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As a manuscript

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**Development and Introduction of Payment Systems' Risk Indicators into the Bank
of Russia's Supervisory Practice**

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1. Introduction

1.1. Relevance of the research

One of the priority directions of Russian state regulation is the reform of the control and supervisory system. The reform is aimed at reducing the costs of the state and business through introduction of a risk-based approach. A risk-based approach means different intensity of control of certain objects, depending on the level and probability of damage to citizens, business and the state. Nowadays, a risk-based approach in Russia affects the control and supervisory powers in all sectors, and in particular, in the sphere of the Bank of Russia.

The Bank of Russia supervises various subjects of the financial market, including the national payment system. Smooth functioning of national payment system is crucial for various sectors of the economy. The payment system is an important part of the settlement between the financial agents¹. According to the Bank of Russia, about 536 trillion rubles were transferred using payment systems in 2017. We could observe the increase in the number of payment systems from 20 in 2012 up to 35 in 2018. It makes the issues of their quality state regulation more relevant. Large domestic payment systems was created. For example, in 2015 MIR Payment system was introduced. The number of payment cards in Russia increased from 119,0 million units in 2008, to 269,2 million units in 2017. The stability of payment systems affects transaction costs, reliability and speed of transfer of funds between the subjects of economic relations².

Currently, the Bank of Russia allocates systemically significant, socially significant and nationally significant payment systems. However, this classification does not allow to evaluate the payment infrastructure service providers from the point of their sustainability³ and the impact on ensuring the smooth functioning of payment

¹ Repousis, S. Money laundering and Greek banking payment and settlement systems / S. Repousis // *Journal of Money Laundering Control*. – 2016. – Vol.19. – №1. – pp.58-69.

² Arzumanova, L. L. National payment system as a guarantor of stability and protection of the national economy/ L. L. Arzumanova // *Actual problems of Russian law*. – 2017. – №2. – P. 132-143.

³ The sustainability of payment infrastructure service providers in this study is understood as their functioning within the payment system. The term of smooth functioning of the payment system is more complex. If the payment infrastructure service operator is excluded from the payment system, the smooth functioning of the payment system may be disrupted, which is due to the sustainability of the

systems. To ensure the smooth functioning of payment systems, the Bank of Russia needs to assess payment infrastructure service operators from the standpoint of their sustainability⁴ in the payment system.

In other countries, the introduction of risk-based mechanisms in the field of payment systems has also started relatively recently. For example, the Federal Reserve System on a regular basis updates the risk management approaches of payment systems under the best international practices. In particular, the latest changes were done in 2017, taking into account the recommendations of the Bank for international settlements. A key element of risk management is the use of risk indicators to classify the participants of payment systems depending on the level of risk.

Bank of Russia adopted regulatory legal act,⁵ containing some indicators to control the smooth functioning of payment systems. However, this act does not include is the issues for the sustainability of payment infrastructure service providers. The system of quantitative requirements to payment infrastructure service providers adopted by the Bank of Russia does not cover all possible risks of payment systems. It does not examine the factors determining the sustainability of payment infrastructure service providers are not controlled.

The research is oriented on developing a new approach to the classification of payment infrastructure service operators depending on the level of risk for the smooth functioning of the payment system. For this purpose, it is necessary to determine the factors affecting the sustainability of payment infrastructure service providers based on theoretical and empirical research, analysis of international practice and econometric modeling. Based on the analysis of J. Tirole and J. Rochet⁶, the theory of information asymmetry and empirical studies the financial and institutional factors of sustainability

payment infrastructure service operators. The presented study focuses more on this aspect of the smooth functioning of the payment system.

⁴ Since 2014, 22 operators of payment infrastructure services have been excluded from the payment systems.

⁵ Regulation of the Bank of Russia dated 03.10.2017 No. 607-P «On requirements to the order of ensuring the smooth functioning of the payment system, indicators of the smooth functioning of the payment system and methods of risk analysis in the payment system, including risk profiles».

⁶ Rochet, J. Controlling Risk in Payment Systems / J. Rochet, J. Tirole // Journal of Money, Credit and Banking. – 1996. – № 4. – P. 832-862.

of payment infrastructure service operators were determined. The standards of the Bank for International Settlements and Russian practices allowed to identify groups of financial and institutional indicators that are significant for risk assessment. The econometric models showed that for payment infrastructure service operators significant financial indicators are: cash, authorized capital, net assets, net profit and foreign exchange assets. Significant institutional factors are: experience requirements, the type of payment system, the use of smooth functioning indicators, as well as the risk management model in the payment system⁷.

The author has developed the coefficients of financial and institutional sustainability. On their basis, the total coefficient of payment systems' sustainability was determined. According to the author, this coefficient will allow the Bank of Russia to introduce a new approach in supervisory activities in the national payment system. As a result, author suggests a draft of the Bank of Russia legal act «About the order of application of risk indicators in supervision of the Bank of Russia in the national payment system».

1.2. Purpose and objectives of the study

The purpose of this study is to develop methodology for the implementation of a risk-based approach to the supervision of payment systems.

To achieve this goal it is necessary to solve the following tasks:

- identify and classify the main factors affecting the risks of payment infrastructure service operators under theoretical and empirical researches;
- systematize the main approaches to reducing the risks of payment systems based on the international experience;
- determine empirically the quantitative indicators characterizing the sustainability of payment infrastructure service operators;
- develop methodological recommendations on the application of risk-based supervision in the national payment system;

⁷ Masino, M. N. Methods of construction of risk management infrastructure in payment systems / M. N. Masino, A.V. Larionov // Banking. – 2015. – № 8. – P. 51-60.

- develop draft to improve the regulatory legal regulation of payment systems.

1.3. Characteristics of the problem elaboration

In international practice, the recommendations of the Bank for International Settlements like, «Principles for financial market infrastructures» are used in the supervision of payment systems by central banks. Most of central banks apply the provisions of these principles in their activities. The principles set out recommendations for the application of indicators of authorized capital, net assets, equity and liquid assets (like securities, foreign exchange assets). The payment system must have the necessary amount of free liquidity to complete operations within the operating day. The principles recommend limiting borrowings from the central Bank not to increase the dependence of commercial structures on state liquidity. The principles are set out recommendations for interaction of the operator of the payment system, payment system participants, and payment infrastructure services. Thus, the principles suggest the impact of internal organizational practices on the sustainability of the payment system. The Principles for financial market infrastructures have been implemented in almost 60 central banks – members of the Bank for International Settlements and in 28 member countries of the Committee on Payments and Market Infrastructures.

In practice, the Federal Reserve System also applies the «Principles for financial market infrastructures», but in addition to these principles, they use their own approach to the assessment of participants in payment systems. The Federal Reserve System uses a system of financial and operational indicators to assess the participant of the payment system in order to assign a limit on overdraft. The Federal Reserve System uses financial indicators to analyze the solvency of payment system's participants. Their approach could be used for estimation sustainability of payment infrastructure service operators. They takes into account capital adequacy, asset quality and liquidity indicators. The category of the participant reflects the size of risk for the FEDWIRE payment system. After estimation, the limit on the intraday loan is determined.

In Russia, the possibility of applying a risk-based supervision approach is provided for in article 8.1 Federal law No. 294-FZ of 26.12.2008 «On protection of the

rights of legal entities and individual entrepreneurs in the exercise of state control (supervision) and municipal control». But the Bank of Russia does not carry out risk-based supervision in the national payment system. The use of risk-based supervision would strengthen the control of payment infrastructure service operators with the high risk to consumers of payment services⁸. The Bank of Russia maintains a Register of payment system operators, which records the exclusion of operators from the payment systems. The main reasons for the exclusion of payment infrastructure service providers are the violation of their financial stability and non-compliance with the requirements of the payment system operator.

The transition to risk-based supervision in Russia is relatively recent, and therefore a small number of researchers have studied this issue. The classification of regulated areas subject to risk is done in empirical studies⁹. A key element of risk-based supervision is the classification of supervised objects to a certain risk category¹⁰. Other elements of risk-based supervision are the differentiation of control and supervision measures for each category of supervised objects.

In Russian practice, the issues of payment systems' regulation are considered most often from oversight. They focus on determining indicators of smooth functioning¹¹. Indicators of smooth functioning can be one of the elements of determining the risk category of payment infrastructure service operators. The presence and design of the risk management system is an important element in ensuring the sustainability of the payment system. A significant contribution to the study of domestic payment systems made by Krivoruchko, Lopatin, Tamarov, Masino, Usoskin and Belousova. However, these works practically do not consider the role of the Bank of Russia in the context of supervision in the national payment system.

⁸ Application of risk-oriented supervision will allow to reduce the Commercial general risk in a payment system.

⁹ For example, Dobrolyubova, E. I. Evaluation of the effectiveness and efficiency of control and Supervisory activities / E. I. Dobrolyubova, V. N. Yuzhakov // Public Administration Issues. – 2015. – № 4. – P. 41-64.

¹⁰ Chaplinskiy, A.V. Risk management in the implementation of state control in Russia / A. V. Chaplinsky, S. M. Plaksin // Public Administration Issues. – 2016. – № 2. – C. 7-29.

¹¹ Tamarov, P. A. Management of intraday liquidity: optimization of payments and regulation / P.A. Tamarov // Banking. – 2015. – № 1. – P. 28-33.

Issues of supervision in the national payment system are considered exclusively from a legal point of view. They do not examine the methodology of supervision in payment systems¹². Thus, the implementation of risk-based supervision of payment infrastructure services operators is extremely relevant.

The international empirical studies allow to determine the following factors that affect the smooth functioning of payment systems: external factors, considering the impact of macroeconomic parameters on the volume of transfer through the payment system¹³ and internal parameters for evaluation of the transfers in the payment system¹⁴. These two groups of factors are important for assessing the level of risk of payment infrastructure service providers, but cannot be analyzed in detail due to the lack of statistics.

The above studies are largely based on theories that study the asymmetry of information, in particular the theory of adverse selection, as well as the theory of moral hazard. Mechanisms of payment systems' supervision can also be viewed in the context of Supervisory control theory (Ramadge–Wonham). In addition, there are theoretical models that consider the impact of transfers within the payment system on a number of macroeconomic parameters, in particular, inflation¹⁵. Thus, to classify payment infrastructure service providers according to the level of risk, it is necessary to take into account their dependence on external factors. It is also worth mentioning that J. Tirole and J. Rochet conducted a comprehensive theoretical analysis of risks in the field of payment systems, considered the role of the Central Bank in assessing the financial solvency of the participants of the payment system, operators. One of the ideas of their study was the confirmation that the Central Bank should control the stability of the payment infrastructure.

¹² Gridchin, V. A. Supervision and oversight of the national payment system: the activities of the Bank of Russia for the Central Federal District / V. A. Gridchin // Money and credit. – 2016. – № 10. – P. 16-19.

¹³ For example, Hasan, R. S. Retail payments and the real economy – Frankfurt am Main: European Central Bank, 2013.

¹⁴ For example, Belousov, V. G., money and credit / V. M., Usoskin, V., Belousov, V., liquidity Regulation as a factor of payment systems development. – 2014. – №3. – P. 57-64.

¹⁵ Geanakoplos, D. Credit cards and inflation / D. Geanakoplos // New Haven: Cowles foundation Paper – 2011. – № 1330. – p. 325-353.

In terms of different approaches, in the dissertation research, statistically significant indicators of sustainability of payment infrastructure service operators are empirically determined.

1.4. Data description

As already mentioned, two groups of indicators have been identified for empirical analysis: financial and institutional. It was used the dataset of the Information Agency Mobile, information from the website of the Bank of Russia, as well as data from the SPARK database were used. Part of the statistical database was collected by the author on the basis of information provided in the Register of operators of payment systems, as well as taken from the Rules of payment systems. The financial indicators were also supplemented by data from the Bank of Russia.

Based on the data collected, a binary panel regression and two logistic regressions were constructed. In addition to econometric modeling, the study conducted a legal analysis of the regulatory system in this area.

2. The content of the dissertation

2.1. Factors of sustainability of payment systems

Federal law No. 161-FZ of 27.06.2011 «On the national payment system» contains minimum requirements for payment infrastructure service providers. At the same time, article 16 of this Federal law establishes that the operator of the payment system independently determines the financial and technological requirements for the payment infrastructure service providers. As a result the operators of payment systems set different requirements. The application of such requirements does not always ensure the sustainability of the payment infrastructure services operator. Moreover, the law contains a minimum list of requirements for payment system operators and payment infrastructure service providers aimed at assessing their financial condition. For example, this Federal law establishes that an organization that is not a credit institution

and wants to become an operator of the payment system must have net assets of at least 10 million rubles.

The international experience of the European Central Bank and the Federal Reserve System demonstrates the feasibility of applying financial indicators such as the authorized capital, net assets, equity, cash and liquid assets. The volume of currency assets and the value of securities can be used as indicators of liquid assets.

The key role of institutional indicators influence is confirmed in theoretical studies. In particular, the sustainability of the payment infrastructure services operator is affected by the availability of services, for example, intraday credit. If the operator of the payment system at an early stage has identified the requirements for the availability of intraday credit, such operators will demonstrate greater sustainability. The significant external indicator is the category information payment system (nationally important, socially important and systemically important). The importance of the payment system is determined based on the amount of funds transferred through the payment system, as well as the number of transfers. The analysis of empirical studies demonstrated the relationship between the external macroeconomic environment and the state of payment systems. The stability of the payment infrastructure services operator will be affected by model of risk management, as well as the structure of the payment system. Thus, the presented study focuses on financial and institutional indicators.

2.2. Binary probit regression estimates of the factors of sustainability of payment infrastructure service providers

To assess the significance of financial and institutional indicators, two econometric models were constructed: a model with financial variables and a model with institutional variables. The model based on financial indicators allowed to define a set of financial indicators and their target values. The model, taking into account the institutional characteristics of the payment system, allows to determine its organizational aspects that have an impact on the stability of the payment infrastructure services operator.

The fact of registration in the Register of payment system operators is indicator of sustainability. Accordingly, the sustainability s can be associated with data about the exception from the Registry of operators of payment systems. If the operator was excluded from the Registry, the value of this indicator for the operator was equal to -1 , if not excluded -0 . It was also necessary to assess the target values of indicators that guarantee the sustainability. For financial indicators, as well as for the indicator of experience, the variables reflecting the target values of indicators were selected. The significance of the dummy variables, in addition to the significance of the financial indicator, will determine the required target value.

Model with financial variables

This model is based on annual statistical data from 2014 to 2017¹⁶. The financial model includes the following indicators (table 1), taking into account the target values of indicators. In total, the financial indicators were divided into 3 main groups: liquidity indicators, indicators of asset quality, indicators of liabilities. Data on three groups of these indicators were taken from the Bank of Russia website, Mobile database, and SPARK Agency data.

Table 1 – System of financial indicators reflecting the stability of the operator's participant in the payment system, million rubles

| Variable name | Minimum value | Medium value | Maximum value |
|------------------------------------|----------------------|---------------------|----------------------|
| Liquidity indicator | | | |
| Foreign currency assets | More 3000 | More 6000 | More 9000 |
| Cash | More 1000 | More 2000 | More 3000 |
| Indicators of asset quality | | | |
| Net assets | More 2000 | More 6000 | More 4000 |
| Authorized capital | More 100 | More 200 | More 300 |
| Net profit | More 0 | More 50 | More 100 |
| Indicators of liabilities | | | |

¹⁶ The period from 2014 was chosen because the first exceptions to the Register of payment system operators were made in 2014. Up to this point, the registration of payment systems was carried out.

| | | | |
|--------------------|-----------|-----------|-----------|
| Operating expenses | More 1000 | More 3000 | More 5000 |
|--------------------|-----------|-----------|-----------|

Source: compiled by the author of the dissertation research based on data from the Bank of Russia website, Mobile Agency database, and the SPARK Agency

To assess the impact of financial indicators on the sustainability of payment infrastructure service providers, a binary panel regression and binary logistic regressions were constructed. The results of the regressions are presented in table 2.

Table 2 – A model that determines financial indicators that have a positive/negative impact on the stability of the operator¹⁷

| Variable name | Full logistic regression | Logistic regression with significant variables | Marginal effects |
|--------------------------------------------------------|--------------------------|------------------------------------------------|------------------|
| Foreign currency assets more than 3000 million rubles | 1,19991 | 1,364053** | 0,2370748** |
| Foreign currency assets more than 6000 million rubles | -3,310006 | | |
| Foreign currency assets more than 9000 million rubles | 7,786359 | | |
| Cash more than 1000 million rubles | -4,824567 | | |
| Cash more than 2000 million rubles | -4,74745 | -1,045061** | -0,1816333** |
| Cash more than 3000 million rubles | 3,907719 | | |
| Net assets more than 2000 million rubles | -4,784143 | | |
| The net assets of more than 4000 million rubles | 5,459388 | | |
| The net assets of more than 6000 million rubles | -1,484286 | -0,6035693* | -0,1049014* |
| Authorized capital more than 100 million rubles | 10,05074 | | |
| Authorized capital more than 200 million rubles | -11,25854 | -0,6004165* | -0,1043534* |
| The authorized capital is more than 300 million rubles | 1,238295 | | |
| Non-negative net profit | -1,018283** | -0,5872104* | -0,1020582* |
| Net profit more than 50 million rubles | 0,1326696 | | |
| Net profit more than 100 million | 0,2627694 | | |

¹⁷ The thresholds were chosen statistically, taking into account the maximization of the quality criteria of econometric estimates.

| | | | |
|--------------------------------------------------|-----------|------------|-----|
| rubles | | | |
| Operating expenses more than 1000 million rubles | 0,0762038 | | |
| Operating expenses more than 3000 million rubles | -5,509639 | | |
| Operating expenses more than 5000 million rubles | 5,095115 | | |
| Residuals | 0,463274 | -0,3067472 | |
| Number of observations | 144 | 163 | 163 |
| Prob>chi2 | 0,0091 | 0,0170 | - |
| R-squared | 0,3360 | 0,1175 | - |

Source: compiled by the author, stars reflect p-value: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The result of the binary logistic regression is significant. The classification table shows that the model predicts 88,34% of cases. The ROC curve also shows a high value of 0,7279 (figure 1). Thus, the results are significant. The average marginal effects were also calculated in the model.

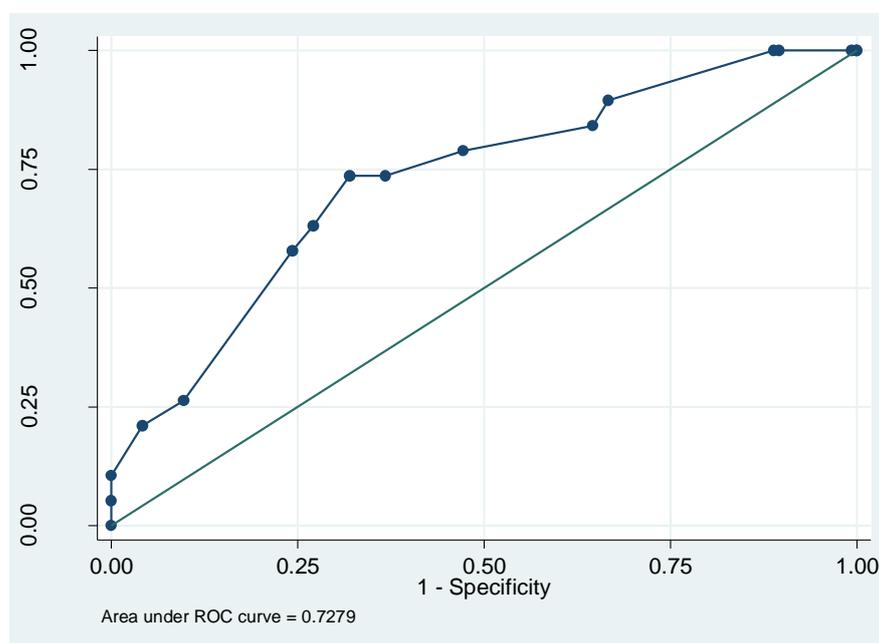


Figure 1 – ROC curve for a model with significant variables

Source: compiled by the author

As a result, a group of significant financial indicators was determined (figure 2).



Figure 2 – Factors affecting the decrease / increase in the probability of exclusion from the Register of payment system operators
Source: constructed by the author

It was found that the sustainability is positively affected by net assets, share capital, cash and net profit. In case of exceeding the thresholds, such payment infrastructure service providers will demonstrate greater sustainability. In particular, if the volume of net assets of the operator is more than 6 billion rubles, the probability of excluding from the Register of payment system operators is reduced by 10.5%. The excess of foreign currency assets causes a negative impact on the stability of the operator after 3000 million rubles. The significant financial variables will be used in the calculation of the financial stability coefficient.

Model with institutional indicators of payment systems

The second group of factors are the institutional characteristics of the payment system, including both organizational features and technological characteristics of the operations. The constructed regression is based on the rules of payment systems.

All groups of considered indicators can be divided into two main types: indicators of smooth functioning and institutional characteristics of payment systems associated with the model of risk management system, the implementation of intraday credit

service and the organization of interaction between operators and the operator of the payment system (table 3). Information on institutional indicators of payment systems was taken from the Rules of payment systems, as well as from the website of the Bank of Russia.

Table 3 – Description of variables for the model with institutional indicators

| Variable name | Description of variables | Interpretation |
|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Work experience requirement | more 3 years, more 5 years | The higher the work experience requirement, the higher the stability of the payment infrastructure service operator |
| Crash recovery time | More than 24 hours, more 48 hours | The shorter the recovery time, the greater the resilience |
| Failure recovery time (P1)) | The use of the indicator P1 in the payment system (dummy variable) | The use increases stability |
| Time between events (P2) | Application of the P2 indicator in the payment system (dummy variable) | The use increases stability |
| Number of payments made to total (P3) | Application of the P3 indicator in the payment system (dummy variable) | The use increases stability |
| A measure of availability of the payment system (P4) | Application of the P4 indicator in the payment system (dummy variable) | The use increases stability |
| Average number of incidents (P5) | Application of the P5 indicator in the payment system (dummy variable) | The use increases stability |
| The availability of intraday credit in the payment system | Is the intraday loan function implemented in the payment system (dummy variable) | Service increases resilience |
| Whether the payment system as nationally important | Whether the payment system as nationally important (dummy variable) | This category is an indicator of high stability |
| Is the payment system socially significant | Is payment system the socially significant (the dummy variable) | This category is an indicator of high stability |
| The coincidence of the infrastructure (completely different operators) | Payment system operators are not affiliated with each other legal entities (1-Yes, 0-no) | If all operators of payment infrastructure services are not affiliated, the probability of stability violation increases |
| The coincidence of the infrastructure (the Operator of the payment system performs one of the functions of the Operator) | At least the operator of payment system performs one of the functions of the operators (but not completely). 0-no, 1-Yes | If all operators of payment infrastructure services are not affiliated, the probability of sustainability violation increases |
| Organization of risk | the operator manages the risk – | If the payment system operator |

| | | |
|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| management system | 1, the operator is distributed among the rest – 0 | manages risks independently, the probability of disrupting the sustainability of payment infrastructure service operators is reduced |
| There is a requirement to the Operator to provide information to the participants of the payment system | 1-there is a requirement, 0-there is no requirement | The presence of a developed system of interaction increases the stability of its functioning |

Source: compiled by the author

Binary probit regressions were constructed in the calculation. Regressions turned out significant at the 5% level of significance (table 4).

Table 4 – Models that determine the institutional factors that reduce / increase the probability of the operator's exclusion from the payment system

| Variable name | Full logistic regression | Full logistic regression with significant variables | Marginal effects |
|------------------------------------------------------------------------|--------------------------|-----------------------------------------------------|------------------|
| The requirement for experience in the market more than 3 years | -4,326319 | | |
| The requirement for experience in the market more than 5 years | -1,508007* | -1,495034** | -0,3009474** |
| Recovery time after a failure of 24 hours | -0,1134712 | | |
| Recovery time after an outage of 48 hours | -0,4537438 | | |
| Failure recovery time (P1) | -1,359599 | | |
| Time between events (P2) | -0,2318881 | | |
| Number of payments made to total (P3) | -0,8193585 | -1,562291* | -0,3144861* |
| A measure of availability of the payment system (P4) | -2,524358* | -2,640016** | -0,53143** |
| Average number of incidents (P5) | 3,024545* | 2,912293* | 0,5862388** |
| The availability of intraday credit in the payment system | -1,227465 | -1,105836* | -0,2226026* |
| Whether the payment system as nationally important | 0,062833 | | |
| Is the payment system socially significant | -1,836232* | -1,60364* | -0,3228095* |
| The coincidence of the infrastructure (completely different operators) | 5,612259 | 2,265198* | 0,4559798** |
| The coincidence of the infrastructure (the Operator of the | -0,0994959 | | |

| | | | |
|---------------------------------------------------------------------------------------------------------|------------|------------|--------------|
| payment system performs one of the functions of the operator) | | | |
| Organization of risk management system | 1,392478* | 1,413765** | 0,2845881*** |
| There is a requirement to the operator to provide information to the participants of the payment system | -0,300512 | | |
| Residuals | -0,3005605 | -0,5444564 | |
| Number of observations | 64 | 64 | 64 |
| Prob>chi2 | 0,0011 | 0,0000 | - |
| R-squared | 0,4736 | 0,4384 | - |

Source: compiled by the author, stars reflect p-value: *** p<0.01, **p<0.05, *p<0.1

The results are significant (figure 3). The ROC curve also shows a high value of 0.9015.

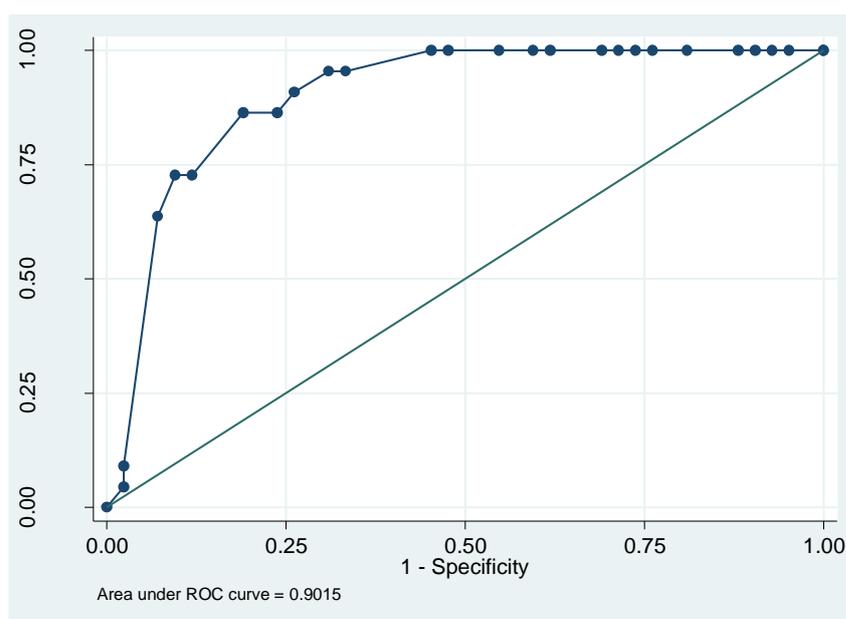


Figure 3 – ROC curve for the model with institutional variables

Source: compiled by the author

As a result, the indicators that positively and negatively affect the sustainability of the payment infrastructure service providers were determined (figure 4).

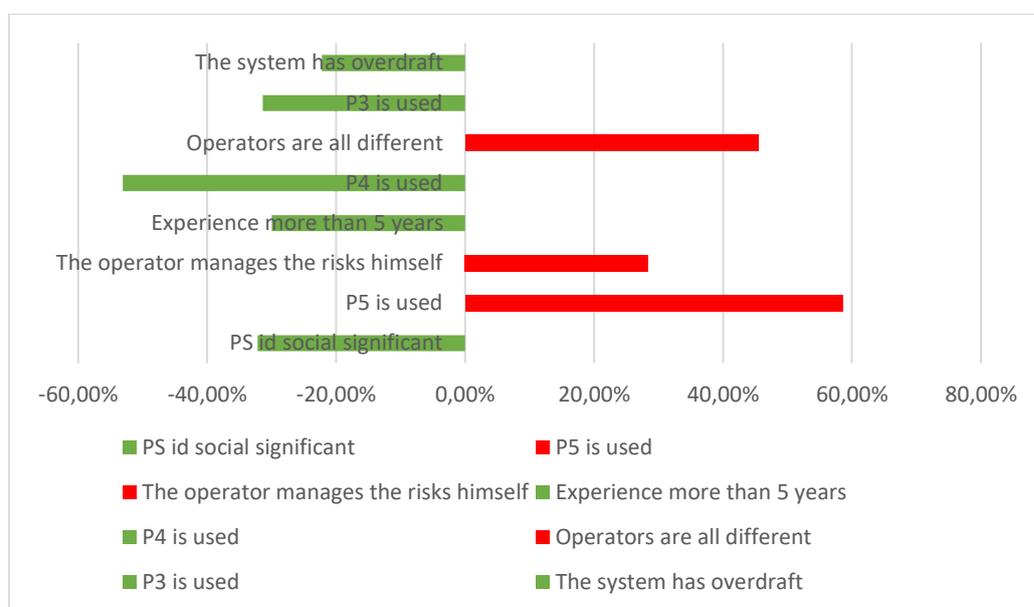


Figure 4 – Factors affecting the decrease / increase in the probability of exclusion from the Register of payment system operators

Source: constructed by the author of the work

The factors that have a positive impact on the sustainability: the fact that the payment system is socially significant, the presence of a requirement for the experience of operators for more than 5 years, the use of the availability index, the number of successful payments, the presence of intraday lending mechanism. The factors that negatively affect the stability of the operator's participation in the payment system include the use of the average number of incidents, independent risk management by the payment system operator, without the distribution of functions between operators. Also, if the operators and the operator of the payment system are different legal entities, the probability of excluding the operator from the Register of payment system operators also increases.

As a result, the following significant indicators were identified:

Financial:

(f1) foreign exchange assets;

(f2) cash;

(f3) net assets;

(f4) authorized capital;

(f5) net profit.

Institutional:

- i1) the requirement for experience in the market more than 5 years;
- (i2) application of the indicator «number of payments made to total (P3)»;
- (i3) application of the «payment system availability index (P4)»;
- (i4) application of the «Average number of incidents (P5) indicator»;
- i5) availability of overdraft service;
- (i6) the fact of socially importance;
- i7) coincidence of infrastructure (totally different operators of payment infrastructure services);
- (i8) organization of the risk management system.

The presented significant indicators reflecting institutional and financial factors of stability of operators in payment systems are used to assess the level of risk of payment infrastructure service providers.

2.3. Coefficient of the payment system stability

In the dissertation research, a new coefficient of stability of the payment system based on the above indicators is proposed. The coefficient characterizes the sustainability of the payment infrastructure service providers.

The following formula was used to calculate the stability coefficient of the payment system¹⁸(1):

$$Z = 0,51 * F (fi) + 0,49 * I(io) (1),$$

where $F (fi)$ – financial sustainability indicator, $I(io)$ – institutional sustainability indicator, and Z – coefficient of stability of the payment system.

The financial stability indicator is calculated using the following formula:

$$F (fi) = 0,32 * f1 - 0,25 * f2 - 0,14 * f3 - 0,15 * f4 - 0,14 * f5, \text{ where}$$

$f1$ – 0, if foreign currency assets are less than 3 billion rubles, 1 – if foreign currency assets are more than 3 billion rubles;

¹⁸ The coefficients of the stability indices (0,51 and 0,49) were calculated on the basis of the estimated strength of the constructed regressions.

$f_2 = 0$, if the cash is less than 2 billion rubles, 1 – if the cash is more than 2 billion rubles;

$f_3 = 0$, if net assets are less than 6 billion rubles, 1 – if net assets are more than 6 billion rubles;

$f_4 = 0$, if the authorized capital is less than 0.2 billion rubles, 1 – if the authorized capital is more than 0.2 billion rubles;

$f_5 = 0$, if net profit is negative, 1 - if net profit is positive.

6. The institutional sustainability factor is calculated using the following formula:

$$I(io) = -0,1 * i_1 - 0,15 * i_2 - 0,18 * i_3 + 0,19 * i_4 - 0,7 * i_5 - 0,11 * i_6 + 0,15 * i_7 + 0,9 * i_8, \text{ where}$$

$i_1 = 0$, if the work experience requirement is less than 5 years, 1 - if the work experience requirement is more than 5 years;

$i_2 = 0$, if the indicator «number of payments made to the total number» is not used in the payment system, 1-if the specified indicator is applied;

$i_3 = 0$, if the payment system does not use the availability indicator of the payment system 1-if used;

$i_4 = 0$, if the average number of incidents is not used in the payment system, 1-if used;

$i_5 = 0$, if the payment system does not implement the mechanism of overdraft, 1 – if the mechanism of overdraft is implemented;

$i_6 = 0$ if the payment system is not socially important, 1 – if the payment system is socially important;

$i_7 = 0$ if the payment infrastructure service providers and the payment system operator are different legal entities, 1 if the payment infrastructure service operator and the payment system operator are the same;

$i_8 = 0$, if the risk management system is decentralized, 1 - if the risk management system is centralized at the level of the payment system operator.

Based on the calculation of the median stability coefficient of the payment system, the following confidence intervals were obtained for stable and unstable payment infrastructure service providers.

Table 5 – Construction of confidence intervals for stable and unstable operators for 2017

| Type | Stable | Relatively stable | Unstable |
|----------------------|------------|---------------------|----------|
| Credit organizations | more 47,32 | from 39,38 to 47,32 | to 39,38 |
| Other legal entity | more 35,31 | from 26,37 to 35,31 | to 26,37 |

Source: constructed by the author of the work

In the dissertation research, the rating of stable payment infrastructure service providers was built by assessing the stability coefficient of the payment system (table 6 and 7).

Table 6 – Example of sustainable payment infrastructure service providers for credit organizations

| Name | Financial sustainability indicator | Institutional sustainability ratio | Coefficient of stability of the payment system |
|----------------------------------------------------------------------------------|------------------------------------|------------------------------------|------------------------------------------------|
| Group I. Sustainable payment infrastructure service providers | | | |
| Sberbank PJSC | 50,99 | 37,99 | 88,98 |
| Bank Vozrozhdenie (OAO) | 50,99 | 31,48 | 82,47 |
| NCO JSC NSD | 50,99 | 27,99 | 78,98 |
| VTB Bank (OAO) | 50,99 | 26,99 | 77,98 |
| JSCB «Svyaz-Bank» | 43,87 | 27,86 | 71,73 |
| OJSC Bank «FC Opening» | 50,99 | 13,51 | 64,5 |
| Isibasi Bank (JSC) | 50,99 | 13,25 | 64,24 |
| PJSC «BANK URALSIB» | 43,87 | 13,12 | 56,99 |
| JSC JSCB «NOVIKOMBANK» | 43,87 | 13,12 | 56,99 |
| OJSC «URALSIB» | 43,87 | 9,5 | 53,37 |
| JSC «Nefteprombank» | 21,74 | 31,48 | 53,22 |
| JSC «GLOBEXBANK» | 43,87 | 8,63 | 52,5 |
| QIWI Bank (JSC) | 21,75 | 26,99 | 48,74 |
| Group II. Relatively sustainable payment infrastructure service providers | | | |

| | | | |
|--------------------------------------------------------------------------|-------|-------|-------|
| JSC CB «UNISTREAM» | 14,42 | 31,48 | 45,9 |
| Rnko «Payment Center» (LLC) | 31,02 | 14,74 | 45,76 |
| JSCB «BANK OF CHINA» (JSC) | 38,31 | 4,62 | 42,93 |
| Group III. Unsustainable payment infrastructure service providers | | | |
| OOO NKO «Western Union DP Vostok» | 7,13 | 31,48 | 38,61 |
| NBCO «JSS» (JSC) | 7,13 | 30,64 | 37,77 |
| KB «Geobank» (OOO) | 14,42 | 23,02 | 37,44 |
| NCO JSC «LEADER» | 7,13 | 27,99 | 35,12 |
| NCO OF MKS, OOO (OOO) | 0 | 32,74 | 32,74 |
| JSC «Bank Voronezh» | 14,45 | 17,34 | 31,79 |
| ZAO AKB «GAZBANK» | 21,75 | 9,5 | 31,25 |
| NCO «Russian financial society» (OOO) | 7,13 | 18,1 | 25,23 |
| CB «Neklis-Bank» | 7,29 | 13,25 | 20,54 |
| OOO RNKO «RIB» | 7,13 | 0 | 7,13 |

Source: constructed by the author of the work

A similar calculation was made for other legal entities (table 7).

Table 7 – Example of calculation of stability coefficient of payment infrastructure service operators for other legal entities

| Name | Financial sustainability indicator | Institutional sustainability ratio | Coefficient of stability of the payment system |
|----------------------------------------------------------------------------------|------------------------------------|------------------------------------|------------------------------------------------|
| Group I. Sustainable payment infrastructure service providers | | | |
| JSC «NSPC» | 50,99 | 33,1 | 84,09 |
| LLC «Multiservice payment system» | 21,75 | 31,48 | 53,23 |
| OOO «Customs card» | 21,75 | 27,86 | 49,61 |
| LLC «BEST» | 21,75 | 22,76 | 44,51 |
| OOO «RUKARD» | 21,75 | 18,14 | 39,89 |
| OOO «KP Retail» | 21,75 | 17,34 | 39,09 |
| JSC «KOKK» | 14,62 | 23,24 | 37,86 |
| Group II. Relatively sustainable payment infrastructure service providers | | | |
| LLC «Digital Payment» | 14,62 | 18,14 | 32,76 |

| | | | |
|--------------------------------------------------------------------------|-------|-------|-------|
| CJSC «ZOLOTAYA KORONA» | 21,75 | 9,86 | 31,61 |
| OOO «ATP» | 21,75 | 8,63 | 30,38 |
| LLC «Handi solutions» | 14,62 | 13,24 | 27,86 |
| Group III. Unsustainable payment infrastructure service providers | | | |
| OOO «EKSMO» | 21,75 | 3,61 | 25,36 |
| CJSC «NCC» | 14,62 | 4,62 | 19,24 |
| CJSC Processing company «Union Card» | 7,29 | 8,23 | 15,52 |

Source: compiled by the author

The Bank of Russia, can allocate these three categories, and then determine the groups of available measures for each category of operators. The inclusion of the operators in the Register of payment system operators shall be based on the assessment of the risk category. Based on the received assessment, the procedure of registration of operators is selected. Sustainable operators can be attracted without the consent of the Bank of Russia. In case attracting relatively sustainable operators, coordination with the Bank of Russia is required. The Bank of Russia should carry out additional assessment. The operator of the payment system cannot attract operators decided as unsustainable.

The risk category of the payment infrastructure service providers determines the composition and frequency of supervisory measures. Sustainable payment infrastructure service providers are not subject to inspection within a year of the evaluation. Operators, recognized as relatively sustainable, are subject to inspection with subsequent reporting of violations, as well as possible penalties. Payment infrastructure service providers recognized as unsustainable should be excluded from the Register of payment system operators.

2.4. Theoretical and practical significance

The research confirmed the ideas J. Rochet and J. Tirole, associated with the use of the concept of information asymmetry and moral hazard in the activities of the payment systems. It was confirmed that the control of financial performance of the payment infrastructure service providers has a positive impact on the smooth

functioning of the payment system. From a practical point of view, the study proposes the coefficients of financial and institutional stability, based on which the total coefficient of stability was determined.

2.5. The scientific novelty

1) As part of a risk - based approach to the supervision of the Bank of Russia, the most significant financial (net profit, cash, authorized capital and net assets) and institutional (availability of overdraft, social importance, requirements for the duration of experience) factors that reduce the risk of disruption of the sustainability of payment infrastructure service providers are determined;

2) The coefficient of stability of payment systems was developed, reflecting the continuity and reliability of the payment infrastructure. By this indicator, the payment infrastructure service providers are classified according to the degree of stability into three groups: «sustainable», «relatively sustainable», «unsustainable»;

3) A method of monitoring the activities of payment systems has been developed. In addition, the order of risk indicators' application in the Bank of Russia's supervision has been proposed. It suggests effective management of the Register of payment system operators and continuous monitoring of the activities of payment infrastructure service providers, taking into account the degree of their sustainability.

3. List of references

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