Modelling of investment development of national economy of Ukraine on basis of regression analysis

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Abstract. The article considers the results of modeling of investment development of national economy of Ukraine during 2001-2011 on basis of regression analysis. Determine the influence of the investment to economic development of national economy of Ukraine. Sectors of national economy divided to three groups of level of investment impact to economic development.

Key words: modeling, investment development, national economy, Ukraine, postindustrial society, regression analysis.

INTRODUCTION

Postindustrial society is characterized by the priority of investment activity as a factor of exogenous economic development of the national economy. Investment activity can have effect on a cyclical development and be foundation for enhancement of economic activities under condition that investment will be directed to research and production areas.

Investment activity of national economy belongs to the highly researched and disputed topics both in domestic and foreign investment theory and occupies leading position in economic researches of prominent scientists: [4], [5], [11], [12], [20], [21], W. Fisher, W. Sharpe and others. Despite numerous researches issue of modeling of the investment development of national economy of Ukraine in the postindustrial society remain unresolved.

THE AIM OF THE ARTICLE

The aim of the article is the modeling of investment development of the national economy of Ukraine in a postindustrial society by means of regression analysis. The basic method that used into the research is regression analysis.

THE RESULT OF INVESTMENT MODELING OF NATIONAL ECONOMY

Current status of investment activity (by the end of 2011): investment in fixed assets - 15.88% of GDP and foreign direct investments - 2.74% of GDP (Fig. 1).

Our calculations show that investment activity influences level of economic development of Ukraine indirectly, when investment in fixed assets occupy sufficiently big share of GDP (13 - 25%). Regression between investments (Xi) and the development of the national economy of Ukraine (Y) during 2001 - 2011 represented in equation (1) and (2):

$$Y = 0.2985X_1 + 68.47,$$
$$(R = 0.9208),$$
$$\tag{1}$$

$$Y = 0.03X_2 + 115.99,$$
$$(R = 0.2385),$$
$$\tag{2}$$

where: Y - the growth rate of the national economy of Ukraine, which display growth or decline of GDP, (%); X_1 - investment activity, which display growth rate of investments in fixed assets, (%), X_2 - growth rate of foreign direct investment, (%), R - correlation coefficient, which represent the level and strength of interdependence between dependent and independent variable.

According to equations (1), (2) we can compare multiplicative effect ($M(X_i,Y)$) of investments during 2001 - 2011, such as growth of investments in fixed assets by 1% produce economic growth by 0.2986% ($M(X_1,Y)=0.2986\%$), while growth of foreign direct investments cause only 0.03% growth of the national economy $(M(X_2,Y)=0.03\%)$.
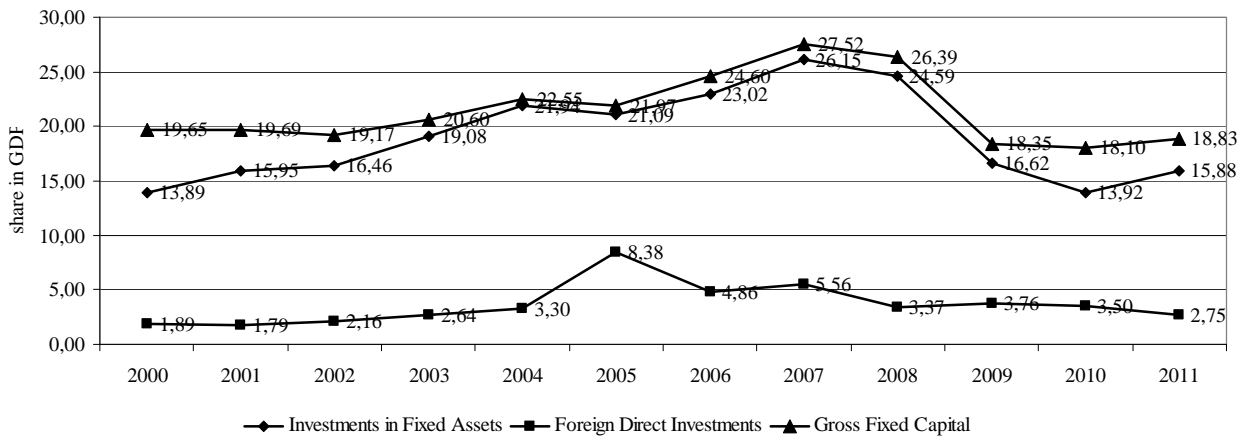
Fig. 1. Value of gross capital formation and investments compare to GDP of Ukraine during 2000 – 2011, (%)

These results indicate that both domestic and foreign investments have indirect effect on the development of the national economy and they are not consistent with innovation and investment vectors of development.

We can conclude, that impact of investment is average for the economic development of the country. Since there are different levels of investments in different types of economic activities, by our opinion it's necessary to calculate a regression equation for each type of economic activity (Table 1).

Regression analysis carried out by means of Excel package "Regression" and satisfied fundamental criteria (Fisher's criterion, Student's t-criterion and average relative error) within the given limits.

In these defined univariate regression models average relative error (ε) have the following intervals:

- when ε does not exceed 10% ($\varepsilon \le 10\%$), it indicates high accuracy level of the models and forecasts for the following types economic activities, such as agriculture, hunting and forestry (X_1), industry (X_3) (mining industry (X_{31}) in particular), production and distribution of electricity, gas and water (X_{33})), transport and communication (X_7), public administration (X_{10}), education (X_{11}), healthcare and social assistance (X_{12});

- when ε lies between 10 - 20% ($10\% < \varepsilon < 20\%$), it indicates average (normally acceptable) accuracy level of the models and forecasts — fishing and fish farming (X_2), processing industry (X_{32}), construction (X_4), trade, repair of motor vehicles, household appliances and good for personal use (X_5), real estate, lease, engineering and services for entrepreneurs (X_9), public and personal services, cultural activities and sports (X_{13});

- when ε more than 20% ($e > 20\%$), it indicates a satisfactory accuracy level of the models and forecasts — hotels and restaurants (X_6), finance (X_8).

To complete this study we deduced the regression equations of impact of each type of economic activity on the economic development of the national economy in a whole - *Iea* → *Yea* (Table 2).

Regression analysis of «the impact of growth of investment in economic activities on their economic development» during 2001 - 2011 allowed us to classify types of economic activity according to the coefficient of determination (R^2), F - criterion and t - criterion:

- group 1 ($R^2 > 80\%$) – investments in these economic activities are crucial for their economic development during this period;

- group 2 ($50\% < R^2 \le 80\%$) – investments in these economic activities have medium impact on their economic development during this period;

- group 3 ($R^2 \le 50\%$) – investments in these economic activities are potentially crucial for their economic development under conditions of post-industrial society.

The first two groups (group 1 and group 2) consisted of economic activities that met the criteria of Fisher and Student, whereas the third group of economic activities, which in analyzed period did not meet the criteria of Fisher and Student, but its trend of investment could have a major impact on economic development in the future in a postindustrial society.

Group 1 - none of the analyzed types of economic activity belongs to this group, i.e. during analyzed period there was no type of economic activity, which has investment as determinative factor of their future development ($R^2 > 80\%$).

Group 2 - economic activities with level of investments which have average impact on economic development of these activities during analyzed period ($40\% < R^2 \le 80\%$): processing industry ($R^2(X_{32}) = 40.1\%$), construction ($R^2(X_4) = 55.4\%$), transport and communication ($R^2(X_7) = 45.9\%$).

Table 1. Impact of investment (X_i) in types of economic activities on their economic development (GVA) (Y_i) during 2001 – 2011

Independent variable	Coefficient of correlation (R)	Coefficient of determination (R^2)	Fisher's criterion (F - criterion)	Student's criterion (t – criterion)	Regression equation	Meaning of equation	Share of X_i in GVA 2011
X_{NE}	0,9208	0,8479	50.1839	7.0840	$Y_{NE} = 0.2985 X_{NE} + 68.47$	PD / SD Growth of X_{NE} by 1% causes growth of GVA by 0.2985%	100.0
X_1	0.4579	0.2097	2.3882	1.5453	$Y_1 = 0.1474 X_1 + 85.65$	PD / AD Growth of X_1 by 1% causes growth of GVA by 0.1474%	7.7
X_2	-0.3736	0.1396	1.4608	-1.2086	$Y_2 = -0.0566 X_2 + 101.86$	ND / AD Decrease of X_2 by 1% causes growth of GVA by 0.0566%	0.04
X_3	0.5818	0.3385	4.6054	2.1460	$Y_3 = 0.2107 X_3 + 78.73$	PD / AAD Growth of X_3 by 1% causes growth of GVA by 0.2107%	36.2
X_{31}	0.2758	0.0761	0.7413	0.8609	$Y_{31} = 0.0732 X_{31} + 94.43$	PD / AD Growth of X_{31} by 1%causes growth of GVA by 0.0732%	10.3
X_{32}	0.6229	0.3880	5.7080	2.3891	$Y_{32} = 0.3262 X_{32} + 67.56$	PD / AAD Growth of X_{32} by 1% causes growth of GVA by 0.3262%	17.3
X_{33}	0.2683	0.0720	0.6985	0.8357	$Y_{33} = 0.0397 X_{33} + 97.06$	PD / AD Growth of X_{33} by 1% causes growth of GVA by 0.0397%	5.1
X_4	0.7448	0.5548	11.2183	3.3493	$Y_4 = 0.4088 X_4 + 50.26$	PD / AAD Growth of X_4 by 1% causes growth of GVA by 0.4088%	8.5
X_5	0.3201	0.1024	1.0275	1.0136	$Y_5 = 0.1467 X_5 + 90.34$	PD / AD Growth of X_5 by 1% causes growth of GVA by 0.1467%	7.3
X_6	0.0657	0.0043	0.0390	0.1976	$Y_6 = 0.0431 X_6 + 107,68$	PD / WD Growth of X_6 by 1% causes growth of GVA by 0.0431%	2.1
X_7	0.6776	0.4592	7.6431	2.7646	$Y_7 = 0.2109 X_7 + 82.72$	PD / AAD Growth of X_7 by 1% causes growth of GVA by 0.2109%	16.5
X_8	0.2208	0.0487	0.4616	0.6794	$Y_8 = 0.1334 X_8 + 96.10$	PD / WD Growth of X_8 by 1% causes growth of GVA by 0.1334%	1.3
X_9	0.4751	0.2257	2.6240	1.6199	$Y_9 = 0.1923 X_9 + 87.18$	PD / AD Growth of X_9 by 1% causes growth of GVA by 0.1923%	17.7
X_{10}	0.4114	0.1693	1.8344	1.3544	$Y_{10} = 0.0641 X_{10} + 93.17$	PD / AD Growth of X_{10} by 1% causes growth of GVA by 0.0641%	0.8
X_{11}	-0.0756	0.0057	0.0518	-0.2277	$Y_{11} = -0.0117 X_{11} + 103.28$	ND / WD Decrease of X_{11} by 1% causes growth of GVA by 0,0117%	1.0
X_{12}	0.2650	0.0702	0.6801	0.8246	$Y_{12} = 0.0266 X_{12} + 99.45$	PD / AD Growth of X_{12} by 1% causes growth of GVA by 0.0266%	1.4
X_{13}	0.3510	0.1232	1.2651	1.1247	$Y_{13} = 0.1269 X_{13} + 90.86$	PD / AD Growth of X_{13} by 1% causes growth of GVA by 0.1269%	4.4

Note: P D – positive dependence between an independent variable (X_i) and depending variable (Y), which is determined by the sign (+) near correlation coefficient; ND – negative dependence between an independent variable (X_i) and depending variable (Y), which is determined by the sign (-) near correlation coefficient; WD – weak dependence between the independent variable (X_i) and depending variable (Y), which is defined by the correlation coefficient (R): 0 £ R£0.25; AD – average dependence between the independent variable (X_i) and depending variable (Y), which is defined by the correlation coefficient (R): 0.25 £ R£0.5 ; AAD – above average dependence between the independent variable (X_i) and depending variable (Y), which is defined by the correlation coefficient (R):0/5 £ R£0.75; SD – strong dependence between the independent variable (X_i) and depending variable (Y), which is defined by the correlation coefficient (R): 0o75£ R£1.0: R^2; Coefficient of determination defines the compliance of the model to constant parameter (R^2≥ 50 %); F - criterion - Fisher's criterion, which verified adequacy of the model ($F_{calc} > F_{tabl}$(5.12)) ; t - criterion – Student's criterion, which verified the importance of factors for the model ($t_{calc} > t F_{tabl}$(2.2622)).

Table 2. Impact of investments in types of economic activities on their economic development and on the national economy during 2001-2011

Type of economic activity	Impact of type of economic activity on development of the national economy of Ukraine		Impact of investment in fixed assets on development of the types of economic activities of Ukraine	
	Coefficient of correlation (R)	Regression equation	Coefficient of correlation (R)	Regression equation
Agriculture, hunting and forestry (X_1)	0.2099	$Y = 0.1688X_1 + 88.04$	0.4579	$Y_1 = 0.1474X_1 + 85.65$
Fishery and fish farms (X_2)	-0,6394	$Y = -0.4022X_2 + 144.04$	0.3736	$Y_2 = -0.0566X_2 + 101.86$
Industry (X_3)	0.9335	$Y = 1.0951X_3 - 6.98$	0.5818	$Y_3 = 0.2107X_3 + 78.73$
Mining industry (X_{31})	0.8421	$Y = 1.0780X_{31} - 5.70$	0.2758	$Y_{31} = 0.0732X_{31} + 94.43$
Processing industry (X_{32})	0.9585	$Y = 0.6557X_{32} + 36.50$	0.6229	$Y_{32} = 0.3262X_{32} + 67.56$
Production and distribution of electricity, gas and water (X_{33})	0.6699	$Y = 1.3669X_{33} - 30.86$	0.2683	$Y_{33} = 0.0397X_{33} + 97.06$
Construction industry (X_4)	0.8984	$Y = 0.3162X_4 + 74.45$	0.7448	$Y_4 = 0.4088X_4 + 50.26$
Trade, repair of motor vehicles, household appliances and goods for personal use (X_5)	0.8517	$Y = 0.3753X_5 + 64.26$	0.3201	$Y_5 = 0.1467X_5 + 90,34$
Hotels and restaurants (X_6)	0.5107	$Y = 0.1730X_6 + 85.62$	0.0657	$Y_6 = 0.0431X_6 + 107,68$
Transport and communication industry (X_7)	0.7888	$Y = 1.1416X_7 - 16.56$	0.6776	$Y_7 = 0.2109X_7 + 82.72$
Finance (X_8)	0.8746	$Y = 0.3252X_8 + 68.01$	0.2208	$Y_8 = 0.1334X_8 + 96.10$
Real estate, lease, engineering and services for entrepreneurs (X_9)	0.7776	$Y = 0.5883X_9 + 38.83$	0.4751	$Y_9 = 0.1923X_9 + 87.18$
Public administration (X_{10})	0.0800	$Y = 0.1041X_{10} + 94.87$	0.4114	$Y_{10} = 0.0641X_{10} + 93.17$
Education (X_{11})	0.3122	$Y = 0.66622X_{11} + 38.18$	0.0756	$Y_{11} = -0.0117X_{11} + 103.28$
Healthcare and social assistance (X_{12})	0.1180	$Y = 0.2610X_{12} + 78.52$	0.2650	$Y_{12} = 0.0266X_{12} + 99.45$
Public and personal services, cultural activities and sport (X_{13})	0.6293	$Y = 0.3907X_{13} + 62.92$	0.3510	$Y_{13} = 0.1269X_{13} + 90.86$

Group 3 - group of economic activities with level of investments which can be potentially crucial for their economic development, under conditions of postindustrial society, include agriculture $(R^2(X_1)=20.9\%)$, trade, repair of motor vehicles, household appliances and goods for personal use $(R^2(X_5)=10.2\%)$, financial activities $(R^2(X_8)=4.9\%)$ and real estate, lease, engineering and services for entrepreneurs $(R^2(X_9)=22.57\%)$. This group includes economic activities of service branch, which confirms the necessity to develop this domain in order to sustain growth of the national economy.

Thus, determining (priority) types of economic activity for the investments and development of national economy are traditional economic activities of Ukraine, i.e. primary and secondary industries of the real economy, such as:

1) industry, where change by 1% cause growth of GVA by 1.095% with highest correlation coefficient – 0.9335 $(M(X_3,Y)=1.095\%$, $Corr(X_3,Y)=0.9335)$, include the mining industry – $M(X_{31},Y)=1.0780\%$, $Corr(X_{31},Y)=0.8421$, processing industry – $M(X_{32},Y)=0.6557\%$, $Corr(X_{32},Y)=0.9585$ and production and distribution of electricity, gas and water – $M(X_{33},Y)=1.3669\%$, $Corr(X_{33},Y)=0.6699$;

2) transport and communication –stimulates the growth of GVA by 1.1416% with a coefficient of correlation – 0.7888 $(M(X_3,Y)=1.1416\%$, $Corr(X_3,Y)=0.7888)$.

The construction industry $(M(X_4,Y)=0.3162\%)$, trade, repair of motor vehicles, household goods and goods for personal use $(M(X_5,Y)=0.3753\%)$ and financial activities $(M(X_8,Y)=0.3252\%)$ stimulate growth of GVA; these are types of economic activities that have strong correlation between development of the branch and national economy $(0.75 <Corr(X_i,Y)<0.89)$, but they have no significant multiplicative effect on the growth of the national economy.

Education and healthcare are among those economic activities that have the potential for determining influence on the economic development of the national economy: growth in education can cause growth of the national economy GVA $(M(X_{11},Y)=0.6622\%)$, but strength of correlation of this branch and national economy is below average $(Corr(X_{11},Y)=0.3122)$; healthcare can also stimulate growth of the GVA - $M(X_{12},Y)=0.26104\%$, but correlation between healthcare and national economy is also below average $(Corr(X_{12},Y)=0.1180)$. So, education and healthcare have potential to become basic branches for sustainable development of national economy in terms of postindustrial society.

According to our calculations only fishing and fish farming has negative multiplicative effect, i.e. growth of the fisheries and fish farm economic activity will cause reduction of growth rate of the national economy by 0.4022% $(M(X_2,Y)=-0.4022\%)$.

CONCLUSIONS

Investment activity is not crucial for the economic development of national economy and economic activities of Ukraine, due to chaotic capital movement and lack of stable trends of investment in economic activities of Ukraine.

Industry, where change by 1% of investment stimulates growth of GVA by 0.1061% $(M(X_3,Y_3)=0.2107\%)$ (including processing industry – $M(X_{32},Y_{32})=0.3262\%)$, construction – $M(X_4,Y_4)=0.4088\%$, transport and communication – $M(X_7,Y_7)=0.2109\%)$, is a type of economic activity, which have strong correlation between investment activity and development of the branches $(0.57<Corr(X_i,Y_i)<0.75)$, but investment does not have significant effect on their growth. For all other types of economic activity, investment activity does not have defining character and significant impact on their development.

Thus, economic activities that have priority meaning for the growth of national economy are industries, such as processing industry, construction, transportation and communication, development of which can be stimulated by the means of investment activity.

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