on the studied function y, the significance of individual regression coefficients b was determined using two equivalent methods: the first involves the use of Student's criterion, and the second concerns the level of significance.

To assess the quality of the model according to Student's criterion, the actual value of t_{obt} criterion is compared with the critical value t_{crit}: if modulo $t_{obt} > t_{crit}$, then the resulting value of the pair correlation coefficient is considered significant [4, p.312]. When $\alpha = 0.05$ and $v = 66$, the critical t_{crit}

899

Int. J Sup. Chain. Mgt   Vol. 8, No. 5, August 2019

(0.05; 66) = 1.997, t $_{calc}$ is 2.36, which is less than the critical parameter. Therefore, according to Student's criterion, the regression coefficients are significant.

The use of a significance level implies an assessment by analyzing the p-value index. The coefficient is recognized as significant if the p-value calculated for it is less (or equal) to 0.05 [4, p. 315], the necessary calculations to determine the p-values are presented in Table 2.

Table 2. Assessment of the significance level for the regression coefficients

Variable	The factor name	t-statistics	P-Value
X_1	Current liquidity ratio	2,748659445	0,0079278
X_2	Long-term liquidity ratio	4,169655984	0.00010133
X_3	Overdue debt	2,339216589	0.02272988
X_4	Aggregate risk by bank insiders	-2,57607584	0,0125166
X_5	LLP (loan loss provision)	4,066792202	0,00014325

The data presented in Table 2 allow us to conclude that all the coefficients considered are statistically significant. Thus, it can be stated that the operational risks of the Russian banking sector from the beginning of 2013 to December 2018 are strongly and strongly influenced by liquidity and crediting risks which include:
- Current liquidity ratio;
- Long-term liquidity ratio;
- The amount of overdue debt;
- The aggregate risk for insiders of the bank ratio;
- LLP.

Using the results of the study, commercial banks which manage liquidity and credit risks can predict operational risks and thus affect them. In addition, having a regression model, it is possible to predict the magnitude of the operational risks in the banking sector. This requires the predicted values of the regressors which in this study were obtained by determining the average monthly rate of change for each indicator:
- For the current liquidity ratio, the average rate of change was 101.52%;
- For the long-term liquidity ratio - 99.39%;
- For of overdue debt amount - 101.43%;
- For the aggregate risk for insiders of the bank ratio - 99.24%;
- For LLP - 101.64%;

Multiplying the average monthly rate of change by the values of indicators for December 2018, their predicted data up to January 2021 were obtained and, accordingly, the monthly data on the operational risk in the banking sector as to their prospects were determined. The results of the calculations are presented in table 3.

Table 3. The operational risk forecast for the banking sector in Russia and the factors affecting its level

Date	Operational risk, billion rubles	H3,%	H4,%	Arrears, bln. rub.	H10.1,%	LLP, billion rubles
	at	X1	X2	X3	X4	x5
01/01/2019	8,137.40	166.4	57.50	3 050.50	0.4	5,712.60
01.02.2019	8,282.72	168.9	57.15	3,094.12	0.4	5,806.29
03/01/2019	8 430.85	171.5	56.80	3,138.37	0.4	5,901.51
04/01/2019	8,581.84	174.1	56.45	3 183.25	0.4	5,998.29
05/01/2019	8,735.73	176,8	56.11	3,228.77	0.4	6,096.67
06/01/2019	8,892.56	179.4	55.77	3,274.94	0.4	6,196.65
07/01/2019	9,052.37	182.2	55.43	3 321.77	0.4	6,298.28
08/01/2019	9 215.20	184.9	55.09	3 369.27	0.4	6 401.57
09/01/2019	9,381.10	187.7	54.75	3 417.45	0.4	6,506.55
10/01/2019	9 550,11	190.6	54.42	3 466.32	0.4	6,613.26
11/01/2019	9,722.27	193.5	54.09	3 515.89	0.4	6,721.72
12/01/2019	9 897.64	196.4	53.76	3 566,17	0.4	6,831.96
01/01/2020	10,076.26	199.4	53.43	3,617.16	0.4	6,944.00
02/01/2020	10,258.17	202.5	53,10	3,668.89	0.4	7,057.88

03/01/2020	10,443.43	205.5	52.78	3,721.35	0.4	7,173.63
04/01/2020	10,632.08	208.7	52.46	3,774.57	0.4	7,291.28
05/01/2020	10,824.18	211.8	52.14	3,828.55	0.4	7 410.86
06/01/2020	11 019.76	215.0	51.82	3,883.29	0.4	7 532.39
07/01/2020	11,218.89	218.3	51.50	3,938.83	0.4	7 655.92
08/08/2020	11,421.61	221.6	51.19	3 995.15	0.4	7,781.48
09/01/2020	11,627.98	225.0	50.88	4 052.28	0.4	7,909.10
10/01/2020	11,838.06	228.4	50.57	4 110.23	0.4	8 038.81
11.11.2020	12,051.89	231.9	50.26	4,169.00	0.4	8 170,64
12/1/2020	12,269.53	235.4	49.95	4,228.62	0.4	8 304.64

According to the model forecast, it can be concluded that the operational risks of the Russian banking sector are likely to increase, which will require a more careful approach of Russian credit institutions to their management and regulation. However, we note that if the macroeconomic situation would be stable, the value of H3 in the next 24 months will not rise to such an extent as reflected in Table 3, as well as the fact that the value of H4 will not decrease so sharply. Whereas with the growth of credit activity, the likelihood of overdue debt increases, therefore, the option that the operational risks will increase in the future, but not as rapidly as reflected in Table 3, seems to be in this vein.

In order to assess the reliability of the operational risk forecast based on the econometric model for the Russian banking sector, it is possible to construct a trend line for operating risks based on a representative sample. There are two trend lines that differ in their properties. If a linear trend (Fig. 1) takes into account certain average intervals within a representative sample and builds its own line on them, then the polynomial trend (Fig. 2) also takes into account the sharpness of the jumps when indicators in the previous sample change their values.
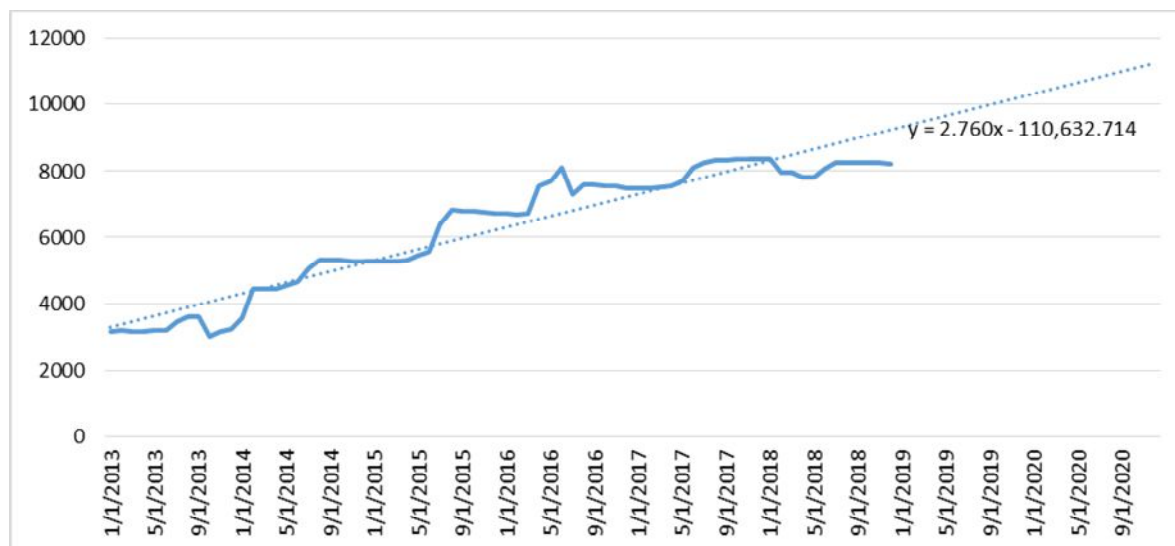

Fig. 1. Forecast of operational risks in the Russian banking sector for 2019-2020 using a linear trend

901

Int. J Sup. Chain. Mgt   Vol. 8, No. 5, August 2019
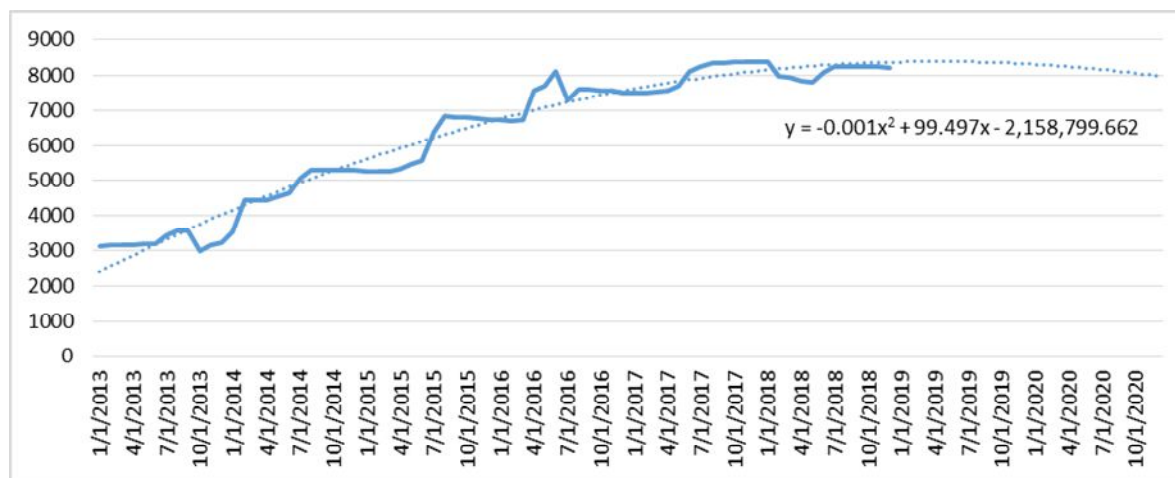
$$y = -0.001x^2 + 99.497x - 2{,}158{,}799.662$$

Fig. 2. Forecast of operational risks in the Russian banking sector for 2019-2020 using a polynomial trend

According to fig. 2, the operational risks in the banking sector will progress in line with the polynomial trend at a slower rate than along a linear trend. If we talk about the values, then according to the polynomial trend, operating risks for 2019 and 2020 could be about 8 290 billion rubles and 8 000 billion rubles, respectively. Whereas, the operational risks in the Russian banking sector following the results of similar dates in line with the linear trend may amount to 10,250 billion rubles and 11,350 billion rubles, respectively.

Thus, the forecast analysis within the framework of the two approaches (according to the regression model and the linear trend) indicates an increase in the level of operational risks of the Russian banking sector, which is explained by the fact that banks in Russia scale their own activities, increase active and passive operations that are associated anyway, with the growth of operational risks. As part of the polynomial trend, a decline is predicted due to the increasing control by the Bank of Russia of the risks of credit institutions, the stabilization of the general economic situation, and the exclusion of unfair participants from the market through the withdrawal of licenses. As a result, we consider it expedient to single out 3 scenarios for the development of events:

- Pessimistic scenario - when operational risks will grow very rapidly (the forecast based on the regression model);
- Optimistic scenario - when operational risks will grow less rapidly, which was observed in the constructed polynomial trend;
- Scenario with moderate growth of operational risks, which is reflected in the linear trend.

Any of the presented scenarios is possible, given that on the one hand, operational risks increased sharply at the beginning of 2014, in mid-2015 and 2016, which speaks in favour of the pessimistic scenario and the scenario of moderate growth. On the other hand, there is a decrease in participants in the banking sector, and, consequently, a concentration of risks in large credit institutions where risk management is established (optimistic scenario).

4. Discussion

This research on operational risk management was based on the works of domestic and foreign scientists, such as M.A. Bukhtin [5], B.V. Sazykin [6], O.V. Basko [7], V.G. Imaev [8], E.Z. Arduashvili [9], M. Korff [10], A.P. Kuritzkes, H.S. Scott [11], A. Manteuffel [12], D. Wilson [13], and others, and on issues of risk modeling by D. Politou, P.O. Giudici [14], X. Zhu, J. Li, J. Chen, Y. YangHuo, L. Gao, J. Feng, D. Wu, Y. Xie [15], Rezaei, M., & Nemati, K. [16], Reyes, N. S., et al [17], Banam, M., & Mehrazeen, A. [18], Escalera Chávez, M. E., et al [19], Halim, S. A., et al [20] , Ahani S, & Pourmohammadi M. [21] and others.

The methodological foundations of operational risk management are also covered in industry standards and recommendations developed, for example, by the Basel Committee on Banking Supervision, the International Federation of Risk Management and Insurance Associations, the Federation of European Risk Management Associations. However, in the domestic and foreign banking literature, operational risk management issues through the impact on typical banking risks have not been sufficiently studied.

5. Summary

Thus, the correlation and regression analysis revealed the dependence of the operational risks level on liquidity and crediting risks, in particular, on such indicators as the current liquidity ratio, the long-term liquidity ratio, the amount of overdue debt, the ratio of the aggregate risk of the bank's insiders and loan loss provision and equivalent debt. In addition, the values of operational risk in the banking sector of the Russian Federation are

predicted based on the scenario approach for 2019-2020. Within the framework of the pessimistic scenario and the moderate growth scenario, the growth of the operational risks level is predicted, which makes it necessary to implement new approaches to managing this type of risk in credit institutions, and to modify the existing methods of their regulation. The Bank of Russia should also improve its own regulatory approaches with respect to credit institutions.

6.   Conclusions

The results of the study can be used by:
- Credit institutions in the management of operational risk and determining measures to optimize its level. In this regard, it is important to know the system of factors that influence the change in the level of operational risk, as well as the nature of this effect;
- The Central Bank of the Russian Federation in monitoring the operational risk level in the banking sector of the Russian Federation and the development of methods for regulating the operational risk;
- Scientists, economists, financiers to expand and deepen the subject areas of scientific research.

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