УДК 336.71

***Naumenkova S. V.***
*Dr. habil. (Economics), Professor, Head of the Banking Department*
*Taras Shevchenko National University of Kyiv,*
*Ukraine; e-mail: snaumenkova@yandex.ru*
***Domanetskyi I. V.***
*Master's degree, 2-nd year, student, Department of Banking,*
*Taras Shevchenko National University of Kyiv,*
*Ukraine; e-mail: igor-domaneckij@yandex.ru*

## FORECASTING OF CAPITALIZATION OF BANKING INSTITUTIONS IN UKRAINE

**Abstract.** In this article peculiarities of existing approaches to the assessment of the bank capitalization are investigated. The advancing tools for mathematical analysis modelling were put forward by authors for predicting of the Ukrainian banks capitalization. The forecast of Ukrainian bank capitalization is given for various combination of economic circumstances.

**Key words**: bank capitalization, mathematical modelling, linear regression, impulse noise, Vector Autoregression Models, synergy effect; forecasting, mathematical simulation.

Formulas: 3; fig.: 1; tabl.: 3; bibl.: 12.

**JEL Classification:** E 44, E 22, F 21, G 29.

***Науменкова С. В.***
*д.е.н., професор, завідувач кафедри банківської справи економічного факультету Київського національного університету імені Тараса Шевченка,*
*Україна; e-mail: snaumenkova@yandex.ru*
***Доманецький І. В.***
*магістр 2 курсу, кафедра банківської справи,*
*Київський національний університет імені Тараса Шевченка,*
*Україна; e-mail: igor-domaneckij@yandex.ru*

## ПРОГНОЗУВАННЯ КАПІТАЛІЗАЦІЇ БАНКІВСЬКИХ УСТАНОВ В УКРАЇНІ

**Анотація.** У статті поглиблено основні підходи до оцінювання капіталізації банку та запропоновано застосування оновленого інструментарію для прогнозування капіталізації українських банків з використанням методів економіко-математичного моделювання. На основі розроблених моделей здійснено прогноз капіталізації вітчизняних банків за різних сценарних умов розвитку подій в економіці України.

**Ключові слова:** капіталізація банку, економетричні моделі, лінійна регресія, імпульсні реакції, VAR-моделі, синергетичний ефект, прогнозування, сценарне моделювання.

Формул: 3, рис.: 1, табл.: 3, бібл.: 12.

***Науменкова С. В.***
*д. э.н., профессор, заведующая кафедрой банковского дела,*
*Киевский национальный университет имени Тараса Шевченко,*
*Украина; e-mail: snaumenkova@yandex.ru*
***Доманецкий И. В.***
*магистр 2 курса, кафедра банковского дела, Киевский национальный университет имени Тараса Шевченко (ул. Васильковская 90-А, Киев,*
*Украина; e-mail: igor-domaneckij@yandex.ru*

## ПРОГНОЗИРОВАНИЕ КАПИТАЛИЗАЦИИ БАНКОВСКИХ УЧРЕЖДЕНИЙ В УКРАИНЕ

**Аннотация.** В статье углублены подходы к оценке капитализации банка и предложено использование усовершенствованного инструментария для прогнозирования капитализации украинских банков с использованием методов экономико-математического моделирования. С использованием разработанных моделей осуществлен прогноз капитализации украинских банков при разных сценарных условиях развития событий в экономике Украины.

**Ключевые слова:** капитализация банка, эконометрические модели, линейная регрессия, импульсные реакции, VAR-модели, синергетический эффект, прогнозирование, сценарное моделирование.

Формул: 3, рис.: 1, табл.: 3, библ.: 12.

**Introduction.** The achievement of proper amount of bank capitalization is one of the major problems of the banking system of Ukraine in terms of its integration into the international financial system, strengthening of international banking groups influence, and activation of mergers and acquisitions process in the banking sector. The relevance of the capitalization process research of domestic banks significantly increased not only in terms of instability strengthening in the banking sector of Ukraine but also of implementing the updated standards of banking supervision. Developing models of bank capitalization, based on the use of different scenario conditions and important macroeconomic indicators is relevant and justified in the face of uncertainty.

**Analyses of recent researches and publications.** Problems of providing the required amount of capitalisation are the subject of numerous works of foreign authors such as E. Brigham, F. Viort, A. Docherty, A. Gosh, B. King, P. Rose, J. Sinkey, D. Rosenberg, D. Pierce, and Ukrainian scientists such as: G. Azarenkova, O. Bereslavska, Z. Vasylchenko, N. Versal, O. Dzoblyuk, M. Dyba, G. Karcheva, V. Mishchenko, T. Momot, L. Prymostka, M. Savluk, S. Savluk, B. Samorodov, O. Chub and others.

The purpose of this paper is developing new methodological approaches and improving of economic and mathematical modeling tools to forecast the amount of capitalisation of banks in Ukraine in terms of macroeconomic imbalances and financial instability.

**Results.** There is no single interpretation of the term "bank capitalization" in economic literature. Thus, D. Rosenberg consider capitalization as the amount of money invested in the bank by its owners [1]. D. Pierce defines capitalization as total amount and structure of bank's share capital [2].

Traditionally, the capitalization of the banking institution is defined as the total amount of the bank's equity. The need for forecasting the volume of bank capitalization in Ukraine is related to the general tasks of forecasting and planning social and economic processes in the country. The question of capitalization of banks is particularly relevant because of the changes that reflect increasing of the minimum authorized capital of a legal entity (that intends to carry out banking activities) to 500 million [5, P .31].

Identification of reserves and possible additional sources of capitalization growth of Ukrainian banks is an important task in modern conditions that reflects the relationship and interaction between banking system and socio-economic and political factors. The impact of the last ones become more noticeable in terms of increasing instability in the banking sector of Ukraine and restricting access to the sources of increasing the capital base of banks [6].

The important role in modern conditions play the development and application of modern tools of economic processes research, including ones that take place in the banking sector. Research of capitalization of banks in Ukraine with the methods of multivariate econometric analysis will allow to analyze the process, to identify the most important factors that influence its dynamics and build adequate forecasts for the short and long term with various scenarios of the development of the process.

Econometric analysis of any process begins with the selection of factors that characterize it. It is necessary to identify dependent and independent factors. The authors propose to choose the amount of equity as a dependent factor in the process of modeling. Independent variables of the model are amount of total assets, profit, authorized capital, and the share of foreign capital in the banking system of Ukraine.

It's important to notice that for adequate results of developed model, an adequate research statistical database should be created, with no less than 10 observations. According to these suppositions, a separate data set of determined indicators of the development of banking system of Ukraine for 2003-2013 years, quarterly (included data for the 1st quarter of 2014) was formed.

The next step of econometric modeling is building a regression model. Regression model allows to examine a degree of dependence between dependent factor and independent ones. Herewith the form of linear regression is widely used and the model is as follows:

$$y = b_0 + b_1x_1 + b_2x_2 + \ldots + b_kx_k, \quad (1)$$

where y – dependent variable;
$b_0$ – constant;
$b_j$ – coefficients of regression;
$x_j$ – independent variables;
k – number of variables in the model.

The model which was created and based on these relevant data using EViews program options is as follows:

$$VK = 2592{,}502 + 0{,}107AKT + 0{,}157PR - 262{,}25INOZ + 0{,}306SK, \quad (2)$$

where VK – amount of equity;
AKT – total assets;
PR – banks' profit;
INOZ – share of foreign capital;
SK – authorized capital of Ukrainian banks.

Analyzing the results, it should be noted that this model is optimal because the value of Student's t-statistic for independent factors is below the level of 5%. Additional model parameters, i. e. the coefficient of determination and adjusted coefficient of determination are approximately 0.999 and 0.998. These figures are very close to 1, pointing to the high quality of the model. In addition, the rate of Fisher F-statistics is in optimal range as the value of the probability of error is less than 5%. This points to the adequacy of the model.

The next step is to check the econometric model on various parameters to determine the probability of forecasting for this model. According to that the functional form of the model should be examined. This procedure could be done using a special method - Ramsey Reset Test, which is an important part of software capabilities of EViews. As a result of this test, the probability is higher than 5%, so the model specification is correct. Thus a linear form of econometric model will be used in this research.

An important step is to test the developed model for the presence of heteroscedasticity. If it exists, the model is considered to be sub-optimal and needs improvement. The model is examined using White's test which is a part of software capabilities of EViews. The results of the check of the model indicate an absence of heteroscedasticity as the value of statistical significance of the model (the level of reliability is 95%) is greater than 5% and is equal to 14%. This means that the econometric model is optimal.

Another important step in testing is verifying the existence of autocorrelation. It can be done using Ljung-Box test. This function is also built into the EViews program. The results of the examination of the model points to the fact of absence of autocorrelation with reliability level of 95% as for each lag the significance level of the model is greater than 5%. Thus

according to comprehensive examination the econometric model can be used in forecasting purposes.

The research based on the constructed model leads to the following conclusions. The equity of Ukrainian banks is in direct connection with assets (indicate the size and scope of the bank), profit and authorized capital and opposite ones with share of foreign capital. If bank assets increase by an average of 1 million hryvnias, their equity increases by 0.1 million hryvnias. The effect of income growth is stronger - equity in this case increases by an average of 0.15 million hryvnias. The largest is the effect of the increase of the authorized capital - in this case the growth of the bank's equity will be more than 0.3 million hryvnias.

It's a widespread situation in economic researches when the same factors, in some cases, are the causes of economic processes, while in others they are their effects. This aspect is not taken into account using linear econometric models. However, there are econometric tools that successfully solve the problem. These are models of vector autoregression (VAR-models).

According to these models, any variable is both a dependent and independent. As a result, the model reveals not only the influence of all independent factors on the amount of banks' equity in Ukraine, but also the impact of equity on the most important indicators of the banking system of Ukraine. VAR (for example the authors represent the model with two variables) can be written as a system of simultaneous equations as:

$$\begin{aligned} y_{1,t} &= c_1 + A_{1,1}y_{1,\,t-1} + A_{1,2}y_{2,\,t-1} + e_{1,t} \\ y_{2,t} &= c_2 + A_{2,1}y_{1,\,t-1} + A_{2,2}y_{2,\,t-1} + e_{2,t} \end{aligned} \qquad (3)$$

where: $c_1$, $c_2$ – free coefficients of the model;
$A_{n;\,m}$ – coefficients of the dependent variables;
$e_{n;\,t}$ – error of the model;
$y_{n,t}$ – dependent variable;
$y_{n,\,t-1}$ – lag value of independent variable.

Models of such a type is useful if the number of variables is not greater than 3. In this case we have 5 variables that complicate the construction of the model, because eventually we will have 5 new equations.

In such circumstances, it should be noted that in addition to this, the most accurate description of VAR models is impulse response. This tool give an opportunity to determine connection between economic phenomena in the direction of "cause-effect". They characterize the change of one parameter in response to the percentage change of the other. Thus, the impulse response takes into account the time factor and is a more precise tool for analysis that enable to obtain the accurate conclusions about the economic dynamic processes.

Testing the model for the optimal number of lags with the help of criteria Akaike, Schwarz and Hannan-Quinn allows to use lags of second or fourth order. However, the model contains 5 variables, and the use of more than 1 lag order can significantly complicate the model and cause appearance of large number of additional variables that make an economic interpretation of the model impossible. Therefore, it is advisable to use a first order lag, where the variables depend on its value and significance of other variables in the previous time t-1.

According to these assumptions a map of impulse responses (for 3-factor model) is provided (fig. 1).

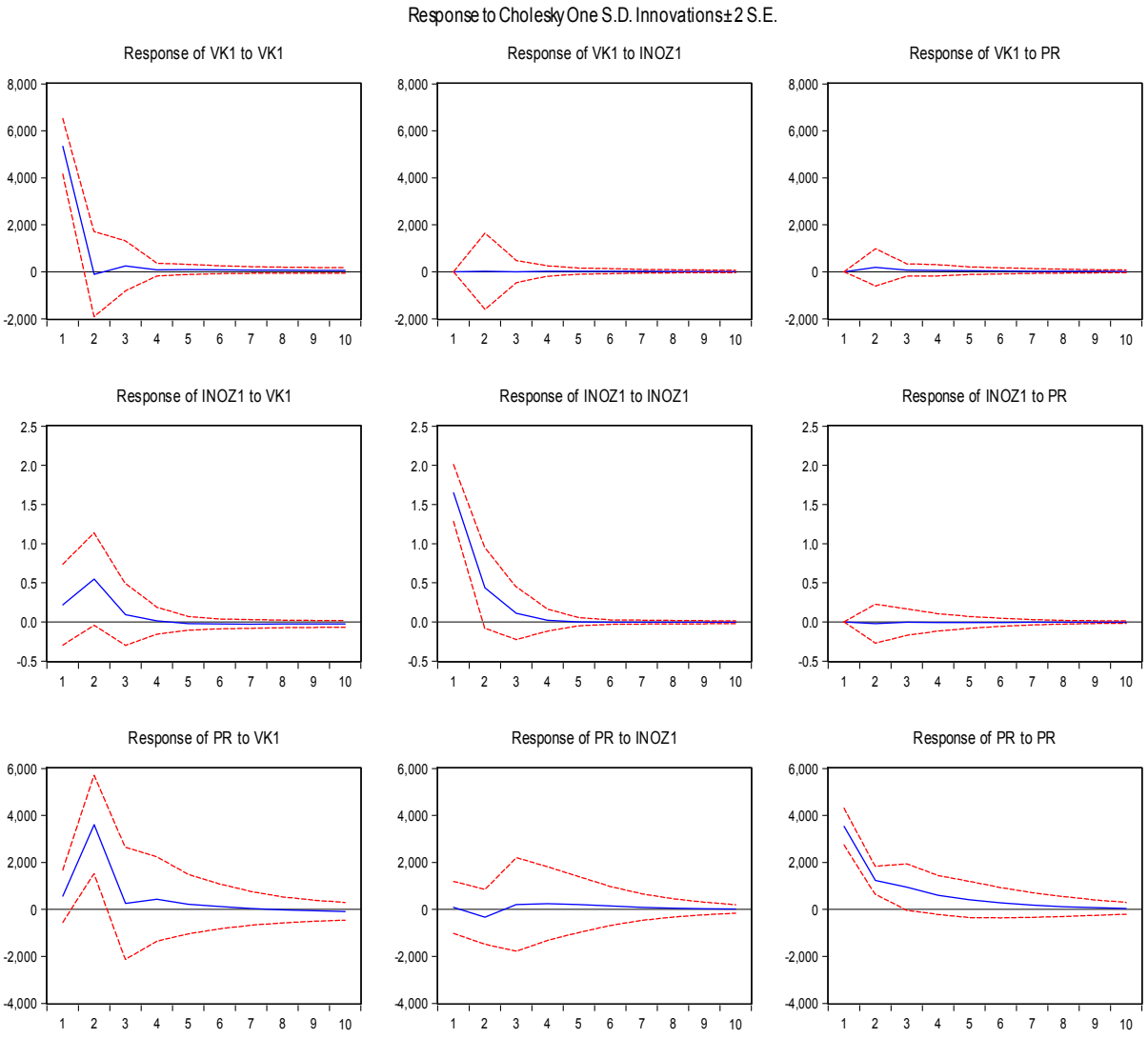


*Fig. 1. The map of impulse responses that is created in application package EViews**

*Source: developed by the authors

For getting correct conclusions when using impulse responses three variables were taken - profit, share of foreign capital, and the amount of equity. Thus, based on the results we can conclude that profit and share of foreign capital does not have a significant impact on the dynamics of equity of banks in Ukraine. This is particularly interesting in the context of leaving Ukrainian banking sector by foreign banks during the last period of time.

Thus, during the process of econometric modeling is revealed that the greatest impact on the change of equity of banks of Ukraine exercise variables such as the amount of authorized capital and the amount of bank assets.

The important area of research process of capitalization of banks in Ukraine is determining the synergetic effect resulting from the interaction of different groups of banks. Thus the exchange of personnel, information and technology is exercised that positively affects the development of banks, and eventually their capital [7].

This method involves the selection of a number of factors for synergetic effects assessment. The elected factors are provided with the expert assessment from 1 to 10 points, and appropriate weight is assigned. Based on these parameters weighted estimates are determined that characterize the level of synergetic interaction between groups of banks in Ukraine. The calculations for the first group of banks are presented in table 1.

*Table 1*

Estimation of factors' connection for the banks from the 1-st group*

| № | Factors | Weight | Groups that obtains | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 2-nd group | | 3-d group | | 4-th group | |
| | | | Rating | Weighted rating | R | WR | R | WR |
| 1 | Marketing activity | 0,35 | 7 | 2,45 | 3 | 1,05 | 4 | 1,4 |
| 2 | Innovations | 0,06 | 6 | 0,36 | 6 | 0,36 | 7 | 0,42 |
| 3 | System of motivation | 0,08 | 6 | 0,48 | 7 | 0,56 | 9 | 0,72 |
| 4 | Technological process | 0,03 | 7 | 0,21 | 5 | 0,15 | 5 | 0,15 |
| 5 | Financial resources | 0,08 | 4 | 0,32 | 4 | 0,32 | 4 | 0,32 |
| 6 | Information provision | 0,16 | 6 | 0,96 | 6 | 0,96 | 3 | 0,48 |
| 7 | Sales channel | 0,2 | 9 | 1,8 | 8 | 1,6 | 7 | 1,4 |
| 8 | Qualification of staff | 0,04 | 6 | 0,24 | 5 | 0,2 | 6 | 0,24 |
| | ∑ | 1 | - | 6,82 | - | 5 | - | 5,13 |

*Source: developed by the authors

The calculations for other 3 groups of banks were done in the same way. It should be noted that the next step is to build a matrix of synergetic interaction that enable to determine the contribution of each group of banks in the process of accumulation of their capital base (table 2).

*Table 2*

Integral of synergetic interaction between groups of banks in Ukraine*

| | | Groups that obtains | | | | Cumulative effect |
|---|---|---|---|---|---|---|
| | | 1-st group | 2-nd group | 3-d group | 4-th group | |
| Groups that transfer | 1-st group | | 6,2 | 6,04 | 5,21 | 17,45 |
| | 2-nd group | 5,13 | | 5 | 6,82 | 16,95 |
| | 3-d group | 5,74 | 6,09 | | 4,9 | 16,73 |
| | 4-th group | 5,08 | 4,35 | 5,78 | | 15,21 |
| Total dependence | | 15,95 | 16,64 | 16,82 | 16,93 | |

*Source: developed by the authors

The statistic data show a positive trend of increasing the amount of capitalization of banks in Ukraine. The obtained results confirm the total capitalization of the banking system of Ukraine depends on capitalization of the first group of banks. These results are explained not only from point of view of financial resources of major banks but also of direct participation of the state in the capitalization of banks. For instance, it reveals by purchasing shares in the authorized capital of the bank or additional shares of banks in exchange for government bonds of Ukraine and/or purchasing of these shares at the expense of the State Budget of Ukraine. These government bonds are subject to mandatory redemption of National Bank of Ukraine, including by appropriate purpose loans from international financial

institutions at their nominal value within five business days of receipt of proposals for their redemption [6]. As the decision of participation of state in capitalization of banks is taken by the Cabinet of Ministers of Ukraine that based on proposals from the National Bank of Ukraine, a situation of indirect influence of the central bank on volumes of government securities issuance can be noticed. Thus, in general, for 2008 – 2011 there was used 25.8 billion hryvnias for recapitalization of private banks in Ukraine. It is equal to almost 2.3% of GDP. According V.I. Mischenko, "now highly topical issue is about withdrawal of the state from capital of these banks, because according to international practice, if this measure was used in frames of anti-crisis program, it is only temporary." [8, P. 12 - 13].

Given the increase in the minimum authorized capital, the fourth group of banks is in the most difficult situation and the number of these banks is likely to be subject to reduction. The analysis of synergism suggests that banks of the second and third groups are engaged in secondary influence on the amount of capitalization of the banking system of Ukraine.

However, the domestic banking system is far behind the level of capitalization of banks from developed countries. The amount of banks' capitalization in Ukraine is equal to a capital base of one large European or US bank.

Thus, the capitalization of banks in terms of imbalances in the economy and financial instability is carried out mainly using external sources and with the participation of the state. Low quality and competitiveness of banking service causes the growing influence of large banks that have higher growth rate of equity.

The forecasting of the optimal level of capitalization of Ukrainian banks and obtaining the adequate prediction are of great importance, because this figure is one of the most important in the sphere of banking. The prognosis is based on previously developed econometric model. The forecasting of capitalization of banks Ukraine provides two scenarios: optimistic and pessimistic (table 3).

Table 3

The value of independent factors of econometric model according to different scenarios*

| Indicator | Pessimistic scenario | Optimistic scenario |
|---|---|---|
| The volume of assets (AKT), m. UAH | 1184325 | 1252523 |
| Profit (PR), m. UAH. | 987 | 2134 |
| Authorized capital of banks (SK), m. UAH. | 177432 | 185321 |
| Share of foreign capital (INOZ), % | 36,5 | 32,3 |

*Source: developed by the author on the basis of Internet-site of National Bank of Ukraine

The prognosis according to the econometric model is made in terms of short-term dynamics. Forecasting on the more distant future in conditions of volatile Ukrainian economy is quite difficult. Given these assumptions, the forward-received amounts of capital of banks in Ukraine in the second quarter of 2014 are obtained.

The cumulative effect of profit, authorized capital and total assets of the banks growth and the decline in the share of foreign capital as well according to the optimistic scenario in the second quarter of 2014 provides growth of equity of banks in Ukraine to 185 billion UAH. Forecast error is only 2.16%, which confirms the stability of the model.

According to the pessimistic forecast is determined that the volume of equity would decrease to 174 billion UAH. Thus quantitative indicators of profit, authorized capital and

amount of total assets influence on the amount of equity more than qualitative indicator of share of foreign capital.

Complex solution of the problems of choice the sources of banks' capitalization growth comprises the following actions on macro- and microeconomic levels:

–increasing regulatory policy of National Bank of Ukraine: increasing requirements to capital and improvement of M&A process in the sphere of banking;

–enhancing risk-management control and implementation the Basel recommendations (Basel II, Basel III) [10, 11, 12];

– improvement of corporate management of banking institutions in Ukraine;

– enhancing the alternative sources of capitalization. For instance, increasing the role of subordinated debts.

The cumulative effect according to such actions will lead to increasing the amount of capitalization of banking institutions in Ukraine and also enhance the positions of banks on world financial markets and provide the financial stability of the economy. These achievements also will stimulate real sector of the economy development and create the conditions for development of the stable competitive environment in the sphere of banking to provide the national security of the country.

**Conclusions on the basis of the results of the research.**

The advanced tools of economic modeling were implemented for forecasting the amount of capitalization of the banks in Ukraine. The system of econometric models that describes connection between equity and factors of influence was used. As a basis the classic linear regression models were chosen. In conditions of the high level of uncertainty and problems with forecasting of the economy of Ukraine the authorized capital and total assets affects the equity of banks in Ukraine the most.

The synergetic effects of interactions of the core banking groups of Ukraine were researched. The forecast of the capitalization of banks was built on the basis of scenario modeling in the aspect of short-term dynamics.

**References**


1. *Banking with a global vision*. (2008). Rotterdam: ABN Amro Bank, 5–8.
2. *The official site of the Basel Committee (2014)*. Available at www.bis.org
3. Naumenkova, S. V. (2013). The modern problems of capitalization of the banking system in Ukraine. *Financial and credit activity: problems of theory and practice*, *2*, 3-11.
4. Mishchenko, V. I. (2009). Improving the regulation of bank capital in time of crisis. *Visnuk of the NBU, 2(5)*, 81- 84.
5. About banks and banks' activity. (2000). *Law of Ukraine. № 2121-III*.
6. About urgent measures to decrease the negative effects of the financial crisis and introducing the changes to some legislative acts of Ukraine (2008). *Law of Ukraine. 639-VI*.
7. Ansoff, I. (2009). *Strategic management: classic edition*. SPb. : Piter, 343.
8. Mishchenko, V. I. (2013). Capitalization of the banking system of Ukraine: present and prospects. *Visnyk of the NBU, 7*, 11- 17.
9. *The official Internet-site of the National Bank of Ukraine*. (2014). Available at http://bank.gov.ua
10. Basel III: A global regulatory framework for more resilient banks and banking systems. (December, 2010). *Basel Committee on Banking Supervision, 68*. Available at http://www.bis.org/publ/bcbs189.pdf.
11. Global systemically important banks: updated assessment methodology and the Higher loss absorbency requirement. (July, 2013). *Basel Committee on Banking Supervision, 20*. Available at http://www.bis.org/publ/bcbs255.pdf
12. Guidance for national authorities operating the countercyclical capital buffer. (December, 2010). *Basel Committee on Banking Supervision, 26*. Available at http://www.bis.org/publ/bcbs187.pdf



*Received 18.11.2014*



*Стаття надійшла до редакції 18.11.2014*