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The Estimation of the Elasticity of the production factors A Case Study of the Agricultural sector of Iran

[1]Farshad Sameni Keivani, [2]Ali Bidarian and [3]Majid Ashouri

[1]Department of Accounting, Roudsar and Amlash Branch, Islamic Azad University, Roudsar, Iran
[2]Department of Accounting, the University of Guilan, Rasht, Iran
[3]Department of Agriculture, Lahijan Branch, Islamic Azad University, Lahijan, Iran

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ABSTRACT

This research estimates the elasticity of the production factors of labor and capital for agricultural sector in Iran covering data 1986 to 2010. The annual time series data which is using in the survey is obtained from the website of Central Bank. The Cobb-Douglas function is applied in order to estimate agricultural sector production function which it involves OLS method using EVIEWS8 and SPSS software. The findings of the paper show in the short run during the years of the study the coefficients of the natural logarithm of the real capital and the natural logarithm of the labor in Iran are 0.601531 and 0.836710, respectively but the coefficient of labor isn't statistically significant. In fact, these coefficients show the amount of elasticity of production factors for the agricultural sector in Iran. Hence, if the capital in the agricultural sector increases one percentage then the production in this sector increases 0.601531. The results of the research will be useful for the decision makers in Iran agricultural sector.

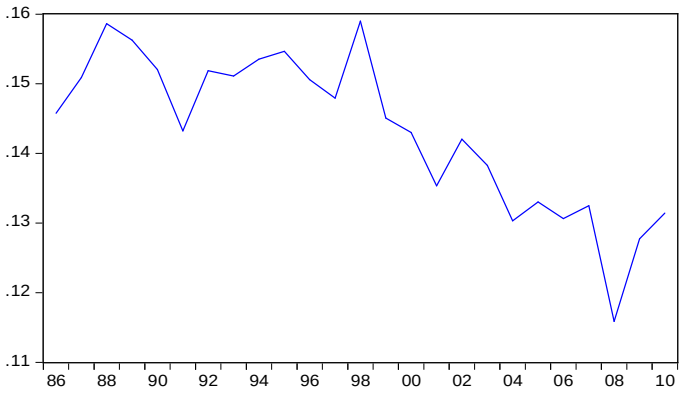
KEY WORDS: Elasticity, Cobb-Douglas Function, Value Added, Agricultural Sector, Production Function and Iran.

INTRODUCTION

According to Iran's economic structure and the relationship among the agriculture and other sectors of the Iran economy, it is so important to invest in the Iran agriculture sector. On the other side, the agricultural activities usually occur in the rural areas so investing in agriculture sector causes decreasing of unemployment rate in rural areas and to avoid emigration of the villagers to the cities [8, 29, 30 and 31].

In the following figure is shown the ratio of the agricultural value add to the gross national product in Iran at the period of this research [43].

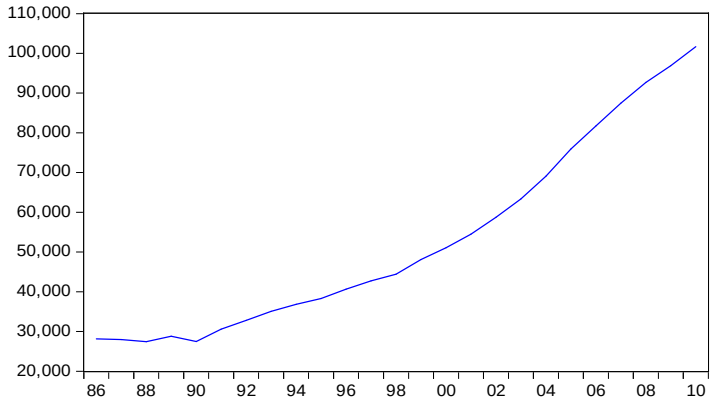
Figure.1: the Ratio of the Agriculture Value Added to the GDP



As we can see at the above figure, the ratio of the agriculture value added has decreased the period of the study in Iran. According to importance of agriculture in the economic development and the economic structure of Iran the trends is not appropriate. The capitals of the agriculture sector show at the following figure in during of study years in Iran other papers on this subject include [32- 41]

Corresponding Author: Farshad Sameni Keivani, School of Social Sciences, Universiti Sains Malaysia, 11800 USM, Pulau Penang, Malaysia, E-mail: farshadsameni@yahoo.com

Figure.2: the Capitat of the agriculture sector in Iran



As we can see at the above figure, the capitals of the agriculture sector have increased period of the study in Iran. Elasticity is one of the most important and empirical concepts. In general, the ratio of percentage changing of two variables is called elasticity. If Y = f(x), then the elasticity, e_{xy}, can be illustrated by following equation:

$$e = \frac{\%\Delta Y}{\%\Delta x} \quad \text{Or} \quad e = \frac{\Delta y}{\Delta x}\frac{x}{y}$$

In fact, the elasticity shows for example if the x variable changes one percent then the y variable will change how much percentage. For example, the elasticity between x and y, e_{xy}, is 3 when a 1 percent increase in x causes a 3 percent increase in y.

Many papers in economics to analyze firms behaviors assumes that production functions of firms are in form of the Cobb-Douglas production function which first introduced by Charles Cobb and Paul Douglas [3,5,6 and9]. It is written as follow:

$$Q = F(L,K) = AL^{\alpha 1}K^{\alpha 2}$$

Where, A, α_1 and α_2 are parameters. In this function, α_1 and α_2 show the production elasticity of labor and capital, respectively. In this form, the marginal product of labor can be estimated as the following equation [1, 2 and 4]:

$$MP_L = \propto_1 AL^{\alpha_1 - 1}K^{\alpha 2}$$

And the marginal product of capital is obtained as follow:

$$MP_L = \propto_2 AL^{\alpha_1}K^{\alpha_2 - 1}$$

Hence, the marginal rate of technical substitution between labor and capital, $MRTS_{LK}$, is:

$$MRTS_{LK} = \left(\frac{\alpha_1}{\alpha_2}\right)\left(\frac{K}{L}\right)$$

The main objective of this paper is to estimate the production function in the Iran agriculture sector. Determination of this function will help the Iran agriculture decision makers to take a good decision to reduce extra costs and increase productivity in this sector.

The main hypotheses in the study are as follow:

1. The labor elasticity in agriculture sector of Iran is statistically significant and positive during period 1986 to 2010.
2. The capital elasticity in agriculture sector of Iran is statistically significant and positive during period 1986 to 2010.

MATERIALS AND METHODS

The paper uses the descriptive and analytical methods. Achieving the aim theoretical discussions and empirical studies was conducted using library methods. The required data, the related background information on empirical studiers and literature was collected by internet and library ways. The statistical data are taken from statistical data of Central Bank of Iran. After collecting the secondary data, it is necessary to determine to be or not to be the stationary for the data. Unit root test of Augmented Dickey-Fuller (ADF) is applied for it. Then is used the Cobb-Douglas function representing the relationship between the agricultural sector value add of Iran as a dependent variable and its factors of production, labor and capital, as the independents variables other papers on this subject include [12- 28].

To representing the model is applied the Cobb Douglas function as the following:

$$Q = F(L,K) = AK_{-1}{}^{\alpha 1}L^{\alpha 2}$$

Now, the paper takes the natural logarithm from two sides of above equation, so we can easily the following liner function:

$$Ln(Q) = \ln(A) + \alpha_1 \ln(K_{-1}) + \alpha_2 \ln(L)$$

Where

A = as a constant amount

ln(Q) = the natural logarithm of the agricultural sector value added of Iran

$\ln(K_{-1})$ = the natural logarithm of the capital stock in the agricultural sector in Iran with one lag period.

ln(L) = the natural logarithm of the number of employees in the agricultural sector in Iran.

Hence, the linear regression model can be used to estimate the production function in this research. The statistical population limits to Iran economy. The studied variables in this study are annual time series data mainly from 1986 to 2010. The study applies EIEWS8 and SPSS Software. Then significant of the model and coefficients investigates using appropriate statistical analyzes.

RESULTS AND DISCUSSION

First step, it is necessary to check the time series data is stationary or not which it can be provided in some ways using EVIEWS8 or other software. One of all is Unit root test of Augmented Dickey-Fuller (ADF) which is used by this survey. Due to the results of the ADF test, at 5% confidence level, all of the data are not stationary at the level but only the natural logarithm of capital is stationary at the level and the other variables in the natural logarithm of the variables are stationary at the first difference. In other words, however the Q and L variables have unit root test at the level but have not unit root test while the natural logarithm of the variables are used in the Cobb Douglas function [7 and 10].

The ADF test results are as come at the following table:

Table1. The results of ADF test

The names of variables	ADF statistics	The Critical Value at 5%	The Stationary at	Prob.
Ln(Q)	-6.243154	-3.622033	1st difference	0.0002
$\ln(K_{-1})$	-5.449293	-3.612199	Level	0.0010
Ln(L)	-4.285861	-3.622033	1st difference	0.0131

In order to estimate the relationship between the private sector investment and the effectives variables in Iran are applied the linear regression model. The function coefficients can be found from the below table [42 and 43]:

Table2. Coefficients of Model

Dependent Variable: LNQ				
Method: Least Squares				
Sample (adjusted): 1987 2010				
Included observations: 24 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.230045	0.407272	10.38630	0.0000
LN K_{-1}	0.601531	0.037377	16.09363	0.0000
LNL	0.836710	0.834862	1.002214	0.3276
R-squared	0.926721	Mean dependent var		10.71758
Adjusted R-squared	0.919742	S.D. dependent var		0.260891
S.E. of regression	0.073910	Akaike info criterion		-2.255470
Sum squared resid	0.114716	Schwarz criterion		-2.108213
Log likelihood	30.06564	Hannan-Quinn criter.		-2.216403
F-statistic	132.7880	Durbin-Watson stat		0.692975
Prob(F-statistic)	0.000000			

And for this model we can write as follow:
Substituted Coefficients:
==========
LNQ = 4.23004493202 + 0.60153128128*LNK + 0.836709849634*LNL

The results of the study show, in the model, the coefficients of the natural logarithm of the capital stock in the agricultural sector with one lag period and the natural logarithm of the number of employees in the agricultural sector in Iran are 0.601531 and 0.836710, respectively. Due to the information of above table α_1 is significant at %5 confidence level. But the coefficient of labor, α_2, isn't statistically significant. Indeed, these coefficients show the amount of elasticity of production factors for the agricultural sector in Iran. Hence, if the capital in the agricultural sector increases one percentage then the production in this sector increases 0.601531.

The coefficients of the variables are also statistically significant due to ANOVA test (see the ANOVA table as the follow):

Table 3. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.451	2	.725	132.788	.000[b]
	Residual	.115	21	.005		
	Total	1.565	23			

a. Dependent Variable: lnQ
b. Predictors: (Constant), ln(L), ln(K)

Due to the ANOVA data in table 3, the Sig is near to zero so the correlations are significant among the the agricultural sector value added and the independent variables also the t-test statistic confirms it and also the value of R-Square is enough big which indicates the contribution of ln(L) and $\ln(K_{-1})$ on the natural logarithm of the agricultural sector value added of Iran is 0.926721%. The closeness of R2 and Adj-R2, 0.919742%, shows the Goodness of fit of data. Generally, one of hypotheses is accepted and the other is rejected means that:

1. The labor elasticity in agriculture sector of Iran is not statistically significant and positive during period 1986 to 2010.
2. The capital elasticity in agriculture sector of Iran is statistically significant and positive during period 1986 to 2010.

The elasticity of labor is not significant in this study because the ratio of labor with respect to capital is high and also the labor in the agricultural sector in Iran has not full efficiency. Many of employees in this sector are unskilled.

Conclusions

This study estimates the factors elasticity of production in agricultural sector of Iran using the Cobb Douglas function in Iran during 1986 to 2010. This survey examines the changes in the production factors how much effect on the change in the agricultural sector value added in Iran. The results of the study show that increasing capital in the agriculture sector causes to increase the agricultural sector value added. So the agriculture sector in Iran needs to support the Iran government more than the past.

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