


**BLOCKCHAIN AS A PROMISING TECHNOLOGY FOR INTERNATIONAL SETTLEMENTS
(ON THE EXAMPLE OF THE RUSSIAN ECONOMY)**

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ARTICLE INFO	ABSTRACT
<p>Article history:</p> <p>Received 09 June 2023</p> <p>Accepted 06 September 2023</p>	<p>Purpose: Development and testing of methodological approaches to the empirical assessment of a possible increase in GDP in the case of simulating the transition of cross-border payments to the blockchain environment using the example of the national economy of the Russian Federation.</p>
<p>Keywords:</p> <p>Blockchain; Transnational Payment Systems; Macroeconomic Effects; GDP Growth.</p>	<p>Theoretical framework: In modern scientific literature, much attention is paid to questions about the prospects for the transition of financial transactions to the blockchain (Adrian T. et al., 2018; Allen D. et al., 2019; Boar C. et al., 2020; Kochergin D., 2021; Nazarenko Y., 2018 and others.). However, it should be argued that the methodological base justifying the macroeconomic efficiency of such decisions has not been formed in a holistic way. In this regard, this study is an attempt to develop theoretical and methodological tools that substantiate the feasibility of creating blockchain platforms for transnational payments.</p>
	<p>Design/Methodology/Approach: Using the national economy of Russia as an example, we conducted an empirical assessment of the potential increase in gross domestic product (GDP) by simulating transitioning cross-border payments into a blockchain ecosystem.</p> <p>Findings: It was determined that the potential cumulative macroeconomic effect (i.e., GDP growth) may reach 4.0% per year, corresponding to 6.05 trillion rubles (\$75.6 billion US dollars).</p> <p>Research, Practical & Social implications: We propose a future research agenda and highlight the contribution of blockchain to FinTech development.</p> <p>Originality/Value: Estimates demonstrate the prospects of blockchain application in transnational payments and highlight their potential use for mitigating risks associated with increasing sanction pressure, including restrictions on access to international clearing services and payment systems (SWIFT, etc.).</p> <p>Doi: https://doi.org/10.26668/businessreview/2023.v8i9.3218</p>

**BLOCKCHAIN COMO UMA TECNOLOGIA PROMISSORA PARA ASSENTAMENTOS
INTERNACIONAIS (NO EXEMPLO DA ECONOMIA RUSSA)**

RESUMO

Objetivo: Desenvolvimento e ensaio de abordagens metodológicas para a avaliação empírica de um possível aumento do PIB em caso de simulação da transição dos pagamentos transfronteiras para o ambiente de cadeia de blocos, utilizando o exemplo da economia nacional da Federação da Rússia.

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Estrutura teórica: Na literatura científica moderna, muita atenção é dada às questões sobre as perspectivas de transição das transações financeiras para a blockchain (Adrian T. et al., 2018; Allen D. et al., 2019; Boar C. et al., 2020; Kochergin D., 2021; Nazarenko Y., 2018 e outros.). No entanto, deve argumentar-se que a base metodológica que justifica a eficiência macroeconômica de tais decisões não foi formada de forma holística. A este respeito, o presente estudo pretende desenvolver instrumentos teóricos e metodológicos que comprovem a viabilidade da criação de plataformas de cadeia de blocos para os pagamentos transnacionais.

Concepção/ Metodologia/ Abordagem: Utilizando a economia nacional da Rússia como exemplo, realizamos uma avaliação empírica do potencial aumento do produto interno bruto (PIB) através da simulação da transição dos pagamentos transfronteiras para um ecossistema de cadeia de blocos.

Constatações: Foi determinado que o potencial efeito macroeconômico cumulativo (ou seja, crescimento do PIB) pode chegar a 4,0% ao ano, correspondendo a 6,05 trilhões de rublos (US\$ 75,6 bilhões de dólares).

Investigação, Implicações práticas e Sociais: Propomos uma agenda de investigação futura e destacamos a contribuição da blockchain para o desenvolvimento da FinTech.

Originalidade/Valor: As estimativas demonstram as perspectivas de aplicação de cadeias de blocos aos pagamentos transnacionais e salientam a sua potencial utilização para atenuar os riscos associados à crescente pressão das sanções, incluindo restrições ao acesso aos serviços de compensação internacionais e aos sistemas de pagamentos (SWIFT, etc.).

Palavras-chave: Blockchain, Sistemas de Pagamentos Transnacionais, Efeitos Macroeconômicos, Crescimento do PIB.

BLOCKCHAIN COMO UNA TECNOLOGÍA PROMETEDORA PARA LOS ASENTAMIENTOS INTERNACIONALES (POR EJEMPLO, EN LA ECONOMÍA RUSA)

RESUMEN

Finalidad: Desarrollo y ensayo de enfoques metodológicos para la evaluación empírica de un posible aumento del PIB en el caso de la simulación de la transición de pagos transfronterizos al entorno de blockchain utilizando el ejemplo de la economía nacional de la Federación de Rusia.

Marco teórico: En la literatura científica moderna, se presta mucha atención a las preguntas sobre las perspectivas para la transición de las transacciones financieras a la cadena de bloques (Adrian T. et al., 2018; Allen D. et al., 2019; Boar C. et al., 2020; Kochergin D., 2021; Nazarenko Y., 2018 y otros). Sin embargo, debe argumentarse que la base metodológica que justifica la eficiencia macroeconómica de esas decisiones no se ha formado de manera holística. En este sentido, el presente estudio es un intento de desarrollar herramientas teóricas y metodológicas que fundamenten la factibilidad de crear plataformas blockchain para pagos transnacionales.

Diseño/ Metodología/ Enfoque: Utilizando la economía nacional de Rusia como ejemplo, realizamos una evaluación empírica del aumento potencial del producto interno bruto (PIB) simulando la transición de pagos transfronterizos a un ecosistema de blockchain.

Hallazgos: Se determinó que el efecto macroeconómico acumulativo potencial (es decir, el crecimiento del PIB) puede alcanzar el 4,0% anual, correspondiente a 6,05 billones de rublos (75.600 millones de dólares estadounidenses).

Investigación, Implicaciones prácticas y Sociales: Proponemos una agenda de investigación futura y destacamos la contribución de blockchain al desarrollo de FinTech.

Originalidad/Valor: Las estimaciones demuestran las perspectivas de la aplicación de la cadena de bloques en los pagos transnacionales y destacan su uso potencial para mitigar los riesgos asociados con la creciente presión de las sanciones, incluidas las restricciones de acceso a los servicios de compensación internacional y los sistemas de pago (SWIFT, etc.).

Palabras clave: Blockchain, Sistemas de Pago Transnacionales, Efectos Macroeconómicos, Crecimiento del PIB.

INTRODUCTION

Additive technologies, artificial intelligence, digital transformation of the economy, blockchain and other so-called end-to-end technologies today determine new points of economic growth (Abirami M., 2023; Navasardyan M., 2023; Ichsan, 2023). In this regard, it

seems to be an extremely important and urgent task to study the emerging macroeconomic externalities that arise in the process of diffusion of technological innovations in all areas of economic activity, including financial ones. At the same time, one of the key technologies that can largely evolve the FinTech sector is blockchain.

International financial organizations and development institutions agree that the introduction of blockchain technologies (DLT) into the implementation of cross-border payments will significantly contribute to both the development of the global system of international payments and the stimulation of world trade as part of the involvement of new participants whose access is limited by the current cost. cross-border money transfers, as well as infrastructural and institutional restrictions in the financial sector. This issue is of particular relevance today for the Russian economy, which is faced with unprecedented sanctions pressure, which limits, in particular, the access of the financial system to international clearing services, which, if they do not localize the potential of foreign economic activity, then significantly complicate the processes of international trade, especially in terms of the growth of transaction costs.

Based on the presented aspects, it can be assumed that works devoted to the prospects for creating specialized blockchain platforms and international transactions implemented on their basis in the framework of the use of digital currencies are of great interest today. At the same time, despite the relevance of the question posed, it should be stated that by now its solution has not been formed in a holistic form. Undoubtedly, there is a very wide range of work aimed at finding answers regarding the prospects for using blockchain in the financial sector of the economy. However, it should be stated that the vast majority of them are based on the methods of expert analysis, which largely makes the proposed assessments and conclusions subjective. In order to develop methodological tools that allow us to move into the plane of formalized methods of analysis, this article attempts to develop and test methodological tools for empirical assessment of macroeconomic effects in the case of simulating the transition of cross-border payments to the blockchain environment.

The goal set identified the following key objectives of the study:

- to develop an algorithm and conceptual approaches to assessing the impact of blockchain payment systems on the prospects for GDP growth of the national economy;
- to develop an author's approach to the empirical assessment of macroeconomic externalities generated as part of the transfer of transnational payments to blockchain technology;

- build a forecast of a possible increase in the GDP of the Russian Federation in the framework of the implemented simulation of the use of blockchain in the system of organizing cross-border payments.

THEORETICAL FRAMEWORK

Currently, the prospects of applying blockchain distributed ledger technology (DLT) in economic relations is discussed actively and sometimes controversially in scientific and expert communities. The demand for these technologies for cross-border payments within supply chains is equally important. Based on the conclusions of foreign and Russian researchers (Allen D. 2019, p. 369; Ganne E. 2018, p. 27; Kochergin D. 2021, p. 73; Safiullin M.R. 2019, p. 44) and international institutions (World Economic Forum, 2019, p. 48; OECD, 2019, p. 68; BIS Working Papers, 2020, p. 16), DLT technologies have significant potential for optimizing the FinTech sector at a supranational level. However, it is unclear how this technology may affect the development of individual countries and regions integrated into the blockchain ecosystem. The proponents of implementing blockchain in international settlements (Clarke R. 2006, p. 11; Sidorenko E. 2021, p. 155; Engert W. 2017, p. 32; Alonso N. 2021, p. 20; Zhang T. 2021, p. 15) note the following effects:

- Localization of intermediation in financial, logistics, transportation, trade, and other economic sectors;
- Comprehensive creation of trust; blockchain can significantly transform supply chain organization systems, reduce entry barriers to the global market of goods and services, and simultaneously enhance the level of security and reliability of transactions within the ecosystem;
- Localization/elimination of inequality in access to international supply chains;
- Time savings in conducting business operations by decreasing paperwork;
- Increased speed of transnational transactions;
- The use of blockchain with letters of credit can significantly accelerate document transfer in trade operations;
- Digitization of international supply chains can reduce fraud, avoid errors in documentation, and reduce costs for compliance with regulatory requirements and labor payments;
- Localization of financing risks for open accounts;

- The currently accelerating regionalization processes promote the integration of blockchain into the financial sectors of national economic systems and facilitate the transition to blockchain interoperability standards of digital payment platforms of different countries. Transnational integration of digital payment systems can increase their efficiency and contribute to the growth of settlements in national currencies;
- Localization of risks from increasing sanction pressure, such as restriction of access to international clearing services and payment systems (SWIFT, etc.);
- Increase in autonomy of interstate relations through the creation of cross-country digital blockchain platforms that enable transactions to bypass global intermediary organizations;
- Reduction of dependence of national economies on global reserve currencies/increased financial sovereignty of national economies;
- Strengthening of trade relations in foreign economic activity (FEA);
- Increase in business activity of economic entities participating in international trade;
- Expansion of economic potential of FEA participants through business process optimization;
- Decentralization of control systems and business operation implementation.

In contrast to the abovementioned arguments, some researchers suggest that blockchain, as a cross-border transaction technology, carries significant risks and threats to the sustainable development of national economies (Boar C. 2020, p. 19; Boar C. 2021, p. 9; Adrian T. 2018, p. 27).

However, despite the contradictions regarding the prospects of applying DLT technologies in the development of international payment systems and the creation of fundamentally new ecosystems based on them, there is currently a high level of interest in DLT technologies. This interest is expressed in scientific articles and analytical reports dedicated to this topic as well as in specific developments, including prototyped systems and successfully functioning blockchain platforms that support international, regional, and corporate supply chains (Kochergin D. 2021, p. 70; Sidorenko E. 2021, p. 159; Report on key features, impacts, and policy options. 2020, p. 44).

Based on the abovementioned arguments and owing to the growing exploration of the prospects for creating central bank digital currencies (CBDCs) in many countries, the issue of methodological support for evaluating the generated externalities of macroeconomic order

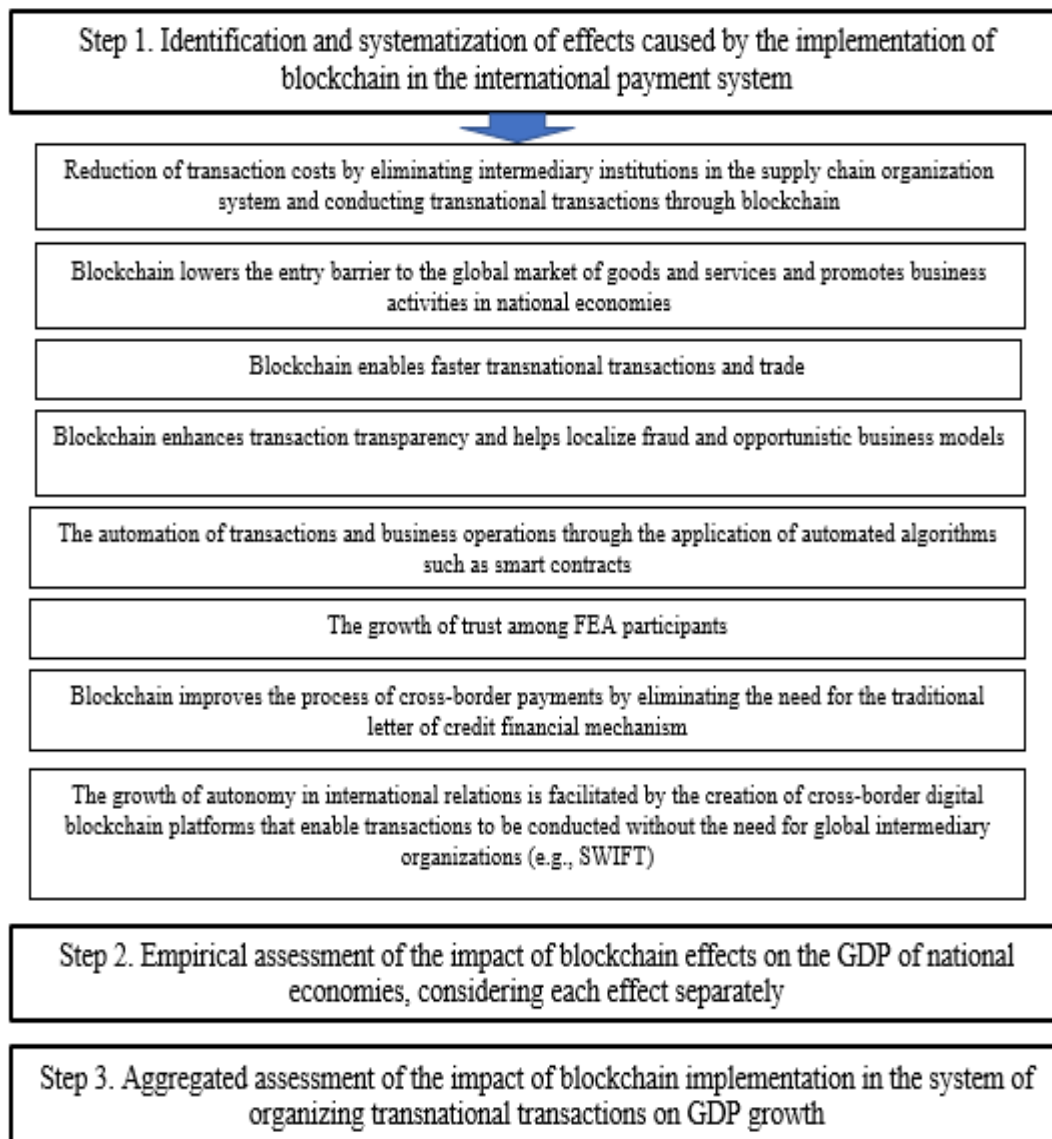
related to DLT technologies is extremely relevant. However, solving this task is not trivial, especially considering the clear justification provided by scientific publications dedicated to this issue, which predominantly focus on qualitative and heuristic analysis methods. Nevertheless, the desire for rigorous formalization of conclusions based on statistical data analysis and the construction of corresponding models forms a more substantiated basis for understanding the studied phenomena or processes. Therefore, it is advantageous to focus the research in this direction.

METHODOLOGY

The solution of the set tasks provides for the need to structure the generated possible macro effects that arise as part of the construction of international blockchain transactions in order to subsequently determine the methodology for their impact on economic growth. At the same time, this structuring should be formed, first of all, on the basis of the emerging technological possibilities for using blockchain, as well as on the basis of institutional transformations that transform the existing mechanisms and principles for organizing transnational payments in the context of systemic transformations.

Abstracting from the possible risks and threats that could potentially arise during the use of blockchain in the system of international payments (money laundering; anonymity of blockchain transactions, potential 51% attacks, etc.), and focusing exclusively on "windows of opportunity", in a concentrated In the form of an algorithm for a formalized study of the aggregate impact of blockchain payment systems on the prospects for GDP growth, it can be represented as the following flowchart (Figure 1):

Figure 1. Algorithm for studying the cumulative impact of blockchain payment systems on GDP growth prospects



Source: Developed by the authors

The described approach for studying the impact of blockchain on the formation of cumulative socio-economic effects through the establishment of new-format digital cross-border payment systems justifies organizing a complex system of empirical assessments. In agreement with both Russian and foreign researchers (Ganne E. 2018, p. 22; Kochergin D. 2021, p. 71; BIS Working Papers. 2020, p. 5; Nazarenko Yu. L. 2018, p. 30), we believe that it is methodologically challenging to evaluate and analyze macro-level economic externalities. Resolving this issue is currently highly relevant.

Therefore, based on the abovementioned factors justifying possible effects from the integration of blockchain into the transnational payment environment, Table 1 systematizes the effects and methodological approaches for their empirical assessment.

Table 1. Methodological approaches for studying the impact of blockchain on the prospects of building a new system for organizing cross-border payments and national economic development

№	Economic effect	Methodological assessment approaches
1	Reduction of transaction costs through the elimination of intermediaries in supply chain management and conducting cross-border transactions via blockchain	Assessment algorithm: 1. Reduction of transaction costs through lower commission rates for conducting transactions (in accordance with the European Commission Roadmap parameters (OECD. 2019. p. 51; Report on key features, impacts and policy options. 2020. p. 29)) 2. Increase in working capital (WC) of economic entities 3. Growth in business and investment activities 4. GDP increase
2	Blockchain reduces barriers to entry into the global market for goods and services and promotes business activity in national economies	1. Reduction of transaction costs through the localization of intermediaries 2. Strengthening the integration of small- and medium-sized businesses into international supply chains 3. Increase in business activities in national economies 4. GDP growth
3	Growth in the speed of cross-border transactions and trade	1. Localization of potential economic losses for international transaction participants through the reduction of the time lag required for transaction execution under conditions of increased currency exchange rate volatility (separately for exporters and importers) 2. Increase in financial results of business entities involved in international trade 3. GDP growth
4	Increased transaction transparency and localization of fraud/opportunistic business models	1. Localization of potential economic losses for international transaction participants through the elimination of opportunistic business models 2. Reduction in the amount of funds allocated by international trade participants within the framework of the open account trade model through export credit insurance 3. Increase in financial results of international trade participants 4. GDP growth
5	Automation of transactions and business operations using automated algorithms and smart contracts	The methodological basis for determining the macro-level economic effect involves assessment algorithms of the externalities presented in points 1–4. In a condensed form, they express the efficiency of implementing smart contracts in international trade.
6	Growth in trust among FEA participants	The methodological basis for determining the macro-level economic effect involves the use of assessment algorithms of the externalities presented in point 4. In a condensed form, they express the growth of trust between international trade participants, which reflects the intensification of business activities in the economy.
7	Improvement of cross-border payment processes using blockchain, eliminating the need for the traditional letter of credit financial mechanism	1. Localization of banking commissions for FEA participants in relation to the use of the letter of credit financial instrument 2. Increase in financial results for international trade participants 3. GDP growth

8	<p>Increased autonomy in international relations through the creation of cross-country digital blockchain platforms that enable transactions without global intermediary organizations such as SWIFT</p> <p>Blockchain is a promising technology for international settlements under sanctions and the unfriendly external environment: the economic aspect</p>	<ol style="list-style-type: none"> 1. Evaluation of cash flows of Russia in terms of export/import using transnational payment systems (such as SWIFT) in a consolidated format and on a country and regional level 2. Assessment of the economic damage to the Russian economy owing to disconnection from SWIFT 3. Modeling of the strengthening of sustainable development in the national economic system of Russia through the construction of a blockchain ecosystem involving a group of friendly states and bypassing SWIFT
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Source: Developed by the authors

RESULTS AND DISCUSSION

Based on the abovementioned effects, we performed an empirical assessment of the most significant macroeconomic effects.

Assessment of the Impact of Eliminating Intermediary Institutions in the System of Supply Chain Organization and Transnational Transactions Through Blockchain

The calculations shown in Table 2 are based on the data on the movement of export–import flows from 2013 to 2021. An abstract model is assumed as a hypothesis, allowing for a complete transition of cross-border transactions in the Russian economy to blockchain. The main effect within the concept of localizing intermediary institutions in the international payment system will be formed within import flows. This occurs because export deliveries are paid by buyers from third countries, and all commissions are paid by them, which is not the focus of this study.

Table 2. Volume of import flows in Russia from 2013 to 2022, in millions of US dollars

	2013	2014	2015	2016	2017	2018	2019	2020	2021
Russian imports, total	315 297,46	287 062,7	182 902,3	182 346,87	219 941	236 475,72	199 463,25	230 577,23	293 323,27
Russian exports, total	525 976,3	526 608,4	520 058,25	522 261,95	525 396,58	528 438,54	527 177,33	529 576,6	528 691,72

Source: Unified interdepartmental information and statistical system, EMISS (2023)

In accordance with the abovementioned arguments, the application of blockchain in cross-border payments will form the basis for localizing transaction support fees. In turn, this will contribute to the release of capital by economic entities and increase the working capital (WC) and financial results.

In agreement with (OECD. 2019. p. 40; Alonso N. 2016. p. 21), the potential increase in WC for Russian residents–FEA participants is based on the hypothesis that the average commission rate for retail cross-border payments will decrease from 7.45% to 1% through the adoption of blockchain ecosystems (Table 12). The corresponding estimates are presented in Table 3.

Table 3. Estimation of the increase in WC for Russian residents–FEA participants upon the reduction in the average commission rate for retail cross-border payments during the transition to blockchain, in millions of US dollars

Indicator	Rate	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022 (January)
		Millions of US dollars									
Current commission	7,45	23489,7	21386,2	13626,2	13584,8	16385,6	17617,4	14860,0	17178,0	21852,6	1737,7
Blockchain commission	1,0	3153,0	2870,6	1829,0	1823,5	2199,4	2364,8	1994,6	2305,8	2933,2	233,2
Released WC		20336,7	18515,5	11797,2	11761,4	14186,2	15252,7	12865,4	14872,2	18919,4	1504,4

Source: Unified interdepartmental information and statistical system, EMISS (2023)

The obtained results allowed us to move to a new stage of solving the problem, which is aimed at finding the relationship between the increase in financial results of economic entities in the national economy of Russia and the change in WC of FEA participants based on the projected parameters of transaction cost reduction. The model was based on the statistical data from the unified interdepartmental information and statistical system (EMISS) and Rosstat for the period from 2010 to 2021. The results of the constructed model, which characterizes the degree of interrelation between the evaluated factors, are presented in Tables 4 and 5.

Table 4. Summary of regression results

<i>Regression statistics</i>	
Multiple R	0,933511
R-squared	0,871443
Adjusted R-squared	0,839303
Standard error	3,16E+09
Observations	12

Source: Calculated by the authors based on the data of the unified interdepartmental information and statistical system EMISS

Table 5. Model coefficients and partial parameter significance

	<i>Coefficients</i>	<i>Standard error</i>	<i>t-Statistic</i>	<i>P-Value</i>
Y-intercept	-1,4E+10	6,32E+09	-2,25342	0,087314
Variable X 1 (Turnover of organizations)	0,146336	0,028103	5,207161	0,006484

Source: Calculated by the authors based on the data of the unified interdepartmental information and statistical system EMISS

$$FR = (-1,4E+10) + 0,146TO \quad (1),$$

Where:

FR – Financial result (net financial result, in thousands of rubles);

TO – Turnover of organizations (turnover of organizations at current prices, in thousands of rubles).

The obtained estimates are characterized by a high level of statistical significance. Furthermore, these estimates allow modeling of the increase in the cumulative net financial result of economic entities in terms of the expected growth of company turnover through the implementation of the blockchain transaction concept. Based on the obtained relationships, Table 6 presents the estimates reflecting the prospects of increasing the turnover of economic entities in Russia.

Methodologically, this research stage was conducted using the following algorithm:

1. Calculation of the net financial result according to the parameters of the obtained model.
2. Forecasted value of the net financial result, taking into account the growth of WC through implementation of the concept of reducing commission expenses for servicing transnational transactions. This parameter is calculated based on the implementation of the following iterations:
 - Estimation of the increase in the WC of economic entities in Russia participating in FEA in accordance with the reduction of expenses for intermediary clearing services.
 - Estimation of the change in the gross turnover of organizations at current prices (Table 6).
 - Construction of the forecasted value of the net financial result considering the updated parameters of the "Turnover of organizations" indicator.

Table 6. Estimates characterizing the prospects of increasing the turnover of economic entities in Russia
** calculated as the sum of columns 2 and 4

Year	Current values		Growth in organization turnover*	Forecasted value of organization turnover**
	Organization turnover	Net financial result		
1	2	3	4	5
2017	158 778 016 710	10 320 526 738	827764770	159 605 781 480
2018	191 813 270 858,3	13 797 162 645	956496817	192 769 767 675
2019	201 315 484 790,04	15 758 425 864	832777342	202 148 262 132
2020	207 561 703 368,98	12 421 070 680	1073029230	208 634 732 599
2021	270 702 054 845,9	29 649 743 813	1393413810	272 095 468 656

Source: calculated based on the data from Table 3, taking into account the conversion of cash flow from US dollars to Russian rubles

Based on the abovementioned calculation algorithm, Table 7 presents the expected growth of the cumulative financial result according to the forecasted change in organizational turnover.

Table 7. Forecasted estimates of the growth of cumulative financial result for 2017 to 2021

Indicator	2017	2018	2019	2020	2021
Forecasted value of cumulative financial result (based on the model), in thousands of rubles	898933 5700	138235 77781	152140 92358	161281 38080	253678 35246
Forecasted value of financial result, considering the growth in the WC, in thousands of rubles	911046 7363	139635 47558	153359 57541	162851 60727	255717 41644
Growth in financial result, in thousands of rubles	121131 663,4	139969 777,2	121865 182,4	157022 647,2	203906 397,9

Source: Calculated by the authors based on the data of the unified interdepartmental information and statistical system EMISS

The final step in the calculations aimed at assessing the macroeconomic effect, which is expressed as the increase in GDP resulting from the growth in the cumulative financial result of economic entities, is the construction of an econometric model that evaluates the relationship between the considered parameters. Tables 8 and 9 present the calculation results based on data from 2010 to 2021.

Table 8. Summary of regression results

<i>Regression statistics</i>	
Multiple R	0,916316
R-squared	0,839635
Adjusted R-squared	0,799543
Standard error	9947967
Observations	6

Source: Calculated by the authors based on the data of the unified interdepartmental information and statistical system EMISS

Table 9. Model coefficients and partial significance parameters

	<i>Coefficients</i>	<i>Standard error</i>	<i>t-Statistic</i>	<i>P-Value</i>
Y-intercept	70231395	10919944	6,43148	0,003006
Variable X 1 (Financial result)	0,00258	0,000564	4,576359	0,010212

Source: Calculated by the authors based on the data of the unified interdepartmental information and statistical system EMISS

$$\text{GDP} = 70231395 + 0,00258\text{FR} \quad (2),$$

Where:

GDP – Gross domestic product, in millions of rubles;
FR – Net financial result, in thousands of rubles.

The constructed model allows to forecast estimates of Russia's GDP, taking into account the current and new values of the net financial result, and to assess the potential changes in GDP (Tables 10 and 11, Figure 2).

Table 10. Forecast of net financial result growth owing to increasing turnover as a result of the localization of transactional burden of commission fees for international payments

Year	GDP, in millions of rubles	Net financial result, in thousands of rubles	Net financial result, considering its growth*, in thousands of rubles
2017	91 843 154,2	10 320 526 738	10 441 658 401,4
2018	103 861 651,1	13 797 162 645	13 937 132 422,2
2019	109 608 305,7	15 758 425 864	15 880 291 046,4
2020	107 658 169,2	12 421 070 680	12 578 093 327,2
2021	135 294 974,6	29 649 743 813	29 853 650 210,9
2022	151 455 552,5	25 925 459 080	

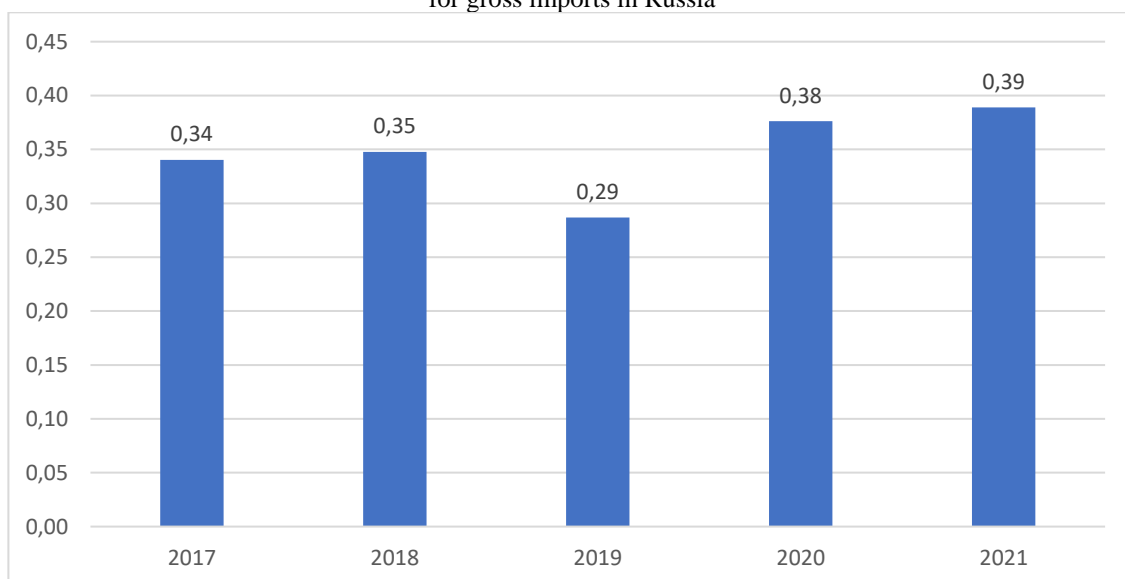
Source: Calculated as the sum of the current value of the indicator and its expected growth, estimated based on the data from Table 7.

Table 11. Forecasted GDP growth based on modeling of the transition of cross-border payments to blockchain for gross imports in Russia

Year	Forecast of GDP based on the model	Forecast of GDP, considering financial result growth	Deviation	Contribution to GDP, in %
2017	96860523,28	97173068,43	312545,153	0,340303157
2018	105830974,7	106192126,1	361151,4465	0,347723575
2019	110891446,1	111205883,8	314437,7862	0,28687405
2020	102280368,2	102685519,6	405151,4356	0,376331344
2021	146733966,3	147260087,6	526121,3671	0,388869852

Source: Calculated by the authors

Figure 2. Forecasted GDP growth based on modeling of the transition of cross-border payments to blockchain for gross imports in Russia



Source: Calculated by the authors

The analysis results demonstrate that the reduction in the cost of cross-border payments in the Russian economy can lead to a GDP growth of approximately 0.3% on average within the total volume of import flows. Undoubtedly, this perspective has a significant level of abstraction. It is unreasonable to assume that all countries importing goods and services to Russia will transition to blockchain transactions. Nevertheless, the obtained estimates reveal

hypothetical effects related to the localization of commission costs for servicing and conducting cross-border transactions.

Assessment of Economic Externalities in the Study of the Impact of Increased Speed of Cross-Border Transactions

Cross-border payments can take several days. Owing to increased risks of exchange rate fluctuations, these slow speeds can negatively affect the economic efficiency of the transactions. Transactions within blockchain ecosystems are executed almost instantly, unlike traditional schemes of organizing international payments. Thus, the reduction in the time required for trade transactions contributes to the reduction of inventories and indirect costs related to labor and transportation expenses.

According to the Roadmap for 2027, the G20 Central Banks are expected to achieve the following key performance indicators (KPIs) in the implementation of cross-border payments (Table 12) (*Financial Stability Board (FSB)*. 2020. p. 33):

Table 12. KPIs of the Roadmap "Enhancing the Efficiency of Cross-border Payments" (Stage 3) for the period up to 2027

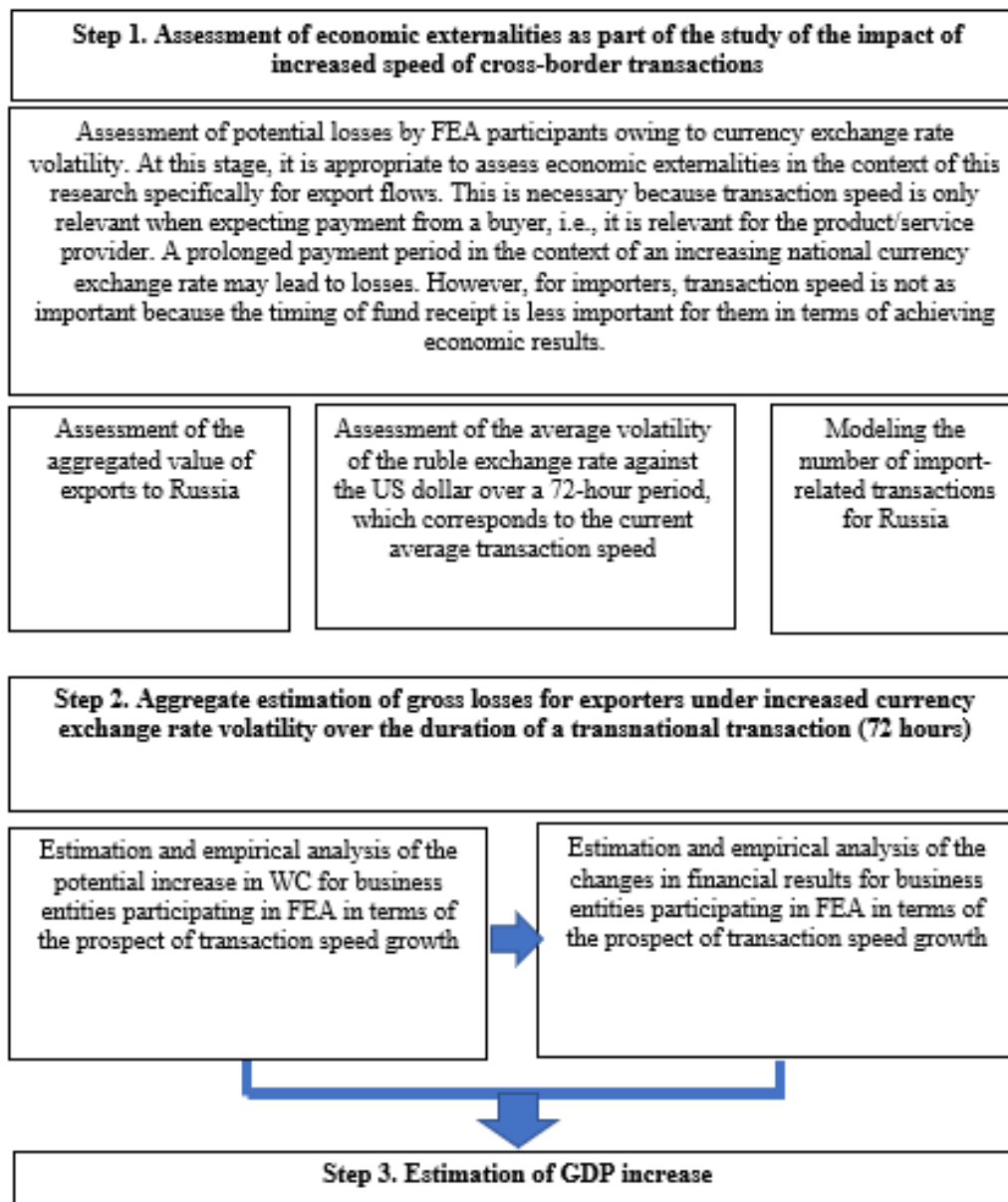
№	Indicator	Target value	Current value
1	Average fee for retail cross-border payment	1	7,45
2	Speed of cross-border transaction, hours	0,001	24–72
3	Ability to track transaction status	Yes	No
4	Ability to make transactions through non-bank channels (service providers)	Yes	No

Source: Financial Stability Board (FSB). 2020. p. 33

The presented efficiency indicators, which are planned for implementation in the international cross-border payment system, largely indicate the potential of blockchain application in modern payment systems and the rapid adaptation of national financial systems to upcoming Fintech innovations. For example, all presented indicators and KPIs in the Roadmap demonstrate the functional capabilities of blockchain and the financial payment platforms that are built using it. Therefore, the parameters presented in Table 12 serve as the basis for calculations and subsequent evaluation of the generated effects in the field of cross-border payment blockchain ecosystems.

When assessing macroeconomic externalities arising from the construction of international blockchain platforms that enable near-instantaneous data exchange and international payments, it is advisable to use the following evaluation algorithm (Figure 3):

Figure 3. Algorithm for assessing macroeconomic externalities generated by the construction of cross-border blockchain platforms facilitating the growth of transnational transaction speed



Source: Developed by the authors

One significant methodological aspect of assessing the impact of transnational payment speed reduction on the prospects of GDP growth is the search for a value that characterizes the level of average volatility of the ruble exchange rate against the US dollar over a 72-hour period. This time period corresponds to the current average value of cross-border payment transaction speed. The assessment of the average annual value of this parameter is calculated using the formula:

$$K_{\text{avg.year}} = \text{average} (K1) \quad (3),$$

Where:

K1 – chain growth rates of the ruble exchange rate against the US dollar averaged over three days;
 $K_{\text{avg.year}}$ – average annual growth index of the ruble against the US dollar averaged over three days.

The calculations are based on the average daily values of the dynamics of the US dollar exchange rate for the period from 2021 to 2022 (Central Bank of Russia, 2023).

The conducted assessments yielded results that characterize the average annual growth index of the ruble exchange rate against the US dollar averaged over three days (Table 13).

Table 13. Average annual growth index of the ruble exchange rate against the US dollar averaged over three days

Indicator	2021	2022	Average value for 2021–2022
$K_{\text{avg.year}}$	0,999941	1,000002	0,999972

Source: Calculated by the authors

Based on the obtained estimates, the next step was to determine the potential losses of exporters owing to currency volatility during the investigated time period required for transaction processing (72 hours). The calculation was performed using the following formula:

$$Y = E - E \times K_{\text{avg.year}} \quad (4)$$

Where:

Y – gross exchange rate losses from exports owing to low cross-border payment speed;
 E – gross exports.

Based on the data presented in Table 13, the key estimates are provided in Table 14.

Table 14. Assessment of gross losses by exporters owing to increased currency exchange rate volatility during the period of cross-border transaction processing (72 hours)

	2017	2018	2019	2020	2021
Exports, in millions of US dollars	525 976,3	526 608,4	520 058,25	522 261,95	525 396,58
Exchange rate losses by exporters, in millions of US dollars	14,90	14,99	14,95	15,02	14,99
Exchange rate losses, in millions of rubles	-869,49	-939,87	-967,83	-1083,68	-1104,37
Potential increase in net financial result	+869,49	+939,87	+967,83	+1083,68	+1104,37

Net financial result (actual value), in thousands of rubles	10 320 526 738	13 797 162 645	15 758 425 864	12 421 070 680	29 649 743 813
Projected value of net financial result considering the increase in transaction speed, in thousands of rubles	10321396230	13798102517	15759393696	12422154364	29650848178

Source: Calculated by the authors

The constructed model (Formula 2) allows to forecast GDP estimates by taking into account the current and new values of the net financial result and to assess the potential changes in GDP (Tables 15 and 16).

Table 15. Forecast of the increase in net financial result owing to the expansion of turnover through the localization of transactional burden of commission fees for international payments

Year	GDP, in millions of rubles	Net financial result, in thousands of rubles	Net financial result, accounting for its growth*, in thousands of rubles
2017	91 843 154,2	10 320 526 738	10321396230
2018	103 861 651,1	13 797 162 645	13798102517
2019	109 608 305,7	15 758 425 864	15759393696
2020	107 658 169,2	12 421 070 680	12422154364
2021	135 294 974,6	29 649 743 813	29650848178
2022	151 455 552,5	25 925 459 080	

Source: The calculation is performed as the sum of the current value of the indicator and its expected growth, estimated based on the data in Table 7.

Table 16. Forecast of GDP growth in accordance with the modeling of the transition of transnational payments for gross imports of Russia to blockchain

Year	Forecast of GDP according to the model	Forecast of GDP, accounting for the financial result growth	Difference	Contribution to GDP, in %
2017	96860523,28	96862766,75	2243,47	0,0023
2018	105830974,69	105833399,76	2425,07	0,0023
2019	110891446,05	110893943,26	2497,21	0,0023
2020	102280368,17	102283164,31	2796,13	0,0027
2021	146733966,28	146736815,77	2849,49	0,0019

Source: Calculated by the authors

The obtained estimates indicate a negligible level of direct impact of reduced cross-border payment timelines on the dynamics of GDP in the context of GDP being tied to the volatility of the national currency exchange rate. However, if the ruble becomes stronger at a more significant rate, the potential effects of GDP growth are enhanced under total transition of international transactions in Russia to blockchain principles (Table 17). These findings align well with the macroeconomic logic of the benefits of a lower ruble exchange rate for exporting

companies. Of note, the implemented estimates are constructed based on the paradigm of reducing the timelines of cross-border export payments.

Table 17. Sensitivity analysis of the potential GDP growth in Russia according to the effect of reduced cross-border payment timelines on the financial losses of exports owing to ruble exchange rate volatility against the US dollar (based on the 2021 data)

Index of ruble-to-US dollar exchange rate change over three days	Potential increase in the net financial result, in millions of rubles	Expected change in GDP, in %
0,999997	1104,4	0,0019
0,995	194690,7	0,34
0,99	389381,5	0,68

Source: Calculated by the authors

Of note, the obtained estimates are informative and can only indicate the overall potential of transitioning transnational transactions to blockchain (in the context of Russian export flows).

Estimation of the Impact of Transitioning Transnational Payments to Blockchain, Eliminating the Need for the Letter of Credit Financial Mechanism

According to the data in the GLOBE NEWSWIRE analytical report, the global letter of credit market reached \$3.9 trillion in 2022 (*Insights on the Letter of Credit Confirmation Global Market to 2027 - Demand for Customized Trade Services Presents Opportunities. 2023*). However, according to the information published at the United Nations Conference on Trade and Development (UNCTAD), the volume of global trade for the same year reached \$32 trillion^D. Thus, clearly, the letter of credit market plays a significant role in servicing global trade.

Using this relationship between the analyzed indicators, it is valid to apply it to the Russian national economy. Thus, in the absence of freely accessible statistical data on documentary operations related to foreign trade transactions in the field of foreign trade facilitation, it is advisable to use this relationship in calculations. Of note, when conducting the corresponding calculations, we focus exclusively on export operations. This approach is chosen because import transactions accompanied by letters of credit are not the focus of this research because the financial burden for these transactions is on importers. Moreover, considering that the research goal is to empirically assess economic externalities in relation to the Russian

^D The global trade reached a record high in 2022 URL: [https://kz.kursiv.media/2023-03-24/lgtm-worldtrade/#:~:text=Объем%20мировой%20торговли%20в%202022-м,продаж%20«зеленых»%20\(экологически%20чистых\)%20товаров](https://kz.kursiv.media/2023-03-24/lgtm-worldtrade/#:~:text=Объем%20мировой%20торговли%20в%202022-м,продаж%20«зеленых»%20(экологически%20чистых)%20товаров) (Assessed on: 14.04.2023)

economy, the focus was specifically on export letters of credit, which impose a burden on Russian economic entities.

Based on this approach, Table 18 presents the calculated data assessing the gross level of export letters of credit for Russia.

Table 18. Assessment of the gross level of export letters of credit for Russia

Indicator	2017	2018	2019	2020	2021
Export, in millions of US dollars	525 396,58	528 438,54	527 177,33	529 576,6	528 691,72
Volume of export letters of credit in Russia, in millions of US dollars	22592,05	22722,86	22668,63	22771,79	22733,74

Source: Unified interdepartmental information and statistical system, EMISS (2023)

The use of blockchain in the system of transnational payments will contribute to increased trust among participants in the entire digital ecosystem, including the automation of all planned transaction iterations. Consequently, the practical use of documentary operations (including letters of credit) in servicing the supply chain process in the foreign trade system is localized. Thus, relying on this hypothesis and based on the data on the volume of the export letters of credit market (see Table 18), it is possible to assume the potential for growth in the net financial result of Russian entities according to the cost savings associated with letters of credit. Table 19 presents calculations reflecting the potential growth of economic efficiency for Russian companies based on the proposed assumptions.

Table 19. Assessment of the potential growth in the economic efficiency of Russian companies upon localization of documentary operations during transnational payments for export shipments using the blockchain technology

* The calculation was performed as the sum of the actual net financial result and the volume of export letters of credit in Russia.

	Net financial results (actual values), in thousands of rubles	Net financial results (forecasted values), in thousands of rubles*
2017	10 320 526 738	11638773027
2018	13 797 162 645	15222113021
2019	15 758 425 864	17225765973
2020	12 421 070 680	14064055603
2021	29 649 743 813	31324084056

Source: developed by the authors based on data from the Unified interdepartmental information and statistical system, EMISS (2023)

In calculations aimed at assessing the macroeconomic effect expressed in GDP growth resulting from an increase in the net financial result of economic entities, the final step is the construction of corresponding econometric models that evaluate the relationship between these parameters (Formula 2). Table 20 presents the calculation results.

Table 20. Forecast of GDP growth based on modeling the transition of transnational payments to the global blockchain ecosystem, fostering trust among transaction participants, in millions of rubles

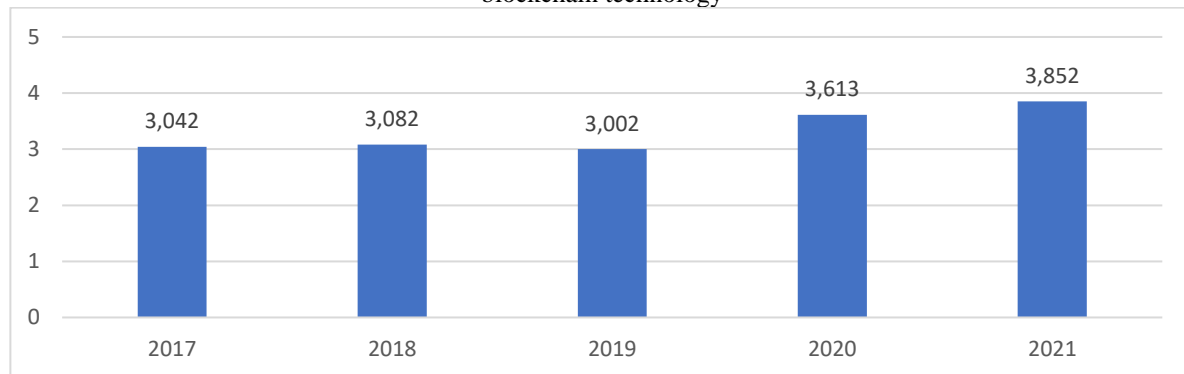
	Net financial results (actual values), in thousands of rubles	Net financial results (forecasted values), in thousands of rubles*
2017	10 320 526 738	11638773027
2018	13 797 162 645	15222113021
2019	15 758 425 864	17225765973
2020	12 421 070 680	14064055603
2021	29 649 743 813	31324084056

Source: Developed by the authors based on data from the Unified Interdepartmental Information and Statistical System, EMISS (2023)

The obtained estimates indicate the significant potential of blockchain for facilitating transnational transactions by building trust among international trade participants, which implies the localization of document-based operations.

A graphical visualization of the consolidated assessment of the calculated effects is shown in Figure 4.

Figure 4. Potential for cumulative GDP growth in Russia owing to the transition of transnational payments to blockchain technology



Source: Developed by the authors

The obtained estimates characterizing the potential GDP growth of Russia owing to the transition of transnational payments to blockchain technology indicate a significant potential for the application of DLT technologies in the international transaction system. According to our results, the level of impact on macroeconomic dynamics, considering all external transactions of Russia, is estimated at approximately 4.0% of GDP, which corresponds to 6.05 trillion rubles (75.6 billion US dollars).

CONCLUSIONS

The obtained assessments and conclusions are of particular relevance in the context of the currently formed severe external pressure on the national economy of the Russian Federation, which limits the potential for the preservation and development of international supply chains and the international transactions that accompany them. In this regard, the methodological solutions and justifications presented by the authors in the field of building a new architecture for providing transnational payment transactions can significantly complement the system of arguments for the transition of international payments to the blockchain. The use of these technologies in foreign economic activity will not only increase the potential for GDP growth, but also ensure the stability of transnational payments with friendly countries in the context of localization of access to international clearing services.

Finally it should be noted that the issue of justifying the prospects of transitioning transaction processes to the blockchain environment is still an unresolved task owing to both methodological and methodical limitations in this field. This conclusion is supported by the fact that scientific and journalistic works rarely include studies that address this question in terms of formalized assessments. Therefore, this study aimed not only to fill this gap, primarily from a methodological perspective, but also to stimulate a discussion within the scientific community on the development of theoretical and methodological approaches for studying the generated externalities in national economic systems in the context of a potential transition of payment systems to the blockchain space.

ACKNOWLEDGMENTS

The research was conducted with the support of a Russian Science Foundation grant (project number 23-28-00587).

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