RESEARCH PAPER

Modeling The Level Of Investment Attractiveness Of The Agrarian Economy Sector

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ABSTRACT
The relevance of the research topic is due to the fact that in the current economic conditions attracting additional investments will ensure the further development of the agricultural sector of the economy. The purpose of the article is to establish a close link between investment attraction and increased agricultural output. Positive dynamics were found as a result of the analysis of the dynamics of investments in fixed assets in the agricultural sector during the analyzed period, but their fluctuations by years are observed due to the influence of factors of the external and internal environment. Scientific methods were used in the research process: modeling - to build an investment model for the development of the agricultural sector of the economy; economic and statistical - to assess the dynamics of capital investment; analysis and synthesis - to find out the reasons that cause changes in capital investment.Results of the research. The result of the study is clearly identified trends in attracting investment in the agricultural sector of Ukraine. The analysis of investment attractiveness on the basis of neoclassical Cobb-Douglas production function is carried out. The obtained model made it possible to predict the volume of production based on the expected values of capital and labor.

KEYWORDS: *Investment; Investment attractiveness; Agricultural sector; Function of production.*

1. Introduction
1.1. Problem description
Significant investment resources are needed for the effective functioning of agricultural enterprises and the production of competitive products, which will allow to solve the issue of updating the material and technical base. Investments play a significant role in resolving this issue. The current state of market transformations in Ukraine requires such conditions that would guarantee economic security for investors and ensure innovative development of the domestic economy.

In economic literature, there is no single approach to defining the essence of the concept of investment attractiveness of the agricultural

sector of the economy. And the main components that have a direct impact on it are not identified.

1.2. Literature review
Thus, in particular Blank I. considers investment attractiveness as an integral characteristic of individual enterprises as potential objects of future investment from the perspective of development prospects, product sales, asset efficiency and liquidity, solvency and financial stability. The scientist considers the estimation of potential and prospective objects of investment by the methods of marketing and financial analysis and formation of the integrated generalization of the results of the estimation [1, 15].

At the same time, Stechenko D. and Endovitskiy, D. [2, p. 249; 20, p.136] in his research notes that investment attractiveness is a reliable and timely achievement of investor goals based on the economic performance of the investee. According to the scientist, the investment attractiveness is determined by a complex of various factors, the list and impact of which may differ and vary depending on the composition of the investors aiming and the production and technical features of the production being invested.

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Ishchuk S. and Kulinich T. view investment attractiveness as an integral metric that integrates systems of formal and informal criteria that determines the feasibility of investing in a potential investment object that enables it to attract the necessary amount of capital on a mutually beneficial basis with investors [3, c. 71]. However, despite the considerable amount of research in this area, the question of economic and mathematical modeling of the investment attractiveness of the agricultural sector of the economy remains unresolved, which determines the relevance and necessity of further scientific research.

1.3. Materials and methods

The theoretical and methodological basis of this study is a set of general scientific and special methods of research. In particular: economic and statistical method - made it possible to analyze the dynamics of the volume of investments in the agricultural sector of the economy; correlation-regression analysis reveals the influence of factors on the productive trait; the method of economic and mathematical modeling was used to build an investment model for the development of the agrarian sector of the economy; theoretical and methodological generalizations were made using the abstract-logical method.

2. Results and Discussion

The current state of the Ukrainian economy clearly demonstrates the need for measures that would strengthen and ensure positive trends in its development. In particular, there is a need to move to an innovation-investment model of development.

Ensuring the reform of the national economy is directly related to attracting investment from both external and internal investors. In recent years, foreign investment has played a much more important role and there is a real need to increase the investment attractiveness of each individual region and country as a whole. It is the investment climate that directly affects the most important indicators of the country's development and its investment attractiveness.

Positive investment climate helps to solve the most common social problems, provides high level of employment of the population, allows to renew production, to carry out modernization and increase of fixed assets of the enterprises, to introduce the latest technologies, etc [4, 15]. Innovation and investment sphere is one of the most sensitive parts of economic development, which is able to respond immediately to the action of both external and internal factors [5,8]. Stimulating investment processes in agriculture is one of the priorities that requires solving a number of problems at all levels of managementThe investment strategy of Ukraine's development should be systematically aimed at agricultural production, the productive functioning of which will ensure the country's food security, public health, efficient development of processing industries, mechanical engineering for agriculture and other.

The agricultural sector in Ukraine remains one of the key sectors of the economy, as it accounts for more than 20 percent of the country's GDP. Agricultural sector products account for a significant share of commodity exports. Ukraine has increased its agricultural export revenues significantly over the last decade, and agriculture's role in total exports has increased accordingly. The share of agricultural food exports in 2018 amounted to almost 40% (fig. 1).
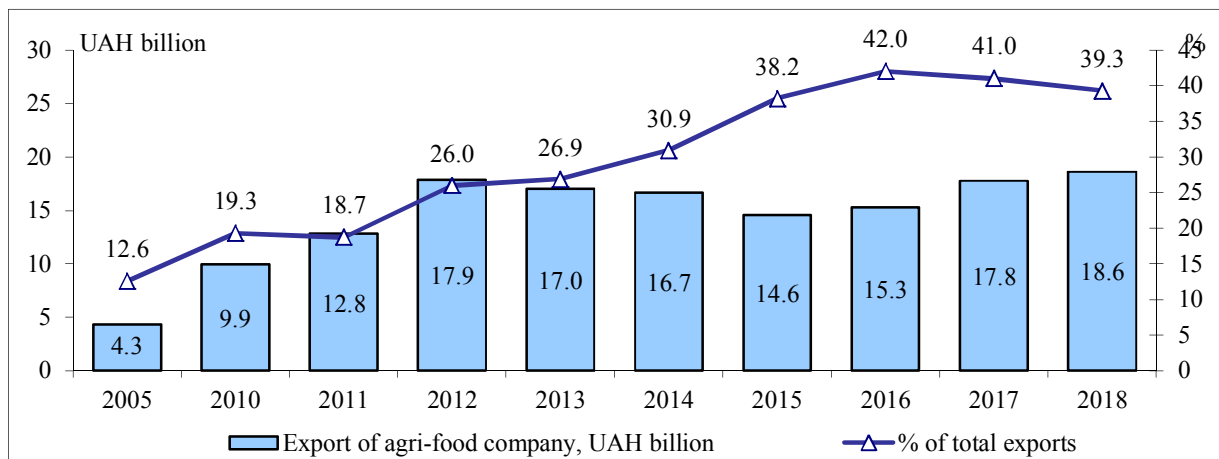

Fig. 1. Structure of agricultural exports

Source: Created by the authors

The analysis of the volume of investments into the fixed capital shows that the investments have increased more than twice as much as in the general economy of Ukraine from 2014 to 2018. In particular, it is worth noting that investments in agriculture have increased almost 3.5 times and in 2018 amounted to UAH 65059 million. Studies have shown that during the analyzed period the share of investments in agriculture in total increased significantly, so in 2014 their share was 8.38%, and in 2018 it increased to 11.24%. However, it should be noted that in the previous year this indicator was 14.14%.

The value of gross output during the analyzed period increased from UAH 1522.7 billion in 2014 to UAH 2983.9 billion. in 2018, which is almost 2 times. Gross agricultural production in Ukraine has more than doubled during the period under review, reaching UAH 727.4 billion in 2018. The financial performance of the economic activity was significantly improved due to the favorable price situation in the domestic and foreign food markets (Table 1).

Tab. 1. Dynamics of investments in fixed capital of agriculture in Ukraine

Indicators	2014	2015	2016	2017	2018	2018 in % to 2014
Investment in Ukrainian economies total, UAH million	219420	273116	359216	448462	578726	263,8
Including agriculture, hunting and related services	18388	29310	49660	63401	65059	353,8
Share of investments in agriculture in their total volume,%	8,38	10,73	13,82	14,14	11,24	134,1
GDP (in actual prices) total, UAH billion	1522,7	1586,9	1988,5	2385,4	2983,9	196,0
GDP (in fact. Prices) of agriculture, billion UAH	315,5	381,2	558,8	655,6	727,4	230,6
Share of all investments in GDP of the country,%	14,41	17,21	18,06	18,8	19,39	134,6
Share of investment in agriculture in GDP,%	5,83	7,69	8,89	9,67	8,94	153,3

Source: calculated by the authors

The main components in the process of assessing the investment attractiveness of a region is the analysis of its production potential (property status) and social, which is expressed in the presence of benefits in terms of the implementation of a certain type of innovation and the feasibility of their implementation for the development of a particular region or country as a whole [6, 12].

One of the first in this area is the study of the Harvard Business School. For comparison, an expert scale was used, which consisted of the following characteristics of each country: the legislative framework for investors, the possibility of capital outflow, the stability of the national currency, the political situation, the level of inflation, the possibility of using national capital [16, 17].

As noted earlier, there are many methods and approaches to assessing and modeling the investment attractiveness of regions. The production function method is widely used in both macro- and microeconomic analysis. In macroeconomics, an aggregate function is calculated for each country. Thus, scientists Douglas P., Solow R., Denison E. calculated the function of American production, J. Tinbergen made the corresponding calculations for Germany, France, Great Britain, USA [9, 18-19]. The production function of a real firm can be determined empirically by measuring its actual indicators. With the help of such analysis, the company makes the decision to choose a technologically efficient method of production.

The econometric model of the production function allows us to analyze the production activity in order to determine the ways to increase its efficiency. The validity of such an analysis depends entirely on the reliability of the model and its adequacy to the relevant real process.

We conducted an analysis based on Cobb-Douglas's neoclassical production function based on data from agricultural enterprises in Ukraine's regions for 2018.

Among all the most important factors that ensure the investment attractiveness of the regions, it is worth mentioning the work potential, because the number of quality staff plays a particularly

important role. Its size and corresponding quality create the most effective activity of the future enterprise [7, 11, 21, 22].

Neoclassical Cobb – Douglas production function:

$$Y = a_0 K^\alpha L^\beta , \qquad (1)$$

Where: Y – output of agricultural products in enterprises, K - cost of capital of enterprises, L – the number of employees of enterprises, a_0, α, β - model parameters.

The above production function equation (1) is multiplicative, that is, nonlinear with respect to parameters. Therefore, in order to bring this function to an additive (linear) form, it is necessary to perform its linearization. This operation is performed by logarithing both parts of the equation [10, 13,].

We perform linearization of the production function and reduce it to a linear form. Linearization is performed in two steps. Prologify both parts of equation 1:

$$\ln Y = \ln a_0 + \alpha \ln K + \beta \ln L . \qquad (2)$$

Variables have been replaced:

$$y = \ln Y; \quad x_1 = \ln K; \quad x_2 = \ln L . \qquad (3)$$

As a result, the nonlinear multiplicative production function (1) is reduced to the following linear:

$$y = b_0 + b_1 x_1 + b_2 x_2 , \qquad (4)$$

where the parameters of linear and nonlinear forms are related by the following relations:

$$b_0 = \ln a_0, \quad b_1 = \alpha, \quad b_2 = \beta . \qquad (5)$$

The conversion of production function variables to further evaluate the linear shape parameters (4) is shown in Table 2.

Tab. 2. Actual data given to a linear function

Region	LnY	LnK	LnL
Vinnytsia	10,7	10,8	3,5
Volyn	9,2	9,3	2,0
Dnepropetrovsk	10,3	10,7	3,3
Donetsk	9,4	9,7	2,7
Zhytomyr	9,7	10,3	2,5
Transcarpathian	7,0	7,9	0,6
Zaporizhzhia	9,5	10,2	3,1
Ivano-Frankivsk	8,7	10,0	1,6
Kiev	10,6	11,2	3,7
Kirovohrad	10,0	10,7	3,3
Lugansk	9,1	9,6	2,3
Lviv	9,4	10,1	2,2
Nikolaev	9,7	10,3	2,9
Odessa	10,0	10,4	3,3
Poltava	10,5	11,0	3,7
Rivne	9,0	9,7	1,9
Sumy	10,1	10,5	3,0
Ternopilska	9,7	10,1	2,6
Kharkiv	10,1	10,7	3,2
Kherson	9,8	10,2	3,0
Khmelnytsky	10,2	10,6	3,1
Cherkasy	10,5	10,9	3,4
Chernivtsi	8,2	8,6	1,3
Chernihiv	10,2	11,0	3,3

Source: calculated by the authors

We construct a multiple linear regression model and estimate the model parameters using the least squares method.

Tab. 3. Indicators of variance analysis

Variance analysis				
	df	*SS*	*MS*	*F*
Regression	2	15,48586791	7,742933957	222,1232039
Remainder	21	0,73203344	0,034858735	
At all	23	16,21790135		
	Coefficient	*Standard error*	*t-statistic*	*P-value*
Y	2,690524554	1,009974698	2,663952432	0,014523153
LnK	0,54315066	0,129376488	4,198217693	0,000404488
LnL	0,490021324	0,126765657	4,125891334	0,000480872

Source: calculated by the authors

The coefficient of determination R^2 characterizes the proportion of variation of the dependent variable that is explained by this model (table 3). The value of the determination coefficient $R^2 = 0,955$ is high that indicates a rather close functional dependence of production on resources. F = 222,123 is greater than the table value of the Fisher F test $(0,05;2;24) = 4,19$, that is, the regression equation is significant. Therefore, the studied dependent variable Y is very closely described by the variables ln (K) and ln (L) included in the regression model.

Based on the data obtained, we can deduce the Cobb-Douglas function for the situation described above:

$$lnY=ln(2,69052)+0,5432lnK=0,4900lnL$$

Based on the obtained model, we can deduce the production function of Cobb-Douglas by exposing:

$$Y=14,7394K^{0,5432} L^{0,49}$$

We calculate the theoretical data of agricultural output of enterprises from the resources by the constructed function and plot the actual and estimated values (Fig. 2).

The resulting model has an increasing scale effect as the sum of the coefficients α and β exceeds 1. This indicates that when the factors K, L, and S increase in a certain proportion, the result Y increases in greater proportion.

The resulting model can be used to forecast future production volumes based on known or expected values of capital and labor.

The analysis of the mathematical model shows that with the current tendency of reducing the number of workers in agriculture to ensure annual output growth by 1%, it is necessary to increase the cost of capital by almost 4% annually (Table 4).
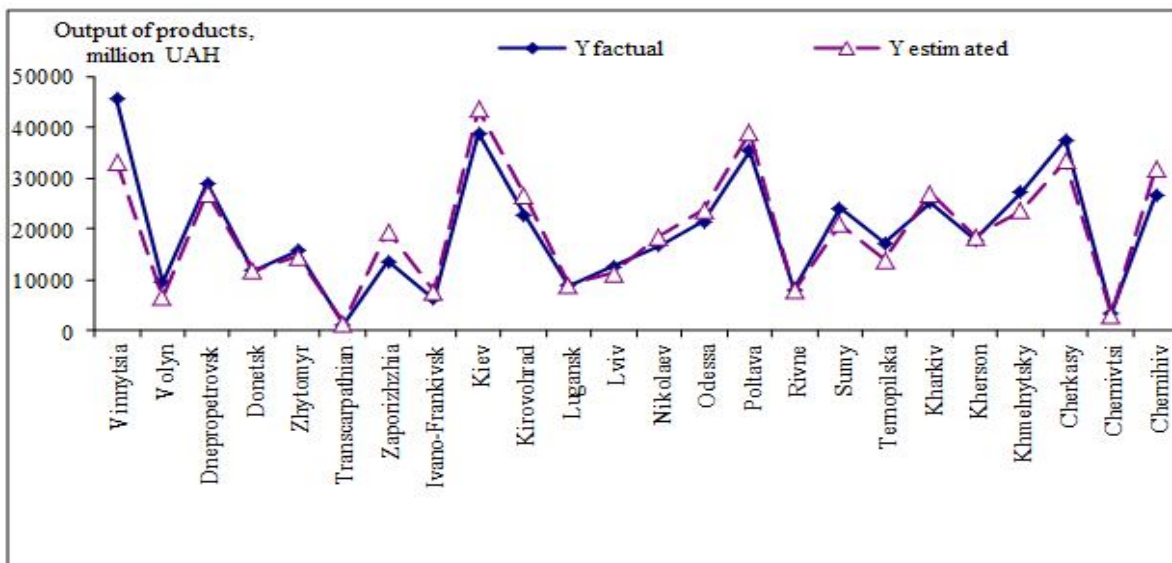

Fig. 2. Factual and estimated data of output of agricultural enterprises of Ukraine
Source: calculated by the authors

Tab. 4. Estimated level of output growth with additional capital raising

Indicators	2020	2021	2022	2023	2024	2025
K (estimated)	862940	896751	931887	968399	1006342	1045771
L (forecast values)	427,2	409,4	392,3	376,0	360,3	345,3
Y (annual growth rate of 1%)	485302	490155	495057	500007	505007	510057
Estimated values to actual level, %	102,0	103,0	104,1	105,1	106,2	107,2

Source: calculated by the authors

Increasing investment activity in the agrarian sector of the economy has a positive impact on the economic development of the country as a whole and of individual sectors in particular. Ensuring stable development of the investment process is possible provided its innovative filling, which will increase the investment attractiveness of agricultural enterprises. Analysis of the investment attractiveness of the agricultural sector shows the significant impact of several factors, both economic and social, political and national.

3. Conclusion

Analysis of the current state of investment support for the agricultural sector of the Ukrainian economy has allowed to establish that during the analyzed period, their positive dynamic was revealed, but their fluctuations by years are observed, due to the influence of factors of the external and internal environment.

Based on the theoretical analysis of methods of modeling investment attractiveness, the authors determined that the most efficient use of the production function of Cobb-Douglas, which makes it possible to predict the dynamics of investment support with the purpose of annual growth of output.

The main factors that increase the investment attractiveness of agriculture are the creation of a stable legal framework; ensuring adequate financing of sectors of priority for the development of the Ukrainian economy, namely the agro-industrial complex; improving and simplifying the country's tax system, formation of the investment risk insurance system.

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