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MODELS FOR THE ANALYSIS OF THE STATE'S FINANCIAL SECURITY INDICATORS DYNAMICS

Abstract. The paper presents a methodical approach to building complex models for analysis of the state's financial security (SFS) indicators dynamics, based on such methods of multivariate data analysis as the principal component analysis, canonical correlation, level of development, vector autoregression technology, error correction model. Vector autoregressive models of the SFS indicators dynamics of Ukraine and the countries of the European Union have been developed. The interrelationships of the SFS components, short–term effects, the rate of return to the equilibrium trajectory after the impact of external "shocks" (threats) have been studied. Were selected the most sensitive to external "shocks" SFS subsystems, sources of threat occurrence. The proposed complex of models can be considered as an element of the model basis of the forecasting and analytical mechanism of the financial security provision system, which is aimed at earlier informing, detecting threats and preventing their negative impact.

Keywords: financial security of the state, early informing and warning systems, predictive–analytical mechanism, dynamics model, multidimensional analysis, vector autoregressive technologies

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МОДЕЛІ АНАЛІЗУ ДИНАМІКИ ІНДИКАТОРІВ ФІНАНСОВОЇ БЕЗПЕКИ ДЕРЖАВИ

Анотація. У роботі запропонований методичний підхід до формування комплексу моделей аналізу динаміки індикаторів фінансової безпеки держави (ФБД), заснований на таких методах багатомірного аналізу даних, як метод головних компонент, канонічні кореляції, рівня розвитку, векторні авторегресійні технології, моделі корекції помилки. Розроблені векторні авторегресійні моделі динаміки показників ФБД України й країн Євросоюзу. Досліджені взаємозв'язки компонент ФБД, короткострокові ефекти, швидкість повернення до рівноважної траєкторії після впливу зовнішніх «шоків» (погроз). Виділені найбільш чутливі до зовнішніх «шоків» підсистеми ФБД, джерела виникнення погроз. Запропонований комплекс моделей може розглядатися як елемент модельного базису прогнозно–аналітичного механізму системи забезпечення фінансової безпеки, яка спрямована на раннє інформування, виявлення погроз і попередження їх негативного впливу.

Ключові слова: фінансова безпека держави, система раннього інформування й попередження погроз, прогнозно–аналітичний механізм, моделі динаміки, багатомірний аналіз, векторні авторегресійні технології

Формул 2; рис. 2; табл. 9; бібл. 11

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МОДЕЛИ АНАЛИЗА ДИНАМИКИ ИНДИКАТОРОВ ФИНАНСОВОЙ БЕЗОПАСНОСТИ ГОСУДАРСТВА

Аннотация. В работе предложен методический подход к формированию комплекса моделей анализа динамики индикаторов финансовой безопасности государства (ФБГ), основанный на таких методах многомерного анализа данных, как метод главных компонент, канонических корреляций, уровня развития, векторные авторегрессионные технологии, модели коррекции ошибки. Разработаны векторные авторегрессионные модели динамики показателей ФБГ Украины и стран Евросоюза. Исследованы взаимосвязи компонент ФБГ, краткосрочные эффекты, скорость возврата к равновесной траектории после воздействия внешних «шоков» (угроз). Выделены наиболее чувствительные к внешним «шокам» подсистемы ФБГ, источники возникновения угроз. Предложенный комплекс моделей может рассматриваться как элемент модельного базиса прогнозно–аналитического механизма системы обеспечения финансовой безопасности, направленной на ранее информирование, обнаружение угроз и предупреждение их негативного влияния.

Ключевые слова: финансовая безопасность государства, система раннего информирования и предупреждения, прогнозно–аналитический механизм, модели динамики, многомерный анализ, векторные авторегрессионные технологии

Формул 2; рис. 2; табл. 9; библ. 11

Introduction. The current stage of economic development is characterized by an intensification of the depth of the financial crisis and threats to the financial security of the state, which are manifested in high volatility of the exchange rate, inflationary processes, decrease in investment activity level, etc. Along with the fundamental factors shaping the financial crisis, such as unfavorable macroeconomic conditions, the dynamics of export–import transactions, a sharp reduction in capital inflows, the crisis situation is also associated with the emergence of numerous threats to infection by the crisis: deterioration of trade conditions in partner countries, asset depreciation, homogeneity of macroeconomic and financial state (unidirectional reaction to "global shocks" and the effect of the "epidemic"). In these conditions, it is necessary to create and apply qualitatively new mechanisms for ensuring the financial security of the state, which, on the one hand, create broad opportunities for attracting investments from transnational holdings and corporations, and, on the other hand, will allow to prevent additional threats and risks generated by financial globalization, the consequences of which are financial turbulence, changing the frequency and depth of financial crises affecting practically all elements of the economic security system.

The problem of economic and financial security was successfully handled by a galaxy of outstanding domestic and foreign scientists. Significant achievements in developing a categorical basis for the mechanisms of the economic and financial security system belong, in particular, to such scientists as O. Baranovsky, M. Yermoshenko, G. Pasternak–Taranushenko. Among russian authors it is necessary to note fundamental works on the theoretical and methodological bases of economic security of L. Abalkin, A. Bogdanov, V. Senchagov. Applied questions related to various aspects of modeling the systems of economic and financial security of the state, region, enterprise are successfully developed by such Ukrainian scientists as V. Geets, T. Klebanova, K. Kovalchuk, Yu. Lysenko, A. Chernyak and others. Thus, in work [1] of A. Cherniak, V. Khomyak were discussed the modeling of currency security, forecasting the crisis of payments balance and the choice of mechanisms for its prevention. The work of Kovalchuk K., Marinchuk S. [2] is devoted to the development of a strategy models complex for using offshore zones for tax optimization, the task of forming effective "internal" zones of tax loyalty also was touched upon. In the work of Velikoivanenko G., Miroshnichenko I., questions of investment potential modeling, raising the level of investment security [3] were considered. Various aspects of production–fiscal effects of security provision modeling were considered in the works of Klebanova T., Gurianova L., Chagovets L. [4–7]. It should be noted that, despite the unconditional effectiveness of the approaches proposed by the authors, the existing developments concern certain functional areas of financial security, as well as local assessment tasks, forecasting the level of financial security, assessing the level of threats, and assessing the consequences of their prolonged impact. Low touched upon the implementation of a systematic approach that allows to analyze the relationship of basic elements of the system; Identify components that, at certain stages, contribute to an increase in the overall level of financial security, or vice versa, create additional threats when external “shocks” are affected.

Formulation of the problem. The paper suggests a set of models for analyzing the dynamics of state’s financial security indicators, which, basing on methods of factor analysis, canonical correlations, the development level method, vector autoregressive technologies, allows assessing the dynamic effects of the external "shocks" (threats) influence on inflation security; currency security; budgetary security; debt security; investment security; security of the banking system; security of the insurance market, security of the stock market. The developed complex of models can be considered as an element of the model basis of the forecasting and analytical mechanism of the early warning system of financial crises and ensuring financial security.

Results of the study. The proposed complex of models includes the following main modules: 1) a module of models for analyzing the dynamics of financial security indicators in Ukraine; 2) a module of models for analyzing the dynamics of financial security indicators of the EU countries; 3) a module of models for analyzing the dynamics of Ukraine's financial security indicators, taking into account possible channels of "crisis infection". The development of the proposed complex of models was carried out on the basis of a methodical approach, which includes the following main stages:

Stage 1. Justification of the state's financial security indicators system on the basis of the multivariate analysis methods.

From system positions, financial security is a complex multi–level structure characterized by the presence of multiple elements, a large number of diverse links, the circulation of large information flows that determine its internal dynamics. Thus, financial security (FS) is characterized by a high degree of complexity and multidimensionality, and as a result, the FS information model should include a large number of quantitative and qualitative indicators. At the same time, taking into account a large number of indicators leads to information congestion in decision–making processes. As a consequence, there arises the task of forming the system of the most informative diagnostic indicators that allow to reduce the dimension of the initial information space of characteristics without losing significant information. To solve this problem, two groups of methods are used in the economic literature: methods based on the criteria of autoinformativity; methods aimed at assessing the informativeness on the basis of the cause–effect relationships analysis (external informativeness) [8]. The first group of methods allows to evaluate the information significance of the indicators, to reveal hidden properties and patterns in large volumes of raw data, in the case when the structure of the input and output data sets is unknown. The advantage of the second group of methods is the possibility of reducing the dimensionality of the information space of indicators on the basis of the cause–effect relationships analysis of the set of input and output indicators. The choice of the method is determined by the complete or incomplete provision of information, the sample size, the structure of the set of input and output indicators, and the availability of a training sample. Taking into account the restrictions on the data type, the structure of the indicator groups, a block diagram was developed for the formation of a financial security diagnostic indicators system, a detailed description of which is given in [4, 9]. The proposed approach is based on the synthesis of principal components and canonical analysis methods. The choice of the main components method is explained by the possibility of forming a system of generalized latent factors, selecting the most significant indicators. The method of canonical correlations makes it possible to analyze the relationship between several output indicators and a large number of factors. This property is important in justifying the indicators in the safety management system, since the dynamics of financial and economic security subsystems is characterized by a large set of characteristics. The choice of only one most significant indicator will lead to a distortion of the results of the assessment.

Stage 2. Complex assessment of the financial security and its structural components development level. The construction of a system of complexed (on the whole system of indicators) and local (on separate components – debt, currency, etc. security) integral assessments of the financial security level is caused by the diversified nature of the change in indicators, which complicates their analysis and requires presentation in the form of a synthetic assessment that is the result of a convolution of indicators, reflecting the development of individual financial security subsystems. The block diagram of the formation of the financial security level integral assessment is based on one of the methods for constructing a reference object – a taxonomic indicator of the development level, a detailed description of which is given in [7]. The choice of the method is caused by its advantages: the absence of restrictions on the nature of the indicators information space (in the system can be included indicators, the positive dynamics of which indicates both a decrease and an increase in the level of financial security); the initial system of indicators can contain features that have different dimensions; the values of the integral index have a normalized range of variation, which ensures the interpretability of the results obtained.

Stage 3. Developing of the financial security level dynamics models. Modeling the dynamics of the financial security system is carried out on the basis of VAR– and ECM–models [10]. The choice of this tool is due to the ability to model interrelated financial variables; investigate the long–term relationship; deviations from the equilibrium state; assess the impact of "shocks" on the dynamics of financial security indicators. Conducting the cointegration analysis involves: checking time series for stationarity using the Dickey–Fuller criterion; definition of the order of integration; checking for cointegration; building an ECM or VAR model; impulse analysis and decomposition of dispersions. Imulse analysis (analysis of response to "shocks") allows dynamic imitation of an external "shock" with respect to each of the endogenous variables, and then evaluate the response of the system to this impulse. The function of impulse responses shows the change in endogenous indicators in response to a "shock" (a change in one of the perturbations of the system). The decomposition of variances in forecast errors makes it possible to analyze the effect of different shocks on the variance of the forecast error for different periods of pre–emption. In other words, the decomposition of variances shows the proportions of the variance caused by the "shocks" of the various variables. A more detailed description of the flowchart for analyzing the dynamics of financial indicators using VAR and ECM–models is given in [11].

The methodological approach proposed above is implemented on the data of financial security indicators of Ukraine and the countries of the European Union over the past eight years in the monthly section. The choice of the analysis period is determined by the methodological continuity and information availability of the system of financial security indicators. The calculations were carried out with the help of the SP "Statistica", "EViews". Below is a description of the main results.

The first two stages of the study formed a system of diagnostic indicators of financial security, local and general integral indicator, the symbols of which are given in table. 1.

Table 1

Symbols of integral indicators of financial security

Structural component of the SFS	Budget security	Money market security	Currency security	Debt security	Insurance security	Stock security	Investment security	Banking Security	Overall
Symbol	BUD_U	MON_U	EX_U	DEBT_U	INS_U	STOCK_U	INV_U	BANK_U	GEN_U

A fragment of the results of testing time series for the presence of two–way cause–and–effect relationships using the Granger test is shown in Table. 2.

Table 2

The results of the analysis of time series using the Granger test (fragment)

Pairwise Granger Causality Tests

STOCK_U does not Granger Cause BUD_U	89	2.06726	0.0669
BUD_U does not Granger Cause STOCK_U		3.09407	0.0092
MON_U does not Granger Cause D_DEBT_U	89	2.12350	0.0602
D_DEBT_U does not Granger Cause MON_U		2.39063	0.0361
STOCK_U does not Granger Cause GEN_U	89	2.49988	0.0292
GEN_U does not Granger Cause STOCK_U		1.40028	0.2256

As can be seen from table 2, the hypothesis of a two–way causal relationship between the integral indicators of the level of the budget security and the stock market security, monetary and debt security is confirmed with a 93% and 94% confidence level, respectively. The hypothesis of the existence of a one–way causal relationship between the level of the stock market security and a complex safety index is confirmed with a 97% confidence level. To justify the value of the lag was used Akaike information criterion, the values of which are given in the table. 3.

Table 3

The values of Akaike information criterion

Lag, taken into account in the model	Number of significant cause–effect relationships	The criterion of Akaike
1	11	–34,05073
2	**13**	**–33,69284**
3	**13**	**–33,18763**
4	9	–32,67463
5	10	–32,64069
6	6	–33,26883
7	7	–36,16740
8	**13**	**–42,14881**

As can be seen from Table. 3, the greatest number of significant cause–effect relationships is observed for lags equal to 2, 3 and 8. The smallest value of the Akaike criterion among the constructed models is inherent in the lag equal to 8. Therefore, in the subsequent stages of the study, the vector autoregressive model was analyzed with a lag equal to 8.

The quality criteria for the equations that entered the system are listed in Table. 4.

Table 4

Quality criteria of the VAR model equations (p=8)

Symbol	BANK_U	BUD_U	D_DEBT_U	D_EX_U	GEN_U	INV_U	INS_U	MON_U	STOCK_U
R–squared	0.950121	0.948928	0.746216	0.781568	0.925050	0.928446	0.914246	0.956088	0.853226
Sum sq. resids	0.086687	0.024622	0.101433	0.042658	0.005739	0.045079	0.024256	0.068872	0.000679
S.E. equation	0.078689	0.041937	0.085119	0.055200	0.020247	0.056745	0.041624	0.070139	0.006964
Akaike AIC	–2.395323	–3.653974	–2.238224	–3.104411	–5.110349	–3.049199	–3.668957	–2.625370	–7.244676
Schwarz SC	–0.326227	–1.584879	–0.169129	–1.035315	–3.041254	–0.980104	–1.599861	–0.556275	–5.175581
m.p.e.	0,093739	0,079472626	0,095459	0,069527	0,017049	0,058969	0,035803	0,092923	0,00654
m.a.p.e.	3,231947	13,07096	12,94245	9,784692	14,73106	15,23299	16,91419	14,64215	1,814057

Analysis of the data, given in table 4, allows to conclude that the value of the coefficient of determination (from 0.746216 to 0.956088) indicates the statistical significance of the model. The value of the average absolute percentage error of the approximation, which varies from 1.81% to 16.91%, indicates a good forecast accuracy. Comparison of actual and predicted data (fig. 1) also allows to conclude that the approximation accuracy is good.

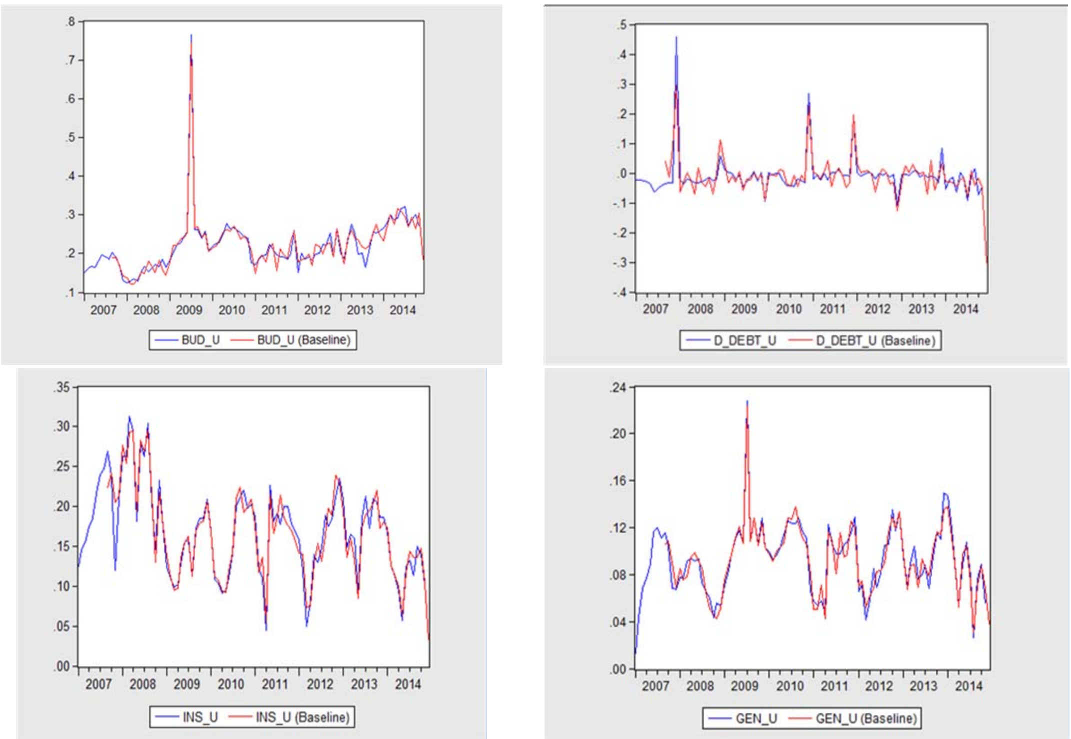


Figure 1. Comparison of calculated and forecasted values of the financial security level and its structural components (fragment)

Several equations of the obtained VAR–model are given below:

- for budgetary security (BUD_U (table 1)):

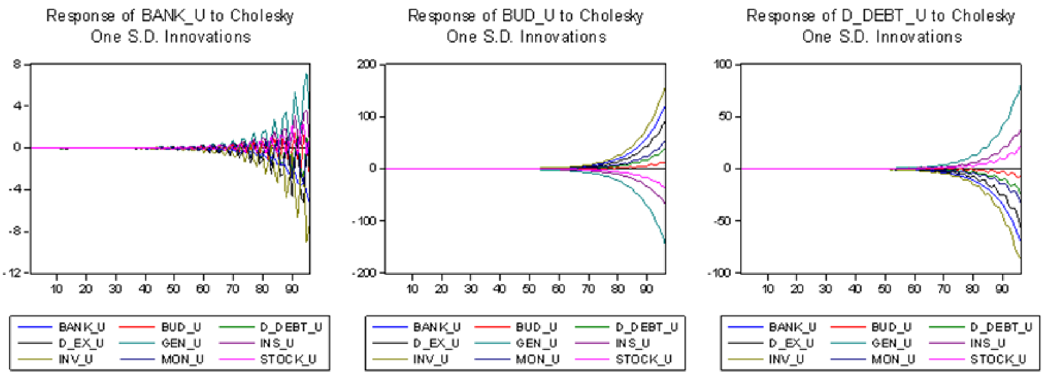
BUD_U = – 0.16392145141 * BANK_U(–1) + 0.0469782691017 * BANK_U(–2) + 0.0116611210279 * BANK_U(–3) – 0.042075715845 * BANK_U(–4) + 0.307291362581 * BANK_U(–5) + 0.0232479654582 * BANK_U(–6) – 0.0990716202338 * BANK_U(–7) – 0.00551593634086 * BANK_U(–8) + 0.411742436253 * BUD_U(–1) + 0.101967117621 * BUD_U(–2) + 0.133087996753 * BUD_U(–3) – 0.0923824407387 * BUD_U(–4) + 0.249134237627 * BUD_U(–5) + 0.281967328615 * BUD_U(–6) + 0.162913896089 * BUD_U(–7) + 0.492931327635 * BUD_U(–8) + 0.509838456461 * D_DEBT_U(–1) + 0.0625328926611 * D_DEBT_U(–2) + 0.212995520785 * D_DEBT_U(–3) – 0.0736462999441 * D_DEBT_U(–4) – 0.17963003619 * D_DEBT_U(–5) – 0.0584373496851 * D_DEBT_U(–6) + 0.325751144619 * D_DEBT_U(–7) – 0.344626409231 * D_DEBT_U(–8) + 0.41450329909 * D_EX_U(–1) + 0.112868910827 * D_EX_U(–2) – 0.00581710051511 * D_EX_U(–3) – 0.321468271467 * D_EX_U(–4) – 0.147677697083 * D_EX_U(–5) – 0.0734681366886 * D_EX_U(–6) + 0.898200636181 * D_EX_U(–7) – 0.997837855679 * D_EX_U(–8) + 0.621184260042 * GEN_U(–1) + 0.0600891004639 * GEN_U(–2) – 0.567601785559 * GEN_U(–3) + 0.365889794477 * GEN_U(–4) – 1.56153697334 * GEN_U(–5) + 0.354473077591 * GEN_U(–6) – 0.0791549557479 * GEN_U(–7) – 2.37702121445 * GEN_U(–8) – 0.249781613544 * INV_U(–1) + 0.135601642808 * INV_U(–2) – 0.0425595900921 * INV_U(–3) – 0.0298858982978 * INV_U(–4) + 0.434509645768 * INV_U(–5) – 0.177389494181 * INV_U(–6) + 0.0122574543822 * INV_U(–7) + 0.529295020943 * INV_U(–8) – 0.109348928345 * INS_U(–1) – 0.108572662142 * INS_U(–2) + 0.138217929383 * INS_U(–3) – 0.202891733324 * INS_U(–4) + 0.382082083299 * INS_U(–5) – 0.0346099539723 * INS_U(–6) + 0.229445794148 * INS_U(–7) + 0.500249301876 * INS_U(–8) + 0.206713255222 * MON_U(–1) – 0.388299263777 * MON_U(–2) + 0.246827969638 * MON_U(–3) – 0.136133262845 * MON_U(–4) – 0.00650237250885 * MON_U(–5) + 0.160048972435 * MON_U(–6) – 0.0668891865466 * MON_U(–7) + 0.13993904092 * MON_U(–8) – 2.02459423936 * STOCK_U(–1) – 0.492985511905 * STOCK_U(–2) + 2.60408298073 * STOCK_U(–3) – 3.47666760513 * STOCK_U(–4) + 1.30187540332 * STOCK_U(–5) + 0.035992809007 * STOCK_U(–6) + 2.21941575407 * STOCK_U(–7) + 4.32237550027 * STOCK_U(–8) – 1.25484253656;

- for debt security:

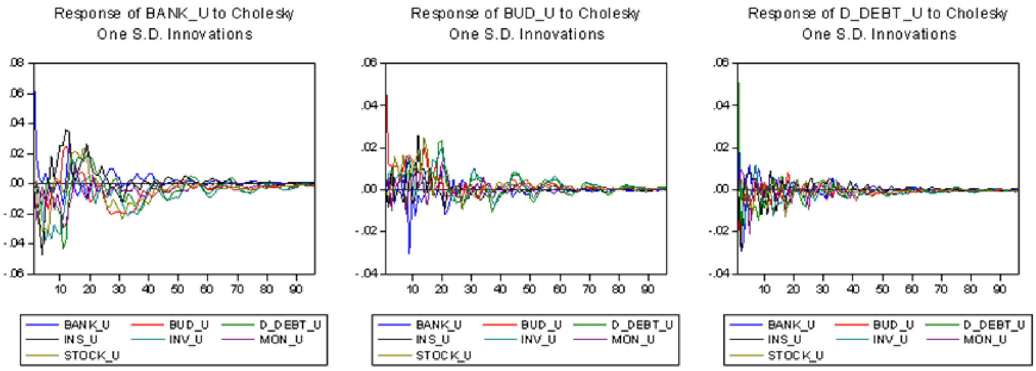
D_DEBT_U = – 0.367191559772 * BANK_U(–1) – 0.669715696878 * BANK_U(–2) – 0.196221229731 * BANK_U(–3) + 0.0897628186199 * BANK_U(–4) + 0.108912615255 * BANK_U(–5) + 0.54236260681 * BANK_U(–6) + 1.0454107084 * BANK_U(–7) + 0.120590619847 * BANK_U(–8) – 2.10014979746 * BUD_U(–1) – 0.448060021588 * BUD_U(–2) + 0.0781007287326 * BUD_U(–3) – 0.00567238149652 * BUD_U(–4) – 1.02318431332 * BUD_U(–5) + 0.285682516914 * BUD_U(–6) + 0.653523377361 * BUD_U(–7) + 0.457067239962 * BUD_U(–8) – 1.14011006778 * D_DEBT_U(–1) – 0.819738804173 * D_DEBT_U(–2) – 0.369362624259 * D_DEBT_U(–3) – 0.749936315143 * D_DEBT_U(–4) – 0.990894954162 * D_DEBT_U(–5) – 1.47955441829 * D_DEBT_U(–6) – 1.80005617038 * D_DEBT_U(–7) – 0.128614973612 * D_DEBT_U(–8) – 1.37897261464 * D_EX_U(–1) – 1.38234721657 * D_EX_U(–2) + 0.122844317896 * D_EX_U(–3) + 0.0965153387869 * D_EX_U(–4) – 0.190879259054 * D_EX_U(–5) – 0.64757716845 * D_EX_U(–6) – 1.27356034249 * D_EX_U(–7) + 0.547744083415 * D_EX_U(–8) + 4.9840009397 *

GEN_U(–1) – 0.12181435153 * GEN_U(–2) + 0.537816708587 * GEN_U(–3) + 0.723266544659 * GEN_U(–4) + 1.20268211259 * GEN_U(–5) – 2.03457877726 * GEN_U(–6) – 2.22259152177 * GEN_U(–7) – 1.86373708892 * GEN_U(–8) – 0.642613087686 * INV_U(–1) – 0.485665265802 * INV_U(–2) – 0.219912680161 * INV_U(–3) – 0.378623689823 * INV_U(–4) – 0.318906455273 * INV_U(–5) + 0.250550721991 * INV_U(–6) + 0.0716834488179 * INV_U(–7) – 0.599148815155 * INV_U(–8) – 2.1593422288 * INS_U(–1) + 0.155239715371 * INS_U(–2) – 0.229919892697 * INS_U(–3) – 1.56566385578 * INS_U(–4) – 1.23698335385 * INS_U(–5) – 0.125099033777 * INS_U(–6) + 0.632482487277 * INS_U(–7) + 0.544101164837 * INS_U(–8) – 0.262140362173 * MON_U(–1) – 0.494833781754 * MON_U(–2) – 0.20960673583 * MON_U(–3) – 0.726973985005 * MON_U(–4) – 0.575158012677 * MON_U(–5) – 0.138284077033 * MON_U(–6) – 0.113580330859 * MON_U(–7) + 0.574640657934 * MON_U(–8) – 5.31419165674 * STOCK_U(–1) – 8.25693986366 * STOCK_U(–2) – 2.98164980268 * STOCK_U(–3) – 1.45412231013 * STOCK_U(–4) – 4.467203625 * STOCK_U(–5) – 5.24881939176 * STOCK_U(–6) – 2.13124996416 * STOCK_U(–7) – 0.819934298704 * STOCK_U(–8) + 8.95382032889

The results of the impulse response function analysis are shown in fig. 2.



a) taking into account the indicators of currency security



b) without taking into account the indicators of currency security

Figure 2. Functions of impulse responses

Analysis of the data shown in fig. 2, allows to conclude that the system is not dynamically stable, and in five years will be at the bifurcation point (fig. 2a). Neutralization of currency security threats (fig. 2b) will stabilize the situation.

The results of decomposition of variances, showing the proportions of the variance, caused by "shocks" that affect the dynamics of currency security, are shown in table. 5.

Table 5

Decomposition of variances caused by "shocks" of currency security

Period	BANK_U	BUD_U	D_DEBT_U	D_EX_U	GEN_U	INS_U	INV_U	MON_U	STOCK_U
1	15.18119	1.260403	57.39022	26.16818	0.000000	0.000000	0.000000	0.000000	0.000000
2	13.19598	2.028122	48.62171	26.36987	2.651754	6.239155	0.023729	0.306103	0.563581
3	20.51773	5.760387	37.91166	22.46248	2.001071	4.742999	3.726343	2.440478	0.436847
4	17.35468	5.432773	34.84492	20.63810	5.416511	4.015034	9.069995	2.411938	0.816052
5	15.64125	6.052333	31.67280	20.56667	5.319157	7.264278	8.815500	2.199206	2.468806

Continuation of Table 5

6	18.29877	7.010413	28.60915	19.10096	4.782502	7.010360	10.47629	2.479982	2.231580
7	19.11796	6.123121	25.34664	20.26249	4.681273	8.245786	11.39368	2.557175	2.271866
8	17.24428	6.312037	23.49581	20.46338	7.193273	8.200384	11.40751	2.882305	2.801016
9	15.72249	5.764912	22.39390	24.41215	6.774315	7.694852	10.76029	3.303664	3.173415
10	14.84183	6.160437	21.25736	23.16962	10.75693	7.564557	10.18114	3.093132	2.975000
11	14.01960	6.066624	19.41079	21.09419	10.85685	7.173799	15.18436	3.137743	3.056049
12	16.38136	5.921841	18.84017	20.47358	10.78200	7.218553	14.05763	3.078108	3.246764

As can be seen from table. 5, the "shocks" of currency security have a significant destabilizing effect on practically all subsystems and, above all, debt security, banking system security, investment security, which later themselves generate additional risks for currency security.

The results of the financial security level variances decomposition, showing the dispersion proportions caused by local "shocks" in individual subsystems, are shown in table. 6.

Table 6

Decomposition of financial security level variances caused by local "shocks" in individual subsystems

Period	BANK_U	BUD_U	D_DEBT_U	D_EX_U	GEN_U	INS_U	INV_U	MON_U	STOCK_U
1	0.000000	0.000000	0.000000	0.000000	34.56063	65.97915	4.548330	0.803238	3.605767
2	16.90904	0.017615	8.443079	2.651754	24.99924	47.00961	4.502488	11.46545	4.436966
3	24.92688	0.695877	10.54345	2.001071	23.31573	44.87961	2.785503	8.114900	3.951086
4	32.70037	0.721911	13.03621	5.416511	20.92625	41.24159	2.385257	5.960295	3.783426
5	32.22014	1.283283	12.79678	5.319157	19.59645	40.31372	2.252633	6.907591	4.110083
6	30.21071	1.193608	12.68009	4.782502	17.41103	35.48713	2.445007	9.851236	13.00163
7	27.81064	1.690586	12.41261	4.681273	15.96688	33.81237	2.404759	12.34660	16.28419
8	27.72203	1.616932	11.75608	7.193273	13.50230	34.22309	2.551329	15.40461	13.95144
9	25.42123	1.970914	11.60479	6.774315	13.97723	32.06987	2.652046	18.29437	13.87484
10	22.80528	1.718108	11.36764	10.75693	10.82272	30.84659	2.466517	19.36624	14.24640
11	19.87224	3.068307	11.49986	10.85685	11.93366	28.02773	2.571952	18.71605	13.75726
12	18.05936	4.300739	12.37120	10.78200	17.58009	27.58719	2.555673	19.27841	13.77886

Analysis of the data given in table. 6, leads to the conclusion about the high level of systemic risk. Dominant are threats to the security of the insurance market, monetary security, security of the banking system, security of the stock market.

A similar analysis was conducted for the EU countries. The results of a comparative analysis of the dynamic effects of the stochastic "shocks" influence for Ukraine and the EU countries are given in table. 7.

Table 7

Comparative analysis of the dynamic effects of the financial security stochastic "shocks" influence

Parameter	Ukraine	Countries of the European Union
Reaction time	In Ukraine, about five years later, the system comes to the point of self–destruction. But if the "shocks" of currency security will be level out, the situation stabilizes.	The system is dynamically stable. In the medium term, the impact of "shocks" is eliminated. At the same time, the probability of occurrence of short–term local crises is high, since the reaction at the time of the impact of "shock" often has the character of "explosive" fluctuations.
The crisis depth	Impulsive reaction of such areas of Ukraine's financial security as stock, debt, insurance security for "shocks" is largely similar to the EU countries. At the same time, in Ukraine there are no stable, life–supporting banking and monetary systems.	The financial system of the countries of the European Union is less susceptible to the influence of external "shocks". Despite the unidirectional reaction of the systems of stock, debt, insurance security, the effects of external "shocks" are less significant in terms of the number of unbalanced areas of EU financial security. While the reaction of Ukraine's financial security system to threats is sharply negative in almost all subsystems, the EU countries have a stable working, life–supporting banking and monetary system.
Dominant sources of threat occurrence	Both for the EU countries and for Ukraine, negative reactions to "shocks", threats to the security of the stock market are typical. This may indicate the primary importance of this channel for the transmission of external financial stresses/infections.	

At the final stage of the study in the VAR model of the Ukraine's financial security indicators dynamics, the level of financial security of the Eurozone countries (GEN_EU) was included as an exogenous variable. The results of the evaluation are given in Table. 8.

Table 8

Results of model evaluation (fragment)

Symbol	BANK_U	BUD_U	D_DEBT_U	D_EX_U	INS_U	INV_U	MON_U	STOCK_U
Model parameters								
D_GEN_EU	–0.169461	0.231499	–0.964688	0.640389	–0.088633	–0.381518	0.821458	–0.029895
Standard deviation	(0.45585)	(0.23564)	(0.41731)	(0.26795)	(0.24116)	(0.31307)	(0.33903)	(0.03970)
T–test	[–0.37175]	[0.98241]	**[–2.31168]**	**[2.38994]**	[–0.36753]	[–1.21863]	**[2.42293]**	[–0.75295]
Quality criteria								
R–squared	0.950646	0.952457	0.820148	0.848245	0.915127	0.935782	0.969749	0.859359
Akaike AIC	–2.382909	–3.702600	–2.559582	–3.445629	–3.656305	–3.134378	–2.975038	–7.264374
Schwarz SC	–0.285470	–1.605161	–0.462142	–1.348190	–1.558866	–1.036939	–0.877599	–5.166935

The data of table 8 allow to conclude that the change in the level of financial security of the EU countries has a strong enough impact on the dynamics of the financial security subsystems of Ukraine and, first of all, the subsystems of currency security, money market security, debt security.

The results of the VAR dynamics model of Ukraine's financial security indicators estimation, taking into account the exogenous variable of the real economy sector state (REAL) are given in table 9.

Table 9

Results of model evaluation (fragment)

Symbol	BANK_U	BUD_U	D_DEBT_U	D_EX_U	GEN_U	INS_U	INV_U	MON_U	STOCK_U
Model parameters									
D_REAL	–0.041731	0.012840	–0.131728	0.058119	0.002127	0.009294	–0.052698	0.089647	–0.001124
Standard deviation	(0.07238)	(0.03890)	(0.07037)	(0.04883)	(0.01885)	(0.03869)	(0.05080)	(0.06042)	(0.00648)
T–test	[–0.57655]	[0.33006]	[–1.87189]	[1.19027]	[0.11283]	[0.24024]	[–1.03740]	[1.48372]	[–0.17346]
Quality criteria									
R–squared	0.951365	0.949352	0.800097	0.803034	0.925123	0.914625	0.933917	0.962447	0.853565
Akaike AIC	–2.397583	–3.639331	–2.453889	–3.184863	–5.088340	–3.650398	–3.105747	–2.758821	–7.223999
Schwarz SC	–0.300144	–1.541892	–0.356449	–1.087424	–2.990901	–1.552959	–1.008307	–0.661382	–5.126560

Analysis of the data allows to conclude that, based on the results of the assessment, the state of the real economy sector at the current moment of time does not have a dominant influence on the deepening the crisis in the financial system.

Conclusions. Thus, the results obtained make it possible to draw the following conclusions:

– a methodical approach to the development of a complex of state's financial security indicators dynamics models, which, based on multidimensional analysis methods, vector autoregressive technologies, error correction models, allow to identify the interrelations between structural components, take into account long–term relationships, short–term effects and the return rate to the equilibrium trajectory after the external "shocks" (threats);

– a model of the dynamics of financial security indicators of Ukraine was developed, the following study of which showed that the "shocks" of currency security lead to significant fluctuations in practically all SFS subsystems. The absence of an effective financial policy will lead to the entry of the system into a bifurcation point in five years. But if the "shocks" of currency security will be leveled out, then the situation stabilizes;

– a model of the dynamics of financial security indicators of the EU countries was developed, the study of which showed that the system is dynamically stable, the consequences of external "shocks" are less significant in terms of the number of unbalanced components of the EU financial security system. At the same time, there is a high probability of short–term local crises, since the reaction at the time of the impact of "shock" often has the character of "explosive" fluctuations;

– models of the dynamics of financial security indicators in Ukraine were developed, taking into account the possible channels of "crisis infection", the study of which showed that the most sensitive to the impact of "shocks" are the subsystems of currency security, money market security, debt security;

– negative reactions to "shocks", threats to the security of the stock market are typical for both the EU countries and Ukraine. This indicates the primary importance of this channel for the transfer of external financial stresses / infections.

The developed complex of models can be considered as a model basis element of the financial security system forecasting and analytical mechanism aimed at early detection and prevention of the threats negative impact.

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