The relationship between oil revenues and the value-added of the agricultural sector

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Abstract- The present study investigates the effects of oil revenues on the value-added of the agricultural sector and the growth of their value-added. The results of the augmented Dickey-Fuller and Phillips-Perron tests indicate that the variables of the value-added growth of the agricultural sector are stationary and the variable of the ratio of consumption expenditures to value-added of the agricultural sector is also stationary in the first-order difference. Hence, given the stationarity of some variables and the non-stationarity of others, the Autoregressive Distributed Lag model was estimated to investigate the relationship between them in each of the studied sectors. In this model, the growth rate of the value-added in this sector is considered a dependent variable, and capital growth in the sector, the ratio of government expenditures to the value-added in this sector, oil revenues, and inflation rate are considered explanatory variables. The results revealed that the growth of oil revenues has no impact on the value-added of the agricultural sector.

Keywords- Oil revenues, Agricultural sector, Foreign exchange revenue, Dutch disease.

Introduction

Iran's economy strongly depends on oil revenues from oil exports. Oil revenues have an undeniable impact on Iran's economic status. They have a double impact on Iran's economic status. We have experienced good economic growth in the years when oil revenues have grown slowly. In other words, the slow growth of oil revenues strengthens economic growth from the supply and demand side. Additionally, evidence suggests that the boom in oil revenues in some periods in Iran's economy has led to the expansion of non-tradable sectors (such as housing and services) and the contraction of tradable sectors (such as agriculture and industry) (Mehrara and Nayeri, 2009). Nowadays, the harmful impacts of oil shocks are referred to as Dutch disease in economic literature. To explain this phenomenon, goods are divided into two general categories: tradable goods whose prices are determined in international markets, and non-tradable goods, which can only be traded within the country. Thus, the price of non-tradable goods will be different in different counties countries. A sudden increase in exogenous foreign exchange revenue, such as an increase in the price of oil followed by an increase in oil revenues, results in a surplus in the balance of payments and an increase in total demand. The demand of the economy will increase rapidly assuming the absorption of this surplus in the domestic economy from monetary and financial channels. The demand for both types of tradable and non-tradable goods will increase if both of them are normal goods. After the demand increases, the price increase will depend on the reaction of the supply side. The relative price of non-tradable goods increases since the supply of non-tradable goods is inelastic in the short run and the supply of tradable goods can be increased through imports. Thus, the real exchange rate is strengthened. An increase in the relative price of non-tradable goods causes movable resources to move from other sectors of the economy toward the non-tradable sector.

In an article entitled "Estimation of direct and indirect impacts of oil price on economic growth with a focus on East and Southeast Asian countries", Abeysinghe (2001) showed that the direct impact of price increase is positive for net oil exporting countries (such as Indonesia). In a study entitled "Oil price fluctuations and its impact on the macroeconomic variables of Kuwait: using VAR models", Eltony examined the reaction of the macroeconomic variables of Kuwait to the fluctuations of global oil prices. In a study entitled "What is an oil shock?", Hamilton (2003) investigated the non-linear impacts of oil prices on GDP growth. The results revealed a non-linear relationship between oil prices and economic activities. Ponzio (2004) evaluated the impact of the prosperity of Mexico's natural resources sector on other sectors from 1970 to 2004. Nazari and Mubarak (2008) examined the association between the abundance of natural resources, Dutch disease, and economic growth in the oil countries from 1960 to 2008 using panel data. In his study from 1978 to 1989, Love Roy (1994) reported that an increase in diamond production in Botswana and its impact on other sectors of the economy is the cause of the Dutch disease. Yuri (1996) evaluated the impact of oil prices on employment in the US agricultural sector during the years 1947-1995. Using the Granger causality, he concluded that the increase in oil price causes a decrease in employment. The present study investigates the impact of oil revenues on the agricultural sector in Iran. The primary question of the study is whether there is a relationship between oil revenues and the value-added of the agricultural sector.

Methods

Independent variables

1. Government consumption expenditures: Government expenditures can be one of the factors affecting economic growth. The ratio of consumption expenditure to the value-added of each sector is considered an independent variable in each sector.
2. Oil revenues: Changes in oil foreign exchange revenues cause fluctuations in the production level of the country. Thus, the growth of oil revenues is also considered another desired variable in each of the sectors.
3. Capital: Capital is one of the factors affecting the economic situation and economic growth, and the growth of various economic sectors. For this reason, the growth rate of capital stock in each of the sectors was considered one of the variables affecting the economic growth of that sector or the growth of its value-added.
4. Inflation rate: Since inflation in Iran is a two-digit number and higher, the inflation rate has been used as an independent variable in this study. It was calculated using the consumer price index.

The dependent variable

The value-added of the agricultural sector: the agriculture group includes the set of agricultural activities, animal husbandry and hunting, forestry, fishing, and agricultural services. In the classification of Iran's national accounts system, the fundamental variables related to these activities are estimated and calculated in five sectors: agriculture, animal husbandry and hunting, fishing, forestry, and agricultural services.

Given what was stated, the model of the agricultural sector is as follows:

Agricultural sector INA=F(KA, CGA, P, OIL)

In this equation:

INA: The growth of value-added in the agricultural sector

KA: Growth of capital used in the agricultural sector

CGA: The ratio of government consumption expenditure to the value-added of the agricultural sector

OIL: Growth of oil revenues

P: Inflation rate

Unit root test

Stationarity is one of the most basic assumptions in estimating economic models with time series data. A time series variable is stationary when the mean, variance, covariance, and correlation coefficients remain constant over time. Therefore, a time series like yt is stationary when:

$$
\begin{aligned}
&1)\ E(y_t) = \mu \\
&2)\ var(y_t) = E(y_t - \mu)^2 = \sigma^2 \\
&3)\ COV(y_t, y_{t-k}) = E[(y_t - \mu)(y_{t-k} - \mu) = \gamma_k \\
&4)\ corr(y_t, y_{t-k}) = \gamma_k / \sigma^2 = \rho_k
\end{aligned} \tag{1}
$$

If one of the above criteria is not met for a time series, the above series will be considered non-stationary. There are several tests to distinguish stationary time series from non-stationary time series. The most significant of these tests are the Dickey-Fuller unit root test, the augmented Dickey-Fuller test, and the Phillips-Perron test.

Autoregressive distributed lag (ARDL) model and error correction model

The general form of the autoregressive distributed lag (ARDL) model is specified as follows:

$$
\begin{aligned}
&\boldsymbol{Q(L, s)Y_t = \sum_{i=1}^{K} b_i(l, n_t)X_{it} + \delta' W_t + u_t} \\
&\boldsymbol{Q(L, s) = (1 - \alpha_1 L - \alpha_2 L^2 - \cdots - \alpha_P L^p)} \\
&\boldsymbol{b_i(L, q_t) = b_{i0} + b_{i1}L + b_{i2}L^2 + \cdots + b_{iq}L^q \quad, i = 1, 2, 3 \ldots k}
\end{aligned} \tag{2}
$$

L: Lag operator

Y: dependent variable of the model

Xit: vector of explanatory variables used in the model

K: the number of explanatory variables used in the model

qi: the number of optimal lags related to each of the explanatory variables

S: the number of optimal lags related to the dependent variable of the model

Wt: vector of deterministic variables such as intercept, dummy variables, time trend, or exogenous variables with a certain lag

Microfit Software estimates the mentioned equation for all possible states for $(m+1)^{k+1}$ times. Then, one of the equations is selected by using one of the Akaike, Schwarz-Bayesian, Hannan-Queen, or adjusted coefficient of determination criteria, used primarily in samples less than 100.

In the next stage, the coefficients of the long-run model are estimated using the selected dynamic model. In this stage, long-run coefficients related to independent variables are calculated using the following equation:

$$\boldsymbol{\theta_i = \frac{\hat{b}_i(L, q_i)}{1 - \hat{\alpha}(1, p)} = \frac{\hat{b}_{i0} + \hat{b}_{i1} + \cdots + \hat{b}_{iq}}{1 - \hat{\alpha}_1 - \hat{\alpha}_2 - \cdots - \hat{\alpha}_p}} \quad (3)$$

To determine that the above long-run relationship is not false or there is a long-run relationship between the variables, the following hypothesis is tested:

there is no long − run relationsip between the model variables

$$\boldsymbol{H_0: \sum_{i=1}^{p} \alpha_i - 1 \geq 0} \quad (4)$$

there is a long − run relationsip between the model variables

$$\boldsymbol{H_1: \sum_{i=1}^{p} \alpha_i - 1 < 0}$$

The null hypothesis indicates the absence of co-integration or long-run relationship. Since the condition for the short-run dynamic relationship to tend towards the long-run equilibrium is that the sum of the lag coefficients of the dependent variable is less than one, the corresponding statistic is calculated as follows to test the hypothesis:

$$\boldsymbol{t = \frac{\sum_{i=1}^{p} \alpha_i - 1}{\sum_{i=1}^{p} S_{\alpha_i}}} \quad (5)$$

If the absolute value of the statistic obtained is greater than the absolute value of the critical values presented by Banerjee, Dolado & Master, the null hypothesis is rejected and the existence of a long-run relationship is confirmed.

Results

Augmented Dickey-Fuller and Phillips-Perron tests are used to examine the significance of the considered variables. Table 1 presents the results of the above tests.

Table 1: The results of testing the stationarity of variables (numbers in parentheses represent P-value)

Variable	Function form	ADF	PP
INA	With intercept and without trend	-7.16(0.00)	-7.87(0.000)
	With intercept and with a trend	-7.07(0.000)	-8.46(0.000)
KA	With intercept and without trend	-2.86(0.060)	-3.44(0.016)
	With intercept and with a trend	-3.69(0.03)	-3.72(0.035)

Table 2: The results of testing the stationarity of the variables (numbers in parentheses represent P-value)

Variable	Function form	ADF	PP
CGA	With intercept and without trend	-1.5	-1.34
	With intercept and with a trend	-0.62	-0.76
DCGA	With intercept and without trend	-4.8	-4.8
	With intercept and with a trend	-5.58	-5.95
OIL	With intercept and without trend	-5.01(0.000)	-5.06
	With intercept and with a trend	-4.99(0.001)	-5.05
P	With intercept and without trend	-3.53(0.013)	-3.42(0.0175)
	With intercept and with trend	-3.45(0.06)	-3.32(0.08)

Based on the results of the stationarity test, the variables can be classified in terms of being stationary and non-stationary as shown in Table (2). The results of the stationarity test, which was conducted using the two methods of augmented Dickey-Fuller and Phillips Perron tests, indicate that the variables of value-added growth in the agriculture and industry and agriculture sectors, the growth of oil revenues, and the inflation rate are stationary and the first-order difference of the ratio of consumption expenditures to value-added of the agricultural sector is stationary.

Table 3: Stationarity level of the variables

Variable	Result	Variable	Result
INA	I(0)	KS	I(0)
KA	I(0)	CGA	I(1)
CGS	I(1)	-	-

Estimation of the agricultural sector model

The estimation of the considered model for the agricultural sector is as follows.

Table 4: The results of the estimation of the dynamic model of the agricultural sector

P - value	T-test statistic	SD	Estimated coefficient	
0.017	-2.60	0.16	-0.427	INA(-1)
0.823	-0.22	0.014	-0.003	OIL
0.749	0.32	0.013	0.004	OIL(-1)
0.056	2.03	0.015	0.031	OIL(-2)
0.003	3.33	0.014	0.049	OIL(-3)
0.495	-0.69	0.095	-0.06	P
0.022	-2.03	0.10	-0.25	P(-1)
0.311	1.04	0.013	0.013	CGA
0.110	-1.67	0.16	-0.27	KA
0.005	3.13	0.03	0.96	C
	F=2.62	DW=2.17	$\boldsymbol{R^2}$ =0.55	

Table 4 presents the results of the estimation of the above function using the autoregressive distributed lag (ARDL) model. It shows the number of suitable lags of the ARDL model in terms of classical conditions for each of the model variables based on the Schwarz-Bayesian rule.

Based on the obtained results, the growth rate of oil revenues is non-significant. Therefore, the growth of oil revenues does not significantly affect the growth of the value-added of the agricultural sector in a dynamic state based on the above results.

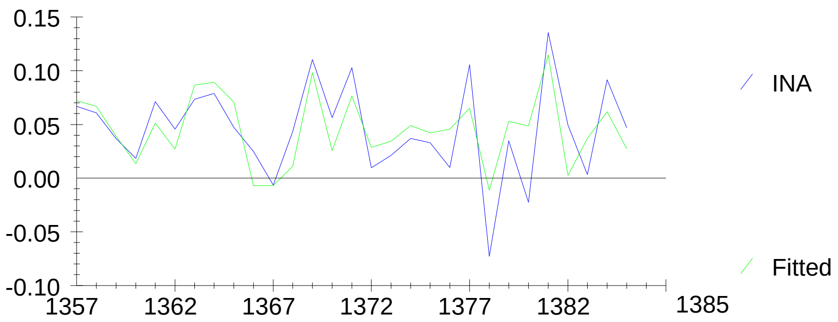

Figure 1: Diagram of fitting real and estimated values

To examine the structural stability of the equation, the CUSUMST test was used.

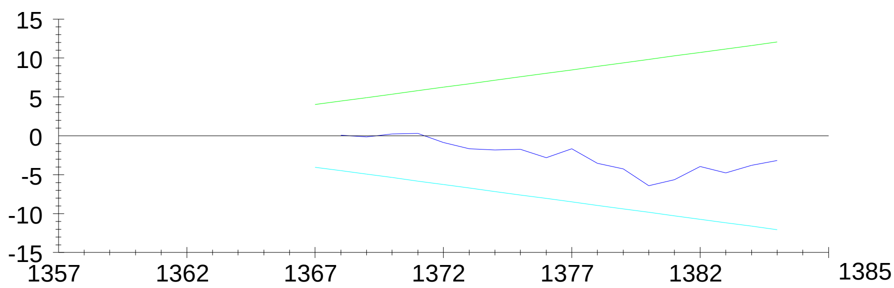

Figure 2- CUSMUS test

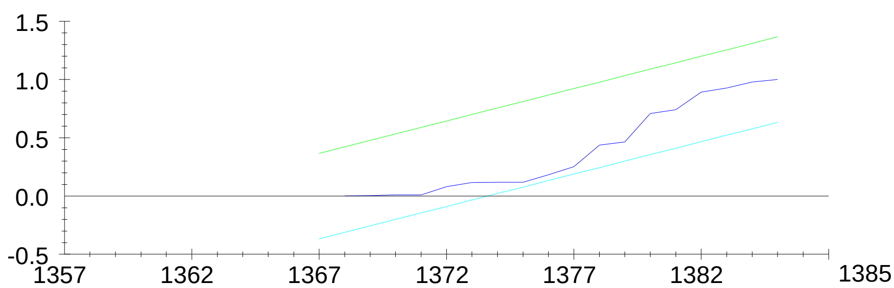

Figure 3- CUSMUS test

After estimating the ARDL equation, it is necessary to ensure the existence of collinearity between the variables. If the sum of the coefficients of the variables with a lag related to the dependent variable is smaller than one, the dynamic model will tend toward the long-run equilibrium model. The statistic of the above test is calculated according to the results of the model as follows:

$$t = \frac{\sum_{i=1}^{p} \alpha_i - 1}{\sum_{i=1}^{p} S_{\alpha_i}} = \frac{-0.427 - 1}{0.16} = -8.91$$

The absolute value of the obtained statistic, which is -8.91, is greater than the absolute value of the critical values provided by Banerjee, Dolado, and Master, which is 43.4 at the 95% confidence level. Thus, the existence of a long-run relationship is confirmed. Since the Y (-1) coefficient is smaller than 1, it confirms that the short-run model converges toward the long-run model.

Table 5: The results of estimating the long-run model of the agricultural sector

P – value	t-test statistic	SD	Estimated coefficient	
0.016	2.63	0.021	0.057	OIL
0.005	-3.17	0.07	-0.22	P
0.315	1.03	0.009	0.009	CGA
0.116	-1.64	0.11	-0.191	KA
0.004	3.311	0.020	0.067	C

As shown, in the long run, the growth rate of oil revenues is positive and significant. Therefore, in the long run, the increase in oil revenues increased the growth of the value-added of the agricultural sector and had a positive and significant impact on it. The most significant estimated coefficient in the error correction model is the coefficient and statistic of the error correction model ecm (-1) since the equilibrium relationship between the variables is explained based on it. The significance of this coefficient indicates that the long-run model is correct and all the equilibrium relationships explained by the explanatory variables were toward the dependent variable since the long-run relationships per se do not indicate the causal relationship and only confirm the existence of equilibrium relationships between the variables. However, the significance of the ecm (-1) shows that the assumed statement was correct in the long run. The above coefficient is -1.42, and since its absolute value is between one and two, the movement towards long-run equilibrium will be fluctuating in case of a lack of short-run equilibrium.

Table 6: The results of the estimation of the error correction model of the agricultural sector

P – value	T-test statistic	SD	Estimated coefficient	
0.82	-0.22	0.014	-0.003	DOIL
0.001	-3.75	0.021	-0.08	DOIL(-1)
0.003	-3.33	0.014	-0.04	DOIL(-2)
0.490	-0.69	0.095	-0.06	Dp
0.310	1.04	0.013	0.013	DCGA
0.109	-1.67	0.16	-0.27	DKA
0.005	3.13	0.03	0.09	DC
0.000	-8.70	0.16	-1.42	Ecm(-1)
	DW =2.17	**F** =13.55	$\overline{R^2}$ =0.75	R^2 =0.83

Conclusion

The results revealed the impact of oil revenues and their significant role in the growth of the value-added of most economic sectors of the country. However, the degree of vulnerability of these sectors is different. The agricultural sector has been least affected by the changes in oil revenues, so the developments in the oil sector do not have a significant long-run impact on the agricultural sector. The agricultural sector does not have the necessary efficiency and investment level and has not used all the capacities and modern imported technologies. In other words, the agricultural sector produces a level of product with minimal technical capability that is less related to the technology and imported capital goods. It is necessary to manage oil revenues, especially considering the unpredictable and extreme fluctuations in oil prices. The unpredictable fluctuations of oil revenues and the depletion of oil resources have prompted the oil exporting countries to find a solution to this problem. Among the oil-rich countries, Kuwait is the first country that has taken practical steps in this regard. It created a fund in the 1960s to store surplus oil revenues. Given the impact of agricultural activities on the regional balance and preventing immigration and creating employment, the existing supports may prevent the deterioration of the agricultural sector. However, the development of this sector in a way that helps the general economic growth process requires investment in the necessary infrastructures of this sector and the development of activities related to agricultural products.

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