

On the Payment Infrastructure in the Context of Payment Industry Spatial Development

Anzhelika Gulko

*Department of Innovative Economics
and Finance*

*Belgorod State National Research
University*

Belgorod, Russia
gulko@bsu.edu.ru

Tatyana Saprykina

*Department of Innovative Economics
and Finance*

*Belgorod State National Research
University*

Belgorod, Russia
saprykina@dsu.edu.ru

Elena Pashkova

*Department of Innovative Economics
and Finance*

*Belgorod State National Research
University*

Belgorod, Russia
epashkova@bsu.edu.ru

Abstract—The article discusses the development of payment infrastructure as a necessary component of ensuring the formation of a modern payment industry in the context of the impact on increasing the availability of financial services as a factor in the spatial development of Russia. The authors of the article present the main stages of the formation of the national payment system, describe the payment infrastructure and its spatial development. The indicators of the payment system infrastructure for the federal districts of Russia were evaluated based on the data of the Central Bank. The concentration of payment infrastructure objects has shown that in Russia there is an uneven distribution of payment infrastructure objects, and, consequently, their low availability to the population and organizations. Based on the same data, structural changes in the payment system infrastructure indicators are calculated using the Kazinet's absolute structural shift coefficient, the coefficients of V. M. Ryabtsev, K. Gatev and A. Salai. The result of the calculation showed that in Russia there is a significant level of differences in structures, which indicates a change in the quantitative indicators of the characteristics of the payment system infrastructure for the analyzed period. The coefficient of uniformity of the characteristics of the payment system infrastructure, made it clear that there are regions of Russia in which there is an uneven distribution of access points for payment services. This study revealed the problems of spatial development of the payment infrastructure, which hinder the development of the national payment system and the availability of financial payment services. The perspective directions of development of the payment infrastructure are defined, taking into account the influence of global and local processes.

Keywords—*spatial development, payment industry, financial inclusion, payment system, fast payments, payment system infrastructure.*

I. INTRODUCTION

The strategy for the spatial development of the Russian Federation for the period up to 2025 "reducing interregional differences in the level and quality of life of the population" defines as one of the main target areas for ensuring "sustainable and balanced spatial development" of the country [22]. In modern conditions of strengthening the processes of digitalization of the economy and their impact on the transformation of financial markets, the creation of ecosystems, the introduction of new services and financial

products, the formation of an open banking environment, the growth of pandemic threats and the need to improve identification procedures, a significant factor in its implementation is the transformation of the national payment system adequate to them. Spatial development of the payment industry contributes to increasing the availability of financial services for the population and business of certain regions, the level and quality of life of citizens of the country. This necessitates a corresponding development of the payment infrastructure. It should be borne in mind that in Russia almost the entire payment infrastructure is formed by banks and it is they who bear the main costs to ensure its functioning. The regulation of payment services has a pronounced bank-centric character, while the regulation of payment services in European legislation has a functional focus.

Quite a lot of scientific and applied research is being carried out on the development of national payment systems, determination of promising directions for their development, taking into account modern challenges [8, 17].

Analysis of the payment system infrastructure, placement of infrastructure objects studied by Flood, Hancock, Smith (2011), Stix (2020) [3, 19]. An assessment of the impact of infrastructure on the state of the banking sector is given by Katircioglu, Tumer, Kılınccedil (2018), Kochukalam, Thomas, Joseph, (2018) [11, 13]. Consideration of the prospects for the development of payment systems and the banking sector was studied by Giovanis et al (2019) [4].

It is no coincidence that payment systems are one of the main objects of anti-crisis measures to support the financial sector, which countries are currently using in the context of a pandemic and the quarantine measures caused by it, which became an unprecedented shock of a huge scale for the world economy [23].

It should be noted that the issues of the payment system infrastructure in the context of the spatial development of the payment industry in the digital economy of Russia have been little studied, which proves the relevance of the study.

The authors agree with the point of view of Gubenko [5], Dubova et al. [9] the development of the availability of payment services is possible only with the expansion of the

availability of the use of payment instruments, an increase in the quality of the payment infrastructure. The authors also believe the time has come at the legislative level to more accurately define the concept of payment infrastructure, considering it from an institutional point of view and its functional significance.

Today, the payment system is becoming a priority segment of the application of financial technologies, which uses innovative products and new services that should be available to the end consumer in each region [6].

The availability of payment services is becoming a major factor in the development of the payment industry, as well as the sustainability of its development and the availability of financial services is a significant factor in ensuring the spatial development of Russia. The development of financial inclusion is recognized as one of the urgent tasks of the world financial practice. Authors Gulko A.A., Saprykina T.V., Pashkova E.N., support the idea of the need to study this problem not only at the global level, but also within any country [7, 6, 18].

Financial availability implies a full-fledged opportunity to receive a basic set of financial services, which includes payment services along with credit, insurance and savings services [6]. At the same time, ensuring the infrastructure for the provision of financial services is one of the necessary conditions. The infrastructural aspect of financial availability for Russia is extremely important due to the country's characteristics: the largest territory in the world; different population density on the territory, the remoteness of settlements from each other, including significant distances between small settlements and regional centers (cities) [1].

II. METHODS

The Bank of Russia annually publishes indicators of financial inclusion. For the first time, these indicators in a regional context were presented to them at the end of 2019 [20].

To characterize the availability of payment services, the Bank of Russia defined the following as indicators of the payment system infrastructure:

- number of ATMs of credit institutions with the function of issuing and / or accepting cash using payment cards (their details)
- number of electronic terminals installed in trade organizations (services)
- number of ATMs of bank payment agents (subagents)
- number of cash registers of bank payment agents (subagents)
- number of branches of federal postal organizations that provide payment services (including postal orders)
- number of outlets with the ability to provide payment card holders with services for issuing cash in trade (service) organizations - bank payment agents using POS terminals.

To assess the indicators of the Russian payment infrastructure, we calculate the quadratic coefficient of absolute structural shifts of Kazinets, the coefficients of V.M. Ryabtsev, K. Gatev and A. Salai [10]

III. MAIN PART

According to the Central Bank data, the authors of the study, the total distribution of payment infrastructure facilities by federal districts of Russia is presented, which is displayed in Figure 1 [20].



Fig. 1. Concentration of payment infrastructure facilities by federal districts of Russia

There is a sharp imbalance in the distribution of payment infrastructure facilities across the federal districts of Russia (Fig. 1).

The Central Federal District (CFD) occupies a leading position in the development of payment infrastructure - it accounts for more than 1 million units of payment infrastructure, which is more than 29.2% of their total number in the country. The Northwestern Federal District is two positions behind with more than 660 thousand facilities (18.6% of the total number of payment infrastructure facilities).

The rest of Russia is in a completely different situation. More than half of the federal districts are located in the position - the concentration of payment infrastructure facilities in the group from 298007 to 447011 units of payment infrastructure facilities, with a share of about 10%. This group includes: Northwestern, Southern, Ural, Siberian federal districts. In the North Caucasian and Far Eastern Federal Districts, the concentration of objects is even lower, they account for 3.4% and 5.9% of their total number of payment infrastructure objects, respectively.

This picture indicates the uneven distribution of payment infrastructure facilities, and, consequently, their low accessibility to the population and organizations.

At the same time, banks provide an opportunity to receive payment services by expanding their remote access. At the same time, "quantity is transformed into quality: credit

institutions are moving from multichannel interaction with clients (through offices and branches, call centers, etc.) to omnichannel interaction through mobile devices and an Internet bank" [15].

The number of mobile payment transactions is increasing every year. Applications Google Pay, Apple Pay, Samsung Pay are actively used. The national payment card system is developing rapidly.

The work on launching and implementing the MirPay application, making contactless payments of the "Mir" national payment card has been intensified. As of October 1, 2020, 269 banks were participants in the NSPK, of which 258 are acquiring credit organizations, 153 are issuers. For 9 months of this year using Mir cards, 0.5 billion contact and 1.5 billion contactless interbank transactions were carried out [14].

The further development of the national payment card system, according to the authors, may become one of the vectors of adequate transformation of the national payment system as a factor in the spatial development of Russian territories.

It can be assumed the development of remote channels of access to financial services should compensate for the lack of payment infrastructure facilities. However, for many territories and groups of the population of Russia, the availability of physical access points to financial services remains relevant (Table 1).

TABLE I RUSSIA PAYMENT INFRASTRUCTURE CHARACTERISTIC

Payment infrastructure indicator	As of 01.01.2019, units	As of 01.01.2020, units	Specific weight, %	
			2019r	2020r
Number of ATMs of credit institutions with the function of issuing and / or accepting cash using payment cards (their details)	190985	195458	5.783	5.474
Number of electronic terminals installed in trade (service) organizations	2588805	2913026	78.391	81.586
Number of ATMs of bank payment agents (subagents)	301070	232613	9.117	6.515
Number of cash registers of bank payment agents (subagents)	182762	186886	5.534	5.234
The number of branches of federal postal organizations providing payment services (including postal orders)	38712	38765	1.172	1.086
Number of outlets with the ability to provide payment card holders with services for issuing cash in trade organizations (services) - bank payment agents using POS terminals	93	3747	0.003	0.105
TOTAL	3302427	3570495	100	100

Let's examine the indicators of Russia payment infrastructure. We will use international experience in studying the population structure. To estimate, let us calculate the quadratic coefficient of absolute structural shifts of Kazinets, the coefficients of V.M. Ryabtsev, K. Gatev and A. Salai [10].

For convenience, we introduce the following notation: d1, d0- are the specific weights (in %) of individual elements of the population in the considered and previous periods, n- is the number of selected elements of the population.

It is determined in the scientific literature the quadratic coefficient of absolute structural shifts of Kazinets is more sensitive to strong vibrations of the structure [12].

$$K_k = \frac{\sum(d_1 - d_0)^2}{n} \tag{1}$$

In our study, this coefficient S_σ=1,692>0, this indicates a change in the infrastructure of the Russian payment system.

To identify the significance of structural differences in relative terms, which take into account the size of the population, the number of groups in the population, and the different contribution of groups to the total volume of the studied trait, we calculate the coefficients of V.M. Ryabtsev, K. Gatev and A. Salai [10, 12] (Table 2).

TABLE II CHARACTERISTICS OF STRUCTURAL CHANGES IN THE INFRASTRUCTURE OF RUSSIA PAYMENT SYSTEM

Formula	Change interval	The result	Characteristic
Coefficient of V.M.Ryabtsev $K_p = \sqrt{\frac{\sum_{i=1}^n (d_1 - d_0)^2}{\sum_{i=1}^n (d_1 + d_0)^2}}$	$0 < K_p < 1$	0.293	Significant level of structural differences
Coefficient of K. Gatev $K_r = \sqrt{\frac{\sum_{i=1}^n (d_1 - d_0)^2}{\sum_{i=1}^n d_1^2 + \sum_{i=1}^n d_0^2}}$	$0 < K_r < 1$	0.362	Significant level of difference
Coefficient of A. Salai $K_c = \sqrt{\frac{\sum_{i=1}^n (d_1 - d_0)^2}{\frac{d_1 + d_0}{n}}}$	$0 < K_c < 1$	0.393	Significant level of difference

The correctness of the calculations carried out by the authors of the study is proved by the inequality V.M. Ryabtsev [10]:

$$K_p < K_r < K_c \quad 0,293 < 0,362 < 0,393$$

On a scale for assessing the significance of structural differences according to V.M. Ryabtsev, during the period under studying, there is a significant level of structural differences in the infrastructure of the Russian payment system [10], which indicates a change in the quantitative indicators of the payment system infrastructure characteristic. So, for example, there is a sharp growth rate in the share of creating outlets with the possibility of providing payment card holders with services for issuing cash in trade organizations (services) - bank payment agents using POS terminals (35 times).

The share of the number of ATMs of bank payment agents (subagents) has decreased, which indicates a decrease in the number of legal entities and individual entrepreneurs that are attracted by a credit institution for the purpose of accepting cash from individual and issuing cash to an individual, including using payment terminals and ATMs [21].

The share of the number of ATMs of credit institutions with the function of issuing and / or accepting cash using payment cards (their details) decreased, but insignificantly. This situation was created in the context of the COVID-19 pandemic; banks have chosen a different strategy of behavior.

Some adopted the strategy of “fighting for a remote client”, others - for the physical presence of the client in the bank. So, for example, the Regional Manager for the Belgorod, Kursk and Oryol regions of “ALFA-BANK” JSC Lushnitskiy NN at the conference in his speech “Pandemic as a factor in the transformation of the business model of banks”. What has changed in the interaction of the bank with clients "noted that JSC" ALFA-BANK "in these conditions pursued a policy aimed at returning the client to the office (Figure 2.), therefore JSC" ALFA-BANK "in the new conditions will open new branches and provide them with ATMs [16].

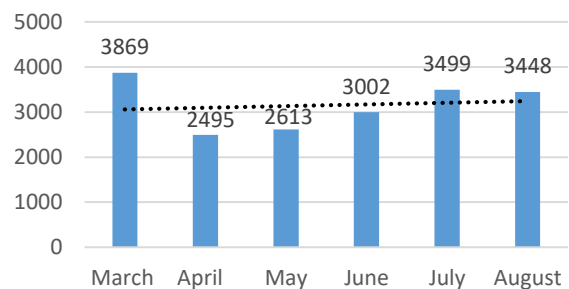


Fig. 2. Client flow in the branches of the bank JSC "ALFA-BANK"

For the first time during the measurement of financial availability indicators, the Bank of Russia presented access points to financial services in a regional context (Table 3).

TABLE III THE PAYMENT INFRASTRUCTURE CHARACTERISTIC BY FEDERAL DISTRICTS OF RUSSIA

Territorial federal district	A Number of ATMs of credit institutions with the function of issuing and / or accepting cash using payment cards (their details)	Number of electronic terminals installed in trade (service) organizations	Number of ATMs of bank payment agents (subagents)	Number of cash registers of bank payment agents (subagents)	Number of branches of federal postal organizations providing payment services (including postal orders)	Number of outlets with the ability to provide payment card holders with services for issuing cash in trade organizations (services) - bank payment agents using POS terminals
Russian Federation	195458	2913026	232613	186886	38765	3747
Central	59637	865962	54347	52347	9904	828
Northwestern	22181	342963	18279	18447	3336	139
Southern	19529	292195	35375	17409	4235	365
North Caucasian	5947	60805	44626	7653	1849	180
Privolzhsky	36589	548372	32231	37090	9460	1140
Ural	18261	284147	13981	16191	2620	204
Siberian	22905	344332	21842	25941	4781	596
Far Eastern	10409	174250	11932	11808	2580	295

These indicators made it possible to calculate the coefficient of uniformity of the payment system infrastructure characteristics across the federal districts of Russia for the period under studying (Table 4). Let us introduce the notation: n is the number of municipalities, d is the proportion of elements in the aggregate.

The uniformity coefficient is calculated by the formulas:

$$k = 1 - \frac{\sigma^2}{\sigma_{\max}^2}, \quad (2)$$

where

$$\sigma_{\max}^2 = \frac{n-1}{n^2}, \quad \sigma^2 = \frac{\sum(d-\bar{d})}{n}, \quad \bar{d} = \frac{\sum d}{n}$$

The uniformity factor shows the quantitative uniformity (uniformity) of the data population. It is believed that the optimal value of the coefficient should exceed 95%, therefore, the elements of the population are evenly distributed. At a value of 77% - a critical value, the elements are unevenly distributed [2].

TABLE IV UNIFORMITY COEFFICIENT ASSESSMENT OF THE PAYMENT SYSTEM INFRASTRUCTURE BY FEDERAL DISTRICTS OF RUSSIA

Uniformity coefficient of the payment system infrastructure by federal districts of Russia	Uniformity coefficient	Value
Number of ATMs of credit institutions with the function of issuing and / or accepting cash using payment cards (their details)	0.941	Close to optimal
Number of electronic terminals installed in trade (service) organizations	0.945	Close to optimal
Number of ATMs of bank payment agents (subagents)	0.963	Optimal
Number of cash registers of bank payment agents (subagents)	0.954	Optimal
The number of branches of federal postal organizations providing payment services (including postal orders)	0.994	Above optimal
Number of outlets with the ability to provide payment card holders with services for issuing cash in trade organizations (services) - bank payment agents using POS terminals	0.927	Close to optimal

The organizations of the federal postal service providing payment services (including postal orders) are evenly distributed in Russia, but their number, according to the authors, exceeds the optimal one. The number of ATMs of bank payment agents (subagents) and the number of cash desks of bank payment agents (subagents) are evenly distributed across the federal districts of Russia; their quantitative characteristics correspond to the optimal value.

There is a shortage of the number of ATMs of credit institutions with the function of issuing and / or accepting cash using payment cards (their details) and the number of electronic terminals installed in trade (service) organizations, their distribution is close to optimal. The lowest indicator is the number of outlets with the ability to provide payment card holders with services for issuing cash in trade organizations (services) - bank payment agents using POS terminals, which indicates the uneven distribution and lack of this outlet.

In this regard, the authors consider it expedient at the state level to stimulate an increase in the number of these three components of the payment system infrastructure, which, due

to the expansion of the perimeter of presence and enhancement of functionality, will help increase the financial availability of payment services in the regions. At the same time, according to the authors, it is not possible to present a true picture of the distribution of access points of payment services today, since monitoring of the characteristics of the payment system infrastructure within the framework of financial availability is insufficiently developed.

IV. CONCLUSION

Thus, the payment infrastructure spatial development should take into account the impact of global and local processes of digitalization of the economy on financial markets and the emergence of new challenges in the context of the current pandemic and the possible emergence of such risks in the future. At the same time, one should take into account the need to balance the interests of credit institutions, consumers of payment services and the state.

Based on the above, the authors consider it appropriate:

- at the legislative level, define the concepts of a payment instrument and payment infrastructure;

- in order to ensure the development of the process of remote banking services for clients in the conditions of forced restrictions on physical contacts with them, make the necessary changes to the legislation to expand the functionality of the Unified Identification and Authentication System, as well as to use alternative methods of identifying persons;

- transparency, security and economic feasibility to determine the main target guidelines for the formation of a special payment infrastructure and new types of services in the implementation of the Bank of Russia project on the creation and implementation of a digital national currency;

- consider the possibility of improving the monitoring by the Bank of Russia of the characteristics of the payment system infrastructure within the framework of financial availability in order to objectively assess the spatial development of the payment infrastructure in each federal district in order to determine promising directions for its development and create new payment services;

- to consider the possibilities of stimulating credit institutions to increase the number of points in each federal district with the possibility of providing payment card holders with services for issuing cash in trade (service) organizations - bank payment agents using POS terminals;

- a balanced approach when the legislator decides on the abolition of fees charged by banks for certain types of payments in order to preserve the payment infrastructure of the regions. At the same time, the tariff policy of domestic credit institutions in the field of payment services should be formed in the spirit of increasing their social responsibility.

A change in the payment infrastructure and national payment landscape that is adequate to modern realities and the target tasks of the spatial development of Russia may become one of the most important factors in their solution.

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