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ASSESSMENT OF THE INFLUENCE OF MACROECONOMIC SHOCKS ON DEPOSIT RESOURCES OF COMMERCIAL BANKS IN THE RUSSIAN FEDERATION AND THE EU COUNTRIES[1]

Abstract. Economic process management takes place in the context of sharply increased shock and turbulence components, when business environment is extremely unstable, and risk, an inevitable element of a managed system, becomes even more unpredictable as a result of the increased influence of systemic factors. Considering the impact of economic shocks on socio-economic welfare, as well as the reaction, the depth of the consequences, and the susceptibility of countries to shock impulses, the issue of assessing the possible consequences for all economic entities, including banks, became acute. Using economic and mathematical tools, including the calculation of regression coefficients and relative velocities, the study determined the influence of macroeconomic shocks and their main types for the economies of the Russian Federation and EU countries. The specificity of the impact of economic shows on the deposits was shown. Conclusions were drawn regarding the impact of shock impulse indicators on the savings behaviour of depositors, the level of inflow and stability of bank deposits in the Russian Federation and EU countries. It was established that for the Russian economy, the instantaneous impact of all assessed factors on the banks deposit resources is an important feature of the impact of shocks. For European countries, there is a time lag with the transmission of impulses through individual development indicators. The proposed method allows analysing and forecasting the modern crises impact, including the projection of the banks' deposit activity in the face of the "new normal". Using this data, future studies may predict a combination of shocks that can affect bank deposit resources, considering the peculiarities of a country development.

Keywords: deposit, deposit operations, stable deposit resources, bank deposit policy, macroeconomic factors, macroeconomic instability, crisis, shocks, relative velocity, regression analysis, GDP, inflation shock, household income

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ИССЛЕДОВАТЕЛЬСКАЯ СТАТЬЯ

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Оценка влияния макроэкономических шоков на банковские депозиты в Российской Федерации и странах Европейского союза

Аннотация. Управление экономическими процессами происходит в условиях резко возросшей турбулентности, нестабильности бизнес-среды, усиления рисков под воздействием системных факторов. Учитывая влияние экономических потрясений на социально-экономическое благополучие, а также реакцию, масштабы последствий и восприимчивость стран к шоковым импульсам, необходимо оценить их возможные последствия для всех хозяйствующих субъектов, включая банки. Данная статья исследует влияние различных макроэкономических потрясений на экономику Российской Федерации и стран Европейского союза. Для этой цели использован расчет коэффициентов регрессии и относительных скоростей. В статье описаны особенности воздействия экономических потрясений на банковские депозиты, а также сделаны выводы о влиянии показателей экономических потрясений на сберегательное поведение вкладчиков, приток и стабильность банковских вкладов в РФ и ЕС. Установлено, что для российской экономики характерна мгновенная реакция факторов, характеризующих систему банковских депозитов, на возникающие потрясения. В европейских странах изменения происходят с задержкой через отдельные показатели развития. Предлагаемый метод оценки позволяет анализировать и прогнозировать влияние современных кризисов, в том числе оценивать депозитную политику банков в условиях «новой нормальности». Использование полученных данных и учет особенностей изучаемой страны позволят в будущих исследованиях прогнозировать сочетание шоков, которые могут повлиять на банковские депозиты.

Ключевые слова: депозит, депозитные операции, стабильные депозиты, депозитная политика банков, макроэкономические факторы, макроэкономическая нестабильность, кризис, шоки, относительная скорость, регрессионный анализ, ВВП, инфляционный шок, доходы населения

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Introduction

Modern economic trends lead to the changes in the world financial architecture, the infrastructure of the financial market, which brings about other conditions for the functioning of financial and credit institutions and requires a study of the transformation of financial processes the institutions undergo in order to react adequately to the current situation. Global challenges and shocks determine the conditions of functioning and efficiency of performing the functions of financial intermediaries. However, deposit resources are still the main source of funding for banks, and deposit policy is an essential element in implementing the development strategy and ensuring the financial stability of credit institutions. At the same time, the congruence of the deposit policy with the bank's development policy and its components, as well as the general monetary policy of the Central Bank are also important conditions.

It is necessary to consider new economic and financial processes accompanying the modern development of the economy, the so-called "economy of new normal", in the course of developing the deposit policy of banking authorities. On the other hand, in modern conditions, under the influence of various factors, a turbulent component, when the business environment is unstable, and risk is an inevitable element of a controlled system, this practice significantly increases the importance of analysing bank deposits. Banking management should have complete and comprehensive information about the actual value, possible forecasts of changes in deposit balances, taking into account internal and external factors, as well as potential risks of their outflow, which determine the relevance of research in this area.

The purpose of the paper is to study the impact of economic shocks, represented by macroeconomic factors, on deposit resources using the example of banks of the Russian Federation and the European Union (EU) countries, as well as to identify the main trends and factors of influence in these processes.

Methods

The process of deposit sourcing is characterised by a multifactorial and multi-vector component. The factors affecting the efficiency of the implementation of the bank's deposit policy are internal and external in nature and are verified, inter alia, using mathematical methods and data analysis tools. In particular, various efficient economic and statistical methods of analysis have been used to solve the problems of data structuring with a large number of parameters: cluster analysis, correlation-regression, factorial, discriminant, etc. The use of factor analysis can be quite informative, as it enables researchers to evaluate the total amount of changes in deposit balances and identify factors that determine the main trends in deposits as sources of financing. However, the use of this method is not always possible due to the limitations in its application, the impossibility of considering the multiplicity of conditions and causes, the combined influence of factors, and other features. At the same time, it is important to have reasonable information, which facilitates accurate perception and adequate regulation on the part of the bank's management personnel. For this reason, it is advisable to use appropriate mathematical tools, which allow experts to generalise the impact, in particular, the impact of external factors that are common to banking institutions of one region/country.

The stability of deposit banking resources provides the basis for the effective functioning of the banking system as a whole, which forms the prerequisite for the overall growth of the economy. However, due to recurring crises and long periods of economic turbulence, it is necessary to closely study the processes of attracting resources to the banking system to ensure the stability of the resource base, which is based on deposits.

Macroeconomic factors have both a direct (for example, on a change in the real value of the bank's deposits) and indirect impacts (changes in the behaviour of depositors due to the changes in the main macroeconomic parameters and conditions). Macroeconomic processes determine the resulting state of the deposit portfolio. Therefore, the problem of maintaining a constant inflow and level of deposit resources for the bank during periods of macroeconomic imbalance, caused by global economic reasons or sanctions, imposed by states in relation to other states, is relevant for producing a solution. At the same time, the issues of stabilising the resource potential and analysing the deposit dynamics in the periods of macroeconomic shocks are increasingly important in the area.

Analysis of the theoretical aspects of economic shocks

For our research purposes, we use the notion of economic shocks. After 2007, the issue of the influence of factors affecting bank deposit resources has become crucial, since in the form of actively developing negative economic changes, shocks, they lead to sudden and quick severe economic consequences and create "economic shocks". This situation increases the risk of losing a larger share of deposits and, as a result, provokes deterioration in terms of lending and managing entities of the national economy and population. The most characteristic effect of economic shocks can be assessed in countries, which have experienced sudden negative changes. Their specific features and impact provide evidence for the economic shock analysis. To this end, Russia may be considered as a typical model. It is advisable to study the impact of economic shocks on the formation of bank deposits in countries with a stable market system and countries undergoing transformational changes.

Global issues of "economic shocks", their nature, mechanism of propagation are presented in the works of leading foreign scientists, such as Bernarke, Blanchard, Dornbusch, Mandelbrot, Reinhart, Minsky, Rogoff, Stiglitz, Schiller, Staufer, Krugman, Hudson, Farmer and others. The problems of the content and impact of external shocks on the economy were considered in the works of the following Russian researchers: Golovin (2015), Kondratiev, Minakir (2018), Bogdanov, Slutskii (1937), Pilipenko (2011), Ochkin (2018), Tsyganov and Borodin (2015). Moreover, their definitions of the term are characterised by significant diversity and are considered in the context of various forms of manifestation and impact on the economic system.

The study of the semantics of this category in Russian, for example, was successfully conducted in the work of Matveyev (2016). Among the works examining the causes, factors, and the history of economic shocks in various countries, we should point out the works by Bordo, Kida and Hargreaves (2010), Hristov and Roth (2019), Fornari and Stracca (2013), Gürkaynak et al. In this part of the present research, the emphasis is placed on the study of external shocks, their spatial consequences and the mechanism of transmission to national financial systems. A considerable number of scientific papers by Russian and foreign scientists and specialists focus on specific aspects of the impact of shocks on various spheres and parameters of the national economy.

Table 1

Systematisation of the definition of "economic shocks"

Authors	Definition
Matveyev (2016)	Imbalance causing instability in the economy
Bordo, Kida and Hargreaves (2010)	The result of the collision of the state economy with growing globalisation, and, consequently, the manifestation of violations in the existing system of commodity and financial turnover
Hristov and Roth (2019)	Economic shock is presented as an indicator of the accumulation of vulnerabilities in the financial sector of the state
Fornari and Stracca (2013), Gürkaynak	Economic shocks are primarily structural shocks that positively affect the financial sector of the state, in particular, absolute prices, private loans, and investment
Blanchard (Blanchard, 2010; Blanchard, 2014)	Supply and demand shocks are fundamental to the economy. At the same time, the formation of a shock is associated with a non-linear component of the influence of some factors, when an inconsiderable shock can sometimes have significant consequences, or the shock effect depends on the economic environment on the whole, which hinders the use of the effect of rational expectations to level the shock
Pilipenko (2011)	A shock as a phenomenon occurs when an economy cannot recover quickly. It is characterised by rapid spread through financial channels to the international level; a severe damage to the economies of other states; specific features different from existing classical theories describing macroeconomic dynamics. The author considers the 2008-2009 crisis as an example of shock
Mankiw (1994)	A shock is, first of all, an unpredictable event that has a significant positive or negative impact on the economy. It is formed under the influence of unpredictable changes in external factors that are not included in the existing economic model of development, but affects internal economic variables
Slutskii (1927 (1937))	The cyclic model of responses of the economic system to the impact of impulses ("shocks")
Demyanchuk (2012)	Economic shocks and their reasons are considered through the prism of the concepts of the «economy of new normal», which is characterised by the absence of economic cycles, unpredictability and correlation with influencing factors (shocks), as well as the concept of «economic turbulence», determined by a high degree of influence of external factors (shocks)
Korchemniy (2018)	An economic shock is a phenomenon that occurs beyond the bounds of the economic system as a result of a random event or caused by a human factor
Ochkin (2018)	Economic shocks are identifying with non-price determinants. The properties of the shock are determined. Even if the shock operational force affecting the economies of countries is the same, the result may be different, which is explained by the different degree of stability of endogenous relationships — the main factor in the efficiency of the macroeconomic impact
Essam-Nassa (2006)	Not only external influences that lead to structural changes and affect specific markets and supporting institutions but also consequences of domestic policy decisions may become the root causes of economic shocks
Nikitin (2016)	A shock is defined as a phenomenon caused by an unexpected, unpredictable event leading to a change in the factors of the national economic system, which in turn triggers the process of changing the basic economy parameters
Tsyganov and Borodin (2015)	External and internal shocks of the exporting country of raw materials caused by the collapse of world prices have been considered. External shocks are presented as a result of passive and active interference. Passive interference is associated with objective factors (for example, climate change), as well as subjective and objective factors (such as the situation in the world raw materials market). Active interference is associated with the targeted actions of competing countries
Golovin (2015)	The investment and financial channels of shock transmission between countries have been examined and the "infection effect" has been studied — the spread of negative effects between countries during periods of crisis
Danilova and Bogdanov (2015)	A random impulse leading to a change in the current trend of economic development is characterised by a number of distinctive features: unpredictability and volatility of the impact; a multitude of possible endogenous and exogenous components (internal «stresses» of the economy, external shocks, etc.); significant destabilising effect; the need for emergency regulation by the state. According to the authors, a shock is characterised by both an unexpected change in the situation and the creation of uncertain and unpredictable reactions of economic entities, leading to the disequilibrium economy and large-scale economic consequences

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Authors	Definition
Tiunova (2018)	External shocks constitute the most significant part of the mechanism for the spread of global financial instability and exert the most significant influence of external factors on the levels of national economies
Minakir (2018)	The shocks of the Russian economy are considered as responses to systemic world crises, while internal economic shocks are considered as shocks of transformational dynamics

Table 1 provides an overview of selected studies reflecting the content and mechanism of the impact of economic shocks on the economy.

The study of economic shocks, presented in modern research, can be generalised in the following directions: the study of their nature and mechanism, including studies through the lens of crisisology; formation of the theory of propagation and consequences of shock impulses; development of methodological tools for estimating the consequences of shocks; the study of the specifics of the distribution of shock impulses for national economies. Recently, scientists have considered the COVID-19 pandemic as an economic shock and the consequences of its impact on economic growth, the welfare of emerging market and developing countries, as well as a country with a developed market system and high incomes (for example, (Maliszewska, Mattoo, van der Mensbrugghe, 2020; Mendoza, Strand, 2009; Michelsen et al., 2020)).

The diversity of different approaches and opinions, the lack of an unambiguous definition of the concept of "economic shock" once again emphasises the relevance of this problem. Classically, this category is characterised by a non-price determinant, which is influenced by factors most often external to the national economy, resulting in the formation of a new equilibrium point. If today there is no consensus on the reasons and understanding of "economic shocks", a firm idea has been produced regarding the impact form and the result of the action in the form of a sudden and destructive force on the economy. The structural connections of the economy under the influence of impulses are destroyed to such an extent that the economic system loses its ability to restore macroeconomic equilibrium in a short time.

We define "economic shock" as a sharp unpredictable change in internal or external conditions, factors, under the influence of events that have a sudden destructive impact, which produces a sharp negative direct or indirect effect on the economy, region, economy sector, which is shown as deterioration of social and economic development indicators and other development indicators, including a radical change in the trend of economic development of the country and/or region (Grinko, Ilyunina, 2019).

Shocks are created as a result of the interaction and influence of many factors (conditions), which should be fairly presented as external and internal. The directed influence of factors dramatically changes the nature of the economic development of a country/region, while the speed, direction, and degree of their influence determine them as economic shocks. The rate of change in socio-economic indicators is one of the main parameters that distinguish shocks. The periodic recurrence of phenomena and processes that cause an economic shock, their predictability, and the level of absorption by the system is low in most cases.

External factors include objective and subjective circumstances that form above and beyond the economic system. These are political, man-made, and natural shocks: wars, revolutions, natural disasters, man-made disasters, pandemics. Internal factors include, first of all, the policy pursued by the state in the external and internal markets.

The relevance of the problem is justified by the growing trend of considering the impact of shocks on the state of economic processes. In particular, the assessment of the degree of influence of shocks on the deposit resources of commercial banks remains an important issue.

Mathematical model for assessing the impact of macroeconomic shocks on deposit resources of banks

To study the impact of individual structural shocks on the formation of banks' deposit resources, official statistical data of the economies of Russia and the EU for the period from 2000 to 2020 is used.

Given a large number of factors affecting bank deposits at three levels (micro-, meso- and macro-levels) (Grinko, Ilyunina, 2018), the authors selected several key indicators that to the fullest extent reflect macroeconomic trends/shocks and are quantitative and objective (Table 2). Assessing these indicators, the level of an economic shock impact on the indicator under study may be determined:

1. external debt of the Russian Federation to non-residents ($X'1$);

Table 2

Statistics, 2000–2020

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Deposit resources of commercial banks, billion roubles	695.81	971.57	1362.33	1924.24	2653.17	3825.54	6989.23	12993.48	16912.11	18427.44
External debt of the Russian Federation to non-residents, billion dollars USA	161.4	151.1	152.1	185.7	214.5	257.4	310.6	463.5	479.9	467.2
External debt of banks of the Russian Federation, billion dollars USA	9.3	13.6	14.2	24.9	32.5	50.1	101.2	163.7	166.3	127.2
GDP level, billion roubles	7305.6	8943.6	10830.5	13208.2	17027.2	21609.8	26917.2	33247.5	41276.8	38807.2
The volume of loans issued, billion roubles	956.29	1467.49	2028.91	2910.21	4227.96	5999.43	8786.2	13297	19362.45	19305.99
Average per capita income, thousand roubles	2.28	3.06	3.95	5.17	6.40	8.09	10.15	12.54	14.86	16.90
Relative velocity of rouble-dollar exchange rate	28.12	29.17	31.35	30.68	28.81	28.29	27.18	25.57	29.38	31.73
Relative velocity of prices per barrel of Brent oil, USA dollars	26.66	18.71	28.33	29.81	39.6	56.86	62.47	90.93	39.95	74.46
Relative inflation rate, %	120.18	118.58	115.06	111.99	111.73	110.92	109	111.87	113.28	108.8

Continuation of the table

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Deposit resources of commercial banks, billion roubles	22224.2	25846.39	32311.52	37261.42	50870.98	59824.37	57000.34	59604.07	64508.5	66837.1	71909.5
External debt of the Russian Federation to non-residents, billion dollars USA	488.9	540.6	636.4	728.9	599.9	519.1	514.1	536.7	518.2	454.7	463.7
External debt of banks of the Russian Federation, billion dollars USA	144.2	162.8	201.6	214.4	171.5	131.7	119.4	103.4	84.6	77.0	72.9
GDP level, billion roubles	46308.5	60282.5	68163.9	73133.9	79199.7	83387.2	86148.6	91843.2	104629.6	110046.1	106607
The volume of loans issued, billion roubles	22781.1	26667.77	32886.90	38767.89	49069.48	54263.0	51074.22	55041.49	62302.4	65675.3	75001.4
Average per capita income, thousand roubles	18.96	20.78	23.22	25.22	27.77	30.47	30.75	31.74	33.01	35.25	35.36
Relative velocity of rouble-dollar exchange rate	30.37	29.39	31.09	31.85	38.44	60.96	67.03	58.35	62.71	64.74	71.94
Relative velocity of prices per barrel of Brent oil, USA dollars	91.45	107.87	109.49	110.76	62.34	38.01	53.31	64.37	57.36	67.31	65.46
Relative inflation rate, %	108.78	106.1	106.57	106.47	111.35	112.91	105.39	102.52	104.27	103.05	104.9

Source: Rosstat, Bank of Russia Statistical Bulletin.

Table 3

Calculations of regression coefficients in nominal units with a shift of one period

Parameter	Odds	Standard error	*t*-statistic	*P*-value	Lower 95 %	Upper 95 %	Lower 95,0 %	Upper 95,0 %
Y	84729.05	53617.05	1.580263	0.145127	–34737.2	204195.3	–34737.2	204195.3
X′1	7.738134	32.49507	0.238133	0.816587	–64.6654	80.14167	–64.6654	80.14167
X′2	24.26146	59.8177	0.40559	0.693586	–109.021	157.5436	–109.021	157.5436
X′3	–0.58144	0.328542	–1.76975	0.107196	–1.31347	0.150601	–1.31347	0.150601
X′4	2.48292	0.721762	3.440082	0.006331	0.874735	4.091106	0.874735	4.091106
X′5	–1488.5	1017.621	–1.46272	0.17425	–3755.9	778.9018	–3755.9	778.9018
X′6	33.65075	192.0551	0.175214	0.864408	–394.275	461.5762	–394.275	461.5762
X′7	102.2353	71.73376	1.425205	0.184554	–57.5975	262.0681	–57.5975	262.0681
X′8	–704.53	430.5948	–1.63618	0.132846	–1663.95	254.8953	–1663.95	254.8953

* deposit resources of commercial banks (*Y*);
external debt of the Russian Federation to non-residents (*X*′1);
external debt of banks of the Russian Federation (*X*′2);
GDP level (*X*′3);
the volume of loans issued (*X*′4);
average per capita income (*X*′5);
rouble-dollar exchange rate (*X*′6);
price per barrel of Brent oil (*X*′7);
inflation rate (*X*′8).

2. external debt of banks of the Russian Federation (*X*′2);
3. gross domestic product (GDP) level (*X*′3);
4. the volume of loans issued (*X*′4);
5. average per capita income (*X*′5);
6. rouble-dollar exchange rate (*X*′6);
7. oil price per barrel of the Brent oil (*X*′7);
8. inflation rate (*X*′8).

The rationale for the choice of indicators was provided in earlier (Grinko, Ilyunina, 2018; Grinko, Ilyunina, 2019). Each of the above factors is considered as a parameter reflecting the influence of structural shock. Table 3 shows the results of calculating the regression coefficients for lag (shift by one period) values of factors expressed in nominal units.

The regression equation is presented as follows:

$$Y = 84729,05 + 7,738X'1 + 24,261X'2 - \\ -0,581X'3 + 2,482X'4 - 1488,5X'5 + \\ +33,65X'6 + 102,235X'7 - 704,53X'8. \quad (1)$$

The absolute term of the regression equation, as well as coefficients for factors such as the rouble exchange rate, external debt of the Russian Federation to non-residents, and external debt of banks of the Russian Federation (shown in Table 3), are insignificant, respectively, in this model: they do not significantly affect the resulting indicator of deposits. The set regression equation (the value of the regression dependence is high; the *F*-criterion is 203.921) reflects the degree of influence of each factor on the resulting indicator. At the same time, the detection of the general trend in terms of the timescale does not allow us to assess the impact of a directly formed shock on the resulting indicator. It is necessary to move to a more complete description of crisis manifestations by analysing changes in speed and acceleration (change in speed, both in numerical value and in vector) of macroeconomic indicators (Grinko, 2019). It is advisable to evaluate economic shocks using relative velocities — relative changes in indicators that have been formed over the previous period. The calculation of relational velocities makes it possible to evaluate the effect of the shock that has been formed in the current period on the main indicator, taking into account the time lag.

The notion of velocity in the study of economic processes is best known in the aspect of the study of the velocity of money. In the study of deposits and their properties, the concept of velocity was used by Burgess back in 1923 (Burgess, 1923), by Edie and Weaver in their work in 1930 (Edie, Weaver, 1930), by Garvy in the 1950s-1960s (Garvy, 1953; Garvy, 1961).

If X_t is the value of the parameter (shock) in the current period, and X_{t-1} — is the value of the parameter in the previous period, then the formula for the rate of change of the parameter looks as follows:

$$V_x = \frac{X_t - X_{t-1}}{X_{t-1}}, \quad (2)$$

where V_x is the relative velocity of the parameter change.

Table 4

Calculations of regression coefficients on the basis of relative velocities*

Parameter	Odds	Standard error	*t*-statistic	P-value	Lower 95 %	Upper 95 %	Lower 95,0 %	Upper 95,0 %
Y	0.071281	0.056697	1.257225	0.237241	–0.055048	0.197609	–0.05504	0.197609
*X*1	–0.413318	0.292359	–1.413737	0.187806	–1.064734	0.238097	–1.06473	0.238097
*X*2	0.529563	0.131871	4.015771	0.002455	0.235737	0.823390	0.235737	0.823390
*X*3	–0.591285	0.356802	–1.657181	0.128478	–1.386289	0.203719	–1.38628	0.203719
*X*4	2.025632	0.620874	3.262547	0.008537	0.642238	3.409026	0.642238	3.409026
*X*5	–2.196119	0.921693	–2.382700	0.038435	–4.249779	–0.14245	–4.24977	–0.14245
*X*6	0.600756	0.213628	2.812166	0.018406	0.124764	1.076749	0.124764	1.076749
*X*7	0.447657	0.127439	3.512710	0.005606	0.163705	0.731609	0.163705	0.731609
*X*8	1.678978	1.333860	1.258736	0.236717	–1.293049	4.651004	–1.29304	4.651004

* *Y* is the relative velocity of deposits;
*X*1 — the relative velocity of the external debt to non-residents;
*X*2 — the relative velocity of the external debt of banks;
*X*3 — relative GDP velocity;
*X*4 — relational velocity of loans issued;
*X*5 — relative velocity of the average per capita income of the population;
*X*6 — relative velocity of the rouble-dollar exchange rate;
*X*7 — relative velocity of the price per barrel of Brent oil;
*X*8 — relative inflation rate.

Based on the results, we will introduce a new notation:

Y is the relative velocity of deposits;

*X*1 — the relative velocity of the external debt to non-residents;

*X*2 — the relative velocity of the external debt of banks;

*X*3 — relative GDP velocity;

*X*4 — relational velocity of loans issued;

*X*5 — relative velocity of the average per capita income of the population;

*X*6 — relative velocity of the rouble-dollar exchange rate;

*X*7 — relative velocity of the price per barrel of Brent oil;

*X*8 — relative inflation rate.

Let us consider the following dynamic regression equation:

$$Y_t = a_0 + a_1 X1_{t-1} + a_2 X2_{t-2} + a_3 X3_{t-3} + a_4 X4_{t-4} + a_5 X5_{t-5} + a_6 X6_{t-6} + a_7 X7_{t-7} + X8_{t-8} + \varepsilon_t. \quad (3)$$

where t is the current time period; $t-1$ previous period of time; ε_t a random deviation in equation (3) in a period of time t.

Thus, the summary table looks as follows (Table 4).

F-test — 18.3951, *R*-square — 0.9363, which indicates the relative reliability of the model.

Hence, equation (3) takes the following form:

$$Y_t = 0,071 - 0,413 X1_{t-1} + 0,529 X2_{t-1} - 0,591 X3_{t-1} + 2,025 X4_{t-1} - 2,196 X5_{t-1} + 0,6 X6_{t-1} + 0,447 X7_{t-1} + 1,678 X8_{t-1} + \varepsilon_t, \quad (4)$$

where ε_t is a random deviation in equation (4).

Further analysis is conducted taking into account the existing lag (Table 5).

The F-test is 4.2158.

Thus, finally, equation (5) will go as follows:

$$Y_t = 0,13 - 1,2 X1_{t-1} + 0,749 X2_{t-1} - 0,028 X3_{t-1} + 1,104 X4_{t-1} - 1,146 X5_{t-1} + 0,096 X6_{t-1} + 0,505 X7_{t-1} + 0,824 X8_{t-1}. \quad (5)$$

Based on the resulting F-test value as the main indicator, we can conclude that the model without time lag is more credible. This means that the previously determined parameters have a greater impact on the deposits directly in the process of their influence than after a certain period of time. Thus, a shock generated in the current period affects the resulting indicator immediately after its occurrence. The second important feature is the determination of parameter significance (*P*-value). In the calculation of lagged variables, we can omit such parameters as GDP, rouble-dollar exchange rate, and inflation rate because they are not shocks that affect in the long run.

Particularly noteworthy is the external debt of the Russian Federation to non-residents, the growth of which leads to a reduction in the volume of deposits. The reason for this development is linked to increased borrowing to cover planned budget deficits in the period in question, created by the oil market crisis, and the resulting shortfall in budget revenues. The COVID-19 pandemic could have a similar effect: budget revenues would fall as a result of the negative impact

Table 5

Calculations of regression coefficients on the basis of relative velocities taking into account the lag

Parameter	Odds	Standard error	t-statistic	P-value	Lower 95 %	Upper 95 %	Lower 95,0 %	Upper 95,0 %
Y	0.130720	0.118404	1.104014	0.298228	–0.137129	0.398568	–0.137129	0.398568
*X*1	–1.200421	0.588065	–2.04130	0.071613	–2.530716	0.129873	–2.530716	0.129873
*X*2	0.749865	0.260197	2.881915	0.018121	0.161259	1.338472	0.161259	1.338472
*X*3	–0.028316	0.681728	–0.04153	0.967775	–1.570492	1.513859	–1.570492	1.513859
*X*4	1.104612	1.186808	0.930742	0.376278	–1.580134	3.789359	–1.580134	3.789359
*X*5	–1.468843	1.758312	–0.83537	0.425129	–5.446421	2.508734	–5.446421	2.508734
*X*6	0.096620	0.415090	0.232770	0.821147	–0.842378	1.035619	–0.842378	1.035619
*X*7	0.505146	0.244508	2.065968	0.068812	–0.047970	1.058262	–0.047970	1.058262
*X*8	0.824920	2.608587	0.316233	0.759037	–5.076114	6.725955	–5.076114	6.725955

on the economy, while social expenditure would increase as a result of support measures for the population and the hardest-hit economic sectors. However, this issue requires a separate, more in-depth study.

At the same time, a smooth increase of public debt in parallel to GDP growth is a positive trend for the economic development of the country as a whole, but a sharp increase of public debt (shock) against the background of slowing economic processes is an indicator of turbulence accompanying the reduction of savings in deposit accounts in the long run.

Significant for the dynamics of deposits is the lending shock (1.105). The predictability of the response of the deposit dynamics to this parameter is determined by the function of financial intermediaries implemented by banks. The response of market participants to the economic recession shows as a reduction in demand for credit resources, as well as withdrawal of deposits from the banking system, which results in a massive outflow during the acute phases of the crisis (Mariev, 2009). In this context, the role of the Central Bank as a mega-regulator of the system is decisive, as it should create conditions and develop instruments for mitigating economic shocks, restoring the balance and stability of the banking system.

The shock of negative dynamics of households' average per capita income is the fundamental shock (–1.469) and the main factor in the formation of household savings in the time interval under consideration. It is emphasised that in the periods of economic instability, the volume of funds allocated by households for savings in domestic banks decreases significantly in the first year, which generally contradicts the behaviour of depositors and the dynamics of deposits in the crisis period in most European countries, where in a similar situation a positive dynamic is typical. This situation characterises the saving behaviour of family households (Grinko, Ilyunina, 2018) and the inability of the financial system of an unstable economy to absorb the economic shock, which shows in the surge of both demand and supply of resources. It should be noted particularly that the growing demand of the population for investments in financial market instruments, observed in recent years in the Russian economy, also supports the indicated trend. Financial instruments may potentially become a significant alternative direction of the investment for households' savings in Russia, which should be taken into account when developing a bank's development policy.

The deposit dynamics has a constant positive component equal to 0.071 units of relative velocity, which is adjusted with structural shocks.

The deposit dynamics in the model excluding lags is one of mostly influenced by the inflation shock (1.679) — an increase in inflation leads to a significant outflow of deposits. The inflation rate, as one of the main indicators of economic stability in the country, directly affects the behaviour of depositors and, accordingly, affects the deposit policy of banks. According to studies, in most countries with transformational market changes, including the Russian Federation, experts point out a dramatic massive outflow of deposits in the context of rising inflation and other crisis manifestations as a result of the fall in the level of confidence in the banking system as a whole. In Russia, a long-term negative historical experience in assessing the consequences of such events aggravates the trend of economic slowdown (Grinko, 2019; Magazov, 2018; Alekhin, 2015). Russian banks were affected by the inflationary depreciation of the monetary unit during the 2008 crisis, as well as in 2014–2015 more seriously than any other banks.

Maintaining a positive bank margin requires an adequate increase in interest rates on bank investments and credit operations, which slows down the country's economic processes and, in turn, leads to a reduction in the potential for increasing

bank deposits (Belekhova, 2017). The advanced economies, on the other hand, demonstrate the resilience of deposits to changes in the inflation parameter (Tables 6, 7). The long-term price stability contributes to the prevention of surges in inflation or deflation, forms stable expectations regarding future economic dynamics in the main economic entities and seed farms, ensuring stability and the flow of funds into bank deposits. The price stability contributes to the attractiveness of savings and financial assets in the national currency and increases the financial stability of the banking sector.

To compare the impact of structural shocks on deposit formation in the Russian Federation and the EU countries, we used similar methods of economic-mathematical modelling to identify shocks in European countries (Tables 6, 7).

Results

Despite the difference in the *F*-criterion in the EU countries between the results obtained with and without time lag, three shocks stand out in each country: a credit shock (similar to the results in the Russian Federation, as the main interrelated indicator and as a result of the intermediation function of banks), the euro exchange rate shock and a GDP dynamics shock with the most significant indicators.

Changes in GDP are a shock to domestic economic dynamics, an indicator in terms of significance. GDP growth leads to a substantial increase in deposits in the EU countries, while a significant decrease in GDP growth rates leads to an outflow of deposits. The time series of values of such a macroeconomic indicator as the gross domestic product provides enough information about the crisis manifestations in the economic system of any country or group of countries. The moment of the beginning of the decline in GDP may indicate the beginning of an economic shock, which may trigger a long-term recession (Grinko, 2019). At the same time, the most important economic characteristic that the GDP indicator provides is the performance of the real economy and the potential of enterprises to form deposits with banks. According to experts studying financial behaviour of the population, stable economic development leads to an increase in incomes of the population, but does not stimulate the growth of savings, as households are more likely to invest in tangible assets, which they traditionally regard as a reliable way of saving money (Alekhin, 2015).

The euro exchange rate shock is expressed by the depreciation of the EU countries' own currency against foreign currencies, in this case, the US dollar. Under the influence of this shock, in contrast to the behavioural pattern of Russian depositors,

Table 6

Values for the impact parameters on EU deposit resources excluding the lag

Country	Relative velocity of the population income	Relative velocity of the US dollar to the Euro	Relative GDP velocity	Relative inflation rate	Relative velocity of the price per barrel of Brent oil	Relational velocity of loans issued
Austria	0.03532667	0.16436151	0.07625886	–0.00262495	0.0003031	0.58379487
Belgium	0.01883406	0.03292986	0.68343629	0.000039	–0.0070326	0.18757742
Germany	–0.0688573	0.02194998	–0.412937	0.004328271	0.00068824	0.59688665
Estonia	0.02196461	–0.3214401	0.15300228	–0.0033172	0.05665893	0.25423567
Finland	0.00204317	0.08866417	0.11505911	0.004005346	–0.0211475	0.53614002
France	0.00013953	0.00286965	–0.408011	0.001209396	0.01565825	0.37365861
Greece	–0.0014211	–0.0603613	1.43344453	–0.00053837	0.06781768	–0.0854135
Ireland	–0.0035253	–0.0425149	0.2772339	–0.00392094	0.0347912	0.44032465
Italy	–0.0210841	–0.105158	0.00547432	–0.00017974	0.02400216	0.87402628
Latvia	–0.0025683	0.63176462	–1.0841837	–0.00341532	–0.0940892	–0.205629
Lithuania	0.0196662	–0.182837	0.23015992	–0.0113129	0.090958	0.31188231
Luxembourg	–0.0224393	0.09901773	1.4348614	–0.00040314	0.00037464	0.03381972
Netherlands	0.02119893	–0.0295072	0.84150803	0.002401729	0.00730873	0.79681415
Portugal	0.0044943	–0.2091195	0.07018524	0.002418689	0.02436331	0.74753678
Slovakia	–0.0208199	–0.174797	0.66342919	–0.00336412	–0.0322612	0.06321203
Slovenia	–0.0082445	0.01656102	0.78425595	0.001453524	0.02263606	–0.0765575
Spain	0.00699481	0.03213253	–0.1391527	0.003400848	–0.0356422	0.89343455
Cyprus	–0.0025693	–1.0447387	2.13149386	–0.00495582	0.1893263	0.29837348
Malta	0.0028268	0.11451343	–0.1696394	–0.03691858	–0.1433593	0.20627657

Source: European Central Bank, International Monetary Fund.

Table 7

Values for lagged impact parameters on EU deposit resources

Country	Relative velocity of the population income	Relative velocity of the US dollar to the Euro	Relative GDP velocity	Relative inflation rate	Relative velocity of the price per barrel of Brent oil	Relational velocity of loans issued
Austria	–0.0248695	0.03330108	1.66929889	–0.00259329	–0.01536626	0.07266429
Belgium	–0.001942	0.07154095	1.89201798	0.000155759	–0.01816816	–0.1330554
Germany	–0.0438348	0.03687897	0.54096419	–0.00651308	0.014805703	0.35410391
Estonia	–0.1957016	–0.1078596	–0.312218	–0.00009391	–0.04829505	–0.087694
Finland	–0.0010563	0.25628444	0.22014057	0.002761156	0.026744376	0.27984508
France	0.00017817	0.08971313	–0.2130731	0.001856524	–0.00781433	0.24715226
Greece	0.02337256	0.21233978	1.22636414	–0.00006087	–0.03732574	–0.0047314
Ireland	0.0170445	–0.4701706	–0.0332058	0.005491413	–0.01084839	0.47942743
Italy	–0.0127337	0.51808544	–1.2120896	–0.00083573	–0.02046182	0.59849827
Latvia	0.005336	–0.914345	–0.2081609	0.003249302	0.127746957	–1.2477652
Lithuania	0.02852812	–0.0580334	–0.0610734	–0.00100012	0.003329511	0.13125677
Luxembourg	–0.078391	–0.3391311	1.31497266	–0.00002628	0.03637569	–0.240974
Netherlands	–0.0494957	0.01872819	0.90829413	–0.00259419	0.007386284	0.47823599
Portugal	–0.0139641	0.2172187	0.40365461	–0.01922700	–0.00182997	0.52592668
Slovakia	0.05340301	0.08982326	0.02148851	0.005739592	0.062677473	0.32233824
Slovenia	0.003277	–0.1290316	0.60229729	0.000498792	0.028422379	–0.0141808
Spain	0.00071866	0.11817574	0.76561441	0.004201835	0.018580299	0.55554753
Cyprus	–0.0043853	1.06430757	1.30745274	0.003509288	–0.09162576	–0.0515578
Malta	0.01045276	0.27561516	–0.9946414	–0.01986959	–0.16997009	–0.3701571

Source: European Central Bank, International Monetary Fund.

most EU countries (especially the most advanced economies) experience an influx of deposit resources. This pattern of behaviour is justified by the confidence of the population in the banking system and the formation of "rainy day" savings. On the banking system side, exchange rate movements largely determine the structure of further deposit transactions by currency and lead to a revaluation of foreign exchange resources, which affects the growth of deposit resources.

The main characteristic of the shock parameters in European countries, in contrast to Russia, is the smooth evolution of macroeconomic indicators. Europe is mostly not characterised by their sharp jumps, whereas Russian economy, for example, depends on the dynamics of world oil prices, which do not directly have a significant impact on deposits, but indirectly influence their formation through changes in macroeconomic parameters (GDP, rouble exchange rate, inflation, etc.).

Conclusion

It has been pointed out that in the modern world, the normal course of the reproduction process of the national product is increasingly interrupted by crises and various kinds of shocks that have no specific periodization, with a low degree of predictability and a high rate of propagation of consequences. The impact of shocks on economic development and social welfare depends on many external and internal factors, which may change their direction, nature, and degree of impact in the course of time.

The consequences of the impact of economic shocks on the deposit resources of banks were assessed by analysing a number of identified factors. They include the channels, which demonstrate the consequences and verify the situation of an "economic shock", reflecting economic shocks and their combinations. In the course of the analysis, the differentiation of the impact of shocks on bank deposits for an economy with a transformational market, as well as for countries with a developed market economy and high sustainable income, was carried out.

It should be noted that the Russian economy has faced a combination of shocks, which includes the global economic recession, the pressure of sanctions, negative dynamics of fuel prices, and significant efforts to contain COVID-19. The recent slowdown in potential growth, in combination with new challenges in the form of a global pandemic, further complicates the challenges facing the economy. In addition, the forced orientation of the Russian banking system in the formation of the resource base exclusively on domestic sources, due to the introduction and prolongation of Western sanctions, puts the issue of an ade-

quate and timely analysis of the deposit resources of commercial banks at the top of the agenda.

Using economic and mathematical tools (regression analysis, relative velocity analysis), we examined the influence of the selected factors on the resulting indicator — deposit resources of banks, the main parameters that reflect structural shocks, such as per capita income of the population shocks, credit shocks, and inflation shocks. The main feature of these shocks is their instantaneous impact on the resultant indicator.

The assessment of the impact of shocks using the key indicating factors is characterised by a significant change in the values of their parameters in the periods of "shock" macroeconomic instability. In the event of a sharp rise or fall in lending, the dynamics of deposits change similarly within the framework of the banks' respective deposit policy and its implementation in the process of further lending and investment activities, taking into account the resources mobilised. When Russian household income grows in the short term, customers' funds allocated to deposit formation are reduced due to their alternative investment in tangible assets, which corresponds to the established model of financial behaviour. It can be assumed that current household incomes, such as wages and equivalent payments of the working population, as well as pensions for the retired, should not be regarded as a stable source of bank deposits. Investments in bank deposits of family households in the Russian economy are carried out at the expense of other sources: investment income from investments in real assets (real estate, participation in organisations), income from the sale of real assets, the income of individual entrepreneurs, income and cash receipts received by the so-called non-bank-oriented persons (unbanked persons). This assumption is confirmed by a comparative analysis of the average per capita income of the population, average wages, and the size of the subsistence minimum for the same time period. The study of the influence of the average per capita income of the population, the profit of enterprises on the formation of bank deposits in the conditions of the economic shock of the transitional economy is relevant and has potential for future research.

In the long term, the external debt of the Russian Federation to non-residents is a shock with a manifestation after a certain period of time. A sharp increase in debt is characterised by negative processes in the economy and, as a consequence, has the effect of reducing bank deposits.

Comparison of the impact of shocks in Russia and the EU countries revealed low importance of shocks of income, inflation, and oil prices for the outcome indicator, which is typical for all European countries. Regardless of the timing of the impact, there are three main shocks in these economies: GDP shock as the main macroeconomic indicator, euro shock, and credit shock similar to that in Russia. An important feature of the EU countries is the smooth upward and downward macroeconomic dynamics characteristic of advanced economies and the banking system, including a high level of public confidence in banks, which does not entail shocks. Both uniformity and a lower speed of the bank deposits response to the factors under study have been noted. This fact indicates a higher level of confidence in the banking system, and also suggests the ability of the financial system of a stable economy to mitigate economic shocks, which shows in surges in both demand and supply resource proposals.

The results, as well as the presented approach to the diagnostics of bank deposit activity using the method of deposit analysis based on the relative velocity method, have both theoretical and practical importance for the development of banking activities and establishment of a balanced deposit policy of banks taking into account the influence of macroeconomic factors, reflecting the nature of the propagation of shock impulses.

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