"Evaluation of the efficiency of state regulation on the derivatives market"

| AUTHORS | Yulia Yelnikova https://orcid.org/0000-0002-8478-4716
https://publons.com/researcher/2021543/yuliia-yelnikova/ |

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
0	0	0

Yulia Yelnikova (Ukraine)

Evaluation of the efficiency of state regulation on the derivatives market

Abstract

In this article the author has developed a scientific and methodical approach to assessing the effectiveness of state regulation on the derivatives market, which is based on building econometric models of dependency of the volume of derivative instruments on quantitative characteristics of the considered instruments of regulation in the form of non-linear multiple regression as well as the application of a system of differential calculus for measuring the sensitivity of changes in the volume of derivatives as a result of state regulation. The use of the proposed approach to assessing the effectiveness of the instruments of state regulation on the market of derivative financial instruments will make it possible to assess the effectiveness of each instrument according to separately defined economic-mathematical models, to predict the dynamics of derivative financial instruments and assess the level of development of this segment of the financial market.

Introduction

Problem statement. A comprehensive analysis and formulation of a system of regulation of the financial derivatives market (hereinafter − FDM) in Ukraine makes it possible to detect a variety of forms, methods and instruments of influence of the subjects of regulation on the activities of the FDM participants. However, given the specific features of the FDM in Ukraine, which is characterized by the relative inexperience of participants, its low popularity, low organizational level compared to other countries and the use of a limited range of derivative financial instruments (hereinafter − DFI), the main regulatory pressure on the activity of this market is carried out by state authorities as a single mechanism of centralized influence and coordination of the FDM activities. Therefore, it is important to review the feasibility and effectiveness of a system of regulation of the FDM in Ukraine and the efficacy of instruments of influence through the prism of state regulation in this area.

Main results of the study. In order to identify the main trends of the study it is proposed to use scientific and methodical approach to assessing the effectiveness of state regulation (control, influence, regulation and management) of the FDM based on econometric models of the dependency of DFI volumes on quantitative characteristics of the considered instruments in the form of a non-linear multiple regression and the use of differential calculus to identify the sensitivity of changes in the scope of DFI as a consequence of state regulation (the first partial derivatives – to identify the range of instruments' variations accompanied by increase and decrease of effective features, as well as the maximum and minimum possible values of the studied indicator; the second partial derivatives – to identify the ranges of successive increases or decreases in DFI). Output data are presented in Table 1.

Table 1. The impact of characteristics of the state regulation instruments on FDM

	2005	2006	2007	2008	2009	2010	2011	2012	2013
IC	0.28	0.41	0.52	0.66	0.67	0.77	8.62	3.23	4.58
II	146.62	148.30	150.00	199.00	193.00	126.00	157.00	158.80	160.62
IR	1742.89	1645.22	1553.03	1466.00	1417.00	1446.00	1319.00	1164.00	1098.77
IM	52.48	58.85	65.99	74.00	92.00	99.00	114.00	117.00	131.20
DFI volume	0.04	0.07	0.14	0.27	0.10	3.75	23.99	24.91	25.87

Note: IC − Instrument of control (paid fines) million UAH; II – Instruments of influence (total number of measures of influence) units; IR – Instrument of regulation (dynamics of the number of issued licenses according to the types of professional activity on the stock market), units; IM – instrument of management (the number of developed regulations), units; grayed-out cells – the values of indicators predicted by the method of extrapolation on the basis of the average coefficient of growth.

The analysis of the instruments of control, influence, regulation and management in the context of the proposed indicators shows the feasibility and effectiveness of implementation of these instruments considering the growth of DFI volumes in the studied period. Moreover, the dynamics shows that an increase in the volumes of DFI is influenced by such a combination of instruments in which there is a quantitative increase of the

indicators of influence and control and the reduction of the indicators of regulation instruments. This trend is explained by the fact that the development of a certain activity requires improvement and expansion of the existing legal and regulatory base for the regulation of different aspects of its activity with the need for continuous monitoring and the use of appropriate measures in the course of inspections and detection of inconsistencies. Regarding the elements of regulation in terms of the indicator of issued licenses we should indicate the qualitative selection of competitive participants. In other words, the reduction of issued licenses is indicative of increased requirements to the FDM participants that contribute to the growth of their stability and reliability, and, consequently, the appeal of DFI transactions.

On the basis of data in Table 1 we will consider each of the four instruments in the context of the following aspects:

♦ dynamics of changes in the volume of DFI depending on the chararcteristics of the indicator of control instrument;

♦ type of functional dependence between the considered indicators that most adequately reflects the studied relationship;

♦ graphical presentation of the dependence of DFI volumes on the indicator of paid fines (instrument of control) in the dynamics during the period of 2005-2013;

♦ results of the research of extremum points and the points of changes of resultative features;

♦ quantitative assessment of the effectiveness of state regulation of FDM.

Based on the analysis of different forms of dependence of the amount of DFI on the quantitative indicator of control instrument − paid fines (linear, polynomial, logarithmic, exponential, in the form of sinusoid and cosinusoid) it was found that the highest value 89.94% of variations in the resultant feature is explained by inclusion into the model of both factor features like the amounts of fines and sinusoids of this feature. For this set of factor features the parameters of regression equation become statistically significant according to the Student's test.

The dynamics of the systematized data shows an increase in paid fines in conjunction with a simultaneous increase in the volumes of DFI transactions. For example, clear changes were observed in 2010-2011. If in 2010 the amount of DFI was 3.75 million UAH and the amount of identified deficit was 0.77 million UAH, in 2011 these figures were 23.99 million UAH with paid fines to the tune of 8.62 million UAH in connection with the extension of future transactions. However, since 2012 the trend of increasing fines parallel to the growth of DFI is refuted and receives a positive dynamics of a lesser number of delinquencies. This quality improvement on the market is explained by the related factors.

Having considered the resultant feature − the volume of DFI as well as a factor feature – the paid fines and sinusoid of the value of the paid fines, we use "Data Analysis – Regression" in MS Excel to determine statistical estimates of the parameters of the desired econometric model in the form of a multiple nonlinear regression (Table 2).

Table 2. Results of statistical analysis of the dependence of the DFI volume on the indicator of paid fines

Indicators	Coefficients	Standard error	t-statistic	Lower 95%	Upper 95%
Y-intercept	4.5526	2.2519	2.0217	-0.9576	10.0627
IC	3.2472	0.5693	5.7040	1.8542	4.6401
Sin(IC)	-9.4560	2.9479	-3.2077	-16.6693	-2.2427

On the basis of the data in column "Coefficients" of Table 2 we build an econometric model of the dependence of DFI volume on the indicator of paid fines in the form of non-linear multiple regression equation:

$$VPFI = 4.5526 + 3.2472 \cdot IC - 9.4560 \cdot sin(IC), \quad (1)$$

where VPFI is the volume of DFI, billion UAH; IC – instrument of control (paid fines), million UAH.

The ratio (1) is exactly the type of functional dependence between the considered indicators that most adequately reflects the relationship between the volume of DFI and control instrument, which is presented graphically in Figure 1.

The analysis of Figure 1 suggests that with the increased influence of control instrument the effectiveness of this instrument in the context of changes in the volume of DFI has a wave-like trend, that is, there is an evident oscillatory component that is superimposed on the growing trend of the resultant indicator.
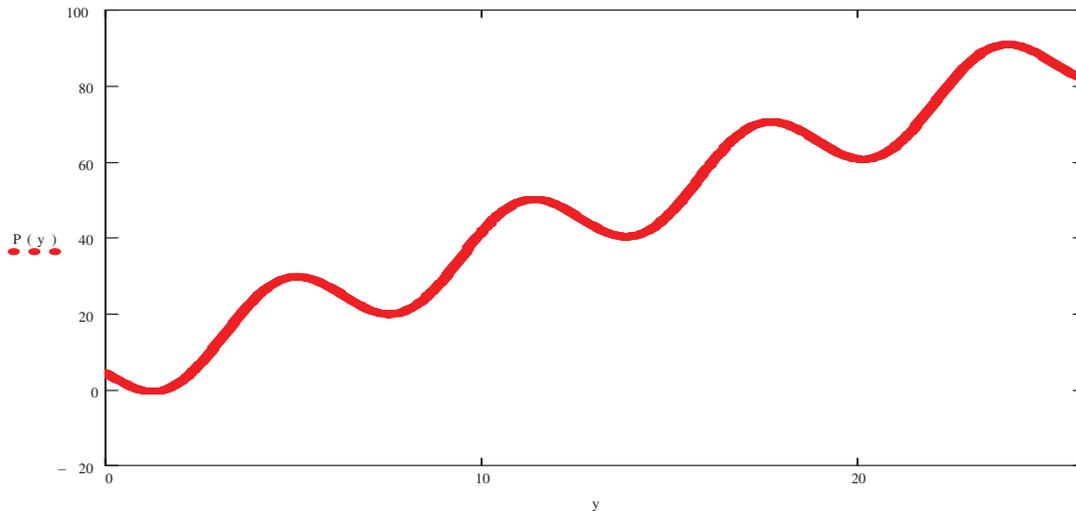
Note: y − paid fines, million UAH, P (y) − the volume of DFI, billion UAH.

**Fig. 1. The curve of dependence of the DFI volume on the indicator of paid fines (instrument control)
in dynamics during 2005-2013**

The next stage of our research of the influence of control instrument on the volume of DFI is the study of extremum points and the points of changing trends in resultant features. Both maximum and minimum points of the studied indicator as well as the change in concavity (convexity) of the P (y) function are observed periodically, as reflected in tables of quantitative assessment of the effectiveness of state regulation of FDM (Table 3). The variations in the trends of DFI volumes are reflected in the second row of Table 3 indicating the direction of this change, while the third row of Table 3 contains the values of extrema of the resultant indicator influenced by changes in the quantitative assessment of the effectiveness of control instrument.

Table 3. Quantitative assessment of the influence of control instrument on FDM

Change of the control instrument (growth)	From 0 to 0.9	From 0.9 to 5	From 5 to 8	From 8 to 12
Change in the volume of DFI (direction)	reduction	growth	reduction	growth
Change in the volume of DFI (value), billion UAH	From 4.55 to 0	From 0 to 29.86	From 29.86 to 20.01	From 20.01 to 50.27

By determining periodic intervals of increases-decreases in the DFI volume depending on changes in the amounts of fines, it was established that by the end of 2013 the growth of the level of control over FDM causes the growth of DFI. If the level of fines is in the range from 5.1 to 7.6 billion UAH, the reduction in DFI transactions is possible, because DFI defects may result in the decline of their attractiveness. However, in the long run it is possible to attract new market participants, which again could lead to an increase in the volumes of DFI, and hence this trend would be cyclical.

The research of a functional dependence of DFI volumes on the quantitative assessment of the instrument of influence – an indicator of the total number of impact measures based on the results of inspections, which would provide an opportunity to carry out the most appropriate specification of the required dependencies, leads to its description with the use of polynomial and logarithmic functions. The criterion of adequacy of the built econometric model obtains the level of 67.97 per cent, which confirms the high quality of the identified multivariable nonlinear regression. In addition, Fisher's criterion, which assumes the value of 3.54 units, exceeds the critically acceptable level confirming the validity of using logarithmic and polynomial functions for quantitative description of dependence of DFI volumes on the indicator of impact measures based on the results of inspections.

The tendency of this indicator's influence on the level of DFI volumes is similar to the previous one, since an increase in the instruments of influence is characterized by the growing importance of DFI. However, a sharp decline in impact measures based on the results of inspections from 193 to 126 in 2010, parallel to the increase in DFI from 0.1 to 3.75 billion UAH shows the impact of other more weighty indicators compared with the instruments of influence or their combined action. The dynamics of growth of the total number of impact measures based on the results of inspections is not the cause for the growth of DFI volumes, because the growth rates of the first indicator relative to the second indicator are more dynamic and the ratio of comparative indicators decreases indicating the growth of DFI volumes.

Using the method of least squares we calculate the equation parameters for the regression and related values of standard error, Student's t-test, lower and upper confidence intervals (Table. 4).

Table 4. Results of statistical analysis of the dependence of DFI volumes on the indicator of impact measures based on the results of inspections

Indicators	Coefficients	Standard error	t-statistic	Lower 95%	Upper 95%
Y-intercept	47157.7341	20076.8549	2.3489	-4451.4645	98766.9326
II	175.0637	72.2843	2.4219	-10.7491	360.8765
II²	-0.2812	0.1137	-2.4735	-0.5734	0.0110
Ln(II)	-13388.2038	5660.5122	-2.3652	-27939.0138	1162.6062

On the basis of values in column "Coefficients" of Table 4 we build a functional dependence of DFI volumes on the indicator of the total number of impact measures based on the results of inspections in the form of the following equation:

$$VPFI = 47157.7341 + 175.0637 \cdot II - $$
$$- 0.2812 \cdot II^2 - 13388.2038 \cdot ln(II), \quad (2)$$

where $VPFI$ is the volume of DFI, billion UAH; II – Instrument of influence (total number of impact measures based on the results of inspections), units.

The study of the dependence of DFI volumes on the indicator of the total number of impact measures based on the results of inspections (instruments of influence) suggests that in 2005-2013 the dynamics is strictly monotonous − characterized by the reduction of values of resultant indicator and the growth of factor indicator.

The defining feature of this dependence is the fact that the curve can be divided into two parts: one part is characterized by the rapid decline in DFI volumes with an increase in the instruments of influence, while the second part is characterized by a slow decrease in the instruments of influence. Tabular presentation of the discovered behavior patterns of dependence of DFI volumes on the instruments of influence on FDM is given in Table 5.

Table 5. Quantitative assessment of the impact of the instrument of influence on FDM

Change in the instrument of influence (increase)	From 0 to 1.0	From 1
Change in the volume of DFI (direction)	Rapid decrease	Slow decrease
Change in the volume of DFI (value), billion UAH	Up to 47465	From 47465

We have identified the relationship between impact measures based on the results of inspections and DFI volumes, which indicates the need to reduce state intervention in order to enable independent development of the market. However, it should be noted that the determined intervals of reduction of DFI volumes indicate a different influence of the studied factor. Thus, a sharp decline in the instrument's influence makes it possible to expand the FDM activity, although in the future it will be necessary to regulate the market with the leveling of the impact of individual factors.

We will consider the following instrument, which has an impact on the state regulation of the DFI market – the instrument of regulation. For this purpose, we choose the dynamics of the number of licenses issued by the stock market as an indicator of quantitative assessment of this instrument, while the volume of DFI is a resultant indicator.

The first phase − determining the dependence of changes in the volumes of DFI on the indicator of the control instrument characteristics. At this stage, we study the behavior of such time series as the volume of DFI, quantitative assessment of the instrument of regulation and its natural logarithm, which makes it possible to explain 80.24 per cent of variations of resultant features by changes of the chosen factor features, confirming the actual values of the Fisher and Student criterion and the adequacy of econometric model of the dependence of an indicator of DFI volumes on the dynamics of the number of licenses issued by the stock market.

Unlike the two previously analyzed instruments of control and influence, the dynamics of the number of licenses issued by the stock market as an instrument of regulation is the opposite to the dynamics of growth of the DFI volumes. It should be noted that an increase in the number of FDM participants does not indicate a definite tendency of the growing volumes of DFI transactions. As we have mentioned earlier, this trend may be caused by stricter requirements to the FDM participants and, consequently, increase in the quality of their operations with DFI. The setting of excessive demands and criteria of activities allows the market to leave strong players who can guarantee the reliability and competitiveness of assets that are offered in the form of DFI, which is the most favorable factor for the growth of DFI volumes.

Let us determine the indicators, which most adequately reflect the studied relationship. Based on

the results regarding the expediency to describe the time series of the DFI volumes depending on logarithmic values of the dynamics of licenses issued by the stock market, we conduct the formalization of the detected dependencies in the form of non-linear multiple regression equation. For this purpose we use the method of least squares to determine the parameters of this equation (Table 6).

Table 6. Statistic alanalysis of dependency of DFI volumes on the indicator of the dynamics of licenses issued by the stock market

Indicators	Coefficients	Standard error	t-statistic	Lower 95%	Upper 95%
Y-intercept	1845.1360	1265.1732	1.4584	-1250.6313	4940.9032
IR	0.1540	0.1463	1.0522	-0.2041	0.5120
Ln(IR)	-283.4547	203.1259	-1.3955	-780.4857	213.5764

On the basis of the data in column "Coefficients" of Table 6 we build an econometric model of the dependence of DFI volumes on the indicator of the dynamics of licenses issued by the stock market in the form of the following non-linear multiple regression equation:

$$VPFI = 1845.1360 + 0.1540 \cdot IR - 283.4547 \cdot ln(IR), \text{ (3)}$$

where *VPFI* is the volume of DFI, billion UAH; IR – instrument of regulation (dynamics of licenses issued by the stock market), units.

The analysis of equation (3) can be fully carried out only with the help of differential analysis and graphical presentation of detected dependencies (Figure 2).
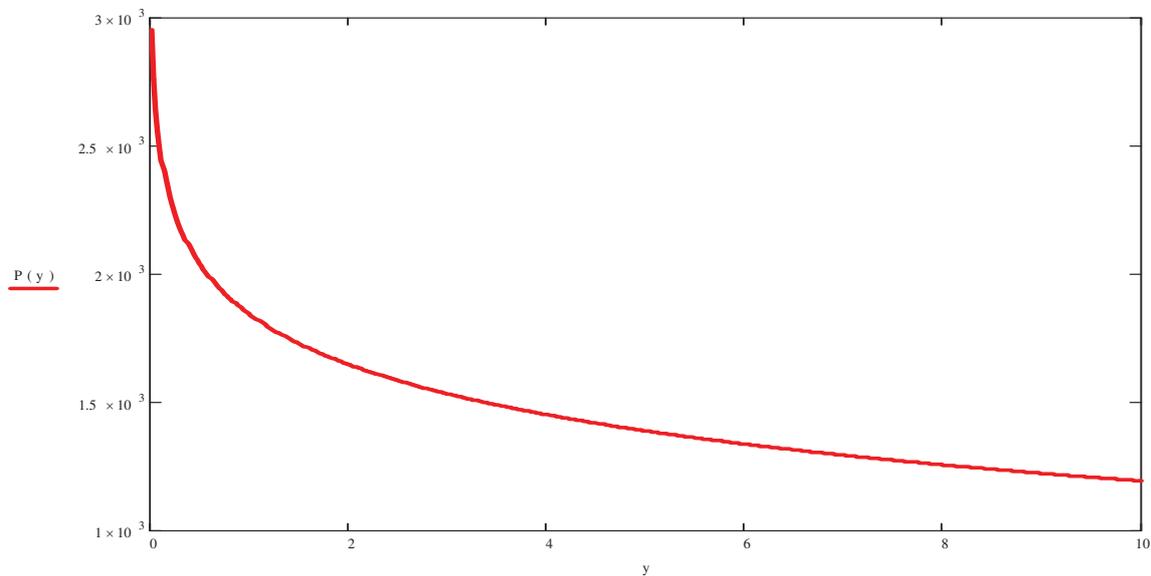
Note: Dynamics of the number of licenses issued by the stock market, units; P (y) − the volume of DFI, billion UAH.

Fig. 2. The curve of dependence of DFI volumes on the indicator of the dynamics of licenses issued by the stock market (instrument of regulation) in the period of 2005-2013

As seen in Figure 2 the function of dependence of DFI volumes on the indicator of the dynamics of licenses issued by the stock market (instrument of regulation) in the period of 2005-2013 is strictly monotonous – characterized by the reduction of values of resultant indicator and the growth of factor indicator.

The defining feature of this dependence is the fact that the curve is characterized by the rapid decline in DFI volumes with an increase in the instruments of influence. The confirmation of the described features of quantitative assessment of dependence of the instruments of influence on FDM is the research of the first and second partial derivatives of the function (3), which shows impossibility of accepting a zero value and concave nature of the curve as a factor feature (Table 7).

Table 7. Quantitative assessment of the influence of the instrument of regulation on FDM

Change in the instrument of regulation (increase)	From 0 to 1.0	From 1
Change in the volume of DFI (direction)	Rapid decrease	Slow decrease
Change in the volume of DFI (value), billion UAH	Up to 1834.2	From 1834.2

Thus, the relationship between licenses issued by the stock market and the volumes of DFI is analogous to the dependence of the resultant indicator on the instrument of influence. This trend can be explained

by the fact that an entry of new market participants is not always accompanied by an increase in the volumes of DFI, because for investors an important characteristic is a trader's experience. Therefore, in this case we see a sharp decline in DFI volumes. However, over time, an increase in the number of issued licenses is accompanied by a quantitative growth of DFI volumes partially offsetting the slump.

Now we will analyze the efficacy of the last instrument of state regulation of FDM – the instrument of management. Based on the analysis of different forms of dependence of DFI volumes on the quantitative indicator of the management instrument – the number of regulatory acts (linear, polynomial, logarithmic, exponential, in the form of sinusoid and cosinusoid) it was found that the highest value 87.14% of variations in the resultant feature is explained by inclusion into the model of both the explaining indicator itself and the need to describe the dependence by using a second-degree polynomial. For this set of factor features the parameters of regression equation become statistically significant according to the Student's test.

Comparing the dynamics of DFI volumes and the instrument of management (the number of legal and regulatory acts) one can trace a direct dependence of these indicators. Typically, the development of legal and regulatory documents sets common compulsory rules for all market participants. It helps to reduce the negative effects of delinquencies on the market and to promote the development of responsible behavior of market participants.

Having considered the resultant feature − the volume of DFI as well as a factor feature – the number of developed legal and regulatory acts, we use "Data Analysis – Regression" in MS Excel to determine statistical estimates of the parameters of the desired econometric model in the form of a multiple nonlinear regression (Table 8).

Table 8. Results of statistical analysis of the dependence of DFI volumes on the indicator of quantity of the issued legal and regulatory acts

Indicators	Coefficient	Standard error	t-statistic	Lower 95%	Upper 95%
Y-intercept	26.9233	23.9213	1.1255	-31.6100	85.4567
IM	-0.8768	0.5633	-1.5566	-2.2551	0.5015
IM^2	0.0069	0.0031	2.2435	-0.0006	0.0145

On the basis of the data in column "Coefficients" of Table 8 we build an econometric model of the dependence of DFI volume on the indicator of quantity of the developed legal and regulatory acts in the form of non-linear multiple regression equation:

$$VPFI = 26.9233 - 0.8768 \cdot IM + 0.0069 \cdot IM^2, \quad (4)$$

where $VPFI$ is the volume of DFI, billion UAH; IM – Instrument of management (quantity of the developed legal and regulatory acts), units.

The analysis of equation (4) reveals this dependence as a polynomial with upward branches demonstrated by the concavity of the curve, i.e. the presence of the range in which the growth of the factor feature is accompanied by the decline in DFI volumes to zero to be later replaced by the range of direct dependence between the studied indicators. A tabular presentation of the revealed patterns is shown in Table 9.

The calculations demonstrate a mixed trend of direct influence of the instrument of management on the resulting indicator – in the range from 0 to 52 units the developed legal and regulatory documents cause a decline in DFI volumes on the initial stage. This is explained by the introduction of new rules and criteria that require a certain period to implement. However, considering the time factor and the need to comply with legislative regulations, the growth of the indicator of the instrument of management contributes to the rapid growth of DFI volumes.

Table 9. Quantitative assessment of the influence of the instrument of management on FDM

Change in the instrument of management (increase)	From 0 to 52	From 74
Change in the volume of DFI (direction)	Decrease	Rapid growth
Change in the volume of DFI (value), billion UAH	From 27 to 0	From 0

Conclusions

Assessing the effectiveness of state regulation of FDM in terms of control, influence, regulation and management we have identified the following: different degrees of impact of individual instruments on the resultant feature (volumes of DFI); uneven influence of these factors; quantitative limits, which cause a monotonous or rapid increase (decrease) of the resultant indicator.

Summarizing the results, we can determine that the state regulation of FDM can be effective only in conjunction with the studied instruments of regulation. It was also proved that at this stage of development of the Ukrainian FDM these instruments are within

quantitative limits, which increase the efficiency of state regulation, because the dynamics of the main indicator (volumes of DFI) is growing.

Thus, the application of the proposed scientific and methodical approach to assessing the effectiveness of state regulation of FDM allows us to estimate the effect of each instrument according to the economic and mathematical model based on non-linear regression equations and to identify a range of indicators for measuring the instruments of state regulation of FDM to predict the dynamics of DFI volumes.

References

1. Zvity Natsional'noyi comissiyi z tsinnykh paperiv ta fondovogo rynku za 2000-2013 roky [National commission reports on capital issues and stock exchange during 2000-2013] [Electronic resourse]. Accessed at: http://www.ssmsC.gov.ua/ShowPage. aspx?PageID=12, National commission on capital issues and stock exchange official site.
2. Inormatyvno-analitychni materialy shchodo pidsumkiv rozvytku ta reguliuvannia fondovogo rynku u 2008 rotsi ta osnovnych napriamkiv rozvytku derzhavnogo reguliuvannia fondovogo rynku u 2009 rotsi [Information analytics materials results on stock exchange development and regulation in 2008 and basic directions of state stock exchange regulations in 2009] [Electronic resourse]. Accessed at: http://www.ssmsC.gov.ua/ShowPage. aspx?PageID=12, National commission on capital issues and stock exchange official site.
3. Ofitsiynyy sayt Banku mizhnarodnykh rozrakhunkiv [Electronic resource]. – Access: http://www.bis.org. – [Bank for International Settlements official site.]
4. Ofitsiynyy sayt Yevropeys'kogo tsentral'nogo banku [Electronic resource]. – Access: http://www.ecb.eu. – [European central bank official site.]
5. Ofitsiynyy sayt Mizhnarodnogo Valiutnogo fondu [Electronic resource]. – Access: http://www.imf.org. – [International Monetary Fund official site.]