“Identification of the critical level in accumulation of systemic financial risk in the economy of countries of Central and Eastern Europe”

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SECTION 1. Macroeconomic processes and regional economies management

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Identification of the critical level in accumulation of systemic financial risk in the economy of countries of Central and Eastern Europe

Abstract

The paper presents the improvement of scientific and methodical approach to the identification of thresholds of indicators for the buildup of systemic financial risks. The testing of the approach developed by the example of the group of Central and Eastern European countries makes it possible to identify threshold and critical levels of indicators of macroeconomic development, which threaten the financial stability of the evaluated countries.

Keywords: leading indicators, systemic financial risk, signal approach, financial risk monitoring.
JEL Classification: G 32.

Introduction

An important aspect of ensuring macroeconomic stability is the monitoring of systemic financial risk, the main task of which, given the fact that systemic risk as a phenomenon cannot be reduced or avoided, because it is formed across the whole economic system, is not the minimization of the accumulated risk, but its early detection and development of measures to reduce its destructive effects. That is why for the timely and comprehensive risk monitoring it is vital to identify the critical level in the accumulation of systemic financial risk in the economy.

Analysis of the latest research and publications. The foundations of the approach to identifying the leading indicators of currency crises in the economy were developed by K. Reinhardt, G. Kaminsky and C. Lizondo [4]. The testing of this approach was also conducted by G. Kaminsky for banking crises [1]. It is worth mentioning the contribution of Russian scientists in this field, in particular, the achievements of K. Mamonov in developing the methodology for determining the relevant indicators [2], the results obtained by A. Pestova in the process of stress testing of the Russian banking system [3] and the dynamic approach to the monitoring of financial stability in the group of countries with transition economies developed by P. Trunin and E. Inozemtsev [5].

Earlier unsolved aspects of the problem. Despite the relatively large number of approaches and their modifications to the definition of leading indicators of financial crises, the effectiveness of the existing methods for assessing systemic financial risks in the economy is low due to the fact that the available historical data is not always sufficient to conduct adequate forecasting of economic development. In addition, a significant number of factors that affect the functioning of the economic system cannot be considered simultaneously leading to the need to simplify the modeling process.

The purpose of the article is to build a system of indicators of systemic financial risk's accumulation and establishing their threshold values on the example of the group of Central and Eastern Europe countries.

The main material. Today, in the practice of systemic financial risk assessment the most effective and common is a signal approach to the formation of a system of early diagnostics of financial crises, the foundations of which were developed by K. Reinhart, G. Kaminsky and S. Lizondo [4] to assess the likelihood of currency crises. This approach is based on the analysis of dynamics of macroeconomic and financial indicators in an economically stable period, a period preceding the crisis, and directly in the period of the crisis. The role of a specific indicator is in sending "signals" – about achieving a certain threshold value, after which, within a specified period, there is the emergence of crisis in the economy.

This approach is based on the following assumptions:

- "warning period" – the time period during which the crisis grows after a signal is given by a corresponding indicator set at 24 months;
- a threshold value of an indicator is defined as a deviation from the average level of an indicator, which was observed in the study

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period, which serves as a "signal" regarding the crisis (the evaluation was conducted at a deviation value of 10%, as well as at the level of deviation of 10-20%). This deviation was assessed in a differentiated way towards increasing or decreasing, depending on the nature of the chosen indicator.

The efficiency of an indicator in predicting the emergence of a crisis is defined as a minimum ratio of "noises" (deviations) that are not accompanied by subsequent emergence of a crisis) to "signals". In order to evaluate the research of indicators a matrix of observations is formed (Table 1).

Table 1. The values of crisis indicators [4]

	The presence of crisis within a "signal window"	Absence of crisis within a "signal window"
"Signal" was given	A	B
"Signal" was not given	C	D

According to Table 1, A is a number of months in which the indicator gave a good signal, B – a number of months with a bad signal – "noise", C – a number of months in which the indicator gave no signal (which could be classified as a good signal), D – a number of months in which the indicator gave no signal (which could be classified as a "noise"). Therefore, the value of a perfect indicator is exclusively in groups "A" and "D".

The conclusion about the effectiveness of a particular indicator is based on the assessment of the following parameters:

- the level of "noise" (formula 1) is the ratio of the adjusted level of bad signals to the adjusted level of good signals;

$$Noise = \frac{B/(B+D)}{A/(A+C)}, \quad (1)$$

- unconditional probability of a crisis (formula 2) – an indicator, which reflects crisis periods during the studied period;

$$Prob = \frac{A+C}{A+B+C+D}, \quad (2)$$

- conditional probability of a crisis (formula 3) – the probability of crisis in the event of a "signal" given by an indicator.

$$Prob_{conditional} = \frac{A}{A+B}. \quad (3)$$

The criteria for the effectiveness of a particular indicator are the minimization of the noise level and a higher value of the conditional probability of crisis in comparison with unconditional probability of its occurrence.

Despite the high effectiveness of this approach (the authors conducted the research of 76 crises in 20 countries revealing that most of them were preceded by "signals" given by the estimated indicators), as well as the development of its modifications in the scientific literature, there are certain drawbacks that limit its possible practical application in the process of monitoring of systemic financial risk, which have not been fixed.

In particular, it is necessary to determine the duration of the "signal window" because the 24 month period does not allow to apply regulatory measures aimed at reducing the effects of the financial crisis (it is worthy considering the fact that in calculations performed by the authors the average lag between the first given signal and the onset of the currency crisis was 15-16 months [4]). In addition, pre-defined threshold values of deviations of the indicator also create limitations for forecasting, because it is impossible to determine a universal level of critical volatility for different evaluated indicators.

Therefore, in order to monitor the accumulation of systemic financial risks it is proposed to use the advanced signal approach by making the following modifications:

- differentiation of the "signaling window" duration for different indicators of economic development based on the definition of time lags of their dependence on the indicators of the economy's stable functioning;
- identification of threshold value of indicators based on their performance in assessing the likelihood of financial crisis.

To determine the duration of "signal window" for each indicator of macroeconomic development, we carried out identification of time lags of the relationship of its volatility with changes in the level of economic growth defined by the dynamics of the gross domestic product (growth relative to the same quarter in the previous year, given the seasonal character of the indicator). For this purpose we use a correlation analysis, which builds a matrix of the level of dependencies for a particular parameter of financial crisis on the values of each of the selected parameters for the period with lags up to 12 quarters. The algorithm for conducting the analysis of indicators for monitoring the accumulation of systemic financial risks in the economy is shown in Fig. 1. In order to reflect various sources of systemic risk,

indicators for the calculations were chosen in the context of different institutional sectors of the economy. It should be noted that the presented division is rather conditional, since all of the indicators are macroeconomic in nature, and close economic relationships between the economy's sectors makes it impossible to separate the indicators that characterize their functioning.

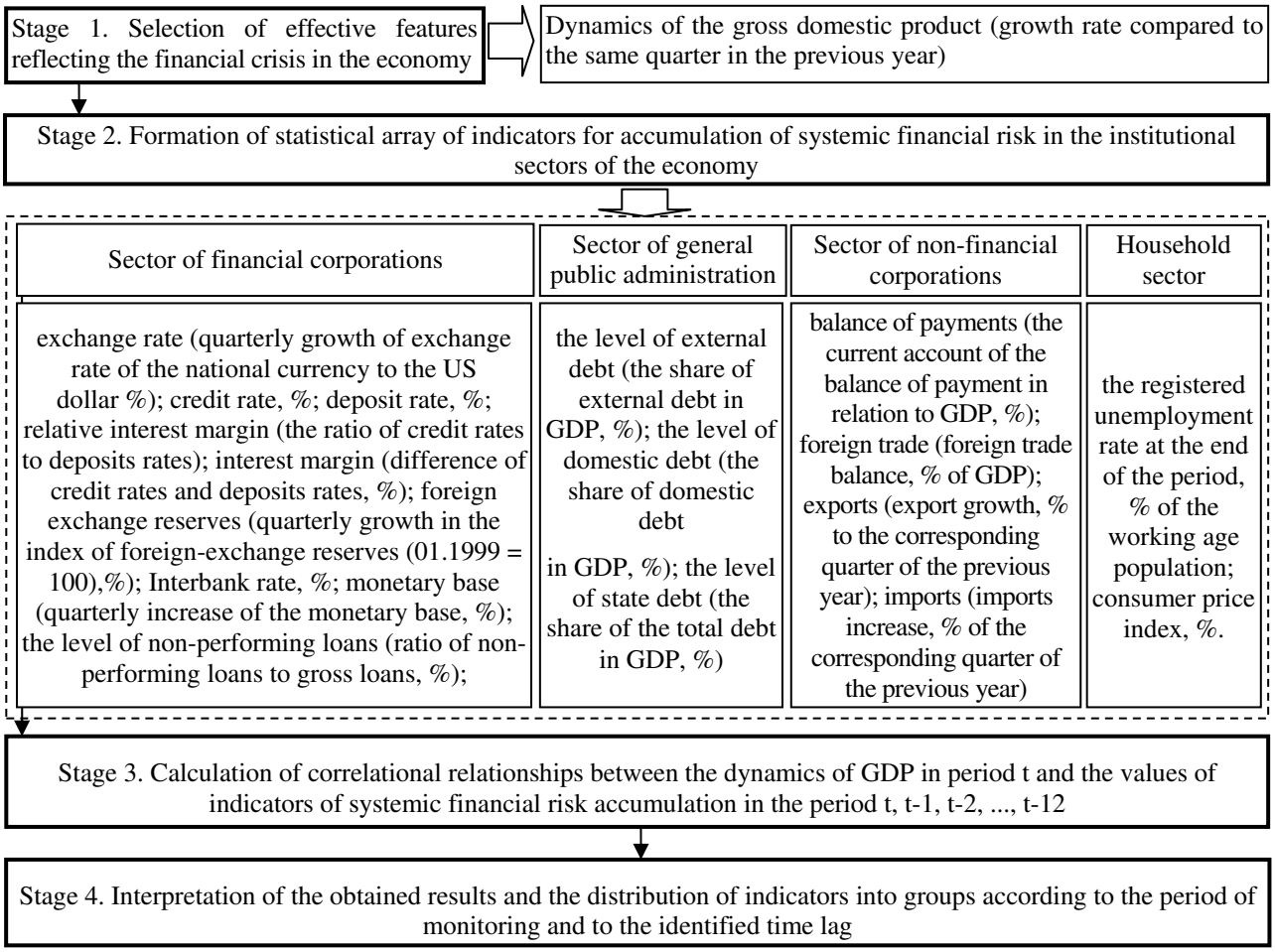

Fig. 1. Algorithm for determining the relevant indicators for monitoring the accumulation of systemic financial risk

The study was conducted for the group of Central and Eastern European countries, which are close according to the specific economic and historic development of Ukraine, and, therefore, are characterized by similar economic processes and includes six countries – Ukraine, Poland, Czech Republic, Hungary, Bulgaria and Latvia. The research covers the period from 1998 to 2013.

The assessment included the building of a matrix for the level of dependencies of the financial crisis parameter on the values of each of the selected indicators for the period up to 12 quarters and determining the period with the strongest relationship. Calculations were carried out separately for each country making it possible to differentiate time lags in terms of indicators and specific features of national economies. According to the results of the correlation analysis the evaluated indicators can be divided into two categories – indicators that should not be used for assessing the level of systemic financial risks and indicators that are suitable for identifying the level of the accumulated systemic financial risk.

Indicators of the first category are characterized by the absence of time lags of their values with dynamics of the effective indicator (maximum correlation coefficient is observed for the values of the indicator in period t) reflecting the onset of a systemic crisis, and, therefore, cannot be used to assess the level of the accumulated systemic financial risk and to predict the probability of its realization.

At the same time, the study has revealed the indicators of institutional sectors' development, which can be used for evaluation of the accumulated systemic financial risk. Depending on the duration of the time lag between the values of indicators and the level of effective indicator of the functioning of Ukraine's economy, these indicators were divided into three categories (early response indicators, timely response indicators and indicators of strategic regulation), as shown in Table 2.

Table 2. Results of grouping of the indicators according to the ability to predict the level of the accumulated systemic risk in the economy of Ukraine

Group	Indicators	Response period
Early response indicators	Exchange rate	1 quarter
	The level of deposits in banks, which are liquidated	1 quarter
	Financial depth of the economy	1 quarter
	Retail turnover	1 quarter
	The level of external debt	2 quarters
	Refinancing rate	2 quarters
	Number of banks	2 quarters
	Capital investments	2 quarters
	Budget revenues	3 quarters
	Budgetary expenditures	3 quarters
Timely response indicators	Consumer price index	4 quarters
	Balance of payments	4 quarters
	Foreign trade	6 quarters
	Loans of banks under liquidation	6 quarters
Indicators of strategic regulation	Deposits of banks under liquidation	7 quarters
	Foreign exchange reserves	7 quarters
	Loans of commercial banks	7 quarters
	The level of capital investments	8 quarters
	Credit rate	9 quarters
	Interest margin	9 quarters
	Unemployment level	9 quarters
	Discount rate of NBU	10 quarters
	Interbank rate	11 quarters
	The level of refinancing	12 quarters
	Relative interest margin	12 quarters

Thus, the results of calculations show a relatively high information content of indicators that reflect the functioning of various institutional sectors at different time intervals, supporting the hypothesis about the accumulation of systemic financial risk in all areas of the country's economic system. For the purpose of selecting a set of universal indicators it is advisable to carry out the interpretation of the obtained results at a level of the estimated range of countries. Thus, the distribution of factors for the formation of systemic risk according to the duration of time lags for other countries of Central and Eastern Europe is shown in Table 3.

Analyzing the obtained indicators, it is worth noting the presence of significant differences regarding their statistical significance in different countries. Along with this, we should pay attention to the fact that there are common indicators in individual categories, which occur with higher frequency than other parameters. In particular, the group of early response indicators includes export, import, credit rate, interest margin, interbank rate, deposit rate and relative interest margin.

Table 3. Results of grouping of the indicators of systemic financial risk accumulation and its realization in the economies of Central and Eastern European countries

Group	Country					Lag
	Poland	Czech Republic	Hungary	Bulgaria	Latvia	
Early response indicators	The level of domestic debt, export	Exports, imports, credit rate, interest margin	-	Import, relative interest margin	Deposits of commercial banks, export, import, credit rate, monetary base	1 qtr.
	-	Foreign exchange reserves	-	-	Interbank rate, deposit rate, interest margin	2 qtr.
	The level of public debt	Interbank rate, deposit rate	Relative interest margin	Export	-	3 qtr.
Timely response indicators	Interbank rate	The level of public debt, relative interest margin	-	Exchange rate, the level of domestic debt	The level of domestic debt	4 qtr.
	Balance of payments, relative interest margin	The level of external debt	The level of external debt, interest margin, monetary base	Deposits of commercial banks	-	5 qtr.
	The level of external debt	Level of unemployment	Level of unemployment	Foreign trade	Foreign exchange reserves	6 qtr.
Indicators of strategic regulation	-	Consumer price index	Credit rate, deposit rate	The level of external debt, interbank rate, consumer price index, foreign exchange reserves, credit rate, deposit rate, interest margin, monetary base	Exchange rate, consumer price index	7 qtr.
	Foreign trade	-	Exchange rate	-	Relative interest margin	8 qtr.
	monetary base	-	Deposits of commercial banks, the level of public debt, the level of domestic debt	The level of public debt, balance of payments	Balance of payments, foreign trade	9 qtr.

Table 3 (cont.). Results of grouping of the indicators of systemic financial risk accumulation and its realization in the economies of Central and Eastern European countries

Group	Country					Lag
	Poland	Czech Republic	Hungary	Bulgaria	Latvia	
Indicators of strategic regulation	-	-	Foreign exchange reserves	Unemployment level	Unemployment level	10 qtr.
	-	-	-	-	-	11 qtr.
	Deposits of commercial banks, exchange rate, unemployment rate, the level of non-performing loans	Deposits of commercial banks, balance of payments, foreign trade, monetary base, the level of non-performing loans	-	-	-	12 qtr.

The most common indicators are the indicators of exports and imports, which show that the dynamics of foreign economic relations is characterized by close relationship with the countries' economic development, and in the short term perspective it impacts the macroeconomic stability more than the parameters that characterize the functioning of the internal market.

Analyzing the group of timely response indicators, we should note that it is often represented by such parameters as the level of external and domestic debt, unemployment level and relative interest margin. Therefore, we can conclude that state borrowings cannot provide a rapid effect on the economy's development while stagnation in the employment sector is reflected at the level of macroeconomic stability.

Quite interesting is an indicator of relative interest margin, which shows that the level and influence of the banking system on the economy as a whole depends on the specific features of its functioning.

With regard to indicators that have a long-term impact on the level of economic development, we should point to the indicators such as foreign trade, monetary base, deposits of commercial banks, exchange rate, unemployment rate, consumer price index, credit and deposit rates, the level of public debt, balance of payments, which appear two to three times in the investigated sample, which reflects a long-term relationship of these indicators with the level of macroeconomic stability.

Comparing the trends in the economy of Ukraine and the countries of Central and Eastern Europe, it is worth noting the presence of significant differences in the patterns of distribution of the identified indicators in the context of the studied groups. Thus, the composition of the early response indicators defined for Ukraine does not include any of the indicators that were relevant to other European countries. A similar situation is observed with the group of timely response indicators, in which we can stress an indicator of the balance of payments, a midterm connection of which to the dynamics of GDP is observed for both Ukraine and Poland. Along with this, we should note that those indicators of strategic regulation identified for Ukraine, the relationship of which with the gross domestic product was estimated for other countries, were relevant in at least one of five cases, and similarly for the national economy, demonstrating the presence of a long-term impact on economic development.

During the next phase of our research we will conduct the calculation of the probability of financial crisis based on the values of indicators forming the systemic financial risk on the example of a particular country's economy. The approbation of this approach was conducted for the economy of Ukraine for the period 1995-2013. In the calculations we used quarterly data for the indicators that reflect accumulation of systemic risk in various institutional sectors of the economy, the time lags of which and their relationship with macroeconomic stability indicators were defined in the previous chapter.

During the studied period there were four crises recorded in Ukraine's economy – 1998-1999, 2004, 2007-2008 and 2013. Given the fact that these financial crises had their origins in different economic sectors, during the process of evaluation we used the time lags of the relationship of indicators with the dynamics of gross domestic product as an indicator that reflects the stability of the economy as a whole. Thus, in assessing the signals given by the indicators, crisis periods and periods within a year of the crisis events are not considered directly, because in these critical phases of an economic cycle critical values of indicators do not have a prognostic effect, but are the result of destabilization in the economy.

It should be noted that in the process of research we assessed the probability of crisis events both after surpassing maximum threshold values of the selected indicators and after reducing their level in order to diagnose the maximum number of manifestations of economic destabilization. The results of the calculations are presented in Table 4.

Table 4. Results of the assessment of the probability of crisis at threshold values of indicators of economic development in Ukraine

Indicators	Threshold value	Unconditional probability of a crisis	Conditional probability of a crisis	Noise level
Sector of financial corporations				
Dynamics of foreign exchange reserves	2	0.718	0.778	0.727
	5		0.750	0.848
	10		0.692	1.131
Sector of non-financial corporations				
Foreign trade	5	0.643	0.643	1.000
	0		0.736	0.643
	-1		0.800	0.450
Balance of payments	5	0.429	0.444	0.938
	0		0.533	0.656
	-1		0.800	0.188
Sector of households				
Consumer price index	1	0.372	0.269	1.608
	3		0.133	3.852
	6		0.250	1.778

Thus, analyzing the obtained results, we can note the existence of the following regularities, which reflect the probability of financial risk's realization under certain conditions in the functioning of various institutional sectors of the Ukrainian economy. In particular, the possibility of macroeconomic destabilization is manifested in the increase of foreign-exchange reserves by more than 2% from the previous year. At the same time, other parameters are not statistically significant. Regarding the field of general state management, it can be noted that the assessment of the selected indicators did not lead to statistically significant results.

Analyzing the role of parameters that reflect the functioning of the sector of non-financial corporations in Ukraine and predicting systemic financial risks, we should note that the reduction of the trade balance to GDP as well as the current account balance to GDP by 1% is the basis for forecasting economic destabilization with the probability of 80%. At the same time, consumer price index as an indicator that reflects the accumulation of systemic risk in the household sector was not a statistically significant indicator to be used in the monitoring of systemic financial risks.

It should be noted that the calculations carried out for a number of other indicators did not yield adequate results, which would be suitable for use in forecasting. In this context, one should pay attention to several aspects that do not allow an effective prediction of the potential financial crisis based on a specific country, resulting in the exclusion of a number of indicators from the evaluation process:

- high frequency of financial crises in the investigated period (maximum period of economic stability: four years) and significant time lag of some indicators explains the artificial leveling of the noise level. Therefore, the results of the evaluation of such parameters as relative interest margin, interbank rate, unemployment level and credit rate were not considered;
- insignificant time lag for certain individual indicators and the absence of significant dynamics in these time intervals compared to previous years (typical for the indicator of exchange rate);
- the research period also covered the 1990s, which were characterized by higher volatility of indicators, which could lead to the distortion of results.

That is why we conduct a similar study for the group of Central and Eastern European countries. In order to avoid the impact of mid-term economic cycles we chose a period 2001-2013 for Ukraine and a period 2001-2009 for Central and Eastern Europe (the end of the study period is limited to the last known year of the crisis, considering the retrospective nature of this phase in the analysis).

In the research, the crisis periods were 2004, 2007-2008 and 2013 for Ukraine and 2007-2008 for the rest of the sample. As in the previous stage, in assessing the signals given by the indicators, crisis periods as well as the period within a year of crisis events in the economy were not considered.

The calculation results revealed a statistically significant number of indicators suitable for use in the monitoring of systemic financial risk in the economy, which reflect a significant and critical level of its accumulation. In particular, in the financial corporations sector the most adequate results were found for such indicators as exchange rate gains, the level of interbank rates, the level of interest margin, the share of non-performing loans and the level of credit rates.

Thus, we consider the results in more detail in the context of individual indicators. Figure 2 shows the distribution of probabilities of the potential financial crisis considering noise levels with different values of the dynamics of exchange rate of the national currency to the US dollar.

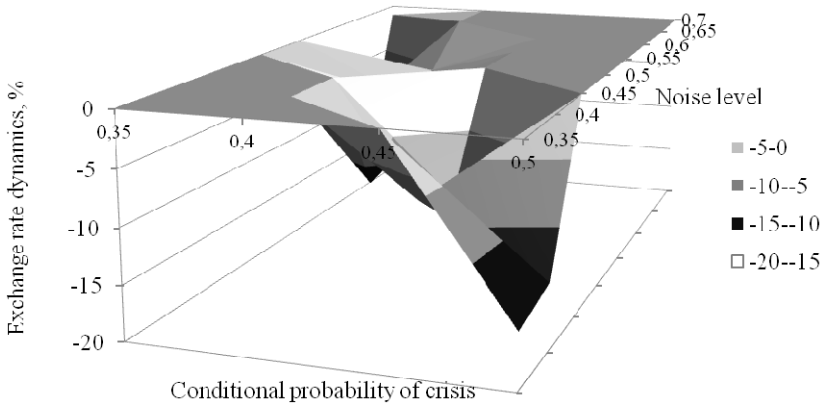

Fig. 2. Distribution of the probabilities of crisis in Central and Eastern Europe, depending on the dynamics of exchange rate

From the data we can see that a critical indicator of systemic financial risk accumulation in the sector of currency circulation is the decline in the exchange rate of the national currency to the US dollar at the level of 15-20% compared to the value of the previous quarter. The conditional probability of financial crisis increases to 50% at very low noise levels. It should be noted that the absolute probability of crisis in this case is 0.242 indicating a fairly high level of statistical significance of this indicator. At the same time, specifying the obtained results, we should note that with the devaluation of the national currency at the level of 8% there is a significant increase in the probability of financial destabilization of the economy (45% if the noise level is 0.4), and the threshold value of 15%.

Another relevant indicator showing the probability of systemic risk accumulated in the sector of financial corporations is interbank rate, the results of calculations of which are presented in Fig. 3.

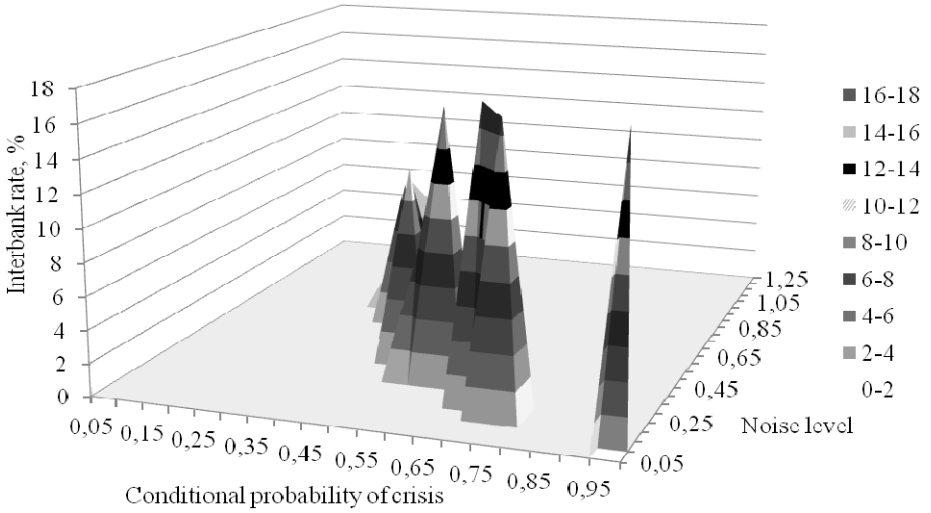

Fig. 3. Distribution of the probabilities of crisis in Central and Eastern Europe depending on the level of interbank rate

Thus, a threshold value of this indicator is its exceeding the level of 7.5% when the probability of financial crisis reaches 55% with the noise level of 0.35 (unconditional probability of crisis is 0.316). At the same time, a further increase of the growth rate determines a feasibility of systemic financial risk – if the value of interbank rate reaches 16.5% financial crisis becomes possible with a probability of 60%. The level of the indicator at 17.5% is the basis for its prediction with the accuracy of 75%, while the critical value of the indicator is 18%, the achievement of which in all the investigated cases was accompanied by the onset of the financial crisis in the period of the signal window.

Very informative are also the results of evaluation of the interest margin's role in predicting financial crises (Fig. 4).

According to Figure 4, a threshold level for the indicator can be considered its reaching values in the range of 6-8%, where the risk of economic destabilization is 60-70% at noise levels lower than 0.3. It should be noted that unconditional probability of financial crisis is 0.294 or 29.4%, which confirms the relevance of using this indicator in the process of forecasting. At the same time, it is advisable to pay attention to the fact that this indicator's exceeding the level 9% is critical for macroeconomic stability, as the probability of crisis increases to 80%.

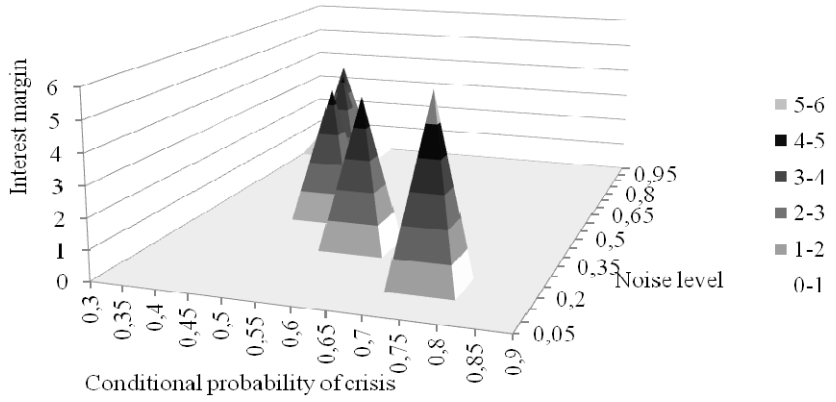

Fig. 4. Distribution of probabilities of crisis in Central and Eastern European countries depending on the level of interest margin

An interesting trend was discovered in the process of conducting calculations to determine the impact of the share of non-performing loans in the gross loans of the banking sector on economic development trends (Fig. 5).

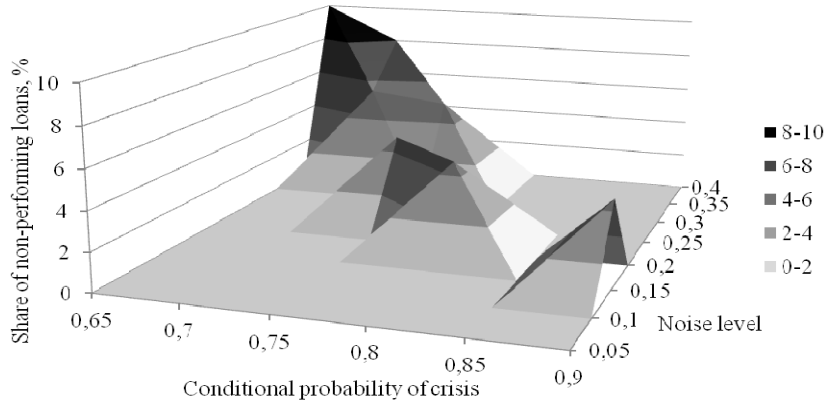

Fig. 5. Distribution of probabilities of crisis in Central and Eastern European countries depending on the share of non-performing loans in gross bank loans

Therefore, the conducted analysis has made it possible to state the fact that a threshold value of the indicator for the share of non-performing loans in gross loans of the banking system is its reduction to the level below 10%, when the conditional probability of systemic financial risk is 65% at the noise level of 0.4 (while the absolute value of the probability of financial crisis is 0.428). Moreover, it should be noted that a further reduction of the indicator's level determines a significant growth in the accuracy of forecasts regarding the potential occurrence of crises: with a share of bad loans in the banking system lower than 5% the probability of crisis increases to 75%, while with further reduction of the indicator it is 90% at the noise level of 0.15.

These tendencies can by substantiated by the presence of short-term cycles of the banking system's functioning and the long time lag of relationship of the investigated indicator with macroeconomic indicators, as well as the fact that the period of macroeconomic stability is characterized by the accumulation of a latent risk level, including in the banking system, which cannot be determined quantitatively through the existing risk management systems of financial institutions.

It is necessary to take into account the results received in assessing the level of such an indicator of the financial sector's functioning as a credit rate and its relation to financial crises in the economy (Fig. 6).

Using the figure's data we can conclude that for the surveyed countries a threshold value of credit rates is in the range of 10-15%, when the conditional probability of financial crisis is 55-80% (while unconditional probability is 0.301 or 30.1%) and the noise level does not exceed 0.4. The highest probability of systemic financial risk in the economy within a signal window was recorded when the indicator's value exceeds 13.5% and stands at 90% with the noise level lower than 0.1, while a further growth of the indicator creates serious grounds for the forecasting of destructive economic trends, although the accuracy of the forecast is reduced to 70-80%, which in all likelihood is caused by the presence of specific features in the functioning of the surveyed countries, which manifests itself in the different levels of average values of economic indicators.

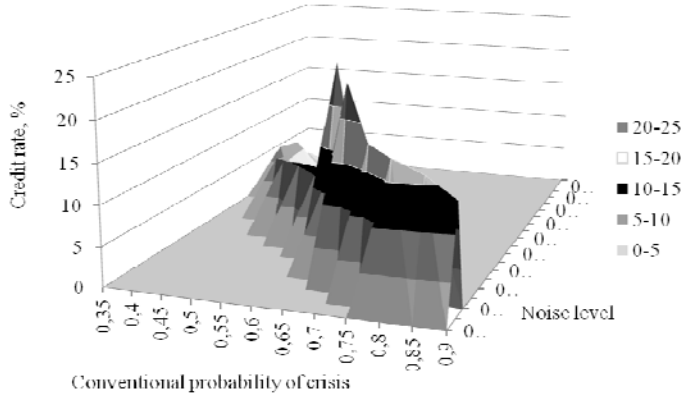

Fig. 6. Distribution of probabilities of crisis in Central and Eastern European countries depending of the level of credit rate

At the same time, the functioning of the sector of general state management also makes it possible to predict the probability of financial crisis in the economy of countries, as evidenced by the results obtained in the evaluation of threshold value for the level of general state debt (Fig. 7).

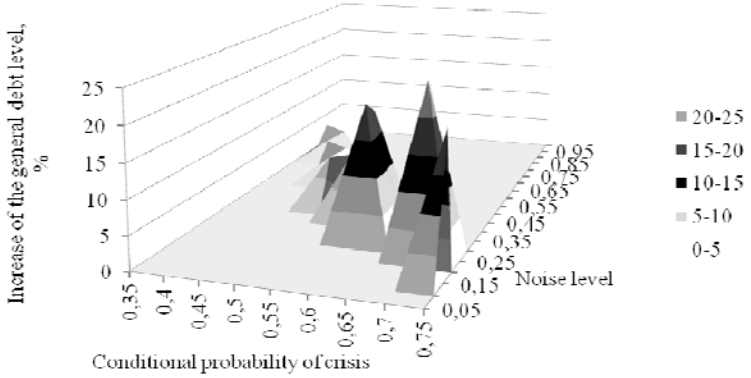

Fig. 7. Distribution of probabilities of crisis in Central and Eastern European countries depending on the increase of the general debt level in the country's GDP

Analyzing the results of the calculations, we see that an increase in the level of general state debt to GDP by more than 10% during a quarter indicates a growing probability of financial crisis on the level of 60-65% with insignificant noise level. The value of unconditional probability of destructive processes in the economy is 0.308. Therefore, a substantial risk of macroeconomic instability already exists with a quarterly growth of the indicator by 5%. It is necessary to pay attention to the fact that in the case of the indicator's growth by 15-20% the probability of financial risk increases to the level of 70-75%, while a further increase in the quarterly growth rate of the indicator is not characterized by worsening conditions of macroeconomic stability in the surveyed countries.

During the monitoring of accumulation of systemic financial risk it is important to take into consideration the performance indicators of the real sector of the economy, including the current balance of payments, the assessment of the forecasting role of which in determining the probability of financial crisis is presented in Fig. 8.

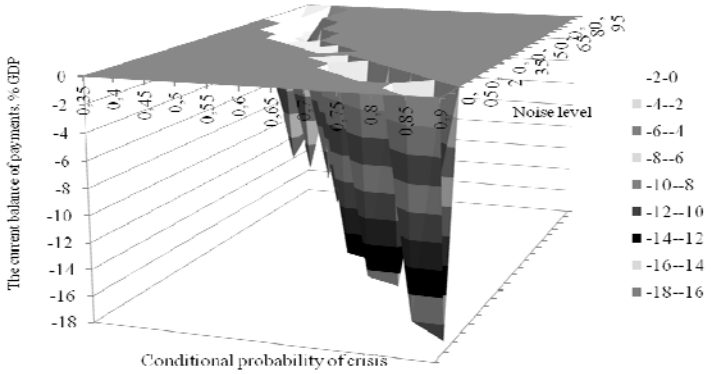

Fig. 8. Distribution of probabilities of crisis in Central and Eastern European countries depending on the current balance of payments to GDP

Thus, the calculations indicate the possibility of financial risk in economies with the reduction of the current balance of payments relative to GDP lower than 10% (conditional probability of financial crisis is 55% with the noise level 0.5 and unconditional probability of a crisis 0.346). The growing imbalances in external payments are accompanied by the increased risk of destructive processes in the economy – the achieving by the current balance of payments of the value of 15% of GDP makes it possible to predict the probability of financial crisis at a level of 75%, while its further reduction (to -17% of GDP) increases this probability to 90%.

A consumer price index has a high data level about the accumulation of systemic risk in the economy as an indicator that affects the functioning of the household sector, the calculations of which are presented in Fig. 9.

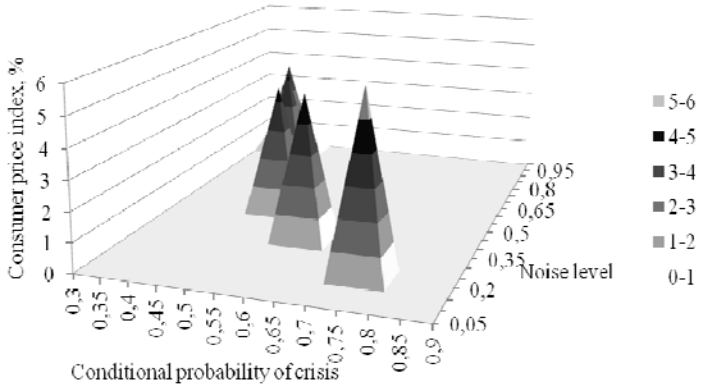

Fig. 9. Distribution of probabilities of crisis in Central and Eastern European countries depending on consumer price index

Thus, we can conclude that a threshold value of the indicator for the group of surveyed countries is the level of 4.5%, the exceeding of which leads to the conditional probability of financial crises of 50% (unconditional probability is at 0.331) with the general noise level of 0.5. At the same time, a further growth of the indicator causes a proportional increase of the probability of crisis economic situation – the achievement by the CPI of 5% makes it possible to predict the onset of financial crisis with 60% accuracy, and the increase of the indicator to 6% makes it possible to record the probability of crisis in the economies of Central and Eastern European countries at 80%.

It should also be emphasized that a critical level of the indicator is 10.5% – with its achievement a subsequent onset of the financial crisis in all cases was recorded.

The obtained results can be summarized as a system of indicators that reflect significant and critical levels in the accumulation of systemic financial risk in the economy (Table 5).

Table 5. Critical levels of indicators for the accumulation of systemic financial risk for Central and Eastern European countries with its potential realization in the economy (calculated by authors)

Indicator	Threshold level (conditional probability of crisis ≥50%)	Critical level (conditional probability of crisis ≥90%)
Exchange rate growth	≤-15%	Not found
The level of interbank rates	≥7.5%	≥18%
The level of interest margin	≥4.9%	Not found
The share of non-performing loans	≤10%	≤4.5%
The level of credit rates	≥9.5%	≥13.5%
The growth of total debt to GDP	≥8%	Not found
The level of balance of payments	≤-10%	≤-17%
Consumer price index	≥4.5%	≥10.5%

Conclusions and prospects

The conducted study has revealed the fact that the monitoring of financial risk accumulation should be carried out by using the indicators that reflect the functioning of various institutional sectors of the economy.

At the same time, in order to obtain the most adequate results in the information base of the research it is necessary to consider the indicators that reflect the development of a wide array of countries in the long time period that will neutralize the effect of single sharp fluctuations of the estimated indicators on the overall results, forming a base of the research from the objects, which are characterized by the appropriate level and the presence of common features of economic development, thus avoiding distortions of the results due to the impact of specific features in the functioning of national economies.

A promising area for the research is differentiation of the system of leading indicators in terms of the researched countries and the types of financial crises that are a potential consequence of realization of systemic risks.

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