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**VULNERABILITY OF THE BANKING SYSTEM IN THE
REPUBLIC OF MOLDOVA TO SYSTEMIC RISK**

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1. CONCEPTUAL GUIDELINES OF RESEARCH

The actuality of the subject. Risk, as an integral element of the economic, political and social life of society, inevitably accompanies all areas and spheres of activity of commercial banks, which operate under market conditions. Under modern conditions, the ambiguity and uncertainty of phenomena and processes that affect fundamental socio-economic changes are increasing, and risk is becoming an essential feature of economic activity.

Of all the varieties of risks that exist in the market economy, the risks that could cause systemic dissensions of banks are the greatest threat to the socio-economic stability of society. This is due both to the special function of banks, which is a link in the economy, without which it is impossible to maintain the continuity of the social reproduction process, and the complexity of systemic risk management.

The current evolution of the domestic banking system has demonstrated the need to identify in due time the criteria of vulnerability of the banking system as well as the application of efficient mechanisms to reduce it in order not to pay attention to the financial security of an economy. The problem, which is now in the sights of political and financial decision makers in the Republic of Moldova, cannot be treated as a momentary situation, being the result of a process of dissonance between the regulatory needs of the banking system and the applied mechanisms. Thus, the relationship between the bankruptcy of some banks and a system crisis is not a direct one, but depends on the degree of fragility of the banking system, the way in which this bankruptcy is managed by the banking supervision institution.

Description of the situation in the field of research and identification of research problems. In the local and foreign scientific literature, only certain aspects related to the research topic are widely covered. In the works of P.V. Anikina, S. Brajovich, Bratanovich, H. Grüning, A. Demirgyuk-Kunta, E. Detragic, P.V. Kovaleva, O.I. Lavrushina, A.A. Lobanova, L.Fotiadi, and other authors revealed issues related to the essence of banking risks, the criteria and methods for assessing them, as well as how to manage them.

In the works of E.A. Korzov, P. Krugman, A. L. Kudrina, L.P. Kurakova, J. Soros analyzes the consequences of the financial crises that have occurred, taking into account the banking system as a whole, analyzes the mechanism of implementation of systemic risks and their impact on the stability of commercial banks.

In the works of G. Kaminski, F. Karamazzi, K. Reinhart, A. Rose, R. Salgado, A.A. Struchenevsky, A. Tornell, P.V. Trunin, H. Edison, B. Eichengrin, R.M. Entov and many other

authors have proposed various methods of assessing the systemic risks of commercial banks, identified the characteristics and trends of changes in macroeconomic indicators in previous periods, during and after the crisis, for a number of countries. However, such works did not begin to appear until the mid-1990s and were usually based on the statistics of developed countries. The available work on developing countries was carried out on the basis of information in a shorter period of time, which makes it difficult to objectively assess the phenomena studied.

Likewise, this topic was addressed in research of economists in our country, including: Cobzari L., Cociug V., Enciu A., Verbeț L., Batișcev R., Grigoriță C., Ștefaniuc O., Dolghii C., etc., highlighting certain features of systemic risk and systemic crisis. The research examined examines risk assessment in banks, early warning and forecasting of banking crises, methods of determining the stability of banks and the system as a whole, but did not address the issue of vulnerability of the banking system.

The field of research is determined by the issues that constitute the systemic risks of banks, as well as their vulnerability to such risks, derived from the specifics of financial and economic relations formed in the banking system of the Republic of Moldova.

The object of research is the complex system of relations and information flows, formed in the banking system of the Republic of Moldova, as well as the techniques and tools used in assessing systemic risk and vulnerability of the system to it.

The research hypothesis refers to the fact that the assessment of the vulnerability of the banking system allows the early identification and smoothing of the systemic risk factors for maintaining the stability of the banking system of the Republic of Moldova.

The purpose and objectives of the paper. The aim of the paper is to improve the methodological apparatus for managing systemic risk in banks, but also to identify effective models for assessing the vulnerability of the banking system.

Scientific research methodology. In order to meet all the requirements of the current period and to determine a model for estimating the vulnerability and mitigating the system risk, the following scientific research procedures will be used:

- application of the dialectical method of systemic organization and approach, which will be implemented on the basis of general scientific methods, such as analysis and synthesis, classification and generalization method, grouping and comparison;

- within the research of the quantitative methods for assessing the vulnerability of the banking system and the systemic risk, economic-mathematical methods will be used, based on multicollinearity and mathematical statistics;

- in the process of selecting the information necessary for the elaboration of the thesis, various classical research methods will be applied, such as systemic analysis, functional, phylogenetic, ontogenetic approaches, retrospective analysis (historical approach) and diachronic analysis (analysis of object structure changes over time).

The study used general scientific methods of knowledge: a systematic approach, generalization, analysis and synthesis, the method of groups. To accomplish the established tasks, the methods of comparative, historical and logical analysis were widely used.

Among the special methods, economic and mathematical methods were used in the process of assessing systemic risks of commercial banks, as well as statistical and graphical methods in analyzing the state of commercial banks in the Republic of Moldova, as well as the country's macroeconomic indicators in times of crisis.

The scientific novelty consists in the development of theoretical foundations and methodological approaches as well as the formulation of recommendations for improving the systemic risk management methodology of the banking sector in the Republic of Moldova by assessing its vulnerability to endogenous and exogenous risk factors.

The theoretical significance of the thesis. Scientific arguments and methodological elaborations on systemic risk management, and the assessment of the vulnerability of the banking system to it have theoretical significance and application value, as follows:

- theoretical and methodological deepening of the concept of systemic risk, vulnerability of the banking system to systemic risk;

- analysis of models of systemic risk assessment, forecasting and estimation of its consequences;

- developing the model for assessing and managing risk-generating factors, which have the potential to trigger a systemic crisis;

- development of an aggregate index to assess the vulnerability of the banking system and endogenous and exogenous shocks;

- substantiating the need to assess the vulnerability of the banking system through a model based on aggregate index, which allows the formalization of the effects of a set of factors, but also the comparability over time of their evolution.

The practical significance of the paper lies in the possibility of widely using the systemic risk assessment methodology of commercial banks adapted to modern conditions. The applicative value of the thesis can be considered as:

- elaboration, proposal and argumentation of the model for assessing the vulnerability of the banking system of the Republic of Moldova to systemic risk;
- the development of a complex indicator for the assessment of systemic risks in commercial banks adapted to modern conditions can be used to form investment portfolios by different types of investors;
- elaboration and proposal in order to absorb shocks in the banking activity and to avoid systemic risk
- the use of research results as methodological support in the training process of higher institutions of economic profile, as well as for the purpose of remote monitoring.

The research results can be used by:

- commercial banks in the management of systemic risks, the assessment of the economic situation and the management of the structure of assets and liabilities, as well as in the development of plans for the consideration of systemic risks and the adjustment of the discount rate;
- National Bank of the Republic of Moldova for the implementation of macroeconomic analysis and development of monetary policy;
- different types of investors who can use a complex indicator to assess systemic risks in commercial banks when forming investment portfolios.

The results of the research can also be used in the real sector of the economy to assess the risks of deteriorating financial market conditions and to manage receivables and payables.

Implementation of scientific results. The research results can be used by: commercial banks in systemic risk management, economic situation assessment and asset and liability structure management, as well as in the development of systemic risk consideration plans and discount rate adjustment; National Bank of the Republic of Moldova for the implementation of macroeconomic analysis and development of monetary policy. A complex indicator for assessing systemic risks in commercial banks adapted to modern conditions can be used to form investment portfolios by different types of investors. The results of the research can also be used in the real sector of the economy to assess the risks of deteriorating financial market conditions and to manage receivables and payables.

Approval of scientific results. The main ideas and conclusions on the issue addressed in the thesis were reflected in national and international scientific conferences, symposia and national and international scientific forums.

Thesis publications: The aspects of the thesis were based on publications in specialized magazines in the country and abroad, as well as in collections of international events, in a volume of 19 publications.

The volume and structure of the thesis. The structure of the paper is based on tasks, in which the research was performed. The paper consists of an introduction, three chapters, conclusions and recommendations, a bibliography and annexes.

Keywords: transparency, banking sector, vulnerability, money laundering, systemic risk, financial stability, volatility, financial shocks, contamination risk, crisis, banking regulation, Basel III, financial crisis, economic recovery, credit risk, commercial banking.

2. CONTENT OF THE THESIS

First chapter "The concept of banking vulnerability and systemic risk" reveals the content of the conceptual apparatus, examines the systemic risk of banks and classifies them; systemic risk management systems are analyzed. The chapter examines the theoretical basis of implementation mechanisms and systemic risk management issues in the banking sector.

The meaning of the word "vulnerability" comes from the Latin *vulnerare*, which means "injury". This etymology associates the word with exposure to precarious damage or injury. When the term vulnerability applies at the macroeconomic level, it is generally used to refer to the country's susceptibility to being affected by external forces as a result of exposure to such forces.

In our opinion, the term vulnerability means the risk of being harmed, injured (adversely affected) by unforeseen events. In the economy, these unforeseen events are often called "shocks": economic vulnerability is a vulnerability to shocks of any kind, a susceptibility to exogenous shocks. The concept of economic vulnerability can be analyzed from several perspectives, firstly from the point of view of its consequences (static or dynamic), secondly from the perspective of the sources of occurrence.

The economic vulnerability of a country, in our opinion, can be defined as the risk of a country not to achieve its development objectives, in the conditions of shocks, which can be internal or external. The literature classifies vulnerability from the perspective of three components:

- a) the size and frequency of exogenous shocks, which may cause this vulnerability;
- b) the fragility of the country to be exposed to these shocks;
- c) the country's ability to react and withstand shocks.

These three factors are from a macroeconomic perspective, namely to block certain negative phenomena, which can divert the country's direction from the goal and development tasks.

If the vulnerability is at risk of being affected by shocks, then it is necessary to analyze the possibilities of measuring the damage. It is possible that immediate loss of well-being results from shocks. When successive and opposite shocks of equal size occur, the loss associated with income instability is only due to a decrease in the marginal utility of income. At first glance, vulnerability (in terms of economic growth) may simply appear as the opposite of sustainable growth, a concept used more intensively, ie the more vulnerable a country is, the less sustainable

its growth is. But the sustainability of growth depends not only (in a negative sense) on vulnerability to shocks, but also on more permanent factors, such as the rate of accumulation of human and physical capital and the conservation of natural resources.

Following the analysis we can say that the vulnerability is not a feature of the system, but it is a process because it is formed inside the system, it is consolidated inside the system and this vulnerability can be reduced by actions inside the system.

Estimating vulnerability, if we consider it a process, is more about identifying the current level of vulnerability, but about predicting future vulnerability.

The concept of systemic risk is relatively new: the bibliographic search reveals that the first mention of it can be found among the titles of scientific papers in finance and economics only in 1994, but this term is used without an explanatory definition. This can be explained by the fact that the term is not the result of economic research, but was borrowed by the managers of commercial banks in the field of political relations. However, the problem of estimating the systemic risk of the banking sector implies, first of all, the existence of an unambiguous definition.

In the paper given under the notion of systemic risk we will understand the probability of unwanted processes in financial networks, which occur from the interconnection of strategic agents or significant unexpected external events, often ignoring the fact that, in conditions of metastability of the financial system, systemic risk significantly changed and the concept needs to be examined more complexly and the microscopic properties of global financial and non-financial systems taken into account.

In addition to the collective behavior of banks, we can also identify two other major sources of systemic risk:

- the tendency of financial institutions to assume excessive external risks (credit, market, liquidity) during the growth phase of the economic cycle (aggregate risk);
- the existence of direct or indirect interbank financial relations, which are a source of the "contamination" effect (contagion effect). The situation is complicated by the fact that banks are not able to take into account the effect of spreading their shares over other elements of the system (network risk).

All the definitions listed (Table 1), however, do not give complexity to the concept of systemic risk. These present the systemic risk from a narrow aspect, emphasizing the effects it brings. We believe that systemic risk could be defined as the risk of triggering a financial crisis

in an economy, as a result of the insolvency of a financial institution in the conditions of transition of the economy from one equilibrium to another.

Table 1. Generalization of the defining notions of systemic risk

Cause	Process	Effect
Risk or probability of failure of the entire system in connection with inability to work (Kaufman and Scott, 2003)	The risk of the occurrence and spread of significant systemic events (ECB, 2009)	Significant adverse effects on financial stability (Dodd-Frank Act, 2010)
The risk of a large-scale failure of a financial system when capital providers lose confidence (Ron Rimkus, 2006)	The risk of a transition phase from one equilibrium to another, characterized by multiple mechanisms (Hendricks, 2009)	A triggering event that causes a chain of unfavorable economic consequences (Steven L. Schwarcz, 2008)
Risks to the stability of all or a significant part of the financial sector, as well as unsustainable levels of leverage, debt or credit growth (UK Department of Finance, 2011)	The risk that an event will lead to the loss of economic value of assets or confidence in them (Group of Ten, 2001)	Externalities of troubled banks over the rest of the financial system or the real economy (De Nicoló, Favara, Ratnovski, 2000)
The orientation of banks in the formation of a collective identity of financial market behavior (George Kaufman and Kenneth Scott, 2003)	The risk of confronting systemic events in the true sense of the word (Olivier de Bandt, Philipp Hartmann, 2000)	Risk of disruption of financial services that is caused by a malfunction of all or parts of the financial system (IMF, 2009)

Source: Developed by the author based on the literature

The effects of the global crisis of 2007-2009. they prove the likelihood of a systemic crisis, as a result of endogenous imbalances, which build up over time and cause serious problems in the major institutions, which are interconnected, as well as through the "domino" effect of national and international financial markets.

The crisis has shown that systemic risk can come from different sources: total shock, which leads to a simultaneous default of several financial institutions and information about exogenous effects (for example, the spread of negative information about a particular bank, increases the cost of financing for other banks), endogenous imbalances, etc.

Thus, systemic risk should be analyzed in the light of the macroscopic effects of the system that occur due to the nonlinear interaction of agents at the microscopic level.

In this way it is important to identify systemic risk. This can be done through tools. Currently, the basis for assessing the stability of the banking system are the financial stability indicators (hereinafter - ISF) of depository institutions, standardized by the International

Monetary Fund (IMF), worldwide. ISFs are a good starting point in banking risk analysis, but they are not enough to identify systemic problems. The traditional approach to systemic risk assessment - aggregate stress tests. The IMF calls stress tests "methods of assessing the sensitivity of the portfolio to significant macroeconomic changes or exceptional but plausible events." Aggregate stress tests are performed on a group of financial institutions and allow the assessment of the outcome of the macroeconomic impact on the aggregate balance sheet of commercial banks. The presence of such a methodology allows not only to assess the potential systemic consequences of the failure of individual institutions, but also to calibrate the threshold at the individual IFS level based on the value of the bank.

The simplest method of determining the systemic importance of a commercial bank is to analyze the specific weight of this institution in the financial market. However, the results of the latest research (The systemic importance of financial institutions), conducted by the Bank for International Settlements (BIS), suggest the existence of a non-linear relationship between the bank and the size of its contribution to the level of risk of payment systems. Thus, to determine the institutions of systemic importance BIS, experts suggest the use of the so-called Shapley value - the principle of optimal distribution of results among participants in the problems of cooperative game theory. The idea of the approach is to calculate the average marginal contribution of each system element in the overall level of risk.

The International Monetary Fund, in 2007, proposed a set of indicators of financial stability. It includes a basic set of 12 indicators and a recommended set of indicators of 27 indicators. The EBA Guide proposes the introduction of a 350-point threshold for determining systemic banks, with local authorities having the power to change this threshold by 75 points depending on the specifics of the domestic banking sector. For example, Romania uses a threshold of 275 points.

The increasing complexity of credit risk, as well as the analysis of bankruptcy risk has fueled the development of sophisticated methods of measuring credit risk at portfolio level, and not just at the level of an individual bond or a loan. These methods are largely statistical and are based on probabilistic models of creditworthiness and asset values. Some of the best known methods developed in recent years are the following:

- CreditMetrics, proposed by J.P. Morgan;
- CreditRisk +, proposed by Credit Suisse Financial Products;
- CreditPortfolioView, proposed by McKinsey & Co.
- Credit Monitor, proposed by KMV.

Following the research carried out in Chapter 1 we can conclude:

1. The topic of analyzing the vulnerability of the banking system to systemic risk is a major topic and is researched at various levels by a very large group of researchers in the field, but each of these researchers identifies the factors of systemic risk, causes of vulnerability and interaction between vulnerability and systemic risk differently. Thus, following the analysis we noticed that a complex approach between vulnerability, systemic risk and the possibility of assessing them. This research, at a theoretical level, we have done in this chapter, and at an applied level it will be extended in chapters two and three.

2. Vulnerability is treated as a static process, most of the models proposed in the literature and researched by us use indicators, which have a time rupture, which reflects the situation at a certain point in time and this is a problem. The problem arises from the fact that the data we work with are static and reflect the situation in a timely manner, so it no longer reflects the current situation at the time of this data and may contain certain relational errors, ie does not fully reflect the relationships and mechanisms transmitted. For this reason we have adopted a definition specific to the vulnerability of the banking system to risks, so vulnerability is not a feature of the system, but is a process because it is formed within the system, is strengthened within the system and this vulnerability can be reduced by actions from within the system. The novelty of this definition is that it approaches vulnerability from a dynamic perspective and views it as a process. This definition will be used throughout the thesis, including in proposing an assessment model, which looks at vulnerability as a prediction of shocks, but not when the shock itself already exists.

3. The systemic risk approach is very important in the literature, but at the same time it is very complicated to find a clear and explicit definition of the phenomenon because there are 3 different levels of approach, namely by effect, cause and process. We proposed the aggregation of these 3 effects in a much simpler, but very broad definition, which allows the explanation of any systemic risk in the financial system and which also allows the research of each component: cause, effect, process. Thus, it allows a detail, which can then be used by researchers based on its research purpose.

4. Systemic risk is important today, even more than 10 years after the consequences of the last financial crisis in 2009, and currently the set of indicators for assessing systemic risk is constantly updated, more and more indicators are being developed for its assessment, but the dynamics of their analysis indicators we can conclude that increasing the number of indicators only complicates the assessment of systemic risk by allowing the loss of important factors. In

this chapter we have identified the stages of the financial crisis, which are: construction phase, shock materialization, amplification and propagation, each stage can be evaluated with separate static indicators.

5. There are a multitude of models in the literature that assess the vulnerability of the banking system to systemic risk taking into account various factors, both internal factors such as credit risk, interest rate risk, system density and concentration, structural factors and aspects macroeconomic factors, such as GDP. We consider that the stability of the system is more of an endogenous phenomenon, so we pursue and have placed major emphasis on assessing endogenous components in triggering systemic risk, namely that the vulnerability of a bank can condition the vulnerability of the banking system, as long as it is important for system. For these reasons, we mentioned the identification model of systemic banks and, at the same time, within a bank the credit risk, which is the main risk, which can trigger financial imbalances of the bank. Relationships between banks can lead to the borrowing of this risk within the system, so we considered that the credit risk assessment model is the most important both at the level of a bank and at the level of the entire system.

6. The assessment of the vulnerability of the banking system to systemic risk is proposed by various economic and financial currents, being developed many models. We systematized these models in the chapter and concluded that they target the vulnerability of the banking system as a vulnerability of an element of this system, such as credit risk, liquidity, density and structure models, but also models of vulnerability assessment by macroeconomic aspects (relation GDP vulnerability). We consider, however, that the models, which are based on microeconomic elements are more valuable from the perspective of evaluating a banking system and we will develop these models in the next chapter to assess the vulnerability of the banking system to systemic risk.

Second chapter "Analysis of the vulnerability of the banking sector to systemic risk in the light of existing valuation systems" includes a study of the state of commercial banks in the Republic of Moldova during the crises of 2008 and 2016, including by comparing the dynamics of some indicators with similar ones calculated for commercial banks before the crisis of 2016 and after. The chapter analyzes the main macroeconomic indicators of the Republic of Moldova, which form the systemic risks of commercial banks, before, during and after the economic crisis of 2016. It analyzes the indicators and methods of assessing systemic risks in commercial banks, proposed by leading economists in the world, and is selected the most suitable for commercial banks in the Republic of Moldova.

We consider a current problem of the banking sector in the Republic of Moldova is the discrepancy between the volume of banks' assets. For example, if we compare the value of BC Moldova Agroindbank SA's assets with those of BC "Eurocreditbank" SA, then there is a difference of 23.5 billion lei or 20 times. This is worrying for the banking sector because the resilience of small banks is low in the face of market shocks and the consequences can be destructive for the system. Similarly, we will analyze the density of the banking sector by calculating the Herfindahl-Hirschman index, which is an indicator used to assess the degree of monopolization of a sector of the economy. Defined as the sum of the squares of the sales quotas of each company in the industry:

$$HHI = S_1^2 + S_2^2 + \dots + S_n^2, \quad (1)$$

where S_n is the share of companies' sales in the total sales volume.

Thus, based on the value of banking assets, we established that the HHI of the banking sector in the Republic of Moldova on 31.12.2020 is 1759.2362, which shows us that the banking sector in the Republic of Moldova is concentrated.

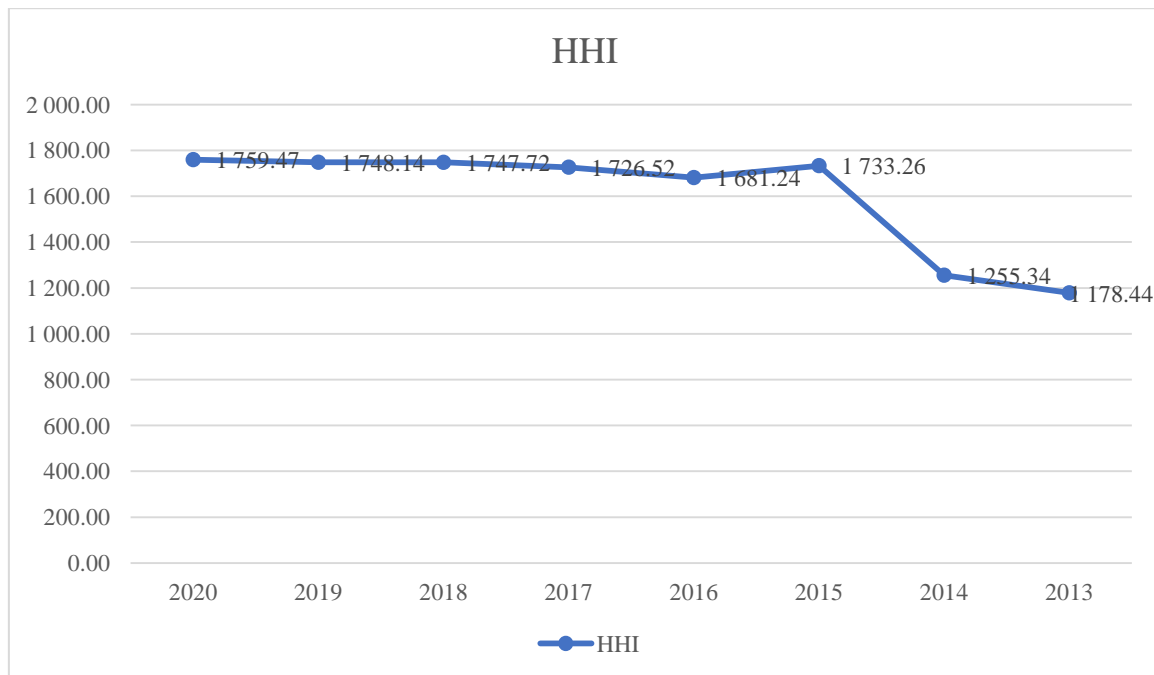


Figure 1. Evolution of the Herfindahl-Hirschman index for the banking sector in the Republic of Moldova for the period 2013-2020

Source: Prepared by the author based on NBM reports

Following the analysis of Figure 1, we notice that the banking sector in the Republic of Moldova is concentrated, thus, a result higher than 1500 is attested starting with 2015. In this

way, the liquidation of the 3 banks had a negative influence on the concentration of the banking sector.

Taking into account the Association Agreement of the Republic of Moldova with the EU, the domestic banking sector will have to comply with the European one, so the analysis according to the guide will be necessary and mandatory in the future, but at the moment the banking sector in Moldova still has its specificity. In this regard, we propose the use of indicators in the guide to analyze the systemic risk of banks in the Republic of Moldova and their ability to generate systemic risk (Table 2). Following the analysis of the evolution of the given indicators, we can see the influence of systemic risk on the financial system in the Republic of Moldova.

Table 2. Indicators for the evaluation of commercial banks in the Republic of Moldova of systemic importance on 30.08.2021

Commercial Bank	Total score
BC „MOLDOVA - AGROINDBANK” S.A.	253,86
B.C. „VICTORIABANK” S.A.	196,18
BC „Moldindconbank” S.A.	176,68
Mobiasbanca - OTP Group S.A.	151,59
B.C. „ProCredit Bank” S.A.	57,22
BCR Chisinau S.A.	51,35
„FinComBank” S.A.	35,33
B.C. „EXIMBANK” S.A.	30,41
B.C. „ENERGBANK” S.A.	19,09
B.C. „COMERTBANK” S.A.	17,39
BC „EuroCreditBank” S.A.	10,61

Source: Made by the author based on the EBA guide and NBM data

The EBA Guide recommends the use of a threshold of 350 basis points for the designation of systemic banks +/- 75 basis points, so as to take into account the particularities of the banking sector in each Member State and the statistical distribution of scores. The NBR uses the threshold of 275 basis points on the recommendation of the European Commission and EBA, in order to have a wider coverage area.

If we try to use the EBA guide, then in the banking sector no commercial bank has accumulated the necessary score. At the same time the leader by score is BC "MOLDOVA - AGROINDBANK" S.A. with 253.86 points, followed by Mobiasbanca - OTP Group S.A. with 196.18 points, BC „Moldindconbank” S.A. - 176.68 points and B.C. VICTORIABANK S.A. - 196.18 points. The rest of the banks in the banking sector in the Republic of Moldova have a score of less than 100.

The International Monetary Fund, in 2007, proposed a set of indicators of financial stability. It includes a basic set of 12 indicators and a recommended set of indicators of 27 indicators.

These indicators can also be supplemented by information on individually viewed financial institutions. Next we will analyze the evolution of the indicators given based on the results obtained by the commercial banks in the Republic of Moldova (table 3).

Table 3. Analysis of systemic early warning indicators of the banking sector in the Republic of Moldova

Chapter	Indicator	Total by banking sector (%)
1. Capital Adequacy	1. Basic level 1 own funds rate ($\geq 5.5\%$)	25,88
	2. Own funds / Total assets	12,86
2. Asset Quality	1. Debt balance on non-performing loans (basic amount) / Debt balance on loans (basic amount)	7,05
	2. Balance of net non-performing assets / Equity	11,54
	3. Amount of reductions calculated for credit debt balance (basic amount) / Credit debt balance (basic amount)	6,86
3. Income and profitability	1. Net interest margin (MJDnet)	3,84
	2. Return on assets (ROA)	1,9
	3. Return on capital (ROE)	11,55
4. Liquidity	1. Current liquidity ($\geq 20\%$)	48,74
	2. Balance of deposits of individuals (basic amount) / Balance of deposits (basic amount)	63,51

Source: Made by the author based on NBM data

Following the analysis of table 3, it is observed that the average score of the banking sector in the Republic of Moldova is 21.79%. The results can be viewed in Annex 3. The largest banks in the domestic banking sector show results on average from 19.29% to 26.27%. At the same time, we consider it opportune to analyze the indicators given in the case of the last 3 liquidated banks (Banca de Economii S.A., BC „BANCA SOCIALA” S.A. and B.C. „UNIBANK” S.A.).

Following the analysis, we conclude that on average Banca Socială SA has a score of 26.42%, an average result for commercial banks in the Republic of Moldova, so it would not be the result that the bank does not show problems. A similar situation is with Banca de Economii SA, which certified an average result of 15.51, so it was slightly lower than the rest of the banks,

and BC Unibank SA being a small commercial bank does not present systemic risk in itself. Thus, this method would not indicate systemic problems in the banking sector in the Republic of Moldova, which happened with the liquidation of these 3 commercial banks. It should be mentioned that the data were taken from 31.03.2015.

The use of early warning indicators of the systemic risk of the banking sector in the Republic of Moldova proposed by the IMF shows the existence of problems that could negatively affect the financial stability of the banking sector, but it does not show the vulnerability of the banking sector to systemic risk. In this order of ideas we can conclude that this method does not allow us to identify the systemic risk of the banking sector in the Republic of Moldova, and the results describe a complex image.

In this order of ideas we will try to use KMV for the banking sector in the Republic of Moldova (KMV Using the Black and Scholes model).

For this we will use the data presented by the NBM for quarter 1 2021 and quarter. 1 2015. In this way we will be able to see the situation from the point of view of the model in different years, but at the same time. At the same time, we consider it opportune to analyze the given model depending on the results obtained by the last 3 liquidated commercial banks, namely: Banca de Economii S.A., BC „BANCA SOCIALA” S.A., B.C. UNIBANK S.A. The information was used on 31.03.2015. The results obtained are summarized in Table 2.10, and the description of the calculations according to the model can be viewed in Annex 9.

Thus, the data of the banking sector in the Republic of Moldova in billions of lei were used, and the result of the distance to bankruptcy must be as high as 0. The smaller it is, the more alarming the situation.

Following the analysis of table 2.10 we notice that the banking sector in 2015 was 4 times closer to bankruptcy than it is in 2019 (2.84 against 0.72 in 2015). Thus, it is observed that the situation in the banking sector on 31.03.2015 was at a very dangerous distance from bankruptcy. This fact is due to the situation with the 3 commercial banks Banca de Economii S.A., BC „BANCA SOCIALA” S.A., B.C. "UNIBANK" S.A., which had a bankruptcy distance of 1,029; 0.989 and 0.315, respectively. But taking into account that banks were operating in concert, then the distance to bankruptcy is 0.682, which increases the vulnerability of the banking sector.

Table 4. KMV (Black and Scholes) model of the banking sector in the Republic of Moldova and of the last 3 liquidated commercial banks in the Republic of Moldova

	banking sector 2021	banking sector 2015	Banca de Economii SA	BC Banca Socială SA	BC Unibank SA
The value of equity	11,03	9,40	0,327994665	0,486478976	0,350491967
Std dev value of equity	0,871253483	4,508189178	4,508189178	4,508189178	4,508189178
risk-free rate	4,22	7,11	14,15	123,54	2,22
time to maturity	1	1	1	1	1
The nominal value of the debt	36,46344483	41,97430315	1,358060879	1,966373965	0,959168451
$= (E/A) * \text{std dev}$ equity Std. Dev. Active	0,202403711	0,825126222	0,876994832	0,89411771	2,412967623
The value of BS assets	86	105	14	17	4
Assd std dev	17,40671919	86,63825329	12,27792765	15,20000107	9,65187049
The distance to bankruptcy	2,845829513	0,727458074	1,029647631	0,989054275	0,31505101
FED empiric	0,000803213	0,000803213	0,000803213	0,003058824	0,030114041

Source: Prepared by the author based on NBM data

After the liquidation of commercial banks in 2015, the economic crisis in the Republic of Moldova and state intervention in systemic banks, in 2021 the distance to bankruptcy is 2,845, which inspires optimism for the system.

Thus, there is a need to identify a complex and adaptable model for the reality of the banking sector in the Republic of Moldova, which will be analyzed in the next chapter.

In conclusion we can say that:

1. The vulnerability of the banking system in the Republic of Moldova was not affected because the NBM went on the path of recovering losses and the stability of the banking system was not affected, but the stability of the country was negatively influenced. This shows the direct relationship between the vulnerability of the banking system and macroeconomic vulnerability.

2. The crisis shall be managed in accordance with the principles of financial stability recommended by international bodies and adopted by the NBM, using unanimously accepted resilience models. However, the NBM applied only three types of resilience models, but none of the models used was favorable to the economy of the Republic of Moldova, although the banking system remained stable, at least the last intervention with the financing of the 3 banks had a major macroeconomic effect. For these reasons, we recommend extending the NBM's responsibilities by tracking and statically calculating the stability of the banking system, but also

tracking its vulnerability by forecasting stability through dynamic models, to act before the problem occurs and not post factum.

3. Assessing the vulnerability of the banking system according to the models described in Chapter 1, we found that the structural and density models applied do not fully reflect the vulnerability of the banking system due to system specificity, because we have a major concentration according to HHI and this system concentration induces a danger of greater vulnerability. We tested this by identifying the banks of systemic importance and analyzing the evaluation methods of the systemic banks until the bankruptcy of the 3 banks, in the bankruptcy process and after. We have identified that the evaluation of the systemically important model is relatively acceptable, it is based on the recommendations of the Basel Committee, but can be extended, which we did in Chapter 3.

4. The models of evaluation of the financial systems proposed by the international bodies did not show the moment of entry of the 3 banks in vulnerability, the indicators being acceptable until their fall, therefore we consider that this model can be used to assess the macrostability of the system, but not can be used to identify system vulnerabilities. Therefore, in the process of recommending the models for assessing the vulnerability of the system, they were no longer used.

5. Models based on aggregate indices, such as CAMEL, which was used until 2018 in the Republic of Moldova NBM or those used by financial analysts, based on Kromonov logic, identify some financial stability problems, but these problems are less noticeable and static, ie the problem is identified at the time of its occurrence and was not observed during the development of the problem. At the same time, these models are quite narrow because they take into account only the general aspects of the bank's activity, such as the volume of capital, the value of assets, credit risk, the volume of liquidity risk. I consider that these models have their application limits in that they do not assess the specificity of the bank's activity and the business model. Likewise, the analyzed models have shown us that they are sensitive to the occurrence of risk and show the risk only at that time, but can not predict the vulnerability without reason that we have defined in one chapter vulnerability as a process, below we propose to develop a model would allow vulnerability assessment as a process. That is why in Chapter 3 we set out to overcome these limits.

In the third chapter "Possibilities to measure the vulnerability of the banking sector in the Republic of Moldova to systemic risk" using the chosen methodology, the systemic risks of commercial banks are assessed before the economic crisis that occurred in 2016, the

advantages and disadvantages of the methodology are revealed. under modern conditions, methods of application and directions are proposed for further improving the quality of systemic risk management in commercial banks.

The main idea of the Z-score method is that this index allows, based on an econometric analysis, to assess the relationship between the stability of the bank and the various financial risks and environmental factors.

As a result of the calculations performed according to the set of mandatory normative indicators, we will establish a vulnerability index (Iv). Each calculated indicator will have a share of 10% of the total, so commercial banks, which meet all the mandatory regulations imposed by the National Bank of Moldova, will be assigned a vulnerability index equal to 1. Otherwise, for each exceedance of the regulations, will be deducted from the vulnerability index 0.1 units.

As a result of the calculations of the indicators in table 3.2 we will establish two totalizing indicators, namely the Systemic Banking Indicator ($IBS = 0.95 * NMI + 0.05 * NI$) and the Systemic Risk Indicator ($IRS = IBS + NMA$). Thus, the systemic banks will be considered those, which have a higher result than the arithmetic average of the systemic banks indicators of all commercial banks, the same will be done with the systemic risk indicator.

Table 5. Mandatory regulations imposed by the National Bank of Moldova

nr.	Indicator	Unit of measure	The norm
1	Total equity rate	%	($\geq 10\%$)
2	Basic level 1 own funds rate	%	($\geq 5.5\%$)
3	The sum of the aggregate value of credit exposures to related customers or group of customers, which is the first ten credit exposures by size / Total loan portfolio	%	(≤ 30)
4	Maximum exposure value to a client or group of connected clients / Eligible capital	%	($\leq 15\%$)
5	Maximum exposure value of the bank to an affiliate and / or a group of customers related to the bank affiliate / Eligible capital	%	($< 10\%$)
6	Amount of the aggregate value of the bank's exposures to affiliates and / or customer groups related to the persons affiliated to the bank / Eligible capital	%	($\leq 20\%$)
7	Tangible fixed assets / Equity	%	($\leq 50\%$)
8	Tangible fixed assets and participation shares / Equity	%	($\leq 100\%$)
9	Principle I - Long-term liquidity	x	(≤ 1)
10	Principle II - Current liquidity	%	($\geq 20\%$)

Source: Prepared by the author based on NBM reports

Next we will perform the calculations of the indicators from table 5 for the commercial banks from the Republic of Moldova at the situation from 31.08.2021. Following the analysis of the results, it can be seen that the arithmetic mean of the systemic bank indicators of all

commercial banks is 12.81%. Thus, there are 4 commercial banks, which have a higher indicator, namely:

- BC „MOLDOVA - AGROINDBANK” S.A. - 31.75%;
- Mobiasbanca - OTP Group S.A. - 17.26%;
- BC „Moldindconbank” S.A. - 21.26%;
- B.C. VICTORIABANK S.A. - 18.13%.

In this way it is observed that there are 4 systemic commercial banks in the banking sector in the Republic of Moldova. The systemic risk indicator calculated based on the results from 31.08.2021, obtaining the arithmetic average of the systemic bank indicators of all commercial banks is 7.01%. Thus, there are 4 commercial banks, which have a higher indicator, namely:

- BC „MOLDOVA - AGROINDBANK” S.A. - 25.95%;
- Mobiasbanca - OTP Group S.A. - 11.46%;
- BC „Moldindconbank” S.A. - 15.81%;
- B.C. VICTORIABANK S.A. - 12.33%.

In this order of ideas we conclude that the banking sector in the Republic of Moldova has 4 systemic commercial banks, and the highest systemic risk is 25.95 pp. Likewise, we consider it opportune to test the aggregate indices on the data from 31.03.2015, in order to see the situation before the liquidation of the 3 commercial banks.

Table 6. The set of indicators and calculation formulas for determining the systemic banks in the Republic of Moldova on macroeconomic level

nr.	Indicator	Calculation formula
Macroeconomic level ($N_{MA} = R_D - R_I - R_{PIB}$)		
1	Annual inflation rate (%) (R_I)	- The difference between the analyzed month and the respective month of the previous year will be calculated - It will be considered an insignificant increase - positive trend
2	Growth rate of GDP (%) (R_{PIB})	- The increase will be used for the last year - It will be considered growth - a positive trend
3	Interest rates (%) (R_D)	- The difference between the analyzed period and the last change will be calculated - It will be considered the reduction - positive trend

Source: Prepared by the author

At the microeconomic level, indicators will be used, which must demonstrate the influence of each commercial bank in the Republic of Moldova, in terms of systemic risk, on the domestic banking sector.

Table 7. The set of indicators and calculation formulas for determining the systemic banks in the Republic of Moldova on microeconomic level

nr.	Indicator	Calculation formula
Microeconomic level ($N_{MI} = (R_A + R_C + R_D + R_N + R_K + R_R) / 6$)		
1	Asset Rate (%) (R_A)	- The ratio between the value of the assets of a commercial bank and the total value of the assets in the banking sector will be calculated. - Maximum value - 100%
2	Loan Portfolio Rate (%) (R_C)	- The ratio between the value of the loan portfolio of a commercial bank and the total value of the loan portfolio in the banking sector will be calculated - Maximum value - 100%
3	Deposit Portfolio Rate (%) (R_D)	- Calculate the ratio between the value of a commercial bank's deposit portfolio to the total value of the banking sector's deposit portfolio - Maximum value - 100%
4	Non-performing loan portfolio rate (%) (R_N)	- The ratio between the value of the non-performing loan portfolio of a commercial bank and the total value of the non-performing loan portfolio in the banking sector will be calculated - Maximum value - 100%
5	Capital Rate (%) (R_K)	- Calculate the ratio between the total amount of risk exposure of a commercial bank to the total value of the total amount of risk exposure in the banking sector - Maximum value - 100%
6	Risk exposure rate (%) (R_R)	- Calculate the ratio between the capital value of a commercial bank to the total value of capital in the banking sector - Maximum value - 100%

Source: Prepared by the author

At the individual level, indicators will be used to demonstrate the possibility of triggering systemic risk within a commercial bank.

Table 8. The set of indicators and calculation formulas for determining the systemic banks in the Republic of Moldova on individual level

nr.	Indicator	Calculation formula
Individual level ($N_I = R_{PF} + R_{VS} - R_{CV}$)		
1	Non-interest expense coverage rate with non-interest income (R_{CV})	- The ratio of the net non-interest income of a commercial bank to the value of the non-interest expenses related to the bank's interest will be calculated - It will be considered a result higher than 100% - positive trend
2	Individual deposit rate (%) (R_{PF})	- The ratio between the Balance of deposits of individuals of a commercial bank will be calculated to the total value of the bank's deposit portfolio - Maximum value - 100%
3	Rate of balance sheet assets in foreign currency (%) (R_{VS})	- The ratio between the Total balance sheet assets in foreign currency of a commercial bank will be calculated to the total value of the bank's assets - Maximum value - 100%

Source: Prepared by the author

In this order of ideas we conclude that the banking sector in the Republic of Moldova has 4 systemic commercial banks, and the highest systemic risk is 25.95 pp.

The next step is to correlate the indicators for achieving an aggregate index for measuring the vulnerability of the banking sector in the Republic of Moldova to systemic risk. Thus, the calculation formula will be:

$$Z_{VRS} = I_{RS} * (2 - I_v) \quad (2)$$

Following the analysis of the results obtained in table 3.4, it is observed that the self-employed banking sector on 31.03.2015 had 6 commercial banks vulnerable in terms of system risk, namely:

- BC „MOLDOVA - AGROINDBANK” S.A. - 18.77%;
- BANCA DE ECONOMII SA - 24.81%;
- BC BANCA SOCIALĂ SA - 29.22%;
- Mobiasbanca - OTP Group S.A. - 17.36%;
- BC „Moldindconbank” S.A. - 18.56%;
- B.C. VICTORIABANK S.A. - 14.83%.

In this way we conclude that our z-score can determine the vulnerability of the banking sector to the systemic risk induced by commercial banks in the Republic of Moldova.

Previous models have partially demonstrated the impact of vulnerability on systemic risk in the banking sector. Thus, the objective of the regression model is to have a detailed explanation of the early warning indicators of systemic banking crises in the Republic of Moldova.

Below we can see the results of the regression model calculated in the STATA statistical package. An overall assessment of the adequacy of the model did not lead to hetero - Schedasticity. Testing the White test showed that the model is suitable for any chosen significance level of 1%, 5% and 10%, because $PV = 40\%$.

Verification according to regression to multicollinearity revealed it. There are several ways to treat multicollinear regression: changing or increasing the sample, excluding variables, converting multicollinear variables. In our model, the most appropriate solution would be to exclude variables that distort the results.

An important factor in influencing changes in vulnerability to systemic risk is the combined measure of deposit insurance. The deposit insurance ratio was excluded from the model, but its interaction is significantly positive and has the greatest impact on financial stability. The positive effect, despite the rigidity of the regulatory system and the costs associated with complying with rules and regulations, allows us to explain the main function of deposit insurance. This system aims to ensure the sustainable development of the banking system, being a guarantor for depositors.

Model evaluation results:

crisis_4	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
1						
z_bank_res	-7.411045	3.749321	-1.98	0.048	-14.75958	-.0625115
z_unemp	.2576157	.1503448	1.71	0.087	-.0370547	.552286
z_av_00	-.0265056	.0119427	-2.22	0.026	-.049913	-.0030983
z_gdp	-2.615913	.3872449	-6.76	0.000	-3.374899	-1.856927
z_priv_cred2	3.882028	.9979518	3.89	0.000	1.926079	5.837978
z_law	-.8606809	.3008568	-2.86	0.004	-1.450349	-.2710124
z_ext_debt	.0490811	.0367774	1.33	0.182	-.0230013	.1211635
net_foreign	-39.59193	11.2799	-3.51	0.000	-61.70014	-17.48373
ext_debt	-.0355475	.0370059	-0.96	0.337	-.1080778	.0369828
2						
z_bank_res	-10.50298	2.65756	-3.95	0.000	-15.7117	-5.294258
z_unemp	.5284741	.0973938	5.43	0.000	.3375857	.7193625
z_av_00	.0103282	.0058731	1.76	0.079	-.0011829	.0218394
z_gdp	-1.307392	.2456376	-5.32	0.000	-1.788833	-.8259517
z_priv_cred2	-3.588345	1.015246	-3.53	0.000	-5.578191	-1.598499
z_law	-.4274058	.1889404	-2.26	0.024	-.7977222	-.0570894
z_ext_debt	.0661844	.0241859	2.74	0.006	.0187809	.1135879
net_foreign	.1402265	7.177155	0.02	0.984	-13.92674	14.20719
ext_debt	-.0576919	.0250643	-2.30	0.021	-.1068171	-.0085667
Multinomial logistic regression				Number of obs	=	658
				LR chi2(18)	=	781.65
				Prob > chi2	=	0.0000
Log likelihood = -332.05974				Pseudo R2	=	0.5406

(crisis_4==0 is the base outcome)

The next step is to determine the early warning indicators of the entry and exit of savings from a recession. Constructing a dependent variable of a recession entry model

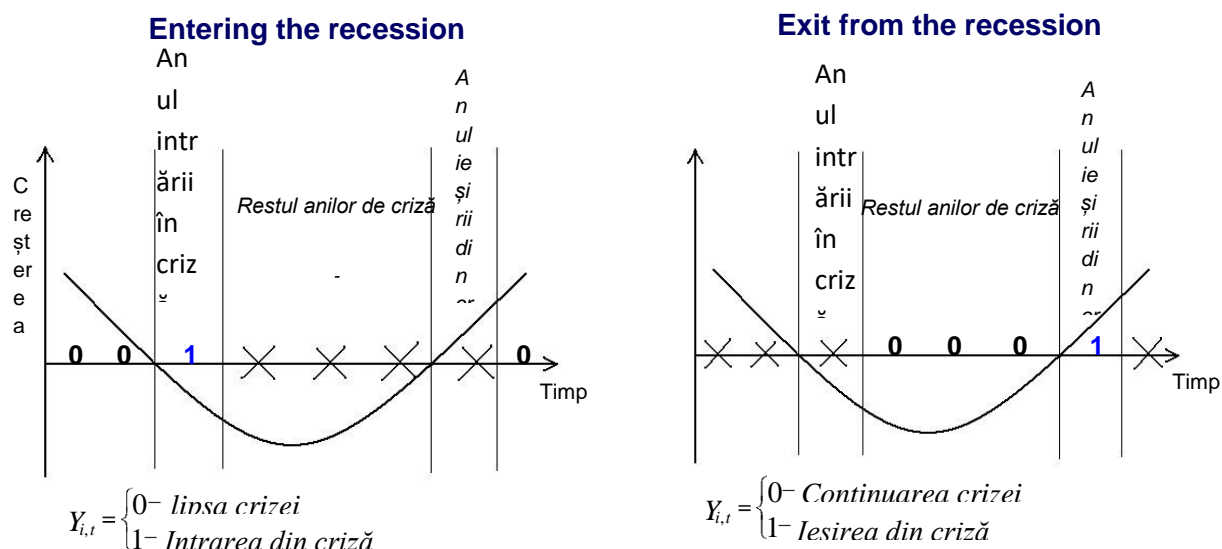


Figure 3.2 Constructing a dependent variable of an input / output model in / out of the recession

$$\Pr - Y_{i,t} = 1 \mid X_{i,t-1} = (\exp X'_{i,t-1} \beta) / (1 + \exp X'_{i,t-1} \beta)$$

$X_{i,t-1}$ - set of explanatory variables for the country and for the year ($t-1$)

β - the vector of the parameters to be evaluated

Following the study, we find the influence of systemic risk on the banking sector in the Republic of Moldova, so we can distinguish a number of dependencies and conclusions. First, all three dependent variables were affected only by GDP growth and the deposit insurance system, combined with the international nature of transactions. In general, domestic commercial banks are in a dynamic developing market with a strict banking control system, which leads to a number of costs for compliance and standards. However, this type of control is more likely to be institutional in nature, being only an instrument of administrative regulation and maintaining the stability of the banking system.

A multi-level integrated approach to commercial bank risk management using a methodology that adapts to the changing banking system is the best solution in the current situation.

3. GENERAL CONCLUSIONS AND RECOMMENDATIONS

The study of the aspects related to the analysis of the vulnerability of the banking sector in the Republic of Moldova to systemic risk was performed by analyzing a variety of bibliographic sources, as well as the analysis of the given topic nationally and internationally. The results of the research were summarized in the following **conclusions**:

- The concept of "systemic risk" is clearly and theoretically described in detail, but there is no consensus between experts and regulators on the practical application. It should be noted that the notion of systemic risk itself is not new. However, in contemporary conditions, there are new directions of study, which have a very important practical character.

Here we first talk about approaches to systemic risk measurement and measurement methods. Obviously, intensive work is being done today, but it is rather to say that evaluation techniques are being developed and it is possible to evaluate the advantages and disadvantages of different approaches in terms of the practical solution to this problem.

Many papers are dedicated to the problem of systemic risk analysis. In our opinion, a complex grouping of the three main types of systemic risk has been proposed by European Central Bank experts. Such an approach clearly demonstrates the diverse nature of systemic risk and the main areas of its occurrence. These are the risk of "contamination" (contagion of the whole system), the risk of macroeconomic shocks (eg simultaneous shocks affecting the economic system) and the risk of imbalances that accumulate over time. These three types of risks are not mutually exclusive and can materialize both separately and in a certain combination.

The risk of "contamination" arises when certain specific problems, as a rule, constantly affect different financial institutions or markets. An example of such a risk may be a situation in which the insolvency of one bank causes the bankruptcy of another, although the second bank could be considered solvent. The second form of systemic risk refers to large-scale exogenous shocks, which at the same time have a negative impact on a number of intermediaries and / or markets. For example, banks have been found to be vulnerable during recessions. The third type of systemic risk refers to the endogenous capacity of large-scale imbalances in the financial system in a short period of time, as happens during the credit boom. Subsequently, (caused by endogenous or exogenous factors) the accumulation of imbalances can have a negative impact on many intermediaries and / or markets.

Obviously, the theoretical and practical aspects of systemic risk require further investigation. It is clear that the macroeconomic models that exist today do not reflect the

relevant aspects of financial stability. Second, theoretical studies should focus on determining both the sources and mechanisms of accumulation of common imbalances. In this regard, for example, attention should be paid to developing appropriate methods for estimating the positive aspects of financial innovation. Thirdly, it is necessary to strengthen the study of certain non-financial intermediaries of systemic importance.

- Globalization and the active involvement of each country's banking systems in the global financial system can lead to the loss of banks' stability, even if, in their opinion, they have pursued a conscious policy with minimal risks.

A better understanding of the relationship between markets, currencies and countries, as well as a clearer definition of the "location" of risk in the financial system is very useful for those public authorities that monitor systemic risk. It is clear that the existence of such comprehensive information will make it possible to act as decisively as possible when signs of systemic risk accumulate.

It is clear that tough regulatory action is easier to justify with reliable data than with suspicions of threats to financial stability.

- The possibility of transferring systemic risks from one financial market to another due to the growing processes of international trade and economic ties requires an assessment of systemic risks in commercial banks not only in their own country but also in countries - trading partners, debtors and creditors, the world's largest economies, countries - holders of reserve currencies.

Risk monitoring requires rapid access to detailed data on the activities of financial institutions and the functioning of both internal and external markets. For several reasons, including related to legal access to information required for supervision, restrictions on the disclosure of information regarding certain markets, difficulties in collecting information on the activities of non-banking intermediaries (including microfinance organizations, insurance), these being just some of the information barriers that cannot be overcome quickly. Thus, in practice, it takes time before a systemic risk monitoring mechanism can work effectively.

Almost all the problems, which together led to the global financial turmoil, were known, including by the financial regulators, before the crisis.

We can say that vulnerability cannot be ruled out, only the immunity of the financial system can be increased. In a globalized and increasingly complex financial environment, the appreciation and promotion of financial stability requires close cooperation - at national and international level - between various supervisory authorities: ministries and government

agencies, central banks, regulators and supervisors. . They also involve maintaining a direct dialogue with financial community actors.

- There are four main systemic risk management issues in commercial banks:

- a. monitoring systemic risks;

- b. identification of systemic risks;

- c. taking systemic risks into account in the bank's plans and strategies;

- d. the impossibility to exclude systemic risks.

The issues mentioned above do not mean that work on measuring and monitoring systemic risk should be suspended. On the contrary, taking into account the globalization of the economy and the interconnection between financial institutions, it is strictly necessary to analyze the systemic risk, to calculate it and to be able to predict it in order to mitigate its effects.

Although the responsibility for monitoring financial stability and early warning lies primarily with national authorities, the financial system is inherently international. This is why there is a clear need for international cooperation and coordination in the areas of financial monitoring, regulation and supervision.

- The banking sector in the Republic of Moldova is a vulnerable one, being influenced by several economic and financial factors, but also political ones. Determining the bankruptcy point of a commercial bank is paramount in the context of a crisis in the Republic of Moldova after the liquidation of 3 commercial banks in 2015. Thus we considered it appropriate to analyze existing models in implementing a model for analyzing the banking market in Moldova.

- The situation of the commercial banks of the Republic of Moldova in 2016, compared to 2008, was several times better, but this did not prevent the loss of stability. The country was facing a new type of crisis, for which it was not prepared.

- The analysis of the dynamics of macroeconomic indicators from previous periods, during and after the global financial crisis of 2016 confirms the impact of systemic risk for commercial banks of the Republic of Moldova and allows the identification of indicators with predictive capacity.

- In international practice, there are a large number of methodologies for assessing systemic risks in commercial banks, but there is still no universal approach to show the complexity and versatility of financial systems, the possibility of unpredictable changes in events. Systemic risk assessment methodologies in commercial banks may fail when faced with a type of crisis that is not embedded in them.

- After analyzing the bankruptcy risk assessment models, we can say that it is possible to divide the risk assessment models into two types:

a. structural models - models in which the risk of bankruptcy depends on changes in the structure of the company's capital. These models are based on the studies of R. Merton (1974).

b. non-structural models - models in which the risk of bankruptcy does not depend on changes in the structure of the company's capital. These models include CreditRisk +, Credit Portfolio View.

The use of the given models becomes difficult to implement due to the non-rating of the Republic of Moldova by the rating agencies, as well as a poorly developed stock exchange. It could be possible to use the KMV model, but with some changes for the situation in the Republic of Moldova, which we will do in the next works.

An instability of the banking sector or a shock can cause serious distortions in the allocation of capital, disrupting market demand and supply, information on which economic agents base their decisions: artificial prices, erroneous profitability assessments, distorted risk divisions, insufficient risk premiums or excessive etc. The problem is that the list of these difficulties always remains open and that they are not easy to diagnose. In these conditions, we consider it opportune to make a series of predictions regarding the possible evolution of the banking sector and its stability.

- Systemic risk assessment techniques in commercial banks in practice for a long time can also not work flawlessly. Works with statistical information that is already history. Also, in many countries there are problems with the availability and quality of information.

- The development of the world's financial systems requires that the composition and weights of macroeconomic indicators analyzed in the systemic risk assessment methodologies in commercial banks be dynamic and change with the system itself, which gives the methodology the property of self-improvement, thus increasing the quality of the forecasts.

- The use of the values of a complex indicator for assessing systemic risks in commercial banks adapted to modern conditions to adjust the discount rate in the business plans of commercial banks allows the integration of risk management system elements in the bank's plans and strategy, making it possible to predict the most risky periods. the activity of the bank.

- Improving the quality of banking supervision is possible by using an integrated approach at 4 levels (financial markets, commercial banks, the country's economy, the world economy), covering a wide range of economic entities and allowing activity at different time intervals. The use of the systemic risk assessment methodology in commercial banks in banking

supervision will allow the follow-up of negative macroeconomic trends and, based on the results obtained, the adjustment of the country's monetary policy.

In order to solve the problems researched in this paper and summarized in conclusions, we propose the following **recommendations**:

- The adjustment of the definitions of systemic risk and vulnerability is necessary both in the literature and in normative acts, using them in a more complex sense. Thus, the author proposed complex definitions for the given notions;

- Within the banking sector in the Republic of Moldova, supervision and control must be approached from a systemic point of view, and the use of instruments by the NBM on banks must be done depending on the size and complexity of the services provided by the bank;

- Use of a complex indicator for assessing systemic risks in the banking sector in the Republic of Moldova. This will make it possible to introduce in the risk management system scientifically grounded theories of macroeconomic risks, including through the methodology for adjusting the discount rate in the business plans submitted to banks. The author proposed an aggregate indicator for the analysis of the vulnerability of the banking sector in the Republic of Moldova to systemic risk, which analyzes individual, microeconomic and macroeconomic factors;

- The problem of assessing the vulnerability of the financial-banking sector of the countries of South-Eastern Europe, including the Republic of Moldova, consists in the fact that the qualitative factors prevail over the quantitative ones. To reduce the influence of qualitative factors it is strictly necessary to improve quantitative indicators. This can be done by:

- a. Attracting foreign investments in the banking sector, thus the capitalization of banks will take place;

- b. Forced transition to BASEL III rules;

- c. Periodic evaluation of the financial sector based on a set of quantitative indicators adjusted to international standards.

- There is a need to increase the transparency of commercial bank shareholders in determining the beneficial owner. At the same time, we believe it is necessary to present to public consultation the legislative rules related to the financial sector.

Implementation of scientific results. The most important research results, presented in the thesis, were accepted for implementation in determining the promising areas of banking risk management, especially in monitoring and assessing systemic risks in commercial banks. The paper confirms the importance of the existing problem and provides a scientific basis for

economically feasible ways to solve it, taking into account the insufficient development of this topic in scientific research dedicated to commercial banks of the Republic of Moldova.

Suggestions for future research directions related to the topic. We believe that in the future researchers could study in more depth the systemic risk assessment methodology in commercial banks, adapted by the author to modern conditions, can be used by commercial banks and the Central Bank to assess systemic risks by investors when predicting the situation. market and assess investment risks by companies when making investment decisions.

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Adnotare
la teza pentru obținerea gradului științific de doctor în științe economice
„Vulnerabilitatea sistemului bancar din Republica Moldova față de riscul sistemic”
Lopotenco Vadim, Specialitatea: 522.01. Finanțe, Chișinău, 2021

Structura tezei: introducere, trei capitole, concluzii generale și recomandări, bibliografia alcătuită din 190 de titluri, 13 anexe și este expusă pe 114 pagini text de bază și conține 27 tabele, 21 figuri și 19 formule. Cercetările sunt reflectate în 19 publicații științifice.

Cuvinte cheie: transparență, sector bancar, vulnerabilitate, spălare de bani, risc sistemic, stabilitate financiară, volatilitate, șocuri financiare, risc de contaminare, criză, reglementarea sectorului bancar, Basel III, criză financiară, redresare economică, risc de credit, bancă comercială.

Domeniul de studiu: finanțe, activitate bancară.

Scopul cercetării constă în identificarea, dezvoltarea și aplicarea mecanismului de gestiune a vulnerabilității sectorului bancar din Republica Moldova față de riscul sistemic.

Obiectivele cercetării: Cercetarea ipotezelor teoretice asupra crizelor de sistem, criteriilor de vulnerabilitate a sistemului și a componentelor sale, formularea opiniei privind determinarea riscului sistemic și a vulnerabilității sistemului bancar; identificarea componentelor cuantificabile de vulnerabilitate a unui sistem bancar, aplicarea modelului de evaluare pentru identificarea gradului de fragilitate a sistemului bancar autohton; analiza experienței internaționale de aplanare a riscului sistemic cu posibilele transpuneri a rezultatelor pozitive a acestor experiențe în recomandările privind gestiunea vulnerabilității sistemului bancar autohton; formularea mecanismului de diminuare a vulnerabilității sistemului bancar la riscul sistemic prin practici de supraveghere.

Noutatea științifică constă în: formularea unei viziuni clare asupra conceptului de risc sistemic și vulnerabilitatea a sistemului bancar; identificarea unor noi criterii cuantificabile de vulnerabilitate a sistemului bancar, formularea unui model de evaluare a acestei vulnerabilități cu propunere spre utilizarea lui la formularea deciziilor de supraveghere bancară; identificarea capacității sistemului bancar de absorbție a riscului sistemic, propunerea unor soluții eficiente de gestiune a riscului sistemic și diminuare efectelor lui asupra economiei; simularea corelației dintre gradul de vulnerabilitate a sistemului bancar și posibilitatea de anticipare a riscului sistemic cu identificarea limitelor de rezistență pentru un set de indicatori de stabilitate financiară a sistemului bancar; formularea propunerilor privind optimizarea supravegherii bancare atât la nivel microprudențial prin stabilirea limitelor de expunere la risc a băncilor, precum și la nivel macroprudențial prin formarea unui cadru stabil de anticipare a riscului de sistem.

Problema științifică importantă soluționată în domeniul de cercetare constă în fundamentarea științifică și metodologică a mecanismului de gestiune a riscului sistemic în redresarea sectorului bancar în situație de criză, iar direcțiile de soluționare a problemei de cercetare vor fi axate pe dezvoltarea unui sistem de diagnosticare a situației de criză și particularităților gestiunii crizei în baza riscului sistemic, precum și dezvoltarea modelelor de gestiune a riscului sistemic în sectorul bancar din Republica Moldova.

Semnificația teoretică și valoarea aplicativă a tezei sunt determinate de cercetarea și dezvoltarea conceptelor de risc sistemic și vulnerabilitatea sectorului bancar față de riscul sistemic; elaborarea modelelor de diagnosticare a situației de criză în cadrul sectorului bancar; fundamentarea particularităților metodologice ale riscului sistemic în redresarea sectorului bancar autohton; evidențierea problemelor și restricțiilor în gestiunea riscului sistemic în practica Republicii Moldova.

Modelele propuse în cadrul tezei vor contribui la operativitatea depistării situațiilor de criză, localizării ariei de influență și găsirea soluțiilor de depășire a acestora.

Rezultatele cercetărilor efectuate vor putea fi utilizate în activitatea practică a băncilor comerciale, în sectorul bancar autohton, în sistemul de instruire a cadrelor din economia națională și a studenților de la instituțiile de învățământ superior cu profil economic, etc.

Аннотация
к диссертации на соискание ученой степени доктора экономических наук
«Уязвимость банковской системы Республики Молдова перед системным риском»
Лопотенко Вадим, Специальность: 522.01. Финансы, Кишинев, 2020

Структура диссертации: введение, три главы, общие выводы и рекомендации, библиография, состоящая из 190 наименований, 13 приложений, представлена на 114 страницах основного текста и содержит 27 таблиц, 21 рисунок и 21 формулу. Исследование отражено в 19 научной публикации.

Ключевые слова: прозрачность, банковский сектор, уязвимость, отмывание денег, системный риск, финансовая стабильность, финансовые шоки, риск заражения, кризис, банковское регулирование, Базель III, финансовый кризис, восстановление экономики, кредитный риск, коммерческий банк.

Сфера обучения: финансы, банковское дело.

Цель исследования - выявить, разработать и применить механизм управления уязвимостью банковского сектора в Республике Молдова к системному риску.

Задачи исследования: исследование теоретических гипотез о системных кризисах, критериев уязвимости системы и ее компонентов, формирование мнения об определении системного риска и уязвимости банковской системы; выявление поддающихся количественной оценке компонентов уязвимости банковской системы, применение модели оценки для определения степени уязвимости национальной банковской системы; анализ международного опыта урегулирования системных рисков с возможным переносом положительных результатов этого опыта в рекомендации по управлению уязвимостью национальной банковской системы; формулирование механизма снижения уязвимости банковской системы к системному риску посредством практики надзора; постановка целей макропруденциальной политики путем исследования связей между банковской системой и реальной экономикой. Возможные несоответствия между двумя элементами могут быть результатом ошибок в области регулирования и надзора за банковским сектором, а также изменений в макроэкономической политике, которые порождают дисбалансы, превращающие системный риск в экономический кризис.

Научная новизна состоит в: формулировании четкого видения концепции системного риска и уязвимости банковской системы; определении поддающихся количественной оценке новым критериев уязвимости банковской системы, формулирование модели для оценки этой уязвимости с предложением по ее использованию при формулировании решений по банковскому надзору; определение способности банковской системы абсорбировать системный риск, предлагая эффективные решения для управления системным риском и уменьшая его влияние на экономику; моделирование корреляции между степенью уязвимости банковской системы и возможностью прогнозирования системного риска с определением лимитов сопротивления для набора показателей финансовой устойчивости банковской системы.

Важная научная проблема, решаемая в области исследования, состоит в научно-методическом обосновании механизма управления системными рисками при восстановлении банковского сектора в кризисной ситуации, а направления решения исследовательской задачи будут ориентированы на разработку системы диагностики ситуации. кризис и особенности антикризисного управления на основе системного риска, а также разработка моделей управления системными рисками в банковском секторе Республики Молдова.

Теоретическая значимость и прикладная ценность диссертации определяются исследованием и развитием концепций системного риска и уязвимости банковского сектора к системному риску; разработка моделей диагностики кризисной ситуации в банковском секторе; обоснование методологических особенностей системного риска при оздоровлении отечественного банковского сектора; выделение проблем и ограничений в управлении системными рисками в практике Республики Молдова.

Предлагаемые в диссертации модели будут способствовать оперативному выявлению кризисных ситуаций, определению зоны влияния и поиску решений по их преодолению.

Результаты исследований смогут быть использованы в практической деятельности коммерческих банков, в отечественном банковском секторе, в системе подготовки кадров национальной экономики и студентов высших учебных заведений экономического профиля и т.д.

Annotation
to the thesis for obtaining the scientific degree of Phd in economics
"Vulnerability of the banking system in the Republic of Moldova to systemic risk"
Lopotenco Vadim, Specialty: 522.01. Finance, Chisinau, 2020

Thesis structure: introduction, three chapters, general conclusions and recommendations, bibliography consisting of 190 titles, 13 annexes and is presented on 114 pages of basic text and contains 27 tables, 21 figures and 21 formulas. The research is reflected in 19 scientific publications.

Keywords: transparency, banking sector, vulnerability, money laundering, systemic risk, financial stability, volatility, financial shocks, contamination risk, crisis, banking regulation, Basel III, financial crisis, economic recovery, credit institution, credit risk, commercial bank.

Field of study: finance, banking.

The purpose of the research is to identify, develop and apply the mechanism for managing the vulnerability of the banking sector in the Republic of Moldova to systemic risk.

Research objectives: Researching the theoretical hypotheses on system crises, the criteria of vulnerability of the system and its components, formulating the opinion on determination of systemic risk and the vulnerability of the banking system; identification of new quantifiable components of vulnerability of a banking system, application of the evaluation model for identifying the degree of fragility of the domestic banking system; analysis of the international experience of systemic risk settlement with the possible transpositions of the positive results of these experiences in the recommendations regarding the management of the vulnerability of the domestic banking system; formulating the mechanism for diminishing the vulnerability of the banking system to systemic risk through supervision practices; setting macroprudential policy objectives by researching the connections between the banking system and the real economy. Possible mismatches between the two elements may be the result of errors in the areas of regulation and supervision of the banking sector, as well as changes in macroeconomic policies that generate imbalances turning systemic risk into economic crisis.

The scientific novelty consists in: formulating a clear vision on the concept of systemic risk and the vulnerability of the banking system; identifying quantifiable criteria for vulnerability of the banking system, formulating a model for assessing this vulnerability with a proposal for its use in formulating banking supervision decisions; identifying the capacity of the banking system to absorb systemic risk, proposing efficient solutions for systemic risk management and reducing its effects on the economy; simulating the correlation between the degree of vulnerability of the banking system and the possibility of anticipating systemic risk with the identification of resistance limits for a set of indicators of financial stability of the banking system.

The important scientific problem solved in the field of research consists in the scientific and methodological substantiation of the systemic risk management mechanism in the recovery of the banking sector in crisis situation, and the directions for solving the research problem will be focused on developing a system for diagnosing the situation. crisis and the peculiarities of crisis management based on systemic risk, as well as the development of systemic risk management models in the banking sector of the Republic of Moldova.

The theoretical significance and applicative value of the thesis are determined by the research and development of the concepts of systemic risk and the vulnerability of the banking sector to systemic risk; elaboration of models for diagnosing the crisis situation within the banking sector; substantiation of the methodological peculiarities of the systemic risk in the recovery of the domestic banking sector; highlighting problems and restrictions in systemic risk management in the practice of the Republic of Moldova.

The models proposed in the thesis will contribute to the efficiency of detecting crisis situations, locating the area of influence and finding solutions to overcome them.

The results of the researches will be able to be used in the practical activity of the commercial banks, in the domestic banking sector, in the training system of the cadres from the national economy and of the students from the higher education institutions with economic profile, etc.

LOPOTENCO VADIM

**VULNERABILITY OF THE BANKING SYSTEM IN THE
REPUBLIC OF MOLDOVA TO SYSTEMIC RISK**

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