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CONTENT

ECONOMICS

Moisei V.I. INSTITUTIONAL INFRASTRUCTURE OF INTERNATIONAL MIGRATION REGULATION IN THE CONTEXT OF GLOBALIZATION.....	5
Bogoslavskaya A.V., Semenchuk I.M. MANAGEMENT OF PROTECTED AREAS AND OBJECTS OF NATURAL RESERVE FUND UNDER SOCIO-ECOLOGICAL-ECONOMIC CONVERGENCE	12
Yemelyanova K.S. STRATEGY FOR SUSTAINABLE DEVELOPMENT OF CRUISE INDUSTRY IN EMERGING MARKETS.....	20
Korneyev M.V. THE FINANCIAL SECTOR IN TERMS OF TRANSITION TO THE FINANCIAL ECONOMY	25
Goltvenko I.V. MECHANISM OF STEEL ENTERPRISES' INTELLECTUAL CAPITAL ASSESSMENT.....	32
Semenova K., Tarasova K. USAGE OF STATISTICAL METHODOLOGY IN THE RISK ASSESSMENT....	40
Gerzanich V.M. MODEL FOR FORECASTING OF ATTRACTING FOREIGN INVESTMENT INTO UKRAINE.....	48
Starovoytov M.K., Medvedeva L.N., Starovojtova J.M. STRATEGIC DECISIONS IN THE AREA OF INFRASTRUCTURE DEVELOPMENT IN RURAL AREAS IN RUSSIA.....	60
Petukhova S. INFORMATION @ COMMUNICATIONS TECHNOLOGY: FROM THE INTENSIFICATION OF THE RUSSIAN ECONOMY TO ITS COMPETITIVENESS	66
Babets I., Kopytko M. ANALYSIS AND EVALUATION OF BRIBERY IN DEVELOPMENT OF DOMESTIC ECONOMY	73

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MODEL FOR FORECASTING OF ATTRACTING FOREIGN INVESTMENT INTO UKRAINE

Summary

The paper explores approaches to forecasting foreign direct investment. The regression models are determined as the most commonly used models in the world. A generalization of the factors used in these models, is made into the two groups: economic-financial and institutional. The model for forecasting foreign direct investment is developed and tested on data taken from the real economy of Ukraine. The amounts of foreign direct investment in Ukraine for the short term perspective are determined in terms of the three scenarios: baseline, pessimistic and optimistic. Key words: foreign investment, forecasting, economic modeling, scenario approach.

I. Introduction

The selection of priorities for attracting foreign investment is one of the components of an effective development of the whole national economy.

The study of basic problems and disadvantages of foreign investment in Ukraine, performed on the basis of learning and generalization of expertise and performance analysis system for attracting foreign investment, revealed that unfavorable investment climate remains one of the major 'narrow spaces' during the entire period of Ukraine's independence almost according to all its basic components [1].

The deterioration of the investment climate in Ukraine at different stages of development of investment activity was associated mainly with the expansion and contraction of incentives for foreign investors, that is the low level of protection of their commercial interests. Also such factors had a negative impact on the investment climate as: overall poor level of socio-economic development of the national economy, particularly low standard of living; inefficient industrial structure of foreign investment, with the minimal share of high-tech and knowledge-intensive industries during the study period; non optimal geographic and regional structure of receipt of investment resources, resulting in a high dependence on a small number of foreign investors and deepening of unbalanced social and economic development of the regions of Ukraine.

Forecasting the volume of foreign investments as a factor to improve the investment climate, particularly in the direction of increasing the reliability of the activities of investors was studied by domestic [2; 3] and foreign [4-11] scholars and analysts of international financial and economic organizations [12].

However, these studies generally used deterministic approach to developing forecasting models of foreign investment, the use of which is currently inappropriate for Ukraine due to the limited statistical data.

II. Problem definition

In this regard, there is a need to develop a new approach using economic-mathematical methods for forecasting foreign investment in Ukraine, which will help to increase the degree of certainty regarding the dynamics of foreign direct investment (FDI) both for foreign investors and governments.

The objective of this paper is developing and testing of the model of forecasting foreign investment in Ukraine on the basis of the real economy data.

III. Results

International financial organizations often use econometric models to forecast the volume of foreign investments. In particular, "UNCTAD scenarios regarding the growth in foreign direct investment are based on predictive indicators and econometric models forecasting incoming foreign direct investment" [12, p.16].

Specialists of the Institute of International Finance while forecasting foreign investments apply statistical analysis and econometric models that use «push» and «pull» factors, which, respectively, have negative and positive effect on attracting foreign investment in the country [9].

Forecasts of foreign investment by certain countries are also using methods of statistical analysis, including multivariate regression.

Thus, ARIMA model (autoregressive integrated moving average, Box-Jenkins modeling approach) was applied for forecasting investments in Jordan and Brazil in studies by A. Bashier & B. Talal [4] and F. Turolla & M. Margarido [11]. The ARIMA model supplemented with the Generalized AutoRegressive Conditional Heteroscedasticity model – GARCH was used for forecasting the attracting of foreign direct investment in China by H. Shi et al. [8]. B. Tsai uses nonlinear least square (NLS) model for estimation of amount of foreign direct investments in [10]. Standard multivariate regression was used by S. Kirchner for forecasting foreign direct investment flows in Australia [5].

By applying simultaneous equation methods and Stepwise Line Search – SLS G. Ruxanda & A. Muraru conducted a forecast of foreign direct investment in Romania [7].

One of the methods of multivariate regression is Double Exponential Smoothing approach, which was used by G. Kumar & N. Dhingra for modeling the amount of foreign investments in Sri Lanka [6].

The forecast of foreign direct investment for Ukraine was made in the study by T. Pohorelova and T. Korolyova [3] on the basis of worked out autoregressive factor model. In the study by R. Bodnar and J. Yeleyko [2] a spot forecast of foreign direct

investment in Ukraine was made on the basis of parabolic trend models, which were constructed from the data on exports and imports of goods.

Determinist and econometric forecasts are based on one or more correlating factors influencing the costs directly.

Such methodologies of forecasting require not only the availability of data about previous periods, but also an understanding of the relationship between multiple variables such as population, inflation, the "local" economic activity, tax rates, consumption structure, consumers interests and others. The proposed approach uses elements based on the use of correlating factors that directly affect the resulting index – foreign direct investment in Ukraine. Unstable economic situation makes the feasibility of meeting short-term and medium-term forecasts, therefore the approach involves forecasting the value of FDI in 2014-2015 years.

Ukraine as a typical state with transforming economy, has inherited general problems in forecasting the expenditures of local budgets. In particular, it concerns the lack of statistical data caused by both their inaccessibility and the presence of leaps and sudden changes in the economic, social and other policies, and the strong disposition of the economy to external shocks. This even allows you to actually use only "fresh" values of information as even in the availability of relatively large amounts of data it often makes a considerable scope of them yielding less information. This makes it impossible to use deterministic forecasting models at this stage, making limited set of stochastic ones (and even trendy for a number of indicators) and inducing to evaluate the accuracy of the forecast basing on available statistics.

Consider the process of verification of models forecasting the amount of foreign direct investment in Ukraine.

Prerequisites of the model. Regarding the model forecasting the value of FDI, it is assumed that:

✓ It belongs to a class of multidimensional stochastic models (additive, multiplicative or transcendental-logarithmic);

The independent variables. Preliminary analysis of the correlation between FDI and indicators of the real economy, and institutional parameters of the economy of Ukraine, proved the feasibility of using the following indicators as independent parameters:

Economic and financial parameters:

- ✓ volume of Gross domestic product of Ukraine;
- ✓ volume of Ukraine's export;
- ✓ volume of Ukraine's import;
- ✓ exchange rate of the national currency against the U.S. dollar;
- ✓ costs spent for carrying out scientific and technical activities;
- ✓ average monthly wage by the types of economic activity;
- ✓ farming area;
- ✓ profit tax rate;

Institutional parameters:

- ✓ the level of governmental interference into the economy;
- ✓ free trade;

✓ freedom of investment.

Though the question arises whether the all above mentioned variables should be included into the forecasting model or not. The matter is that 4 out of the parameters listed above, together with the resulting parameter, that is the amount of FDI, are significantly dependent on the GDP volume, which has the role of certain scale coefficient. Therefore the analysis of the chosen indicators relating to the parameter 'Amount of FDI to GNP volume' is appropriate.

Output data available is shown in tables 1 and 2.

Table 1 Output data for the parameters of the model (1st group)

Year	FDI to GDP	GDP	Currency exchange rate, UAH/doll.	Export to GDP	Import to GDP	Average monthly wage
2001	0,0216	204190	5,3721	0,0148	0,0144	0,0047
2002	0,0236	225810	5,3266	0,0149	0,0141	0,0081
2003	0,0249	267344	5,3327	0,0162	0,0161	0,0102
2004	0,0242	345113	5,3192	0,0178	0,0158	0,0103
2005	0,0371	441452	5,1247	0,0152	0,0160	0,0099
2006	0,0389	544153	5,0500	0,0140	0,0164	0,0095
2007	0,0409	720731	5,0500	0,0135	0,0167	0,0085
2008	0,0377	948056	5,2672	0,0134	0,0171	0,0085
2009	0,0438	913345	7,7912	0,0056	0,0064	0,0086
2010	0,0413	1082569	7,9356	0,0060	0,0071	0,0083
2011	0,0379	1302079	7,9676	0,0066	0,0080	0,0074
2012	0,0387	1408889	7,9910	0,0061	0,0075	0,0075
2013	0,0400	1454931	7,9930	0,0054	0,0066	0,0073

Table 2 Output data for the parameters of the model (2nd group)

Year	FDI to GDP	Farming area, thousands of hectares	Profit tax rate	Governmental interference	Free trade	Freedom of investment
2001	0,0216	41817,0	30	58,9	71,0	50
2002	0,0236	41800,4	30	68,1	74,6	30
2003	0,0249	41788,5	30	77,8	74,4	30
2004	0,0242	41763,8	25	78,6	76,2	30
2005	0,0371	41722,2	25	75,8	77,2	30
2006	0,0389	41675,9	25	53,2	77,2	30
2007	0,0409	41650,0	25	43,0	82,2	30
2008	0,0377	41625,8	25	39,0	84,0	30
2009	0,0438	41596,4	25	41,1	82,6	20
2010	0,0413	41576,0	25	32,9	85,2	20
2011	0,0379	41557,6	23	29,4	84,4	20
2012	0,0387	41536,3	21	29,4	84,4	20
2013	0,0400	41500,4	19	37,5	86,2	20

Individual correlations of the listed indicators with the resulting one (in this case the share of foreign direct investment in the volume of gross domestic product) is given in the Table 3.

The analysis of the Table 3 shows that only 7 out of 11 listed indicators correlate not only with the amount of FDI in absolute dimension, but also with its share in the GDP, namely:

- ✓ volume of Gross domestic product of Ukraine;
- ✓ volume of Ukraine's export;
- ✓ average monthly wage by the types of economic activity;
- ✓ farming area;
- ✓ profit tax rate;
- ✓ the level of governmental interference into the economy;
- ✓ free trade.

Table 3 Statistical interrelation of the share of FDI and indicators from the Tables 1 and 2

Indicator	Correlation with the amount of FDI
Volume of Gross domestic product of Ukraine	0,747
Currency exchange rate	0,529
Export volume to GDP	-0,704
Import volume to GDP	-0,480
Costs spent for carrying out scientific and technical activities to GDP	0,089
Average monthly wage by the types of economic activity to GDP	0,801
Farming area	-0,850
Profit tax rate	-0,714
Governmental interference	-0,730
Free trade	0,841
Freedom of investment	-0,690

As to the characteristics of the model 3 the following dilemmas took place:

- ✓ the model is additive, multiplicative (or transcendental-logarithmic);
- ✓ the use of a complete set of significant independent indicators (selected in the previous correlation analysis) or only those that have confirmed the importance of their impact on FDI not only in absolute but also in relative terms (Table 3);
- ✓ the model is linear-nonlinear.

As a result, the first 2 dilemmas had 4 variants of models:

✓ additive model with 11 independent variables $y = \sum_{i=1}^{11} a_i x_i$;

✓ multiplicative model with 11 independent variables $y = \prod_{i=1}^{11} x_i^{a_i}$;

✓ additive model with 7 independent variables $y = \sum_{i=1}^7 a_i x_i$;

✓ multiplicative model with 7 independent variables $y = \prod_{i=1}^7 x_i^{a_i}$,

Which were supplied with 2 models having quadric form,

$$y = \sum_{i=1}^4 a_i x_i + \sum_{i=1}^4 \sum_{j=i}^4 b_{ij} x_i x_j$$

with two variants of 4 variables of the most correlated with the resulting indicator:

1st variant –

- ✓ the volume of GDP;
- ✓ the average monthly wage;
- ✓ profit tax rate;
- ✓ the level of governmental interference in the economy;

2nd variant–

- ✓ the volume of GDP;
- ✓ the average monthly wage;
- ✓ farming area;
- ✓ free trade.

Verification results. The certain type of regression equation by 12 points (2001-2012) was built was each of 5 model types. The Least Square method was applied for calculation of a_i and b_{ij} coefficients. The following equations were made as a result:

$$y = 9862838,9 - 0,102x_1 + 7804,3x_2 - 0,0004x_3 + 0,001x_4 - 7,044x_5 - 39,99x_6 - 239,9x_7 - 58,202x_8 + 247,402x_9 + 1502,389x_{10} + 459,43x_{11}; \quad (1)$$

$$y = 10807,821 \cdot x_1^{1,495} \cdot x_2^{-2,291} \cdot x_3^{0,716} \cdot x_4^{-0,167} \cdot x_5^{-0,731} \times x_6^{-1,930} \cdot x_7^{-1017,539} \cdot x_8^{2,155} \cdot x_9^{-1,832} \cdot x_{10}^{2,692} \cdot x_{11}^{-1,604}; \quad (2)$$

$$y = 3380499,4 + 0,038x_1 - 0,0002x_2 - 4,625x_3 - 81,294x_4 + 136,749x_5 - 29,408x_6 + 228,942x_7; \quad (3)$$

$$y = 14373,317 \cdot x_1^{-1,843} \cdot x_2^{1,62} \cdot x_3^{-1,534} \cdot x_4^{-1353,365} \cdot x_5^{2,479} \cdot x_6^{1,863} \cdot x_7^{-5,65}; \quad (4)$$

$$y = 6039961,2 - 20,541x_1 + 0,458x_2^2 + 0,0002x_3^2 + 1290,71x_4^2 - 0,002x_1x_2 + 0,001x_1x_3 - 0,089x_1x_4 - 0,041x_2x_3 + 27,976x_2x_4 - 4,314x_3x_4 \quad (5)$$

In this case the amount of FDI in 2013 played the role of the testing data for estimation of the accuracy of the forecast according to the model. At forecasting the values of independent variables the forecasts by the IMF, Ukraine's government and author's calculations were applied.

The comparison of the forecasting results as to 5 described models were is given in the Table 4.

Table 4 Comparison of the FDI amount forecasts according to 5 models, millions UAH

Year	Actual value	11 variables		7 variables		quadric
		additive	multiplicative	additive	multiplicative	
2013	58156,9	68059,8	151672,1	58458,9	214812,6	868238,7
Error of the forecast		0,170	1,608	0,005	2,694	13,929

As it is evident from the Table 4, the best testing forecast for 2013 is given by the additive model with 7 variables, sample of which correlate with the resulting indicator (the volume of foreign direct investments) both absolutely and in the normalized dimension (as to the GDP amount).

More of that, the second of the most accurate forecasts is given also by the additive model, which contains all 11 parameters important in the absolute expression. Multiplicative models show 3rd and 4th forecasts as to their accuracy (provided that the forecast of 11-factor model is more accurate), while the model of quadric form in the certain case proved to be the worst for forecasting.

So, according to this, the seven-factor additive model will be used for further forecasting of FDI volumes (3):

$$y = 3380499,4 + 0,038x_1 - 0,0002x_2 - 4,625x_3 - 81,294x_4 + 136,749x_5 - 29,408x_6 + 228,942x_7,$$

Where the independent variables are as follows:

- ✓ x_1 – volume of Gross domestic product of Ukraine;
- ✓ x_2 – volume of Ukraine's export;
- ✓ x_3 – average monthly wage;
- ✓ x_4 – farming area;
- ✓ x_5 – profit tax rate;
- ✓ x_6 – level of governmental interference into the economy;
- ✓ x_7 – free trade index.

Scenarios for dynamics of FDI amount for different vectors of change of independent variables. First of all, once again lets outline the classification of seven selected indicators. They can be subdivided into 3 groups: 1st-4th indicators are macroeconomic ones; 5th is a financial parameter; 6th and 7th are institutional indicators. We will not variate the indicator of 'farming area': it is weak for adjustment and hardly anyone was going to use it as a regulator. Indicators of 'volume of Gross domestic product of Ukraine, 'volume of Ukraine's export' and 'average monthly wage' are not regulative as well, but at the same time they describe the state of the national economy, and moreover are statistically interdependent. The profit tax rate is a direct regulator, and indexes of government intervention and free trade are reflecting a regulatory policy directly.

Therefore we are going to analyze the dependence of FDI dynamics for variation of indicators' values separately in each of 3 groups: the 1st group – 1st-3rd indicators: 'volume of GDP', 'volume of export' and 'average monthly rate'; the 2nd group – in-

indicator number 5 'profit tax rate'; the 3rd group– indicators «governmental interference» and 'free trade index'.

Baseline values of macroeconomic indicators are taken as their approximate values given by the Cabinet of Ministers; profit tax rate is taken as of January 1, 2014, the value of institutional indicators – as of the level of 2013 (Table 5, real values of 2013 are given for comparison).

Table 5 Baseline forecast values of independent variables

Group no.	Indicator	2013	2014	2015
1	GDP volume	1454931	1570000	1686482
1	Export volume	63312	82700	81804
1	Average monthly rate	3265	3379	3691
2	Profit tax rate	19	18	18
3	Governmental interference	37,5	37,5	37,5
3	Free trade	86,2	86,2	86,2

Variation of the 1st group of indicators.

Taking into account direct interrelation of the indicators of the group, the corridor around their baseline values was used with pessimistic and optimistic scenarios: the growth less and above of the baseline one, provided that for all three parameters simultaneously (Table 6; the real data as of 2013 are given for comparison).

Table 6 FDI volume forecast for variation for values of macroeconomic indicators

Year	FDI	GDP	Export	Average monthly wage
2013	58156,900	1454931	63312	3265
<i>Pessimistic scenario</i>				
2014	60929,270	1527678	79140	3265
2015	65888,744	1604061	75183	3428
<i>Baseline scenario</i>				
2014	61458,437	1570000	82700	3379
2015	66777,454	1686482	81804	3691
<i>Optimistic scenario</i>				
2014	61482,922	1600424	88637	3428
2015	67230,918	1760467	94841	3771

Variation of profit tax rate.

The value of this indicator gradually decreased over time. Thus, by 2003 inclusive profit tax rate was 30%, in 2004 it was reduced to 25% and fixed for 7 years, and since 2011, the tax burden was reduced by 2% each year. As a result, in 2013 the rate of this tax was 19%. Since January 1, 2014 the rate was reduced by 1%. Therefore it is reasoned to assume that the trend in this case would be to further reduction of the

profit tax – up to 17 % in 2015. However, considering the difficult economic situation in the country, the new government declared a temporary waiver of further reducing the profit tax rate, and maybe even return it to the level of 2013 – to 19%. Therefore, the baseline scenario in this case is the freezing rate at 18 %, and pessimistic – to raise it to 19%.

The reaction of foreign direct investment on the mentioned options of profit tax rate dynamics is reflected in the Table 7.

Table 7 FDI volume forecast for profit tax rate variations

Year	FDI	Profit tax rate
2013	58156,900	19
<i>Pessimistic scenario</i>		
2014	62368,731	19
2015	68117,571	19
<i>Baseline scenario</i>		
2014	61458,437	18
2015	66777,454	18
<i>Optimistic scenario</i>		
2014	62231,982	18
2015	67844,072	17

Variation of the 3rd group of indicators.

In this case there seems no escaping the suggestion similar to the 1st group of indicators concerning mutual dependence of indicators 'governmental interference into the economy' and 'free trade'. Undoubtedly, a high freedom to trade proves that the government does not interfere into the market activities by far. However this does not mean that it is not interfering into any other sectors of the economy. Therefore, logically, we can not argue about the connection of indicators 'governmental interference' and 'free trade'. The conclusion is supported by the statistical analysis: correlation value of these indicators as of the last 20 years (1994-2013) was -0,203. Therefore a decision was made to check all 9 possible scenarios for these two parameters: each of three (pessimistic, baseline, optimistic) for the rate of governmental interference for each of the same three for free trade index. The results are given in the Table 8.

Table 8 FDI volume forecast for variations for values of institutional indicators

Year	FDI	Governmental interference	Free trade
2013	58156,900	37,5	86,2
<i>scenarios:</i>		<i>Pessimistic</i>	<i>Pessimistic</i>
2014	60866,819	41,3	84,1
2015	65594,932	45,4	82,0

<i>scenarios:</i>		<i>Pessimistic</i>	<i>Baseline</i>
2014	61348,155	41,3	86,2
2015	66545,863	45,4	86,2
<i>scenarios:</i>		<i>Pessimistic</i>	<i>Optimistic</i>
2014	61841,524	41,3	88,4
2015	67544,935	45,4	90,6
<i>scenarios:</i>		<i>Baseline</i>	<i>Pessimistic</i>
2014	60977,101	37,5	84,1
2015	65826,523	37,5	82,0
<i>scenarios:</i>		<i>Baseline</i>	<i>Baseline</i>
2014	61458,437	37,5	86,2
2015	66777,454	37,5	86,2
<i>scenarios:</i>		<i>Baseline</i>	<i>Optimistic</i>
2014	61951,806	37,5	88,4
2015	67776,526	37,5	90,6
<i>scenarios:</i>		<i>Optimistic</i>	<i>Pessimistic</i>
2014	61197,664	30,0	84,1
2015	66194,128	25,0	82,0
<i>scenarios:</i>		<i>Optimistic</i>	<i>Baseline</i>
2014	61679,000	30,0	86,2
2015	67145,060	25,0	86,2
<i>scenarios:</i>		<i>Optimistic</i>	<i>Optimistic</i>
2014	62172,369	30,0	88,4
2015	68144,132	25,0	90,6

The analysis of all scenarios suggests that foreign direct investment, although being statistically dependent on all these seven parameters, but the variation of its value relative to them is fading (Table 9, 10).

Table 9 Marginal values and variations of independent and resulting variables, 2014

Indicator	Value			Divergence	
	Minimal	Maximal	Average	Absolute	Relative
FDI volume	60866,8	62172,4	61519,6	1305,6	2,1%
GDP volume	1527678	1600424	1564051	72746	4,8%
Export volume	79140	88637	83888	9497	12,0%
Average monthly rate	3265	3428	3347	163	5,0%
Profit tax rate	18	19	18,5	1	5,6%
Governmental interference	30	41,25	35,6	11,25	37,5%
Free trade	84,1	88,4	86,2	4,26	5,1%

Thus, even for large deviations of absolute values of the independent variables on the forecasted ones, deviation of actual FDI value will be substantially lower. Therefore, it can be predicted with a sufficiently high probability that foreign direct investment in the Ukrainian economy will be – \$ 61,5 ± 0,7 billion in 2014, \$ 66,8 ±

1,3 billion in 2015 in case of the absence of huge external impulses (which are not amenable to statistical consideration), that error comprises 1.1% for the 1 year's forecast and up to 2% – for 2 years' forecast.

Table 10 Marginal values and variations of independent and resulting variables, 2015

Indicator	Value			Divergence	
	Minimal	Maximal	Average	Minimal	Maximal
FDI volume	65594,9	68144,1	66869,5	2549,2	3,9
GDP volume	1604061	1764468	1684264	160406	10,0
Export volume	75183	94841	85012	19658	26,1
Average monthly wage	3428	3771	3600	343	10,0
Profit tax rate	17	19	18	2	11,8
Governmental interference	25	45,4	35,2	20,4	81,5
Free trade	82,0	90,6	86,3	8,5	10,4

IV. Conclusions

The study of approaches to forecasting foreign direct investment showed that regressive models are the most commonly used in the world practice.

Summary of the factors used in these models by different scholars allows to divide them into 2 groups: economic-financial and institutional ones.

Further analysis of the impact degree of economic and institutional factors on foreign direct investment showed that a strong economy with a relatively low average salary, and market nature of the economy stimulate FDI inflows. The first index is not subject to direct regulation, so to encourage FDI, special attention should be granted to the gradual reduction of interference in the economy and increased trade freedom, i.e., measures towards liberalization of economic relations.

Another conclusion that can be drawn based on the analysis of the model: variation of FDI volumes comparatively with the values of independent parameters is fading. That is, the divergence of the actual value of the FDI from the forecasted one is relatively less than similar divergences of actual values of the independent variables, and hence in the absence of strong external impulses that can not be statistically estimated, foreign direct investment in the Ukrainian economy can be forecasted with a fairly high degree of accuracy.

It should be noted the obtained results require further clarification, since the accuracy of forecasting foreign direct investment in Ukraine can only be improved under conditions of extended economic analysis. In addition, powerful single pulses of an external nature (externalities) that are present in modern Ukrainian reality can make quite weighty adjustments.

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