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Research Article

Econometric Modeling The Impact Of Multi-Disciplinary Farms On The Development Of Agriculture, Forestry And Fisheries Using The Cobb-Douglas Production Function

Utanov Bunyod Kuvondikovich[1], Habibullayev Ibrokhim[2], Hayitova Nigora Ilxomovna[3], Abdikulova Dilnoza Abdukadirovna[4]

Abstract

In this article agriculture, forestry, fishery production and the volume of investment in these industries are analyzed in the context of the Republic of Uzbekistan using statistical methods. Furthermore, the econometric model using the Cobb-Douglas production function is constructed in four variants, the optimal option is selected to interpret.

Keywords: Agriculture, forestry, fishery products, model, multidisciplinary farms, P.Douglas and D.Cobb production model, diversification, current valuation, fixed valuation, register, investment, number of items, programs, interpretation, OLS regression, Breusch -Godfrey, Akaike and Bayes Information Crtiterions.

Introduction

The agricultural, forestry and fisheries sector is one of the main sectors in the Republic of Uzbekistan, the main task of which is not only to ensure food security of the country, but also to export products grown in the industry. Such tasks necessitate the direct development and diversification of the network. It is well known that the concept of diversification means "diversified development" and is the simultaneous development of technologically unrelated types of production and the proliferation of product types. Today, as a result of diversification, it leads not only to the development of agriculture, forestry and fisheries, but also to the creation of multidisciplinary farms on the basis of farms in our country. As a result of diversification of farms, as of January 2021, we can see that 65,317 multidisciplinary farms have been established in the country. From this figure we can see that today the role of multidisciplinary farms in the cultivation of agricultural, forestry and fisheries in Uzbekistan is significant. This highlights the need to study the impact of multidisciplinary farm activities on agriculture, forestry and fisheries. From this point of view, an important factor is to build econometric models and determine the

[1] P.h.D. Head of Statistics and Econometrics Department at Tashkent Institute of Finance. Tashkent, Uzbekistan. E-Mail: bunyod1285@gmail.com. ORCID: 0000-0003-0605-4328

[2] Doctor of science, prof.of Statistics and Econometrics Department at Tashkent Institute of Finance. Tashkent, Uzbekistan. E-Mail: ibroximxabibullaev@mail.ru ORCID:0000-0002-9260-1246

[3] Teacher of Statistics and Econometrics Department at Tashkent Institute of Finance. Tashkent, Uzbekistan. E-Mail: nigorahayitova@mail.ru ORCID: 0000-0003-3167-8829

[4] Doktorant of Statistics and Econometrics Department at Tashkent Institute of Finance. Tashkent, Uzbekistan. E-Mail: dilkaraeva@mail.ru ORCID:0000-0002-7236-8045

direction of development of the agricultural, forestry and fisheries sector of the country, in particular, through the study, analysis and analysis of the activities of multidisciplinary farms.

It is known that many scientific works have been published using the Cobb-Douglas model in modeling the production of agricultural products and the factors that affect it. In particular, the Chinese scientist Lin J. In his research, he modeled the effects of labor, land, capital, and mineral fertilizers on agricultural products as variables, while in her co-authored work, Russian scientist T.P. Seliverstova modeled the effects of changes such as capital, labor, investment, and average per capita income. Another Chinese researcher, Chi Ju Ju, using data on Uzbekistan, developed an econometric model based on the growth rate of agriculture as a result, the rate of change of labor, the rate of change of land fund and the rate of loss of material. As a result of all the above-mentioned scientific works, the problem of correct selection of factors influencing the modeling of agricultural development trends using the Cobb-Douglas model, as well as the periodicity of data and their statistically significant acquisition remains.

Methodology

Different econometric methods can be used to model the result and the factors influencing it, depending on the nature of the object under study. In our research, we used the production model of Cobb-Douglas. It is well known that the production function in the first equation is often used to model a particular region or the whole country (i.e. to solve problems at the macroeconomic as well as at the microeconomic level). Where, a_0, a_1, a_2 — are parameters of Cobb-Douglas production function. These parameters are positive. (In most cases for a_1 and a_2 , $a_1 + a_2 = 1$ holds).

$$y = a_0 x_1^{a_1} x_2^{a_2} \quad (1)$$

Based on statistical data, P. Douglas and D. Cobb built a mathematical model that reflects the relationship between the output produced in the processing industry and the capital and labor costs that affect it. Cobb-Douglas production function is used widely due to its simplicity. In the applications of Cobb-Douglas production function will have the following form:

$$Y = a_0 K^{a_1} L^{a_2}$$

Where: *K*- is capital, *L*- labor force, and also $a_0 > 0$, $a_1, a_2 \geq 0$, $a_1 + a_2 = 1$.

It will be possible to add several more variables to the above formula view. For example, Lin J., mentioned above. developed the following model in his researchwork

$$\ln(Y_{it}) = \alpha_1 + \alpha_2 \ln(Land_{it}) + \alpha_3 \ln(Labor_{it}) + \alpha_4 \ln(Capital_{it}) + \alpha_5 \ln(Fert_{it})$$

Russian scientists T.P. Seliverstova in their co-authored scientific work calculated the empirical data using the following model view.

$$Y = A * K^{\alpha} * L^{\beta} * I^{\gamma} * D^{\delta}$$

Chinese researcher Chi Ju Ju used the following model:

$$\ln(Y) = \ln(\mathrm{A}) + \mathrm{a}_1 \ln(L) + a_2 \ln(K) + a_3 \ln(M)$$

As a result of our research, the country's agriculture, forestry and fisheries are the factors influencing the volume of investment in the sector, the number of workers in the sector and the number of multidisciplinary farms operating in the country.

Using ordinalry least squares method (OLS) to generate the results, the models were constructed and the significance of the constructed models was determined using the Fisher and the Student`s t statistics. Breusch-Godfrey test was used to determine whether autocorrelation exists. Besides that, cumulative summation was test to check parameter stability. Akaike and Bayes Information Criterions were used to select the model to interpret.

Results

As a result of reforms in the agricultural sector in Uzbekistan, the volume of agricultural, forestry and fishery production is growing from year to year (Table 1). This requires us to study other statistical indicators in addition to the above indicators (Table 1).

Table 1 Data on the production of agricultural, forestry and fishery products in the Republic of Uzbekistan, investments in it, the number of workers and the number of multidisciplinary farms (for 2000-2020)

	Agriculture, forestry and fishing production of products, bln·som[5]	Investments in the production of agricultural, forestry and fishery products, bln. som[6]	The number of workers in the production of agricultural, forestry and fishery products, in thousand people	Number of multidisciplinary farms
2000	1387,2	42,8	3093	87
2001	2104,8	72,2	3062	120
2002	3255,3	102,4	3046	165
2003	4083,3	98,7	3063	227
2004	4615,8	113,7	3042,5	312
2005	5978,3	138,2	2967,4	428
2006	7538,8	164,4	2935,9	589
2007	9304,9	200,9	2998,2	809
2008	11310,7	261,2	3036,6	1112
2009	13628,6	385,9	2898,4	1528
2010	32746,5	1655,0	3118,1	2101
2011	48068,3	2489,3	3229,4	2888
2012	58549,3	2745,4	3251,7	[7]3969
2013	69391,3	3129,0	3402,1	5456
2014	85101,7	3858,3	3528,9	11553
2015	103302,0	4515,4	3601,7	18278
2016	119726,7	4795,3	3646,7	25460

[5] Priliminary data
The data for 2010-2020 are presented taking into account the data that have been clarified (revalued).
[6]Note: Data for 1998-2009 are prepared according to XXTUT (Classification of Sectors of National Economy). Data for 2010-2020 are prepared according to IFUT (types of economic activity). Data for 2020 are presented based on the results of preliminary calculations.
[7] Author's calculation using statistical methods based on the share of total farms in the country

2017	154369,4	6110,6	3641,4	31153
2018	195103,7	7991,9	3574,8	41240
2019	224265,9	12199,1	3551,2	53197
2020	260306,8	18025,5	3654,6	65317

From the table above, we can see that the volume of agriculture, forestry and fisheries in the country in 2000 amounted to 1387.2 billion soums, and by the end of 2020 this figure amounted to 260306.8 billion soums. In our opinion, the increase in this indicator was due to the fact that since 2010, as a result of the revaluation of agricultural products in the country, the calculations have been adapted to market mechanisms. Of course, since this figure is at current prices, it would be illogical to compare these figures directly. It is usually recommended that users transfer the data to a comparative estimate and compare the indicators to draw the correct conclusion. In our research, we modeled the current price indicators by moving them to 2020 prices. In the same situation, the volume of investments in the production of agricultural, forestry and fishery products in 2000 amounted to 42.8 billion soums, and by 2020 this figure amounted to 18025.5 billion soums. In 2000, 3,093,000 people were employed in agriculture, forestry and fisheries, while by the end of 2020, the figure was 3,654.6 thousand. In our country, we can see that the number of multidisciplinary farms has been growing year by year since their establishment.

As a result of our research, the volume of the country's agriculture, forestry and fisheries was taken, and the factors influencing it were the volume of investments in agriculture, forestry and fisheries, the number of workers and the number of multidisciplinary farms in the country (2-table). Data were analyzed using the STATA 16 program.

Table 2 Descriptive Statistics of Variables

Variables	**Mean**	**Standard deviation**	**Minimum**	**Maximum**
Production of agricultural and fishery products, bln. som	67339.97	80356.71	1387.20	260306.80
Investments in fixed assets in agriculture, forestry and fisheries amounted to billions. Som	3290.25	4650.18	42.8	18025.5
Number of people engaged in agriculture, forestry and fisheries, thousand people	3254.457	274.1554	2898.4	3654.6
Number of multidisciplinary farms	12666.14	19464.61	87	65317
Land fund in agriculture, forestry and fisheries	28602.77	359.8759	28068.4	29131.05
Production of agricultural and fishery products in natural logarithmic form	10.10253	1.677745	7.235043	12.46962
Investments in fixed assets in agriculture, forestry and fisheries in natural logarithmic	6.766852	1.953717	3.756538	9.799542

form				
Number of people engaged in agriculture, forestry and fisheries in natural logarithmic form	8.08445	0.0833352	7.971914	8.203742
Number of multi-disciplinary farms in natural logarithmic form	7.798625	2.146081	4.465908	11.08701
Land fund in agriculture forestry and fisheries in natural logarithmic form	10.26118	0.0125611	10.2424	10.27956

Table 2 shows the variables used in econometric analysis and the natural logified forms of these variables. It can be seen that when the variables are naturally logarithmic, the variability of these variables is significantly reduced. Therefore, in econometric analysis we include variables in natural logarithm.

Table 3 OLS REGRESSION RESULTS

Dependent variable: Production of agricultural and fishery products in natural logarithmic form				
Independent variables	***Model 1***	***Model 2***	***Model 3***	***Model 4***
AR(1)	0.531***	0.544***	0.395***	0.382***
Investments in fixed assets in agriculture, forestry and fisheries in natural logarithmic form	0.386***	0.399***	0.386***	0.405***
Number of people engaged in agriculture, forestry and fisheries in natural logarithmic form		-0.607		-0.856
Number of multi-disciplinary farms in natural logarithmic form			0.108	0.134*
Constant	2.273***	6.959	2.764***	9.489**
Adjusted R^2	0.9969	09969	0.9972	0.9974
F statistics	3104.36***	2098.732***	2268.645***	1892.527***
AIC	-37.939	-37.427	-38.980	-40.392
BIC	-34.951	-33.444	-34.997	-35.413
Breusch-Godfrey chi-square statistics	1.22	0.499	1.275	0.061

*Note: *** Statistically significant at 1% significance level, ** Statistically significant at 5% significance level, * Statistically significant at 10% significance level*

Table 3 shows the coefficients of the regression equations of 4 different types using the variables given in Table 2 above. At the same time, all 4 models do not have autocorrelation problems. This is because in all 4 models, the Breusch-Godfrey test chi-square statistic is not statistically significant at the 10% significance level. To avoid the problem of autocorrelation, each model includes the previous value of the dependent variable, ie the autoregressive part (AR (1)).

One of the important results of Table 3 is that the impact of investment dynamics on the dynamics of agricultural production is almost the same in all 4 models. This means that investment is an important factor in increasing agricultural production.

In 4 models of Table 3, we perform a cumulative sum test to check the stability of the parameters in the coefficients.

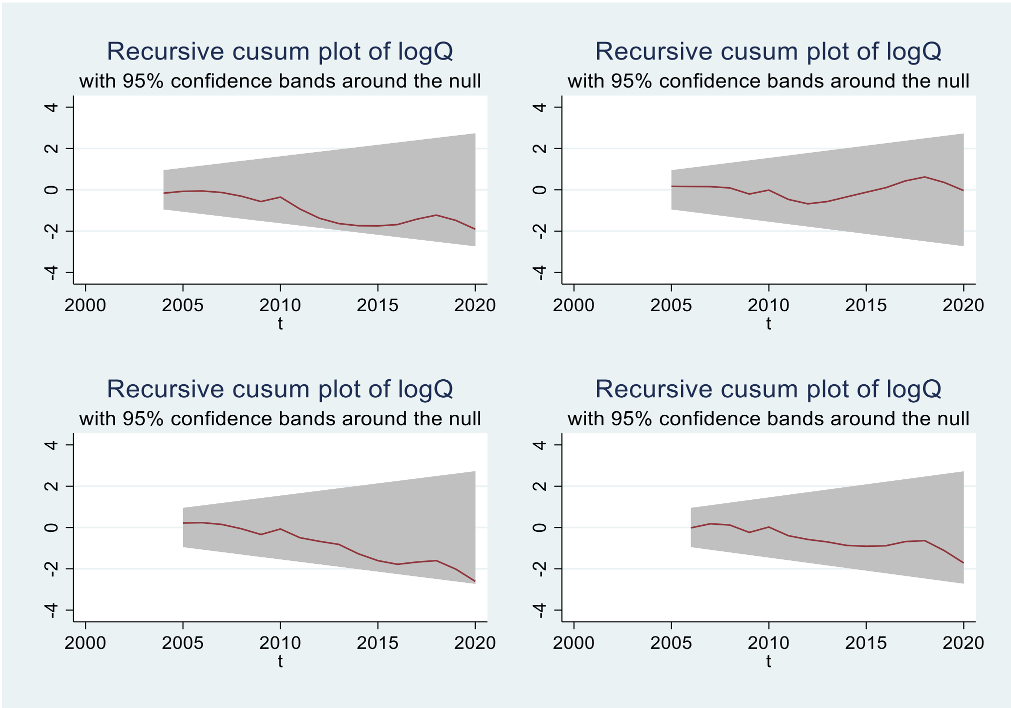

Figure 1. Results of the cumulative sum test of parameter stability.

According to the results of the cumulative summation test in Figure 1, the parameters of the 4 models are stable. This is because the cumulative sum line does not exceed or decrease the 95% range of parameter stability.

In the next step, we select the best model from the regression equations given in Table 3 for interpretation.

For this we use Akaike and Bayes Information Criterions. According to these information criteria, Model 4 is the best model for interpretation. This is because the values of the information criteria in these equations are the smallest.

$$lnY_t = 9.489 + 0.382lnY_{t-1} + 0.405lnI_t - 0.856lnL_t + 0.134lnF_t \quad (2)$$

In this case, the variables given in Equation 2 are expressed as follows:

Table 4.

Variables	**Abbreviations**
Production of agricultural and fishery products in natural logarithmic form	lnY_t
Investments in fixed assets in agriculture, forestry and fisheries in natural logarithmic form	lnI_t
Number of people engaged in agriculture, forestry and fisheries in natural logarithmic form	lnL_t

Number of multi-disciplinary farms in natural logarithmic form	lnF_t

Discussion

The coefficients of the regression equation in Equation 2 can be interpreted as follows. In the absence of other variables, the increase in agricultural production by 1% in the past period will increase the volume of agricultural production in the current period by 0.38%. A 1% increase in investment will increase agricultural production by 0.405%, a ratio that is statistically significant at 1%. A 1% increase in the number of multi-sectoral sectors will increase agricultural production by 0.134%, which is statistically significant at 10%. An increase in the employed population in agriculture by 1% will reduce the volume of agricultural production by 0.856%. This result may not be consistent with the overall economic reality. This is because an increase in the number of workers should increase production. We can explain the result obtained here with two different arguments. First, this result is not statistically significant even at the 10% significance level. Second, as a result of automation in agriculture, the importance of the labor force is declining. In our research results, we proposed several model options, in contrast to the results of foreign scientists studied above.

Хулоса (Conclusion)

According to the results of the study, we can draw the following conclusions:

- For the further development of agriculture, forestry and fisheries, it is necessary to accelerate the analysis, modeling and implementation of empirical data with the widespread use of econometric methods;
- it is necessary to create an electronic tracking system to ensure the transparency of investments in agriculture, forestry and fisheries;
- it is possible to increase labor productivity through labor incentives;
- further development of diversification of multi-disciplinary farms is needed;

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