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The Effect of Renewable and Non-Renewable Energy Consumption on the Value Added of the Agricultural Sector

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ABSTRACT

This paper examines the effects of renewable and non-renewable energy consumption, human capital and physical capital on the value added of the agricultural sector for the nine elected members of the ECO countries during the period 1994 to 2011. The empirical results from employing panel cointegration technique with the dynamic ordinary least squares (DOLS) method show that renewable and non-renewable energy consumption have positive impact on the value added of the agricultural sector.

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INTRODUCTION

It is generally believe that energy plays a crucial role in the process of economic activity. Energy as a complement to other production inputs; capital and labor is effective in enlarging production capacities and providing appropriate situations for better social life [5]. Developing and developed countries depends on the structure of economic activity are highly depended to various form of energy. In view of the sustainable development strategy, separating of renewable and non-renewable energy consumption can be suitable consequences for optimum using of scare resources and protection of environment.

Energy as one of production inputs enters production function of agriculture sector. Dependency of the agricultural sector is largely related to the degree of development and the use of agricultural machinery and equipment. Employing agricultural machinery, equipment and modern irrigation tools consistent with improving of agricultural sector, increases use of energy in this area of economic activity [2].

Energy requirements in agriculture are divided into two groups: direct and indirect. Direct energy is required to perform various tasks related to crop production processes such as land preparation, irrigation, intercultural operation, threshing, harvesting and transportation of agricultural inputs and farm production [3,4]. Indirect energy consists of the energy used in the manufacture, packaging and transport of fertilizers, pesticides and farm machinery

Regarding the fact that the impact of the renewable energy consumption on the value-added of the agricultural sector has received less attention in the conducted research in ECO countries, this study seeks to investigate influences of the value-added of the agricultural sector in the selected ECO countries of renewable and non-renewable energy consumption.

The remainder of this study is organized as follows. Section 2 outlines the literature review of research. Section 3 presents methodology of research and the data used in our study. Empirical results are presented in section 4. Finally, Section 5 reviews the conclusions and presents policy recommendations.

Literature review:

Investigating the influence of agriculture sector from energy consumption has less been the subject of empirical studies. Hatirli *et al* [2] investigate the effect of energy on output levels in Turkish agriculture during

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the period 1975–2000. Their results show that non-renewable, direct and indirect energy forms have a positive impact on output level.

Kiyani and ranjbari (2001) study the long-run relationship among the Iran's energy, labour and capital factors of agriculture sector using the cointegration and Auto-Regressive Distributed Lag (ARDL) models for estimating the Cobb-Douglas form of production function during the years 1967-1999. Results showed that in the agriculture sector, there is a long-run relationship among the production and energy, labour and capital factors. Also, the energy factor's coefficient is positive and meaningful -like the other coefficients- with the considerable effect on the agriculture sector's production.

There is little body of literatures on analyzing the role of energy consumption in the production process of agriculture sector. This lack is the most motivation of this research.

Methodology and Data:

The Panel cointegration technique with the dynamic ordinary least squares (DOLS) method has been employed to investigate the effects of energy consumption (renewable and non-renewable energy), human capital and physical capital on the value added of the agriculture sector for the nine elected members of the ECO countries during the period 1994 to 2011. Based on theoretical background the econometric model has been modified as follow:

$$LnAGR_{it} = \alpha_0 + \alpha_1 LnRE_{it} + \alpha_2 LnNRE_{it} + \alpha_3 LnK_{it} + \alpha_4 LnH_{it} + \varepsilon_{it} \quad (1)$$

AGR indicates the value added of the industrial sector. RE represents renewable energy consumption which is a combination of energy, hydropower and nuclear, geothermal and solar which is combination of energy, fossil fuels, including coal, petroleum and natural gas. NRE reflects non-renewable energy consumption. K denotes fixed gross capital formation as physical capital. H represents highly educated and skilled labour as human capital. Ln represents the natural logarithm. Finally, ε is a random error term representing. Data on all variables have been extracted from the World Bank Indicator.

Empirical Results:

Unit root and co-integration tests have been employed in order to verify stationary property and long-term relationship between the variables of modified model. Furthermore, identification tests have been applied to determine the method of estimation.

Panel unit root:

Table 1 reports empirical result from the Im, Pesaran and Shin (IPS) panel unit root test. Renewable and non-renewable energy consumption variables are stationary at the level (I(0)), where variables of fixed gross capital formation, highly educated and skilled labor and value added of the agriculture sector gets stationary with the first difference (I(1)).

Table 1: Panel Unit Root Test.

Im, Pesaran and Shin test				Variable
At first differences		At level		
Prob.	Statistics	Prob.	Statistics	
0/0000	-4/2572	1/0000	7/0475	LnAGR
-	-	0/0758	-1/4337	LnRE
-	-	0/0253	-1/9547	LnNRE
0/0504	-1/6409	1/0000	4/2588	LnH
0/0000	-4/6750	0/9958	2/6342	LnK

Source: Research results

Cointegration analysis:

Regarding to the I(1) property of some variables, cointegration or long-run equilibrium relationship between variables should be investigated. To this end, the Kao cointegratio test results have been shown in the table 2. From the table 2 it can be concluded that there is cointegration or long-run equilibrium relationship between variables.

Table 2: Panel kao cointegration test.

Kao Cointegration				
			t-Statistic	prob
ADF			-3.2324	0.0006

Source: Research results

Estimation of Model:

The fixed effect test has been employed to determine the type of model (panel or pooling method). The empirical results of the fixed effect test in table 3 suggest that the panel method must be used in the estimation process.

Table 3: Results of the fixed effects test.

Test Summary	t Statistic	d.f.	Prob.
Section F- Cross	36/9643	(8, 143)	0/0000
Cross-Section Chi-square	159/9627	8	0/0000

Source: Research results

The Hausman test is employed in order to specify the type of estimation in terms of the fixed or random effects. Empirical results from Hausman test in table 4, implying use of the fixed effects method in estimation of the modified model.

Table 4: Results of Hausman test.

Test Summary	t Statistic	d.f.	Prob.
Cross-section random	13/2804	4	0/0000

Source: Research results

The empirical results from estimating model have been reported in table 5. Based on the research findings, the effects of renewable and non-renewable energy consumption on the value added of the agriculture sector are positive and are significant in %1. It seems that energy consumption plays a crucial role in the process of creating value added at the ECO selected countries. Furthermore highly educated and skilled labour and fixed gross capital formation variables have positive impact on the value added of the agriculture sector.

Table 5: The estimation results of model.

Variables	Coefficient	t-Statistic	Std. Error	Prob.
C	17/3798*	11/3662	1/5331	0/0000
LnH	0/5861*	4/8399	0/1211	0/0000
LnK	0/2547*	10/2785	0/0247	0/0000
LnRE	0/0337*	5/0247	0/0067	0/0000
LnNRE	0/1350*	3/4178	0/0395	0/0008
R-squared	0/9205			
Adjusted R-squared	0/8840			
Durbin-Watson stat	1/6278			
n	162			
* indicates statistical significance at the 1% level.				

Source: Research results

Concluding Remarks:

Employing Panel dynamic technique this paper examines the impact of renewable and non-renewable energy consumption on the value added of the agriculture sector in the selected ECO countries. Empirical findings show that renewable and non-renewable energy consumption have positive impact on the value added of agriculture sector of ECO countries.

In view of the positive relationship between the renewable energy consumption and the value added of the agriculture sector, attention to role of energy consumption in the process of agriculture production is important in designing effective development policies of agriculture sector.

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