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Evaluation Method of Banking System Stability Based on the Volume of Subsystems

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Abstract Evaluation of banking system stability is enough hard task and it has very limited approaches and methods for solving of this problem. At the same time, this task is staying in the first place in the most banking systems, because it is important for further decision making and forecasting for the next development of these systems. This method also allowed to get the stability evaluation for banking systems (on example of the Ukraine banking system) based on more easy approach and will use it in the future each time when we need to get current volume of this estimation. This volume will help to us to receive a dynamic distribution, based on which we will be able to create a forecast and will decide right making for our object of researching (based on example banks).

Keywords: *banking system, evaluation, system stability, subsystems, banking system stability*

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1. Introduction

In modern time the majority of the banks, working in the unstable economic and political environment, endure decline in production and are in a serious financial condition. All these facts and events in this area are actualized a problem of evaluation of the banking system stability (will entering the following abbreviation BSS).

In an era of global financial and economic crisis in the banking sector relationships, which consisting in its functioning processes, acquire a different meaning. Their global idea is that used previously well-known approaches and concepts are not justified their merits today. Therefore, some examples are the various statistical and analytical studies of famous companies: Perimetrix, Finjan, Ernst & Young, Ponemon Institute and others. All results are submitted to them and show a dynamic increase of BSS. This negatively affects the overall economic development of the banking system and its impact on the national economic development (an example of the Ukraine banking system). The investigation of these and some other similar events has been often liquidation of the banks, a sharp decline in their effectiveness, resulting in a global job cuts, large acquisitions of smaller banks and other negative processes.

Sooner or later, but before the head there is a question of evaluation of BSS, after all, in modern conditions it is a necessary component of competitiveness of any bank. Therefore, the special value of the problem of the development of theoretical, methodological and methodical bases, which would consider the features of functions, gets structures, processes, is more whole than an evaluation of BSS and transformed them into a complex of the corresponding procedures.

Banking system stability is calculated with the help of some different mechanisms and approaches of out of the negative problem situations. As one of those mechanisms and approaches is a synthesis and improving the state regulatory policy, which is an account of all processes dynamically and those negative problem situations. However, the most current well-known mechanisms or approaches are static or based on the indicators, which are not getting.

Previous empirical research provides contradictory and inconclusive evidence on the relevance of the banking system stability in different countries. Thus, the present study using the proposed approach based on calculating of some main indicators for the National bankingsystem of Ukraine shed more lights on the issue.

BS is considering some different mechanisms and approaches of out of the crisis phenomena. As one of those mechanisms and approaches is a synthesis and improving the state regulatory policy, which is an account of all processes dynamic. However, the most current mechanisms or approaches [1] are static or based on the indicators, which are not getting.

2. Common Information

Proposed method or approach can be used for any kind of banking system for any country, but in this article, we

are considering based on example of the national banking system of Ukraine.

As for the manager of any level of banking system management (Figure 1) it is topical the effectiveness of realization and improvement of management decision, there is a need to develop an evaluation method of banking system stability. To prove the actuality we present the research results in this field based on the author's method [9].

Some different banking system was considered in the context of socioeconomic security on an example of the Indian national banking system by prof. Seeta Prabhu [10] as a case study in 2001.

This and some other similar conceptions of evaluation of BSS, conventionally defined in terms of contingency related measures in the banking sector, is confined largely to bankers employed in the national sector. The definition is inadequate in situations where employment in the national sector (it means national banking sector based on the examples of different countries, in our case in Ukraine) is limited and instability is widespread. This paper defines one from more method of evaluation of BSS from a wider perspective as constituting measures that enhance bank capabilities, ensure financial and banking security and enable the vulnerable sections of the small banks to survive. When viewed from this paper, the provision of evaluation of BSS in Ukraine has been unsatisfactory. It is argued that the Government and the national bank system constitute the two pillars that need to be strengthened for meeting the genuine need for evaluation of BSS of the national bank system in Ukraine, particularly during the period of economic reforms.

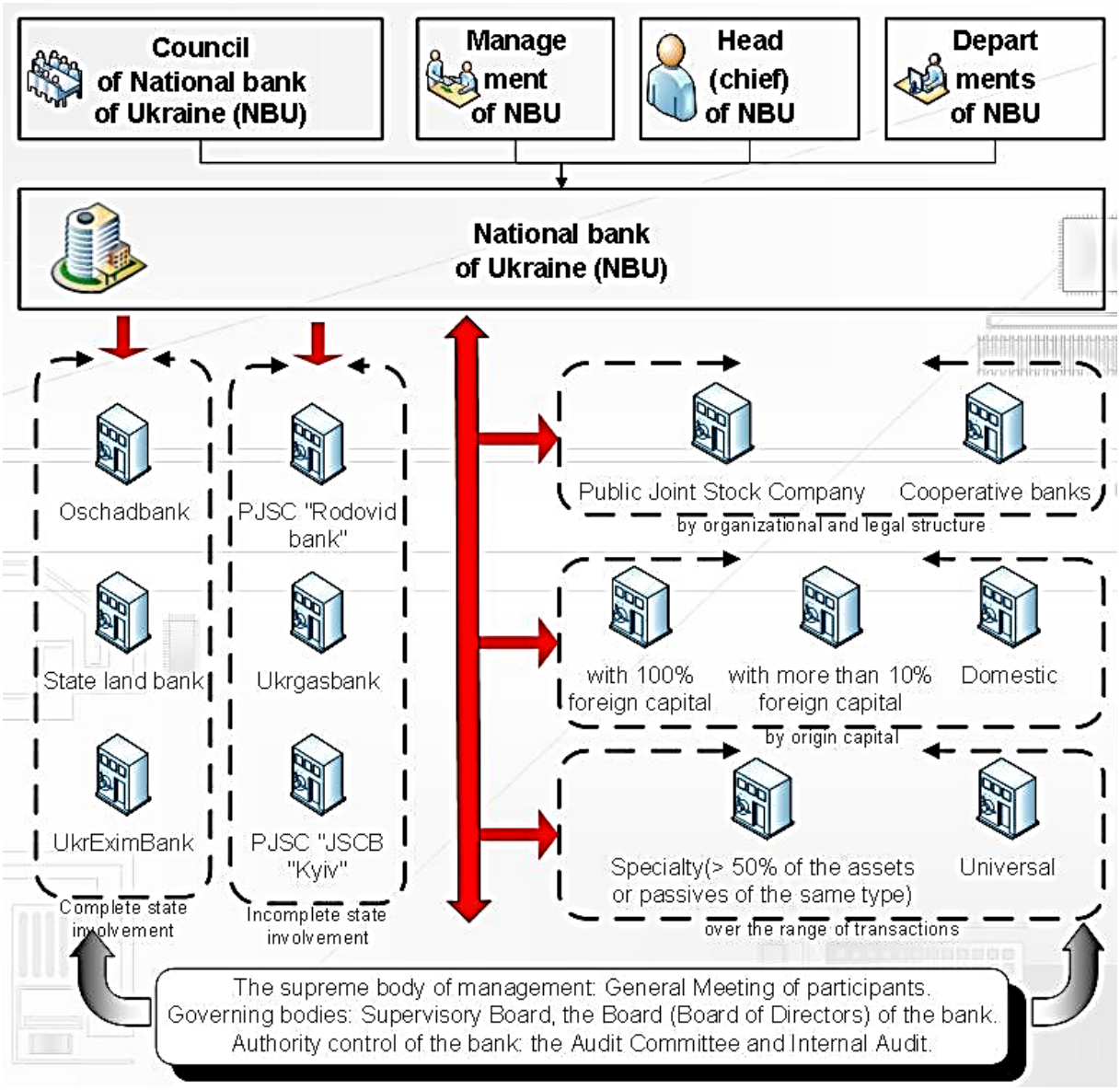

Figure 1. Structure of the national banking system on an example of Ukraine

For getting the possibility of evaluating the banking system stability, we introduce the concept of the level of stability of the banking system and indicate it as *LSBS* (level of stability of the banking system). As the concept of the national economy uses as a basis of the banking system within its life cycle, it is fair the following dependence

$$\mathrm{LSBS} = \max\left\{\mathrm{LSBS_h}\right\} \quad (1)$$

where $LSBS_h$ is meaning of level of stability of the banking system at the time *h*, if we take the length of research for one year and the frequency rate of 1 every month, it is possible to obtain the change dynamics of the

level of stability of the banking system. At the same time, an example of the change dynamics of the level of stability of the banking system at any time can be changed slowly like it is shown in Figure 2.

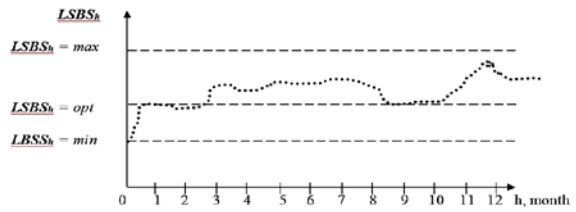

Figure 2. Example of change dynamics of the level of stability of the banking system

This example clearly shows that the level can vary during the time within the permissible limits (maximum and minimum). However, it is desirable that the level of stability of the banking system has insignificant fluctuations or changes within the optimum value that will keep the banking system from significant effects of crisis and provide a stable and sustainable development of the national economy.

3. Theoretical Fundamentals

Using the systematic approaches [5,6,7] it is possible to carry out the decomposition of the banking system into the subsystems, which will provide the opportunity to introduce the following components:

V_{ST} (standards) is the "subsystems volume" or business processes in the banking sector, which meet the requirements of well-known banking standards (both domestic, and international [4]) and determines the appropriate cost of their realization, and the cost should be less than 30% (the current and further estimates made by experts on the results of expert evaluation); for some banking processes the research was conducted based on the author's method [8], which results are shown in the domestic and international market in Figure 3.

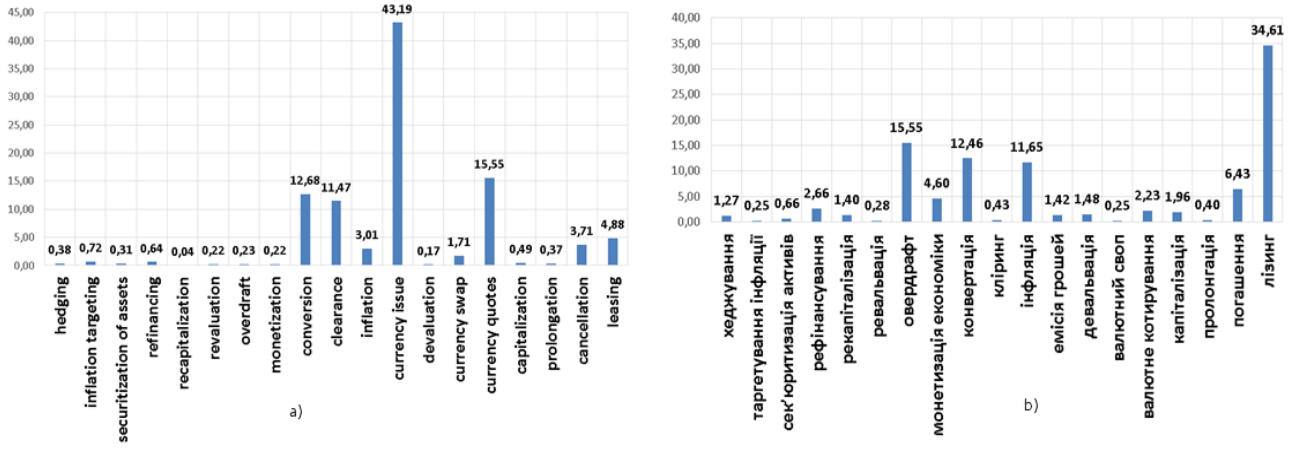

Figure 3. Distribution of weight share (relative to the total number of links (demand) for the current time) of main business processes of the banking sector for domestic (a) and international (б) market, %

It should be mentioned that nowadays we can see a strengthening of a popularization for some definitions or key aspects in this area [8], for example, it covers the following definitions – hedging, inflation targeting, securitization of assets, refinancing, recapitalization, revaluation, overdraft, monetization, conversion, clearance, inflation, currency issue, devaluation, currency swap, currency quotes, capitalization, prolongation, cancellation, leasing, lending. For those and some other similar definitions, the authors have carried out a research for all these definitions about their distribution on the time line (2000-2013). This research is based on the method of Internet-analysis [8]. At the same, this distribution was based on their popularization or demand; also, it can call as time-frequency analysis. The source data of these definitions were made based on the author's data received by experimental way of own research [8]. All of these submitted data has been normalized for better visualization and to receive a possibility of comparing those results between themselves.

As a continue of our research for those definitions and similar security areas, we could build some distributions for separated definitions with forecasting in the next time period (for the next several years) based on the well-known trendiest models.

Thus, we could describe the common tendencies in this and other areas based on using of developed by one from the authors method of Internet-analysis [8]. The method of Internet-analysis developed by the authors can be applied in any given area of an activity, regardless of its properties and features. The purpose of using this method is to get some assessment or collection of selected concepts (terms or definitions), which form the so-called categorical apparatus of a scientific research (in our case it is banking system). According to estimates, authors can formulate a conclusion about the need for a further research in this area, show the urgency and demonstrated the importance of the calculations, to allocate a narrow major for a further research of young scientists. The proposed method can be used to study the activities of prominent scientists, professionals from designated areas of activity. Secondly, this method can be used for demonstrating the importance and the relevance of a research, and the conclusions and recommendations drawn, for example, to select consultants (leaders) in their scientific activities.

For a more complete openness, authors could show the possibilities of the research conducted by the authors on the example of a field of the economic security, which was selected, because of its global relevance. Using of this method based on the specifics of the query language that

is supported by all search engines and the shape of the query, the results on the set of selected search engines are averaged at a given time interval. Thereby, the dynamism of the study is achieved. As the authors show as an example of some limited areas of interest an interpretation of the developed method with the help of graph theory to be able to use known techniques of optimization and further analysis [7]. Thus, the scope of the developed method of Internet-analysis is multi-faceted in its specificity and tolerance in limited areas of an interest [8].

Also the given statistics show that more than 85% of all processes in the banking sector in the domestic market of demand consist of the following: overdraft (15.5%), the monetization of the economy (4.3%), conversion (11.65%), inflation (10.9%), cancellation (6%), leasing (32.35%) and lending (6.55%). That is the most actual and popular banking processes in the national economy of Ukraine at present. However, on the international market, there are some changes in the structure of the most necessary and popular banking processes, which provide the next list, which is almost 95% of all banking processes: conversion (12.1%), clearance (10.9%), currency issue (41.1%), currency quotes (14.8%), cancellation (3.53%), leasing (4.64%) and lending (4.86%). Also, based on the above-mentioned author's method [8] it is possible to obtain the change dynamics of demand for these processes during the time period.

V_{AR} (audit and level of risks) is the "volume of subsystems" or business processes, for which the audit is made, it is conducted and assessed the level of risks, determines the appropriate cost for implementation of mentioned measures, which should be no less than 10%;

V_{VCO} (vulnerabilities, channel of outflow) is the "volume of subsystems" or business processes, where the analysis of vulnerabilities and channel of information outflow with restricted access (i.e., bank secrecy) is made, defines the relevant costs that should be no less than 28%;

V_{VSSF} (antivirus, antispam, antispyware, firewalls) is the "volume of subsystems" or business processes, for which the antivirus, anti-spam, anti-spyware tools and firewall programs are installed, determines the appropriate costs for acquisition, installation and maintenance, the cost should be no less than 12%;

V_{ND} (normative documents) is the "volume of subsystems" or business processes, for which the normative documents are developed and implemented, determines the appropriate costs for development and implementation of a system of circulation of documents, the cost should be no less than 15%;

V_{All} – "volume of subsystems" or business processes that remained (business processes), determines the appropriate cost of their implementation, the cost should be no less than 5%;

V_{BS}(the banking system) is the "volume of all subsystems" or all business processes, determines the appropriate cost. Then

$$V_{BS} = V_{ST} + V_{VCO} + V_{VSSF} + V_{ND} + V_{AR} + V_{All} = 100\% \quad (2)$$

To provide more clarity, we present the graphical distribution V_{BS} taking into account the share of certain components received from the expert survey (Figure 4).

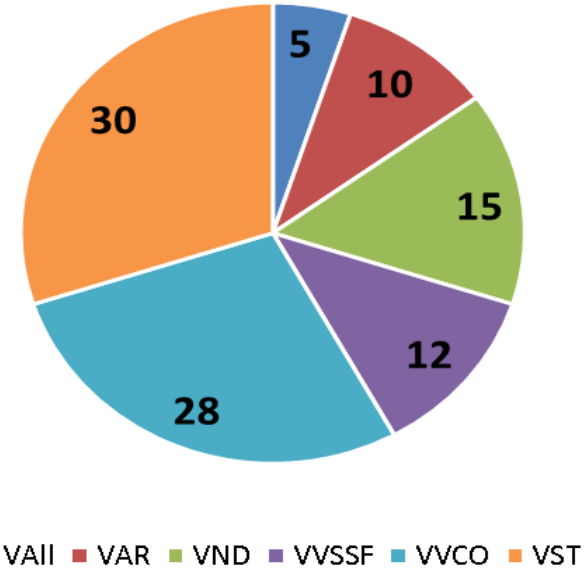

Figure 4. Distribution of costs of banking subsystems, which are recommended by authors

4. Mathematical formalization

Such distribution cannot make a significant impact on the determination of the level of stability of the banking system because it gives only the proportion of each separate banking subsystem, i.e. this distribution affects only the balance of coefficients of importance for banking subsystems. Moreover, for these types of distribution the following condition should be carried out that ensures the feasibility and need of additional research and implementation of experiments in the banking system.

If $V_{All} > V_{ST} + V_{VCO} + V_{VSSF} + V_{ND} + V_{AR}$, assess the level of stability of the banking system is not appropriate, because the cost of implementation and maintenance of subsystems exceed the costs, which have a positive balance of the banking system. As the subsystem, in our case on example for Ukraine, we can consider each bank in this country, some kinds of which were shown in Figure 1.

Thus, there is a functional dependence of the level of stability of the banking system on various development factors of the banking system [3,11]. Then, we get the following dependence

$$\mathrm{LSBS_h} = \mathrm{f}\,(\overline{T}, \overline{T_Z^B}, \mathrm{V_{ST}}, \mathrm{V_{VCO}}, \mathrm{V_{VSSF}}, \mathrm{V_{ND}}, \mathrm{V_{AR}}, \mathrm{V_{All}}) \quad (3)$$

$$\mathrm{LSBS_h} = \mathrm{f}\,(\overline{T}, \overline{T_Z^B}, \mathrm{V_{BS}}) \quad (4)$$

and $\overline{T} \to \max$, $\overline{T_Z^B} \to \min$, $\mathrm{V_{BS}} \to \min$, where

$$\overline{T} = \frac{1}{\frac{1}{N}\sum_{i=1}^{N}\sum_{j=1}^{K} IB_{ij}}, \quad (5)$$

$\overline{T}$ is an average time between the incidents (crisis, force majeure, different disturbances, etc.) in the banking system;

$N$is a number of reporting periods, usually, $N = 12$, for the number of months of research and its duration during

one year; can be changed according to current banking standards;

*K*is a number of types of crisis or other negative impacts on the national economy from the banking system [2];

$IB_{ij}$is the frequency of incidents of banking sector since i-period of j-type violation;

$\overline{T}_Z^B$ is an average time of recovery of *z*-unit (subsystem) of the banking system.

$$\overline{T}_Z^B = \frac{1}{N}\sum_{j=1}^{N} t_{zj}^B, \quad (6)$$

where t_{zj}^B – recovery time of *z*-unit of banking system for *j*-time period.

When using the optimal approach to the assessment of the level of stability of the banking system with the determination of the optimal direction, the equation (1) becomes:

$$LSBS_h = f\left\{\begin{array}{l} \overline{T} \to \max \\ \overline{T}_z^B \to \min \\ V_{ST} \to \max \\ V_{VCO} \to \max \\ V_{VSSF} \to \max \\ V_{ND} \to \max \\ V_{AR} \to \max \\ V_{All} \to \min \end{array}\right. . \quad (7)$$

To provide the possibility to calculate the level of stability of the banking system, it should be the physical parameters of the banking system, which would provide the ability of dynamically obtain by an automated process:

K_{PC} is the number of workstations, personal computers, involved in ensuring the functioning of the banking system, if we assume that on average 85% of employees (*M*) have computers in their workplace, and considering those

$$V_{ST} = \{V_{VCO}\} \dot{E} \{V_{VSSF}\} \dot{E} \{V_{AR}\},$$

then $K_{PC} = \lceil 0{,}85 \times M \rceil$.

$K_S$is the number of servers, involved in ensuring the functioning of the banking system, if we assume that on average 20-25 workstations have one server, then

$$K_S = \ddot{e} K_{PC} / \ 25\hat{u}.$$

K_{NE} is the number of network equipment, which are involved in ensuring the functioning of workstations and servers, on condition that the number of ports for connection of network equipment *Z = 5, 8, 12, 16, 32, 64*, depending on the company and the technical characteristics of network equipment, then

$$K_{NE} = \acute{e}(K_{PC} + K_S) / Z\grave{u}.$$

K_{CE} is the number of communication equipment, involved in ensuring the employees' activity (PPC, cell phones, PDA phones, smartphones, netbooks, mini PCs), so, in the simplest case, K_{NE} is the number of employees (*M*), but, taking into account that every second worker in the banking sector has several devices, then

$$K_{CE} = 0{,}5'M + M = \acute{e}1{,}5'M\grave{u}.$$

K_{CTI} is the number of channels of transfer information, which found the channels of information leakage (Table 1) with the help of which are created or formed the incidents affecting the stability of the banking system.

Table 1. Classification of channels of information leakage

Devices type	Number by order	Type of channels of information leakage
Personal computers and servers	1	e-mail
	2	FTP-service
	3	HTTP-service
	4	P2 P-service
	5	CHAT-service
	6	ICQ-service
	7	IRC-service
	8	Wi-Fi-channel
	9	IrDA-channel
	10	Bluetooth-channel
	11	WWW-service
	12	USB- interface
	13	COM- interface
	14	Cardreader-channel
	15	Skype-service
	16	SCSI-interface
	17	LPT- interface
	18	FDD-interface
	19	HDD-interface
	20	simple copying by network with using of the set $\{K_{NE}\}$
Cellphones and the like devices	1	Wi-Fi-channel
	2	IrDA-channel
	3	ICQ-service
	4	CHAT-service
	5	Skype-service
	6	EMS-service
	7	WWW-service
	8	FTP-channel
	9	P2P-service
	10	WAP-service
	11	MMS-service
	12	SMS-service
	13	IRC-service
	14	USB-channel
	15	HTTP-service
	16	Bluetooth-channel
	17	e-mail

Then, by using the classifier, the number of channels of information leakage will be determined by the formula:

$$\begin{aligned} \mathrm{K_{CTI}} &= \acute{e}\left(20+\mathrm{K_{NE}}\right)'\left(\mathrm{K_{PC}}+\mathrm{K_S}\right) \\ &+17'\mathrm{K}_{CE}+2'\left(\mathrm{K_F}+\mathrm{K_T}\right)\grave{u} \end{aligned} \quad (8)$$

where $K_T$is the number of telephones,

K_F is the number of faxes, and fax has two channels of information leakage: acoustic and data transfer.

Then, taking into account the introduced parameters of the system (7) is transformed:

$$LSBS_h = f\left\{\begin{array}{c} \overline{T} \to \max \\ \overline{T_z^B} \to \min \\ K_{PC} \to opt(\min) \\ K_S \to \min \\ K_{NE} \to \min \\ K_{CE} \to \min \\ K_{CTI} \to \min \end{array}\right\}. \quad (9)$$

Based on the possibility of absorption and transformation (we have thefollowing $\{K_{CTI}\}=\{K_{PC}\}\cup\{K_S\}\cup\{K_{NE}\}\cup\{K_{CE}\}$) on the basis of the formula (7) and orientation of optimization (*min*) it can be obtained the minimization of system (9) as follows

$$LSBS_h = f\left\{\begin{array}{c} \overline{T} \to \max \\ \overline{T_z^B} \to \min \\ K_{CTI} \to \min \end{array}\right\}, \quad (10)$$

or in the linear form

$$LSBS_h^{LIN} = f\left(\max\left(\overline{T}\right)\times\min\left(T_z^B, K_{CTI}\right)\right) \quad (11)$$

If we make the system of equations (10-11) to a single optimum orientation, we get

$$LSBS_h = f\left\{\begin{array}{c} \left(1-\overline{T}\right)\to\min \\ \overline{T_z^B}\to\min \\ K_{CTI}\to\min \end{array}\right\}, \quad (12)$$

$$LSBS_h^{LIN} = f\left(\min\left(\left(1-\overline{T}\right), T_z^B, K_{CTI}\right)\right) \quad (13)$$

With the introduction of the dynamics of time considering that means take into account the dynamics of evaluation of the stability of the banking system, it is also necessary to introduce the rationing of all intermediate factors, because they have a different nature of existence and measurement. Then the following system of correlation is correct:

$$\left\{\begin{array}{c} V_{SES} = \frac{1}{N}\sum_{i=1}^{N} V_{SES}^i, \\ \sum_{i=1}^{N} V_{ST}^i + \sum_{i=1}^{N} V_{VCO}^i + \sum_{i=1}^{N} V_{VSSF}^i + \sum_{i=1}^{N} V_{ND}^i + \sum_{i=1}^{N} V_{AR}^i + \sum_{i=1}^{N} V_{All}^i = N \times V_{SES}, \\ \sum_{i=1}^{N} V_{SES}^i = \sum_{i=1}^{N} V_{SES}^{i+1}, \\ \sum_{i=1}^{N} {}^H V_{ND}^i = 1, \sum_{i=1}^{N} {}^H V_{AR}^i = 1, \sum_{i=1}^{N} {}^H V_{All}^i = 1, \\ \left(V_{ST}^i + V_{VCO}^i + V_{VSSF}^i + V_{ND}^i + V_{AR}^i + V_{All}^i\right) = V_{SES} \text{ для } \forall \text{ i}, \\ V_{All}^i = V_{SES}^{i+1} - \sum_{i=1}^{N}\left(V_{ST}^i + V_{VCO}^i + V_{VSSF}^i + V_{ND}^i + V_{AR}^i\right), \\ \sum_{i=1}^{N} {}^H V_{ST}^i = 1, \sum_{i=1}^{N} {}^H V_{VCO}^i = 1, \sum_{i=1}^{N} {}^H V_{VSSFI}^i = 1, \end{array}\right. \quad (14)$$

$$\left|\begin{array}{ccc} \left\{\begin{array}{l} \sum_{i=1}^{N} T_{CP}^i = 365, \\ \sum_{i=1}^{N} {}^H T_{CP}^i = 1, \end{array}\right. & \left\{\begin{array}{l} \sum_{i=1}^{365/N} IB_{ij} < 365, \\ \sum_{i=1}^{365/N} {}^H IB_{ij} = 1, \end{array}\right. & \left\{\begin{array}{l} \overline{{}_i T_z^B} \times \frac{1}{N}\sum_{i=1}^{N} IB_{ij} < 365, \\ \sum_{i=1}^{N} \overline{{}^H {}_i T_z^B} = 1, \end{array}\right. \end{array}\right| \quad (15)$$

$$\left\{\begin{array}{c} K_{PC} + K_S < M \ , \\ K_{PC} + K_S << V_{SES}, \\ \left\{V_{All}\right\} \neq K_S. \end{array}\right. \quad (16)$$

Moreover, you must adhere to the following conditions

1. If $\overline{T_Z^B} \geq T_{cp}$, the banking system is considered as with lost working capacity and cannot be restored, that is, in a time of the recovery of *i*-unit arises an another incident.

2. If $IB_{ij} \geq i$, the banking system is considered as with lost working capacity and cannot be restored, it means that the time period during which there are a number of incidents, corresponds to the duration of the current period of functioning of the banking system, so it does not function.

3. If $.\overline{T_z^B} .\geq 1/ IB_{ij}$, the banking system is considered as with lost working capacity and cannot be restored, because the average recovery time of the system after one incident exceeds the time till the next incident.

Thus, the task of evaluation of the stability of the banking system based on the volume of subsystems is formulated, i.e. the formalized as multicriteria (three factors) optimization task or a task of linear programming with the functional (12 or 13) and system of correlation (14,15,16).

5. Conclusions

That the evaluation of the banking system stability is the difficult phenomenon does not raise doubts. In our opinion, the apologia of proposed method or approaches to evaluation of the banking system stability is justified by that for its help: first, it is possible to develop a mathematical model in which the characteristic of communications between components of the banking system is important, after all the visual and some other kind analysis can give a rich material for the formulation of hypotheses. Secondly, it is possible to comprehend structure, functions, processes in the banking system, the purpose which will allow to come nearer to understanding of the evaluation of the banking system stability as to system; thirdly, more precisely to define internal cause

and effect sheaves and to coordinate the theory with practice. Therefore, distribution of the evaluation of the banking system stability to subsystems allows to understand, what its components it is possible to operate; which it is easy to influence, but which are difficult for forecasting and vice versa; and which cannot be predicted, and only to estimate probability of emergence of needs for evaluation and to create conditions for the sake of the evaluation of the banking system stability. In this work, proposed method or approach to research on evaluation of the banking system stability understands in such expanded interpretation.

Therefore, high levels of ensuring evaluation of the banking system stability is a preliminary condition of formation of a complex system of stability evaluation because only those banks can help which are profitable. In turn, the formation of the evaluation of the banking system stability will lead to increase of loyalty of bank consumers (clients) to the banks and to decrease in level of regulating influence of the negative factors, which will promote ensuring evaluation of the banking system stability. The most successful banking system that which puts the means in the implementation of important projects on advantage to national banking system is considered.

Because of the statistical and some other kind of information shown, the need, topicality and popularity of using of proposed approach or other similar methods and algorithms for evaluation of the bankingsystem stability on the national banking system has been proved.

An algorithmic implementation of the proposed method has also presented on the basis of which can easily develop an analytical tool or software for use in the national banking system as a part of the overall system of management.

Acknowledgement

The directions of further researches are formations of some special and new principles of ensuring evaluation of the banking system stability that is a generalization of all norms, rules, regularities and empirical experience in a type of certain requirements that will allow learning features of her behavior as purposeful multi reasonable national banking system.

References

[1] Annual Vietnam Business Forum on December 3, 2013. [Online]. Available: www.vbf.org.vn/documentation-center/doc_download/1496-annual-vbf-full-report-2013-eng.html [Accessed Dec. 18, 2013].

[2] Compton, E.N. (1983) Principles of Banking, USA: American Bankers Association.

[3] Economic, Political, and Legal Factors in Financial System Development: International Patterns in Historical Perspective. Caroline Fohlin, California Institute of Technology. For presentation at the Midwest Political Science Association meetings, April 28, 2000, Chicago, IL.[Online]. Available: http://www.hss.caltech.edu/SSPapers/wp1089.pdf [Accessed Dec. 18, 2013].

[4] European Committee for Banking Standards. [Online]. Available: http://www.ecbs.org/. [Accessed Dec. 18, 2013].

[5] General System Theory: Foundations, Development, Applications (Revised Edition) (17 May 1969) by Ludwig von Bertalanffy.

[6] Gerard P. Cachon and Marshall Fisher. (2000). Supply Chain Inventory Management and the Value of Shared Information. *Management Science*, 46 (8), 1032-1048.

[7] John Collins and Maria Gini. (2001). A Testbed for Multi-Agent Contracting for Supply-Chain Formation. Workshop on Agent-Based Approaches to B2B, May.

[8] Kavun, S. V., Mykhalchuk, I. V., Kalashnykova, N. I., Zyma, O. G., A Method of Internet-Analysis by the Tools of Graph Theory. *Intelligent Decision Technologies. Smart Innovation, Systems and Technologies*, 15 (1), 35-44. 2012.

[9] Kavun, S., Brumnik, R., Management of corporate security: new approaches and future challenges. Editorial Denis Galeta and Miran Vrsec. Cyber security challenges for critical infrastructure protection (pp. 141-151). Ljubljana: Institute for Corporate Security Studies. Retrieved August 5, 2013, [Online]. Available: http://www.ics-institut.com/research/books/5 [Accessed Dec. 18, 2013].

[10] Socio-Economic Security in the Context of Pervasive Poverty: A Case Study of India by K. Seeta Prabhu, [Online]. Available: http://www.ilo.int/public/english/protection/ses/download/docs/india.pdf. [Accessed Dec. 18, 2013].

[11] The World Bank site. Part of report about financial sector. [Online]. Available:http://data.worldbank.org/about/world-development-indicators-data/financial-sector. [Accessed Dec. 18, 2013].