INFRASTRUCTURAL SUPPORT OF ELECTRONIC PAYMENT SYSTEMS MARKETS IN RUSSIA

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Abstract
For economic development is necessary to increase the number of transactions, which contributes to their simplification and acceleration, provided by the development of electronic payment systems. Electronic payment systems are rapidly developing modern tools that are necessary for the development of entrepreneurial activity. Therefore, study on their development is of practical interest to entrepreneurs and their clients. For the development of electronic payment systems require special infrastructure support. As part of the accession of the Russian Federation to the WTO is changed economic conditions in the Russian economy, open access to the global infrastructure. To maximize the use of new opportunities, you need to analyze the opportunities and prospects for the development of infrastructure to ensure markets of electronic payment systems.

Key words: cash money, electronic payment systems markets, infrastructure, national financial system, Russia.

JEL classification: E42, H54.

1. Introduction
To create in Russia an international financial center must provide a variety of financial instruments to meet the needs of the majority of customers of financial markets and the high market liquidity of these instruments to reduce the transaction costs of operations in the financial market. This is facilitated by the development of the market of electronic payment systems.

Firstly, the market for electronic payment systems characterized by a variety of financial instruments, constantly improve the process of competition (Evrstratov and A.I. Berezhnova 2013). Secondly, electronic payment systems contribute to the development of foreign trade, as "most of cross-border transactions performed with the use of electronic payment systems. In most cases, this is a big deal, as measured by the hundreds of thousands of dollars. Thirdly, electronic payment systems are gaining in popularity around the world. An increasing number of transactions performed with their use.

In 2013, in 2010-2013 there was annual increase in the world market of electronic payment systems by 15%. In 2014-2017 projected annual growth of electronic payments by 25% (Fullerton et. al., 2014). Given this trend, it can be concluded that the lag of the Russian market of electronic payment systems of the world will slow the development of the financial market of the Russian Federation. And vice versa - the

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sustainable development of the Russian market of electronic payment systems will facilitate the creation in Russia of a favorable investment climate.

In this study, the conclusion is made, according to which the development of the Russian market of electronic payment systems need appropriate infrastructure support. This study focuses on the verification of this hypothesis using econometric methods.

2. Role of electronic payment systems in Russian economy development

Reveal the existence of a relationship between the development of the market of electronic payment systems and sales in the Russian Federation. For this we turn to regression analysis and form the Simple Linear Regression Model. The initial data for the simulation are shown in Fig. 1, 2.

![Figure 1: Dynamics of payments using electronic payment systems in 2003-2013, billions of dollars](image1)

![Figure 2: The dynamics of retail trade turnover in the Russian Federation in 2003-2013, billions of dollars](image2)
Based on identified depending Simple Linear Regression equation is as follows:
\[ \hat{y}(x) = b_0 + b_1 x \] (1)

Calculate the parameters of a linear function to characterize the dependence of y on x using MathCad, we obtain: \( b_1 = 36,556 \), \( b_0 = 3559 \). Thus, we obtain the regression equation:
\[ \hat{y}(x) = 3559 + 36,556x. \]

Index \( b_1 = 36,556 \) suggests that an increase in the volume of payments using electronic payment systems 1 billion of dollars. Retail trade turnover in the Russian Federation increased by 36.556 billions of dollars. The correlation coefficient for the resulting model \( r_{xy} = 0.954 \) So, we can conclude that there is a close relationship between the amount of payments using electronic payment systems and retail trade turnover in the Russian Federation. Calculate the coefficient of determination:
\[ D = r_{xy}^2 \times 100\% = 95.4\%. \]

Consequently, retail trade turnover in the Russian Federation by 95.4% explained by the amount of payments using electronic payment systems. We estimate a linear regression model through average approximation error, which for the resulting model is 6%. From this we can conclude that the model quality. We estimate a linear regression model of the F-Fisher criterion. Put forward the null hypothesis:
\[ H_0: b_1 = 0. \]
\[ F = \frac{r^2}{1 - r^2} \times \frac{n - 2}{n - 2} = \frac{0.99}{1 - 0.99^2} \times \frac{11 - 2}{11 - 2} = 91.129 \]

\[ F_{crit} = 5.12. \] We have \( F_{exper} > F_{crit} \), so the regression equation is significant at a predetermined level. Therefore, the hypothesis \( H_0 \) is not true.

Thus, according to the resulting linear regression equation, with an increase in payments through electronic payment systems 1 billion. Rubles. Retail trade turnover in the Russian Federation increased by 36.556 billion. rubles. Communication between these signs of strong and straight (\( r_{xy} = 0.954 \)). The variation of the volume of payments through electronic payment systems 95.4% (D) is explained by the variation of the retail trade turnover in the Russian Federation. Approximation error (6%) shows good agreement between the calculated and actual data. Since \( F_{nabl} > F_{tabl} \), the hypothesis \( H_0 \) is rejected on the random nature of addiction and revealed statistically insignificant parameters of the equation, closeness of the connection parameters.

3. Edgeworth Diagram of Russian payment system

Let’s estimate the impact of electronic payment systems on the efficiency of the payment system of the country. The concept of effectiveness involves determining the relationship of the positive effect to the costs. The most important positive effect of the monetary system is a convenience for citizens, as well as its compliance with the interests of the state, (Guisan and Aguayo 2013). As a quantitative positive effect of the payment system of the country may make the amount of tax revenue to the state budget, GDP, number of transactions in the economy, and others. The cost of the payment system include primarily the cost to society for its content.

Thus, the efficiency of the payment system = F (taxes, GDP, transaction costs and other factors). The development of electronic payment systems market economy becomes more transparent and manageable, so the size of tax revenues to the state budget increases and decreases the level of corruption. As a convenient means of
payment, electronic payment systems facilitate the process of purchase and increase the number of transactions.

The cost of cash payment varies from 20 to 25 rubles for each transaction, while the cost of the use of electronic payment systems is from 7 to 9 rubles (Schahovskaya and Morozova 2009). In other words the use of electronic payment systems is by 70% more efficient than the content of cash. Consequently, the development of the market of electronic payment systems reduces the maintenance costs of the payment system.

As a result of the development of the market of electronic payment systems, the positive effect of the payment system is increased, and the costs of its maintenance are reduced, there is an increase in efficiency. Graphically, this process can be represented by an efficiency curve, which is known as the “Edgeworth diagram” (Edgeworth 1881).

The choice of method for modeling the efficiency of the payment system is not accidental Edgeworth diagram provides two goods in the economy. Money is a specific commodity, so the model of the payment system is one commodity cash, and the other - electronic payment systems.

The horizontal axis shows the positive effect of the payment system, and the vertical - the cost of its maintenance. In the upper left corner is cash, and in the lower right - electronic payment systems. Efficiency curve of the payment system will reflect the various combinations of electronic payment systems and cash.

In 2011 in the Russian Federation, the share of electronic payment systems in 2012 was about 12%, in 2013 about 16%, and in 2012 close to 20% (Popkova and Tinyakova 2013). The isoquant shows the ratio of electronic payment systems and cash in the economy at various positive effects of the payment system and the costs of its content (Fig. 7).

![Figure 3 Edgeworth Diagram of the payment system efficiency](image-url)
Fig. 3 builds three isoquant electronic payment systems (EPS) with a level of 12%, 16% and 20%. Isoquant cash rotated by 1800 to build three isoquants cash (ND) with a level of 88%, 84% and 80%. Points of intersection isoquants of electronic payment systems and cash to the efficiency curve of the payment system is a situation of Pareto efficiency. Fig. 7 shows that the efficiency of the payment system increases as one moves down the right, that is, as the share of electronic payment systems in the economy. In the three-dimensional model is a combination of electronic payment systems and cash in the economy is shown in Fig. 4.

Figure 4. Model combination of electronic payment systems and cash in the economy

As can be seen from Fig. 4, economic efficiency increases with the proportion of electronic payment systems. In addition to the above advantages electronic payment systems contribute to the strategic objectives of the Russian Federation in the field of finance. According to statements by the Ministry of Economic Development of the Russian Federation, "the development of the financial market in the Russian Federation is an integral part of public policy aimed at effective" infusion "of the Russian economy into the world economy in the process of globalization. Only the financial market will help ensure the country's more balanced, based on innovation and sustainable in the long term economic growth", (Schahovskaya and Morozova 2009).
4. Relationship of market development of electronic payment systems and the availability of appropriate infrastructure

Since the infrastructure in itself does not create economic potential, but only contributes to the productivity of labor and private capital, the deficit does not allow the latter to assess the effect of infrastructure. The use of empirical estimates of the physical characteristics of infrastructure capital, excluding customer satisfaction, which includes innovation, excellence management, operational efficiency of existing facilities, it distorts the real assessment.

Conducted numerous studies have shown [39, p. 78] that the effect of growth on 1% efficient use of infrastructure is 7 times the impact of a 1% increase in investment in infrastructure. The apparent shortage of infrastructure services, ultimately, is due not need to invest in its expansion, and the need to improve service quality and operational efficiency. Ultimately, the problem is the lack of effective management. As a result of the accession of the Russian Federation to the WTO is expected to develop market infrastructure of the Russian electronic payment systems (Chen 2014), as well as to increase its competitiveness.

The main problem of the market infrastructure of electronic payment systems efficiency criteria formation is absence of single and fairly accurate method of determining the economic effectiveness functioning and property assessment (business value) of electronic payment systems.

The fact that the composition of indicators that can be recommended for evaluating the performance of, as well as a property evaluation of electronic payment systems is significantly different from the complex similar groups, to assess the effectiveness of traditional payment systems. This is due to their diverse organizational, economic and technical-technical features. Traditional indicators for assessing the effectiveness of electronic payment systems can be divided into three main groups (Succurro and Mannarino (2014):

1. The performance evaluation of the effectiveness of creating an electronic payment system (investment project on the development of the system);

2. The indicators to measure the efficiency of the payment system;

3. The valuation indicators electronic payment system.

For electronic payment systems, which are not only in domestic but also in foreign practice in a significant percentage does not get for a few years as a result of its business profits, the use of conventional long-indicators used to evaluate the effectiveness of business projects is uninformative.

The main reason is the lack of consumer confidence in these systems, so many systems in the early years of the focus only on what to get in the target market, gain experience and gain the trust of consumers. Only after this electronic payment systems are oriented to making a profit.
Thus, to evaluate the effectiveness of market infrastructure of electronic payment systems that do not have income over a considerable period of time, need special rates and methods of calculation. In this method of forming the basis of performance criteria of innovation infrastructure of e-commerce on the principles of accounting functionality, performance and price indicators, as well as their dynamics. Comprehensive performance criterion infrastructure of electronic payment systems in the proposed form:

$$K_{eff} = K_{func} \times K_{exp} \times K_{con},$$

(2)

where $K_{func}$ – group criterion functional efficiency of the innovation infrastructure system, determined by the relation:

$$K_{func} = (F_{fact}/F_{etal}) \times C_{bal},$$

(3)

where $F_{fact}$ is the actual value of the system's functionality;

$F_{etal}$ is a reference value system functionality;

$C_{bal}$ is balance system;

$K_{exp}$ is group criterion operational efficiency of the innovation infrastructure systems determined from the relation:

$$K_{exp} = [H_{fact}/H_{etal}] \times C_{ovm} \times [(I_{poten}-I_{fact})/I_{fact}] \times [(E_{poten}-E_{fact})/E_{fact}],$$

(4)

where $H_{fact}$, $H_{etal}$ is the actual reference and operational reliability of the system;

$C_{ovm}$ is compatible infrastructure systems;

$I_{poten}$, $I_{fact}$ is the actual reference and innovative development of the system;

$E_{poten}$-$E_{fact}$ is potential and actual size of the market, reflecting the possibility of increasing segment of the market served by the system;

$K_{con}$ is group criterion of economic efficiency of the innovation infrastructure system, determined by the relation:

$$K_{con} = (C_{fact}/C_{etal}) \times (P_{fact}/P_{etal}) \times (F_{Ifact}/F_{Ifetal}),$$

(5)

where $C_{fact}$, $C_{etal}$ is the actual and the reference value of the infrastructure system;

$P_{fact}$, $P_{etal}$ is the actual profitability and reference system infrastructure;

$F_{Ifact}$, $F_{Ifetal}$ is the actual and the benchmark return on investment in infrastructure systems.

Evaluate the effectiveness of the infrastructure of the Russian market of electronic payment systems. The actual functionality of the Russian market of electronic payment systems can be estimated by 0.4, since about 40% of goods and services can be paid for the use of electronic payment systems. Reference functionality of the market in question is equal to 1, as ideally possible mass distribution of non-cash payments. Balance system can be estimated at 0.3, as different types of electronic payment
systems have little to do with each other. Thus, we obtain the following value group criterion functional efficiency of the innovation infrastructure of the Russian market of electronic payment systems:

\[ K_{\text{func}} = (0.4/1)*0.3 = 0.120. \]

Actual operational reliability Russian electronic payment systems can be estimated by 0.5 since the probability of breaking the system is about 50%. Standard operating reliability of such systems is equal to 0.8, as they provide a 100% security is not possible. Compatibility infrastructure system is about 0.2, as interchangeability of infrastructure of various kinds of electronic payment systems is very low.

Actual innovative development of the Russian market of electronic payment systems can be assessed by 0.6, as the market is developing dynamically, although lagging behind the US and European market. Potential innovative development of the market is equal to 1, as the innovative potential of this market is very high, as the market is in its infancy. The potential size of the market is equal to 1, since ideally the market may reach 100% of users. The actual size of the market is about 0.7, since about 70% of the population is Russian polzovaielyami electronic payment systems.

Thus, we obtain the following value criterion group operational efficiency of the innovation infrastructure of the Russian market of electronic payment systems:

\[ K_{\text{exp}} = [0.5/0.8]*0.2*[(1-0.6)/0.6]*[(1-0.7)/0.7] = 0.035. \]

The actual cost of the infrastructure of the system can be estimated by 0.7, as infrastructure wound electronic payment systems are expensive. The reference value of the infrastructure of the system is equal to 1. The actual return on the infrastructure of the system is about 0.6, as features of the system are used by about 60%. The reference system is cost-effective infrastructure 1.Faktichesky return on investment in the infrastructure of the system is about 0.8. The reference ROI is 1.

Thus, we obtain the following value of the group criteria of economic efficiency of the innovation infrastructure of the Russian market of electronic payment systems:

\[ K_{\text{econ}} = (0.7/1)*(0.6/1)*(0.8/1) = 0.336. \]

We obtain the following criterion of efficiency of integrated infrastructure of electronic payment systems:

\[ K_{\text{eff}} = 0.120*0.035*0.336 = 0.001. \]

This low value of the criterion of efficiency shows that the market of electronic payment systems is at an early stage of development, so has not yet received widespread recognition of consumers. To create electronic payment systems require significant financial resources and the payback of these systems in the tens of years. The innovative nature of the market determines the presence of high risks impeding attract long-term investment in the infrastructure of the market of electronic payment systems.
5. Model of infrastructure economic development

For consideration of the market of electronic payment systems as an infrastructure component of the economy by the authors of this study was to develop a model of infrastructural development of the economy based on the model of economic growth of the American economist and Nobel Prize in 1987 “for fundamental research in the theory of economic growth” Robert Solow. The model is based on a Cobb-Douglas. Terms of models:

1) Limit productivity factors are positive.
2) In the absence of one of the factors is zero release.
3) An increase in investment output increases.
4) An increase in investment is the development of infrastructure.
5) The rate of elimination of infrastructure is a constant.
6) The production function has constant returns to scale (the unit of scale).

Model infrastructural development of the economy is one-sector model of economic growth. In this model, the economic system is considered as a whole. The model adequately reflects the most important macroeconomic aspects reproduction. Exports and imports are not explicitly taken into account-evaporated. State of the economy in the infrastructural development of models of the economy is given by the following three endogenous or internal variables, which are calculated in the interaction within the model:

- X - gross domestic product (GDP);
- I - investments in infrastructure;
- INF - infrastructure components.

In addition, the following model uses exogenous (for data outside the system) parameters:

- ν - an annual growth rate of investment in infrastructure;
- μ - the proportion of retired a year of basic infrastructure;
- ρ - share of gross investment in gross domestic product.

Exogenous parameters are within the following limits:

\[-1 < ν < 1, \ 0 < μ < 1, \ 0 < ρ < 1\] \hspace{2cm} (6)

Exogenous parameters assumed to be constant in time, and the rate of accumulation is a control parameter, t. E. The initial time can be set by control system at any level of the tolerance range. The time t is considered continuous and measured in years. It is expected that the annual production at any given time is determined by the linear homogeneous neoclassical production function:

\[X=F(INF,I),\] \hspace{2cm} (7)

The function is considered linear-homogeneous if the equality:
F(λINF,λI)=λF(INF,I)

(8)

Let's see how changing infrastructure investment within a short period of time \( Δt \).

According to the definition of the rate of growth:

\[
\frac{Di}{dt}=vl,
\]

(9)

Solving the task of Cauchy, we find the dependence for infrastructure investments from time to time:

\[ I=I_0 e^{vt} \]

(10)

where the initial condition \( I_0 = I \) (0) is investment in infrastructure at the initial time of observation, which is associated with the variable \( t = 0 \). Depreciation and investments per year are \( \mu_{INF} \) and \( Δt \) - respectively \( \mu_{INF}Δt \) and \( IΔt \), therefore increase infrastructure during this time:

\[
ΔINF=mINFΔt+IΔy,
\]

(11)

from which we obtain the differential equation:

\[
\frac{dk}{dt}=-mINF+I, \ INF(0)=INF_0
\]

(12)

The role of electronic payment systems in economic development is to increase the infrastructure component, which is the sum of the infrastructure in the economy. According to official data of Rosstat, Russia's economy was characterized by the following indicators in 2011 and 2012 (Table 1).

**Table 1 Some indicators of the Russian economy in 2011-2012**

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP of Russia, billions of dollars.</td>
<td>44 939 200</td>
<td>46 736 768</td>
</tr>
<tr>
<td>The volume of investments in infrastructure, billions of dollars.</td>
<td>9 152</td>
<td>10 777</td>
</tr>
<tr>
<td>The volume of electronic payments, x, billions of dollars.</td>
<td>310</td>
<td>350</td>
</tr>
</tbody>
</table>

The value of the infrastructure components in the development of the Russian economy in 2011 was:

\[
INF_{2011} + \PiC = \frac{44939200}{9152} - 310 = 4910 - 310 = 4600 \text{ billion of rubles.}
\]

Then GDP in 2012 can be calculated as follows:

\[
X_{2012} = (4910 + 310) * 9152 = 44939200.
\]

For comparison, we calculate the GDP in 2012, with the volume of payments using electronic payment systems in 2011. Then the value of the infrastructure components will be more, which results in a larger volume of GDP:

\[
X_{2012/11} = (4910 + 350) * 9152 = 48139520.
\]
Calculate the GDP in 2011 with the volume of payments using electronic payment systems in 2012:

\[ X_{2011/12} = (4910 + 520) \times 9152 = 49695360. \]

Increased payments using electronic payment systems by 3% resulted in an increase of 8% of GDP, hence the connection between the development of electronic payment systems and direct GDP.

### 6. Conclusions

The market of electronic payment systems is an infrastructure component of economic development, as it helps to increase the volume of cross-border transactions, the internationalization of the national currency, the effectiveness of the national financial system, creating the conditions for attracting investment, enhance the competitiveness of the national economy.

In conclusion, it should be noted that in order to increase its share in the global economy, the Russian Federation is necessary to abandon the strategy of catching up development and move to innovative development of the economy, involves identifying current trends in the world economy and the search for possible ways to use them for their own purposes. Need to focus on the supply of new goods and services, to develop promising markets, one of which is the market of electronic payment systems. Therefore, if the Russian Federation will be able to develop this market, it will help to create in our country an international financial center. Thus, the financial sector can be a driving force behind the development of the Russian economy.

### References


