Informational and Methodological Approach to Ensuring the Economic Security of the State in the Banking Sphere

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Summary
The existing approaches to ensuring the banking security of the state do not take into account the peculiarities of the banking system in the rapid development of the information economy (increasing uncertainty, imbalance and nonlinearity of processes in the banking system under the influence of innovation, institutions, information asymmetry, etc.). A methodological approach to determining the synergetic effect in the implementation of the regulatory influence of the state on the development of innovation processes related to informatization in the banking system, based on the use of differential equations and modelling the sensitivity of innovation processes related to informatization in the banking system, to the regulatory influence of the state to prevent the deployment of risks and threats to economic security of the state in this area has been suggested in the present article.

Key words:
Information aspects, delivery management, logistics clusters, logistics systems.

1. Introduction

In the conditions of the development of the information economy the banking system of Ukraine is acquiring features of a complex, nonlinear, open, non-balanced, poorly structured system, which has a number of characteristics, in particular:

on the background of a significant reduction in the number of "stationary" bank branches there are "customer-free" branches and self-service areas;

newly created fintech companies are appearing on the banking market, competing, cooperating and sometimes merging with "classic" banks;

there are significant changes in the operational area of banks, which are manifested in the emergence of new operations, services, banking products, customers;

there are changes in the monetary system connected with a significant decrease in the share of cash transactions in favour to non-cash;

the nature of the relationship between banks and customers is changing, which is manifested in the changing the focus on remote online services, emergence of mobile services, contactless payments, virtual cards, chatbots, etc.

The impact of these factors on the economic security of the state in the banking sector of any country is dual: as an opportunity to strengthen it and as a threat to its sustainability, and therefore it should determine the methodology, methods, models and tools for its ensuring. With the rapid development of the information economy, the "rules of the game" for players of the banking system are changing fast, a pool of its members is expanding, "classic" banking operations, services and products are being radically transformed following principles of self-organization. The said is translated into a change in approaches to ensuring the state's banking security, taking into account a possibility of a "soft" targeted influence of the state (represented by the regulator) on innovation and self-organization processes in the banking system to get positive synergetic effect taking into account strategic goals of the banking system that correspond to the trajectories of the information economy. The "classic" approach to ensuring the state's economic security in the banking sector involves the establishment of a number of "strict" economic standards (normatives) by regulators and control over adherence to them by government authorities [19]. Such approach is adequate for a relatively stable system consisting of an almost constant number of banking institutions operating by certain clear rules over a long period of time without significant changes.

Therefore, the search for an acceptable balance between possibilities of strengthening the state's economic security in the banking sector in the context of rapid growth of its informatization, on the one hand, and the risks arising from excessive government regulatory influence on innovation and self-organization in this area on the other is becoming an up-to-date research problem.

The objective of the study is to determine an approach to the economic security in the banking sector in the conditions of the development of the information economy on a synergistic basis, clarify a list of indicators for its assessment and set a task to justify an impact of the

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government regulatory influence on innovation and self-organization processes in banking using a differential model, which forms the basis for calculating and forecasting changes in indicators of the state's economic security in the banking sector.

2. Literature review

Among the works of the experts who have made a significant contribution to the study of the mechanism of functioning of the banking system in the rapid development of the information economy and its security the works of some scientists should be noted, in particular, of O. Baranovskyi [1], T. Bludova [32], T. Bolgar [2]. , Z. Varnalyi [4], T. Vasyltsiv [5], O. Vlasiuk [6], O. Vovchak [2], T. Havrilesky [34], V. Heiets [8], B. Danylyshyn [9], O. Dziubliuk [10], E. Etsebeth [33], J. Zhalilo [11], O. Zarutska [12], V. Zauter [13], B. Ivasiv [14], O. Iliash [15], S Kavun [16], I. Liutyi [17], T. Maiorova [18], V. Mishchenko [20], S. Naumenkova [21], K. Naumik-Gladka [22], N. Pantielieieva [23], L. Prymostka [24], P. Rose [25], P. Senyshch [27], K. Skynner [28], T. Smovzhenko [29], G. Söderberg [35], D. Spath [36], J. Tarud [37], O. Sharov [30], N. Shulha [31] and others [37-39].

At the same time, the definition of the concept and a comprehensive approach to assessing the state's economic security in the banking sector in the conditions of the development of the information economy is not fully addressed. In addition, the analysis of the government regulatory influence on innovation and self-organization processes in the banking sector in the context of ensuring the state's economic security requires substantiation for new approaches to determine the synergistic effect of this influence. To do this, it is advisable to model a degree of sensitivity of innovation processes related to informatization in the banking system to the government regulatory influence to prevent risk deployment and threats to the state's economic security in this area.

3. Methodology

The activity of the banking system in the conditions of the information economy and elements of the state's economic security system have a dual interrelation, in particular, the former should be considered as a tool for national economic interests, which creates new opportunities to strengthen the state's economic security connected with increasing the competitiveness of the national economy, stimulating innovation, modernization and development of infrastructure, development of priority sectors of the economy. At the same time, the banking system can be considered as a source of new risks and threats to the state's economic security by its components (primarily to the banking security), which is connected with insufficient cybersecurity, as well as problems of the banking system with ensuring timely payments and settlements, bank bankruptcy risks and the like.

New opportunities that the development of the information economy gives to banks include, in particular, increasing the efficiency of their activities (by expanding their customer base and increasing volume of sales of services, conquering new market segments without the need to open new "points of sale", increasing revenues, reducing operating costs for the purchase, lease and maintenance of premises, optimization of staff and wage costs, increasing the level of process automation, accelerating the information processing process). Fundamentally new banking risks associated with the rapid development of the information economy include: the risks associated with the development of non-cash payments (increasing competition with non-banking institutions, loss of fee and commission income, increase of vulnerability of banks' digital infrastructure because of expanding network of equipment, risk of fraudulent activities with payment cards, cyber risks, which in general directly affect the level of banking security of the state); the risks associated with the spread of cryptocurrencies (high exchange rate volatility, which can provoke significant losses, potential loss of customers, of cash flows, of interest income, of assets and liabilities, liquidity risk: reduction of balances due to loss of customers, risk of fraudulent activities with cryptocurrencies, undermining of the state monetary monopolies, impairment of seigniorage of the central bank, reduction of demand for the national currency, which causes its depreciation and change in velocity, impossibility of leading effective monetary policy, destabilization of the financial market in general due to the fall of the cryptocurrency market); risks associated with the proliferation of electronic credit platforms (increasing competition with non-banking institutions, potential loss of customers, of cash flows, of interest income, of assets and liabilities, lack of reporting and regulation by the NBU, lack of the state deposit guarantee for investors, liquidity risk, that may provoke the bankruptcy of banks, which has a negative impact on the level of banking security of the state as a whole).

Changing of the conditions of the banking system of countries connected with the rapid development of the information economy, requires a need to flexibly respond to the challenges associated with this, the development of theoretical basis and methodology for ensuring the state banking security in the conditions of the development of the information economy.

In the conditions of the development of the information economy, the essence of the concepts of "a bank" is being changed (with an emphasis on the possibility of remote provision of services), "the banking system of Ukraine" (which implies the inclusion of non-

bank financial institutions into the banking system), as well as "the state economic security in the banking sector in the conditions of the development of the information economy" (it should take into account the peculiarities of contactless banking operations using IT technologies).

In our opinion, ensuring the state's economic security in the banking sector in the conditions of rapid development of the information economy should be based on synergetic principles [26], as this aims not only to achieve local "stability" or "sustainability", but also to ensure the trajectory of the banking system in accordance with global trends in the development of the information economy. At the same time, tools for creating a vector of this development should include implementation of a "soft" government regulation of self-development of the banking system and achievement of positive synergetic effect from various forms of cooperation between banks and non-bank financial institutions that are participants of the credit and non-cash payments markets; use of cryptocurrencies by market participants, etc.

A system of indicators of the state's economic security in the banking sector should include indicators that characterize the digital (information) aspects of ensuring the banking security of the state in the conditions of development of the information economy:

- indicators that characterize the degree of development of non-cash payments in the economy:

- the level of cash in the economy, or the ratio of monetary aggregate M0 to GDP of the country is one of the target indicators of The Comprehensive Program of the Development of the Financial Sector of Ukraine until 2020, approved by the NBU's Management Board, Resolution No. 391 of 18.06.2015. According to the NBU, as of 01.01.2015 the value of this indicator was 17.8%, as of 01.01.2019 it decreased to the level of 10.3%, and in 2020 it should not exceed 9.5%;

the level of non-cash payments (a share of non-cash transactions in the total volume of transactions using payment cards). According to the NBU, as of 01.01.2015 the value of this indicator was 25.0%, as of 01.01.2019 it increased to 44.3%, and in 2020 it is expected to increase to 55%;

- the indicators characterizing the extent of development of the banking infrastructure of non-cash payments in the economy:

- a number of POS terminals per 1 million people (ratio of POS terminals to the population, thousand units / million people). According to the NBU, as of 01.01.2015 the value of this indicator was 4,700, as of 01.01.2019 it increased to 6,700, and in 2020 it is expected to increase to 11,000;

- the indicators characterizing the level of development of electronic credit platform services in the country and the level of penetration of cryptocurrencies in the country:

- the ratio of granted P2P loans to the loan portfolio of the banking system. According to the author's calculations, during 2014-2019 the value of this indicator ranged from 0.0% to 0.5;

- a share of economic entities that accept cryptocurrencies for payment. It is estimated that during 2014-2019, the value of this indicator was minimal (due to the minimum absolute and relative number of legal entities that accepted cryptocurrency as a means of payment).

3. Results and Discussions

The results of the calculation of the integrated index of the state economic security in the banking sector in the conditions of the development of the information economy for 2014-2018 (Fig. 1) show that the processes of spreading of nomenclature and infrastructure made a positive impact on its value of non-cash payments, development of the infrastructure of the card payments market and a growing popularity of card payments, growth of loans provided through electronic credit platforms; gradual development and institutionalization of the cryptocurrency market, accompanied by the development of appropriate payment infrastructure.

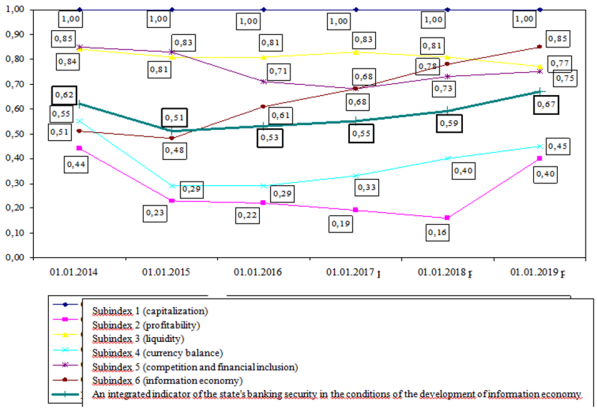

Figure 1. Dynamics of subindices and an integrated index of the economic security of Ukraine in the banking sector in the conditions of the development of the information economy in 2014-2018. Source: created by the authors according to the NBU, government statistics agency.

In the conditions of the information economy the banking system is becoming an open system, which is characterized by processes of spontaneous self-organization. A theoretical basis for modelling the processes of the government regulation of the state's banking security in these conditions is a synergistic approach that is supposed to use a mathematical apparatus that would take into account the presence of many equilibrium states, which is due to the irreversibility of social and economic processes and directed self-organization (i.e. processes of self-regulation in the system

and its regulation in accordance with the quantified parameters of the state of economic security of the state).

The above can be used to model many economic processes with quadratic nonlinearities, the dynamics of which is determined by the so-called logistic curves. The work [22] contains examples of phenomena in a field of science and technology that have been modelled with a high degree of adequacy using a logistic equation, which is justified as a universal tool for describing economic reality that can be used to describe patterns of economic evolution to forecast the development of complex social and economic systems.

We propose to conduct an evaluation and modelling of the sensitivity of innovation processes in the banking system in the conditions of the development of the information economy to the regulatory influence of the state, which affects the state of economic security in the banking sector, using the apparatus of differential equations taking into account the approaches proposed by K.G. Naumik-Gladka [22, p.99-134].

We will consider an addition of the basic differential equation below, the initial form of which is as follows (1):

$$\dot{x} = x(x-a)(b-x), \qquad (1)$$

where $x = x(t)$ – a time-dependent indicator of the gross output of a banking product, which characterizes the degree of distribution of the new banking product in the banking system; $a < b$ - positive parameters that determine non-trivial equilibrium levels of distribution of the innovative banking product.

Let us suppose that there is a need to determine the regulatory influence of the state on the dynamics of the distribution of the innovative banking product, for example, in the process of testing dissatisfaction with the values of equilibrium states of the process under study, and we seek to change them in a desired way with some exogenous influence. Structurally, the influence (or regulation) has to be realized in a form of additional negative linear feedback in the basic equation. In this case, the state restrains the growth of the supply of the banking product, i.e. the basic equation is modified to the following (2):

$$\begin{aligned} &\dot{x} = x(x-a)(b-x) + u \\ &u = -(k_1 x + k_0) \end{aligned} \qquad (2)$$

where k_1, k_0 – parameters of the regulator (control influence), and with this $k_1 > 0$.

After the transformation, the equation will look like (3):

$$\dot{x} = -k_0 - (ab + k_1)x + (a+b)x^2 - x^3. \quad (3)$$

For a detailed analysis of this situation, there is a need to transform this equation using linear substitution $x = y + \frac{a+b}{3}$. After the transformation, it will look like (4):

$$\dot{y} = \mu_1 + \mu_2 y - y^3. \qquad (4)$$

In this system, there can be 1 - 3 of the equilibrium states that merge in pairs on the bifurcation lines G_1, G_2, that form a semi-cubic Neil parabola (or a semi-cubic parabola) beginning at A (0, 0). In this case, point A corresponds to the merging of all three equilibrium positions into one. For the values of the parameters on the plane μ_1, μ_2, lying inside the parabola in the area of 2, there are 3 equilibrium positions: 2 are stable and 1 is unstable between them, and for those lying in the area 1 – 1 there is a stable equilibrium position.

It should be noted that with bifurcation values of display parameters projecting of variety $F(y, \mu_1, \mu_2) = 0$ on space of parameters has a feature of a type of "addition". The dynamic system in the vicinity of this bifurcation shows hysteresis.

This type of behaviour cannot be explained using methods of comparative statics [7], which are traditionally used in the process of economic analysis. After all, the study of the dynamics of the system in terms of equilibrium position shows that the behaviour of the system ceases to be characterized by a smooth and unambiguous response to small changes in parameters. Multiple equilibrium positions appear or disappear against this background, including multiples, and sudden jumps due to the irreversibility of processes in the country's banking system.

Based on the above, it is possible to conclude that the presence of a linear, but not optimal, regulator for influence on the nonlinear dynamics of the innovation process changes the behavioural characteristics of the object under study, making it structurally unstable. This circumstance initiates the appearance of unwanted bifurcations, which are accompanied by a catastrophic loss of stability.

It can also be stated that in the conditions of a gradual change of the regulating parameter by the state, the dynamics of the process will change by leaps and bounds. When the parameter changes inversely, the investigated point does not return to its equilibrium state, meaning that the system behaves irreversibly. This confirms that a certain value of the control parameter is a dangerous limit of loss of stability of the equilibrium state, and any small imbalance can cause the system to move to a new state that does not get closer the original one by a choice of small violations of the limit.

The effects described above that occur when regulating processes of production and consumption of a banking product, are explained primarily by the nonlinear

nature of the dynamics of human behaviour in the consumption of the banking product in the conditions of information influence. That is why when choosing a model of economic behaviour in the banking services market in the information economy at the level of the regulator (the NBU) it is necessary to provide a sufficient stability margin to avoid catastrophic events that lead to imbalance of social and economic system, in this case – of the banking system of Ukraine.

5. Conclusions

Ensuring the state's economic security in the banking sector in the conditions of rapid development of the information economy is becoming not only the achievement of local "stability" or "sustainability", but also correspondence to the trajectory of the banking system with global trends that include both opportunities and risks.

A comprehensive assessment of the state's economic security in the banking sector in these conditions should include both assessment of the current state of the state's banking security using an updated system of indicators (including assessment of the extent to which the banking system of Ukraine corresponds to dominant trends in the development of the information economy) and assessment of the regulating influence of the state on the processes of self-organization of the banking system in order to achieve a positive synergistic effect and prevent the negative one in the context of ensuring the state's economic security.

The proposed tool is the basis for making decisions to ensure compliance with the vector of innovative development of the banking system through the implementation of a "soft" government regulation over the processes of self-development of the banking system and achieving a positive synergistic effect from various forms of cooperation between banks and non-bank financial institutions that are participants in the credit market and of non-cash payments market. The study of the impact of government regulation on the use of cryptocurrencies by market participants is a direction of further researches.

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