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FOREIGN DIRECT INVESTMENTS IN THE ECONOMIC GROWTH OF THE OPEN ECONOMY OF UKRAINE

Abstract. In terms of globalization of the world economy, the open economy of a country participating in the globalization process becomes an organic element of the world economy and thus receives additional incentives for development. International flows of goods and capital allow countries to get new sources for economic growth. Economic growth is now not only a function of internal but also of external factors. It is they who now determine the modernization tendencies of national economic policies, forcing them to move in accordance with world trends. **The purpose** of the research is to assess the relationship between economic growth of the country and external factors of its economic development, as well as to identify the dependency between external factors in order to clarify their role in the modernization of national economy. With this aim, the analysis of the main parameters of openness of Ukraine's economy is carried out, as of external factors that influence on the national economic development, changes in the traditional production function under the influence of introduction in it of external factors of development, the estimated indicators of the named influences are modeled. **The novelty** of the research is the identification of dependency between the forms of openness of the economy and economic growth, the development of a model of relationship between the forms of openness of the economy. **Research method.** The study is based on a set of economic and economic-mathematical methods that are needed to identify the influence of external factors on the national economy, especially methods of abstraction, systematic and structural-comparative analysis, synthesis and modeling of economic processes. Among the models used in the research is a multifactor regression model. The empirical basis was the materials of official statistics of Ukraine for 1999—2019. The results of research showed: the role of globalization of Ukraine's economy in its economic development, the importance of FDI as an external factor of economic development, the strong link between international capital flows and international flows of goods into the Ukrainian economy, the positive impact of the latter on the former.

***Keywords*:** economic growth, globalization, external factors of economic growth, production function, open economy, FDI, foreign trade, government investment policy.

JEL Classification F21, F43, F47, F62

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ПРЯМІ ІНОЗЕМНІ ІНВЕСТИЦІЇ В ЕКОНОМІЧНОМУ ЗРОСТАННІ ВІДКРИТОЇ ЕКОНОМІКИ УКРАЇНИ

Анотація. В умовах глобалізації світової економіки відкрита економіка країни, що бере участь у глобалізаційному процесі, стає органічним елементом світової економіки і завдяки цьому отримує додаткові стимули для розвитку. Міжнародні потоки товарів та капіталу дозволяють отримувати нові джерела для економічного зростання. Економічне зростання відтепер є не лише функцією внутрішніх, а й зовнішніх факторів. Саме вони нині визначають модернізаційні тенденції національних економічних політик, примушуючи їх рухатися відповідно до світових трендів. Метою дослідження є оцінка зв'язку між економічним зростанням країни та зовнішніми факторами її економічного розвитку, а також виявлення залежності між самими зовнішніми факторами задля з'ясування їхньої ролі в модернізації національної економіки. З цією ціллю проводиться аналіз основних параметрів відкритості економіки України як зовнішніх чинників, що впливають на національний економічний розвиток, зміни у традиційній виробничій функції під впливом уведення в неї зовнішніх факторів розвитку, моделюються оціночні показники названих впливів. Новизною є виявлення залежності між формами прояву відкритості економіки та економічним зростанням, розбудова моделі зв'язку форм прояву відкритості економіки. Проведене дослідження базується на сукупності економічних та економіко-математичних методів, які потрібні для ідентифікації впливу зовнішніх факторів на національну економіку, насамперед методи абстрагування, системного і структурно-компаративного аналізу, синтезу і моделювання економічних процесів. До числа використаних у дослідженні моделей належить багатофакторна регресійна модель. Емпіричною основою є матеріали офіційної

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статистики України за 1999—2019 рр. Результати проведеного дослідження показали: роль глобалізації економіки України в її економічному розвитку, значущість ПІІ як зовнішнього фактору економічного розвитку, сильний зв'язок між міжнародними потоками капіталу і міжнародними потоками товарів в українську економіку, позитивний вплив останніх на перші.

***Ключові слова*:** економічне зростання, глобалізація, зовнішні фактори економічного зростання, виробнича функція, відкрита економіка, ПІІ, зовнішня торгівля, державна інвестиційна політика.

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The problem statement. In current trends of deepening globalization processes, a country can successfully develop only on the basis of an open economy. In terms of formation of open economies, which perform a special state of national economic systems, more and more countries are involved in foreign economic activity: an increase in participation of countries in operations on the international market of goods and services, international financial markets and international labor market. Open economy contributes to their further international specialization and, accordingly, their implementation of foreign economic activity.

Ukraine's participation in global economic development began with the country's independence. However, still in assessing the level of its involvement in the world economic processes, relative isolation is stated as a manifestation of the country's isolation from the main trends of development on the world markets. In 2019, the level of openness of commodity markets in Ukraine in terms of export quota was 47.6%, import quota was 49% [1]. These figures throughout the years of independence remain within a maximum of 50%. Ukraine's international investment position is rather weak: 0.5% of world domestic flows and 0.06% of world external flows [2]. This situation can be explained primarily by the country's political instability, underdeveloped market infrastructure, unfavorable investment climate and tax environment that is determined by opacity, etc. In the country there is virtually no mechanism of government adjustment of globalization influences and reproduction processes in general, insufficiently clear foreign economic policy, unmodernized investment policy and economic growth policy. Government macroeconomic stimulation of business performs its functions poorly, so economic growth has slowed significantly in recent years: in 2019, GDP reached only 68% of GDP in 2012 [1]. Undoubtedly, business and economy need a balanced modernization policy that would take into account external factors of economic development and protect national business, creating conditions for strengthening its international competitiveness and strengthening international representation. The development of such a policy requires a scientifically grounded understanding of globalization effects.

Literature Review. In the research of external components as factors of the development of an open economy can be distinguished two main areas: on the one hand, studies proving the dominance of positive influences, on the other — a careful and cautious assessment of these effects, as they are seen as destroying economic autonomy of the country, putting it in economic dependence from more powerful partners [3].

Noteworthy are studies that reflect the correlation between economic growth and foreign trade. Depending on the stages of economic development the correlation would be positive or negative [4]. Such studies have been conducted both in the leading countries of the world [5; 6] and in transition economies [7; 8].

It is noteworthy that among the external influences, the influences related to the international capital flows embodied in foreign direct investment (FDI) are researched first of all. Many scholars argue that FDI is at the forefront of these influences because it has the most significant positive effect in terms of economic development of the recipient country [9]. First, along with direct capital financing, FDI can be a source of valuable transfer of know-how technologies, help strengthen international relations of business structures through financial and production support of export-import operations; second, they often bring with them new

technologies and knowledge, implement progressive management methods and improve organizational arrangements; third, provide the workforce of the host country with new skills in accordance with the introduced technologies; fourth, by increasing the productivity of industries in the recipient country, they determine domestic investment and technological progress; fifth, they have potentially desirable social consequences, manifested in the mitigation of negative shocks in the face of growing financial instability [10; 11]. At the same time, Lipsey R., researching the effects of FDI in host and home countries, emphasizes that they depend on the policy of the host country, from the terms of its development and the technological level of industries [12]. In his view, FDI is an obvious stimulus for export growth. Selma Kurtishi-Kastrati views FDI as a key component of an open economy and a successful international economic system, as the main mechanism of their development [13]. Under these conditions, FDI is a key component of successful and sustainable economic growth.

However, FDI is not a perfect external source of economic development of the host country. J. Stiglitz notes the duality of the links produced by FDI: on the one hand, economic growth is an active factor of FDI, on the other — vice versa [14]. At the same time, Thalassinos, analyzing the role of FDI in the open economy during crises, proves that under adverse conditions, capital flows between countries can destabilize the real economy of these countries [15]. The research by Jayaraman and Singh of the relationship between FDI, employment and GDP showed that there is a long-term, but one-way and random relationship between FDI and employment, which goes from FDI to employment [16]. They also found a short-term one-way random link between FDI and GDP with direction from FDI to GDP. Aktar and Ozturk on the example of Turkey (2000—2007) analyzed the relationship between FDI, exports, unemployment and GDP [17]. The results of analysis showed the lack of ability of FDI to reduce unemployment, fluctuations of GDP also do not reduce unemployment. Chowdhury A. and Mavrotas G. analyzed the causal relationship between FDI and economic growth based on econometric methodology [18]. A study of the relationship between the two variables showed that just GDP is the cause of FDI, but not vice versa.

Authors V. Navickas, M. Navickas, M. Kordoš in their article consider the influence of corruption and control variables on FDI inflows into the EU [19]. Authors emphasize that corruption has both positive and negative impact on FDI attraction.

The influence of FDI on economic growth in transition economies, and in Ukraine is considered in the article by L. Melnyk, O. Kubatko, S. Pysarenko. Authors revealed that in transition countries, FDI have positive effect on economic growth [20]. Scientists such as E. Siskos and K. Darvidou analyze the dynamics of FDI and the investment climate that influences on the economic development of the BSEC member states. They note that FDI are necessary for the economic growth of the BSEC countries [21].

Researching the impact of FDI on the economic development of the host country on the example of Ukraine, A. Malay drew attention to both positive and negative effects of foreign crediting and investment for the national economy in terms of global dependence [22]. This fact, in his opinion, is the basis for strengthening the regulatory function of the government in the field of investment, especially with regard to correcting imbalances between internal and external sources of investments.

Thus, there is no single point of view on this problem in science. In each case, there are additional factors and components that, by influencing the relationship between internal and external factors of economic development, will change the effects, scale and direction of influences. FDI as a component of the development of an open economy in the context of its impact on the economies of host countries continues to be studied and remains a key topic of discussion among both scientists and politicians.

Methodology. Most published current researches focus on the two-dimensional relationships between the pairs «economic growth and FDI», «unemployment and FDI», «economic growth and unemployment», and so on. In pairs, as a rule, one external variable and one internal are combined. As for expanding the two-dimensionality in the direction of introducing a wider range of variables that combine the growth of the national economy with globalization processes, then such

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developments are unreasonably in small quantity, in particular the identification of the overall relationship between economic growth and the degree of globalization of the country's economy and the establishment of a link between the main forms of economic globalization that influence on economic growth: FDI and foreign trade.

For the research, using E-Views, a multifactor regression model was built and tested the hypothesis of the influence on economic growth of internal and external factors:

$$Y = f(F_h, F_i), \quad (1)$$

where F_h — internal factors of economic development; F_i — external factors of economic development.

The use of software product E-Views was due to the fact that it is currently one of the most powerful packages for building econometric models. Thanks to him, it is possible to solve a number of important research problems, namely: analysis of scientific information, modeling of economic processes, etc. Therefore, the choice of outlined software product is relevant from the point of view of the tools capabilities to the tasks set in the research. Statistics for analysis are taken for the period 1999—2019, and therefore, the model includes 21 observations.

The formation of a set of indicators that influence on FDI was carried out on the principles of (1) representativeness, when the analysis includes the most significant indicators (in our case, those that directly influence on the volume of FDI attraction); (2) reliability — indicators adequately reflect the state of investment sphere; (3) information accessibility — the use of official statistics during calculations.

The general view of the model of factors influencing external variables on FDI was described by the equation:

$$FDI = f(E, I), \quad (2)$$

where *FDI* — cumulative foreign direct investments, million US dollars; *E* — export of goods and services, million US dollars; *I* — import of goods and services, million US dollars.

In the process of analysis of the model, correlations between the selected variables were revealed and a correlation matrix that explains them was constructed. The constructed model was tested for autocorrelation and tests for heteroskedasticity were made, tested for explanatory and predictive quality. The results of the author's model proved its adequacy and high quality.

Results and Discussion. Globalizational development and economic modernization of the country as a condition for its economic growth. The realities of modern life are increasing globalization, which covers the entire world community, and radical changes in international relations, which have a transformational nature and directly influence on the countries' development. Under these terms, on the one hand, the importance of effective international cooperation is increasing; on the other hand, there are significant threats to national development. Today, the world faces new global threats and challenges resulting from the adaptation of the world economy to new geopolitical terms. The leading tool of adaptation to them is the economic modernization of countries. It is based on production and investment processes aimed to meet the needs of the economy in accordance with the globalization requirements, and a high degree of creativity of the business entity, which comprehensively uses world information flows.

The process of modernization of the national economy itself consists of processes of economic, political, social and cultural transformation. And since adaptation to global processes is unalterable, it is a matter of finding a major source of economic growth that would meet national economic interests and at the same time take into account the needs of the global economy as an environment of which the national economy is an element. On the agenda is the issue of effective use of forms of economic globalization: foreign trade, international capital flows, labor and other factors of functioning of real and monetary sectors of economy.

Transformational (institutional) reforms in Ukraine are just beginning to be implemented into practice and they concern mainly political sphere. This trend indicates that the country is supporting the project of economic modernization «from above» in the form of government support of economic development. However, the most important components of economic modernization

remain unnoticed — the intensification of the process of economic reproduction through increasing industrialization with the transition to Industry 4.0. Having passed the stage of economic liberalization, Ukraine is entering a new stage, the core of which is to ensure the international competitiveness of the country's economy. Exactly here the issues of flexibility of the open economy and its readiness to resist the negative manifestations of globalization become particularly acute. Therefore, the country's foreign economic policy becomes a leading component of economic modernization policy. What should be decisive in this policy? What external factors of economic development should the government focus on in order to ensure the growth of national welfare? The first answer, which is somewhat axiomatic, is international capital flows, which modernize the investment sphere by expanding the reproduction of fixed capital by economic agents of investment activity.

The conclusion about the need to modernize the government policy of stimulating investment activity in Ukraine was led not by scientifically substantiated conclusions and recommendations of the scientific elite, but by the real struggle for foreign direct investments on the world capital markets. The essence of such a policy was considered in the perspective of creating a so-called «future» economy, which implements the tasks of Industry 4.0 and the country's participation in global economic processes. From the modernization of government policy of stimulating investment activity began to expect larger FDI inflows.

World experience also shows that the modernization of government policy to stimulate investment activity leads to an increase of the role of FDI in economic growth. In economically developed countries, the internationalization of production through foreign investment stimulates technology transfer and raises the technological level of the country as a whole. It often plays a key role in reducing regional disparities in income distribution and job creation, acts as a means of technology transfer and know-how to backward regions. Of course, Ukraine expects to get similar effects. But foreign investments have tendency to repatriate. In the absence of a favorable investment environment, FDI tend to return. Thus, welfare can increase in parallel with FDI if this condition is met. What are the trends inherent to foreign capital flows into Ukraine's open economy with its extremely high degree of liberalization of domestic commodity markets? Is the latter appropriate? And how does it affect the inflow of foreign capital? The answer to these questions allows to formulate a scientifically, and not only empirically grounded decision on external instruments of economic modernization policy and provides certain principles for the development of foreign economic strategies of Ukrainian business structures.

Econometric modeling of the influence of globalization factors on the FDI growth in the economy of Ukraine. Involvement of the Ukrainian economy in the globalized economic environment puts forward its requirements to national business structures. The measure of a country's global progress is the measure that forms strategies of their business behavior, giving it an internationally oriented coloration. However, to what extent should this strategy depend on external influences and how should it take into account specific forms of manifestation of globality? The general answer to the first part of the question can be obtained by analyzing the functional relationship between economic growth and globalization (external) factors of economic development. If we represent external factors in aggregate form by the index of globalization, we obtain a slightly modified function of economic growth:

$$Y = f(F_h, GI), \tag{3}$$

where *GI* — is the globalization index (in our case, a combined indicator of the Swiss Economic Institute (KOF Swiss Economic Institute), which allows to assess the scale of integration of a country in the world area).

Abstraction from internal factors allows to establish a link between Y and GI. As shown by calculations based on a multifactor regression model (GDP and globalization index are shown in *Table 1*), the relationship density is 11%, which is a relatively strong positive correlation, the rest of the growth is provided by internal factors. Thus, in the development strategies of business structures it is appropriate to take into account international factors.

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Table 1

GDP and Globalization Index of Ukraine

Indicators		2012	2013	2014	2015	2016	2017	2018	2019
GDP, trln dollars		182,6	190,5	133,5	91,0	93,4	112,2	137,7	137,3
Globalization Index	Place in the ranking	-	47	44	42	41	45	49	45
	Index	62,92	74,25	74,48	76,36	76,22	70,24	70,60	74,83

Source: compiled by the authors for [1; 23].

Regarding the second part of the question. The answer to this follows from the generally accepted classical postulate: economic development and its growth are the basis of the nation's welfare. Economic growth, as an increase in the nation's total production and consumption, depends on the amount of resources used by it. The technical relationship between them describes the production function. The theory of production traditionally uses a two-factor production function, in which production volumes functionally depend on labor and capital as the main factors of production. Mathematically, this dependence was first described by C. Cobb and P. Douglas as:

$$Y = A \cdot L^1 \cdot K^k, \quad (4)$$

where Y — total volume of output; L — labor contribution (labor costs); l — the coefficient of elasticity by work; K — the amount of capital spent; k — the coefficient of elasticity by capital; A — total productivity of all factors (constant coefficient).

The two-factor function was used in their researches by V. Leontiev, in whose model the factors are presented as absolute complements; R. Harrod and E. Domar, who by using the production function of V. Leontiev, analyzed the macro level; R. Solow introduced into the neoclassical form of the production function the effect of scale, the decreasing return of factors, the positive elasticity of factor substitution and the constant rate of savings and, finally, technological growth. The latter model influenced the whole macroeconomic theory, becoming the starting point for all modern studies of economic growth and modern economic-mathematical models of production functions (output function, cost function, capital cost function, etc.). However, despite all the modifications, these models considered a closed economy. A globalizing economy is an open economy. Its formation in itself is the result of the use of external factors. Because of this, the traditional production function acquires a transformed form

$$Y = A \cdot (L_h + L_i)^1 \cdot (K_h + K_i)^k, \quad (5)$$

where L_h — labor costs of national labor; L_i — labor costs of foreign labor; K_h — domestic capital expenditures; K_i — foreign capital expenditures.

At the same time, the openness of the economy is not only the openness of capital and labor markets. The market of goods and services opens first. Therefore, it should be reflected in the production function for the globalized economy. It can be assumed that investment goods are embodied in capital expenditures, but consumer goods then remain unaccounted for, however in many countries of the world in the commodity structure of foreign trade just consumer goods are dominating. Can capital expenditures fully absorb the foreign trade component? What is the relationship between the external factors when considering their impact on economic development and growth? Thus, it is a question of establishing a connection between external factors of development — factor of production foreign capital in the form of foreign direct investments and foreign trade, represented by export-import operations. The research is based on empirical data characterizing these macroeconomic parameters in Ukraine over the past 21 years (*Table 2*).

Table 2

External components of economic development of Ukraine

obs	GDP	FDI	E	I	LM
	million US dollars				mln people
1999	31580.9	2810.7	15195.5	12959.3	21.0037
2000	32375.3	3281.8	18227.6	15107.0	20.175
2001	39309.6	3875	19996.6	16922.7	19.9715
2002	43956.4	4555.3	22260.9	18171.7	20.0912
2003	513315	5471.8	27591.7	24485.4	20.1633
2004	67217.6	6794.4	38278.8	31059.7	20.2957

Table 2 (continued)

obs	GDP	FDI	E	I	LM
	million US dollars				mln people
2005	89239.4	9047.0	40671.6	39078.1	20.6800
2006	111885.0	16890.0	46159.8	48769.2	20.7304
2007	148734.0	21607.3	58731.2	65613.5	20.9047
2008	188111.0	29542.7	79227.4	92016.8	20.9723
2009	122993.0	35723.4	49825.4	50619.5	20.1915
2010	141210.0	38992.9	63341.5	66163.8	19.1802
2011	169333.0	45370.0	80330.5	88822.4	19.2311
2012	182592.0	48197.6	83010.7	91367.7	19.2614
2013	190499.0	51705.3	77416.9	84509.8	19.3142
2014	133503.0	53704.0	68134.9	60801.8	18.0733
2015	91031.0	38356.8	49647.4	43039.4	16.4432
2016	93356.0	32122.5	46098.3	44576.3	16.2769
2017	112190.0	31230.3	53132.7	55083.3	16.1564
2018	137691.0	31606.4	58972.9	63496.4	16.3609
2019	137282.1	32905.1	65292.1	67328.1	16.5783

Source: [1].

We use the multifactor regression method to identify the relationship between FDI and foreign trade. The regression equation has the following general form:

$$FDI = C(1) \cdot I + C(2) \cdot Exp + \varepsilon, \quad (6)$$

where C (1, 2, …, n) — regression coefficients for selected variables; ε — vector of random deviations.

Based on regression, we build a correlation matrix that allows us to establish the relationship between the selected variables (*Table 3*).

Table 3

Correlation matrix of selected variables

	FDI	I	E
FDI	1	0.8299	0.8829
I	0.8299	1	0.9875
E	0.8829	0.9875	1

Note: authors' development.

Based on the matrix data, a strong positive correlation is inherent to FDI and I — the correlation coefficient is 82.9%; and FDI and E — the correlation coefficient is even higher, it is 88.3%. It can be argued that export creates a more attractive environment for foreign investor.

The results of further regression analysis are given in *Table 4*. This linear regression makes it possible to estimate the influence of import and export factors on the variable (FDI) within selected interval.

Table 4

The Results of Multi-factor Regression of FDI

Variable	Coefficient	Std. Error	t-Statistic	Prob.
I	-1.149220	0.392018	-2.931548	0.0089
E	2.077955	0.469918	4.421955	0.0003
C	-20043.00	5219.517	-3.840010	0.0012
R-squared	0.850844	Mean dependent var		25894.78
Adjusted R-squared	0.834271	S.D. dependent var		17395.02
S.E. of regression	7081.485	Akaike info criterion		20.69992
Sum squared resid	9.03E+08	Schwarz criterion		20.84914
Log likelihood	-214.3491	Hannan-Quinn criter.		20.73230
F-statistic	51.33940	Durbin-Watson stat		1.049445
Prob(F-statistic)	0.000000			

Note: authors' development.

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For the model we set requirements regarding the qualitative parameters of factors. As a rule, in such models a marginal 5% significance level is applied to the factors. The results of *Table 4* show:

1. The export ratio affects the variable positively, the import ratio — negatively. With exports growing by 1%, FDI increases by 2%; with imports growing by 1%, FDI decreases by 1.15%. Thus, the value of FDI directly depends on exports and inversely on imports.

2. The magnitude of regression R^2 shows the extent to which variables of exports and imports of goods and services and their volumes are related to the scale of attracting foreign direct investments in Ukraine. According to regression calculations, 85% of *FDI* growth depends on foreign trade (correlation coefficient is 0.8508). This indicates a strong relationship, as there are other quantitative and qualitative factors that influence on *FDI*. The probability of accepting the null hypothesis is close to zero (*F*-statistic = 0.00), which confirms the alternative hypothesis, that indicates the significance of the equation as a whole. According to Fisher's *F*-statistics, all coefficients of the regression equation are not equal to zero at the same time. Besides, all selected factors are significant in terms of impact on *FDI*: exports — 0.03%; imports — 0.9% and this corresponds to a threshold value of less than 5%. As a rule, there are no strict requirements to the constant, but in our case it is also statistically significant, because it is less than 1%, i.e. all three indicators are statistically significant.

3. Using the Durbin-Watson test, we check the equation for the presence of first-order autocorrelation. The value of the DW criterion is in the range from 0 to 4; zones are divided into a zone with no autocorrelation, with positive, negative autocorrelation and a zone of uncertainty (critical zone). From *Table 3* it is seen that this criterion (DW) is 1.0494. Using Durbin — Watson statistics, we determine the significant (critical) points d_L and d_U. For the number of observations 21 and 2 variables at a significance level of $\alpha = 1\%$, $0.89 < DW < 1.27$. This means falling into the zone of uncertainty, which requires a transition to a higher-order autocorrelation research, because it is not yet possible to affirm the absence of autocorrelation.

The presence of higher (second) order autocorrelation is checked using the Breusch-Godfrey test (*Table 5*). We construct the dependence of the variable of random deviations from all exogenous variables, as well as lag variable deviations to the order of *t*. If the value of the observed statistics exceeds the critical point, then the null hypothesis at this level of significance must be rejected. The autocorrelation test comes down to the null hypothesis test. It should show whether the null hypothesis is accepted or rejected.

Table 5

Breusch — Godfrey Serial Correlation LM Test

F-statistic	2.149592	Prob. F(2,16)	0.1490
Obs*R-squared	4.447610	Prob. Chi-Square(2)	0.1082

Variable	Coefficient	td. Error	t-Statistic	Prob.
I	0.183927	0.382804	0.480472	0.6374
E	-0.231303	0.459945	-0.502892	0.6219
C	2109.708	5033.021	0.419173	0.6807
RESID(-1)	0.478137	0.258932	1.846574	0.0834
RESID(-2)	0.011059	0.257946	0.042874	0.9663

Note: authors' development.

The idea of this test is as follows: if there is a correlation between neighboring observations, it should be expected that in the regression equation the coefficient ρ should be significantly different from zero:

$$e_t = \rho \cdot e_{t-1} + v_t, \ t = 1, ..., n, \quad (7)$$

where e_t — regression residues, obtained by the usual method of least squares; v_t — constant of *n* period.

In the table above Breusch — Godfrey indicators of matter are Prob. F (2.16) and Prob. Chi-Square (2), which directly indicate the presence or absence of higher-order correlation. In our case, their values are more than 10%. This is the evidence of absence of higher-order autocorrelation. When using the following lags, we also observe the absence of autocorrelation. Thus, we can accept the null hypothesis, i.e. in this equation there is no higher-order autocorrelation of random deviations.

The next stage of checking the equation — check for heteroskedacticity (volatility of dispersion) of random errors of the linear regression model. To do this, we use the tests White, Breusch-Pagan-Godfrey, Harvey, Glejser, ARCH. The tests results are given in *Table 6*.

Table 6

The Results of Heteroskedasticity Test

Heteroskedasticity Test: White	Obs*R-squared	9.444551	Prob. Chi-Square (5)	0.0926
HeteroskedasticityTest: Breusch-Pagan-Godfrey	Obs*R-squared	1.052596	Prob. Chi-Square (2)	0.5908
Heteroskedasticity Test: Harvey	Obs*R-squared	0.410154	Prob. Chi-Square (2)	0.8146
Heteroskedasticity Test: Glejser	Obs*R-squared	0.424640	Prob. Chi-Square (2)	0.8087
Heteroskedasticity Test: ARCH	Obs*R-squared	0.607140	Prob. Chi-Square (1)	0.4359

Note: authors' development.

The probability of accepting the null hypothesis according to the White test is 9.26% (which is less than 10%, but more than 5% of significance and may indicate the presence of heteresedacticity); however, all other tests confirm the absence of heteroskedasticity: the Breusch — Pagan — Godfrey test — 33%, Harvey — 17.8%, ARCH — 30% of probability of accepting the null hypothesis.

Next indicator needed for analysis is the Ramsey test. It shows whether a linear equation fits our problem. The Ramsey RESET is 28.3%. If the Ramsey value is less than 10%, then the equation is not a linear regression equation, the regression cannot be described by a line. In this case, logarithms, polynomials, etc. should be constructed. Thus, we have the linear regression equation and the curve is chosen correctly. The equation is identified (*Table 7*).

Table 7

Ramsey RESET Test

	Value	df	Probability
t-statistic	1.107735	17	0.2834
F-statistic	1.227077	(1, 17)	0.2834
Likelihood ratio	1.463593	1	0.2264
F-test summary:	Sum of Sq.	df	Mean Squares
Test SSR	60768137	1	60768137
Restricted SSR	9.03E+08	18	50147431
Unrestricted SSR	8.42E+08	17	49522684
Unrestricted SSR	8.42E+08	17	49522684
LR test summary:	Value	df	
Restricted LogL	-214.3491	18	
Unrestricted LogL	-213.6173	17	

Note: authors' development.

Thus, the regression equation constructed for an open economy was verified (a) by testing on autocorrelation, (*b*) on the presence of heteroskedacticity, (c) on quality as a linear equation. All types of verifications proved its correctness. From this we can conclude that, firstly, the equation is an economic-mathematical model, which, secondly, is adequate. But this is not enough yet for the verification of constructed model. It is necessary to check it on explanatory ability, i.e. to find out to what extent it reflects the dynamics of FDI, which is the result of changes in the arguments under research, and on predictive quality.

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Fig. shows the growth of FDI under the influence of variables employed population and import of goods and services. As the graph shows, the simulated values (Fitted) fairly accurately reflect the actual (real) values (Actual), therefore, according to the criterion of explanatory ability the model is completely acceptable.

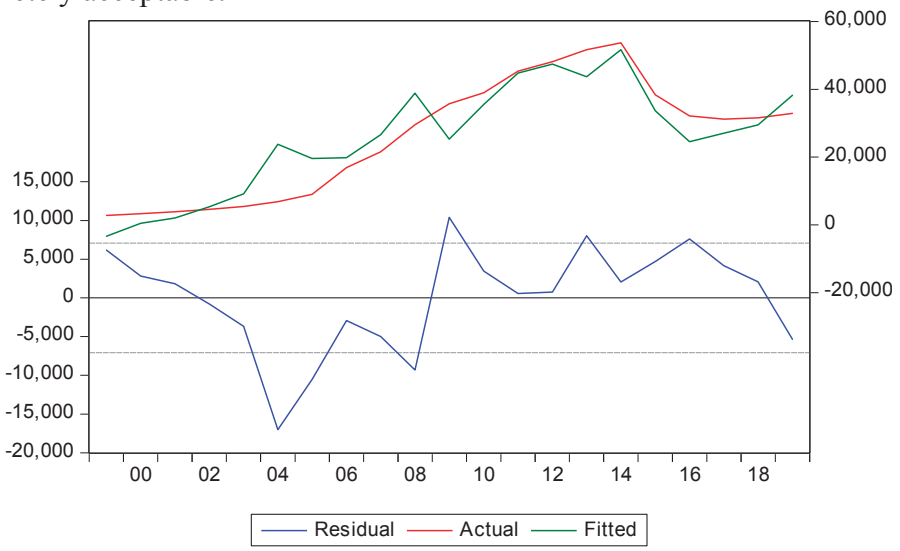

Fig. **Explanatory ability of the model**

Note: authors' development

The causal relationship between the selected variables and FDI we researche by using the Granger test. The idea of such a test can be described as follows: if change *A* is the cause of change *B*, then change *A* precedes change *B*; that is, we can find out what is primary: *A* or *B*. The Granger test makes it possible to test the null hypothesis — *A* is not the cause of changes *B*. The criterion for accepting the hypothesis is *Prob*. (the value of probability of accepting the hypothesis). If *Prob*. is less than 0.05, then the null hypothesis is not accepted. Feedback is checked at the same time. If two coefficients are statistically significant at the same time, the dependence is two-way or with feedback. The presence of a two-way relationship may indicate the existence of a third variable, which is the real cause of the changes in those two variables represented in the equation. If two coefficients are statistically zero at the same time, there is no cause-and-effect relationship (this is possible even with a statistically significant correlation). The tests were performed for lags 2, 3, 4. The results of the test are given in *Table 8*.

Table 8

Pairwise Granger Causality test on all the variables, 1999—2019

	The null hypothesis	lag 2			lag 3		lag 4	
		F-Stat.	Prob.	Conclusion	F-Stat.	Prob.	F-Stat.	Prob.
1	I does not Granger Cause FDI	5.5122	0.0172	reject	3.8871	0.0406	1.93878	0.1974
	FDI does not Granger Cause I	0.2070	0.8155	accept	0.2023	0.8926	0.42156	0.7893
2	E does not Granger Cause FDI	2.9848	0.0832	accept	1.8849	0.1906	0.87622	0.5187
	FDI does not Granger Cause E	0.2783	0.7612	accept	0.3143	0.8148	0.45047	0.7700
3	E does not Granger Cause I	0.3285	0.7254	accept	0.3501	0.7900	0.26232	0.8941
	I does not Granger Cause E	0.6248	0.5496	accept	0.6543	0.5968	0.51329	0.7286

Note: authors' development.

The Granger test was performed on all variables with lags 2, 3, 4, that allow to include in the research a long-term period of interaction of all indicators selected for analysis. Presented in regression 6. data suggest about the existence of cause-effect relationship between FDI, on the one hand, and foreign trade, represented by import and export, on the other. Export, as a component of foreign trade, has a positive influence on FDI. It acts as a complement to them. The impact of import is reversed, so it can be assumed that it is a substitute in relation to FDI.

Thus, equation (6) is statistically significant, with a high coefficient of determination. The multi-regression model of the dependence of FDI growth on independent variables, which has been tested, has the form:

Substituted Coefficients:

$$FDI = C(1) \cdot I + C(2) \cdot E + C(3)$$

$$FDI = -1.14921974011 \cdot I + 2.07795478165 \cdot E - 20042.9976797.$$

Thus, an open economy modifies the traditional production function. The essence of this modification is that in the long run the growth of FDI, which is represented by a set of financial and non-financial assets, is due to the growth of export and drop of import deliveries. The influence of foreign trade on GDP growth is similar.

Presented model can be considered as an initial stage in understanding and researching the place and role of FDI in the development of host economies. It proves that along with objectively acting factors of FDI, as forms of openness of the economy and its globalization, FDI need an active government assistance policy, which emphasizes, firstly, to stimulate and support the export activities of business structures, and secondly, attracting innovative capital, which will positively affect their competitiveness and international trade position. Under these terms, FDI will be a real external source of economic development of the host country.

Conclusions. The globalization of the world economy strengthens the effects of external factors of national economic development. 1% of Ukraine's economic growth is provided by global (external) factors. This is the basis for an active policy of economic modernization. We are dealing with a growing trend.

Until recently, the economic policy of the Ukrainian state has been aimed on the globalization of domestic commodity markets and services markets (markets openness reaches almost 50%). Capital market has not yet become the subject of its active actions (0.06% of world external flows), that is why foreign trade is a stronger source of economic development than foreign investment, although theoretically the real situation should have been different. And if in Ukraine there is a strong direct relationship between export and FDI, when the former significantly affect the scale of the latter (multi-regression model of dependence of FDI growth from foreign trade showed that an increase in export by 1% leads to an increase in FDI by 2%) and the growth of import reduces the volumes of foreign investments (with imports growing by 1%, FDI decreases by 1.15%), the policy of economic modernization should be based just on this trend. In this way, it can protect both the national economy and its subjects — business structures. By doing so, government will help strengthen the level of international competitiveness of the Ukrainian economy. In modern conditions, when the non-economic global factor Covid-19 is active, the decline of Ukraine's GDP in the current 2020 may be according to the forecast of the Kyiv School of Economics 5.3%, according to the forecast of the Cabinet of Ministers — 4—8%, according to the International Monetary Fund — 8.2%. It will be accompanied by a weakening of the exchange rate and inflation [24]. Taken together, predicted factors will lead to a decline of both foreign trade and foreign direct investments. Thus, negative changes in the economic environment will worsen Ukraine's global economic position. The government should in advance take this into consideration in its policy of economic modernization.

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