



Uluslararası Sosyal Araştırmalar Dergisi

The Journal of International Social Research

Cilt: 9 Sayı: 42 Volume: 9 Issue: 42

Şubat 2016 February 2016

www.sosyalarastirmalar.com Issn: 1307-9581

RELATIONSHIP BETWEEN ENERGY CONSUMPTION, ECONOMIC GROWTH AND TRADE OPENNESS IN TURKEY

Ercan ŞAHBUDAK*

Dilek ŞAHİN**

Abstract

Energy plays a crucial role in the economic growth and development of a country. This study investigates both the short and long term dynamic relationship between energy consumption, trade openness and economic growth in Turkey through econometric model during the period 1980-2013. The long term results show that trade openness has positive and insignificant relationship with energy consume. The results show that increase of 1 percent trade openness energy consume increase by 0.13 percent in Turkey. Real GDP has positive and significant relationship with energy consume. This results show that increase of 1 percent real GDP energy consume increase by 0.50 percent in Turkey. The short term results show that trade openness has positive and significant relationship with energy consumption. The results show that increase in the trade openness by 1 percent leads to 0.22 percent increase in energy consumption. Real GDP has positive and significant relationship with energy consumption. The results show that increase in the real GDP by 1 percent leads to 0.88 percent increase in energy consumption. Estimated lagged error correction term (ECM-1) is negative and statistically significant.

Keywords: Energy Consumption, Economic Growth, Trade Openness, Turkey, ARDL Bounds Testing.

I. INTRODUCTION

Energy is one of essential factors for any country's economic growth and development. Energy demand, supply and pricing impact on the soci-economic development and living standart. Also, higher level of economic development increases more energy consumption.

Trade openness is an essential component of economic growth and increase in international trade increases the economic activities and the energy demand. The economic condition of the country and the extent of relationship between economic growth and trade openness determine the impact of trade openness on energy consumption. Energy affects trade openness via various channels. Firstly, energy is an important input of production because machinery and equipment in the process of production require energy. Secondly, exporting or importing manufactured goods or raw materials requires energy to fuel transportation. Without adequate energy supply, trade openness will be adversely affected. Consequently energy is an important input in trade expansion and adequate consumption of energy is essential for expanding trade via expanding exports and imports. The relationship between trade openness and energy consumption is important. If energy plays its key role to increase the flow of exports or imports then any policies aiming at reduction in energy consumption such as energy conservation policies will negatively impact the flow of exports or imports and hence reduce the benefit of trade openness (Nasreen and Anwar, 2014: 82).

Energy consumption in Turkey has been growing rapidly. The higher demand for energy consumption in Turkey has grown rapidly technical, social and economic development. The aim of this study is to determine the relationship energy consume, trade openness and real GDP for Turkey using time series data in the long run and short run using empirical approach. This study is organized as follows. The second section focuses on literature review, the third section deal with methodology and discussed the empirical findings and the final section concludes.

II. LITERATURE REVIEW

The topic of relationship between energy consumption and economic growth has been well-studied in the energy economics literature for both developing and developed countries. It is possible to summarize as follows some of studies:

Kaplan et. al., (2011), examined the causal relationship between energy consumption and economic growth for Turkey during 1971-2006. The results indicated that energy consumption and economic growth was cointegrated and there was bidirectional causality running from energy consumption to economic growth and vice versa.

* Yrd.Doç.Dr., Cumhuriyet Üniversitesi, Edebiyat Fakültesi, Sosyoloji Bölümü, Sivas.

**Yrd.Doç.Dr., Cumhuriyet Üniversitesi, Turizm İşletmeciliği ve Otelcilik YO, Sivas.

Sadorsky (2011), used panel cointegration methods to examine the impact of trade on energy consumption in 8 Middle Eastern countries covering the period 1980 to 2007. Short run dynamic showed Granger causality from exports to energy consumption and a bidirectional feedback relationship between import and energy consumption. Long run elasticities estimated from FMOLS showed that 1% increase in per capita exports increase per capita energy consumption by 0.11% while a one percent increase in per capita imports increase per capita energy consumption by 0.04 %.

Zhixin and Xin (2011), analyzed gross domestic products, energy consumption, fixed asset investment and employees for Shandong Province from 1980 to 2008. It was used unit root, cointegration and Granger causality test. The results showed that energy consumption and economic growth have long-term trend relation and there was two-way causality between them.

Chaudhry et al., (2012), investigated the relationship between energy consumption and economic growth for the period of 1972-2012. The empirical results showed that the consumption of electricity was significantly stimulating economic growth among other sources of energy.

Kwakwa (2012), examined the causality between disaggregated energy consumption and overall growth, agricultural and manufacturing growth in Ghana's economy from 1971 to 2007. Johansen test showed the presence of cointegration between the variables. The granger causality test indicated a unidirectional causality from overall growth to electricity consumption both in the short and long run and a feedback relationship between manufacturing and electricity consumption.

Saatçi and Dumrul (2013), investigated empirically the role of energy consumption in economic growth for Turkish economy from 1960 to 2008. Consequently this study showed that Turkey's energy consumption and economic growth had a positive relationship varying quantity with structural breaks.

Belke et al., (2014), examined the long-run relationship between energy consumption and real GDP for 25 OECD countries from 1981 to 2007. Consequently, it was found the long run relationship between energy consumption and real GDP. Causality tests indicated the presence of a bidirectional causal relationship between energy consumption and economic growth.

Bozkurt and Akan (2014), examined economic growth, CO₂ emissions and energy consumption relationship in Turkey by using cointegration test. For this purpose 1960-2010 periods taken. This study indicated that CO₂ emissions effect negatively economic growth while energy consumption effect positively.

Farhani et al., (2014), investigated the relationship between Carbone dioxide (CO₂) emissions, output (GDP), energy consumption, and trade using the bounds testing approach to cointegration and the ARDL methodology for Tunisia over the period 1971-2008. The empirical results revealed the existence of two causal long-run relationships between the variables. In the short-run there were three unidirectional Granger causality relationships which run from GDP, squared GDP and energy consumption to CO₂ emissions.

Pao et al., (2014), investigated the relationship between energy consumption and economic growth in Brazil from 1980 to 2008. The cointegration test indicated a long run equilibrium relationship between variables. The causality results from the error correction model showed that a unidirectional short-run causality from energy consumption to economic growth.

Safaynikou and Shahmehri (2014), investigated relationship between financial market development, economic growth and trade openness with energy consumption in Iran economy using Auoto Regressive Distributed Lag (ARDL) Model during 1967-2010. Results of this study indicated there was significant relationship through estimation of short term and long term models. There was two-way causality relationship between energy consumption and trade openness and there was one-way causality relationship between economic growth and energy consumption and financial development and energy consumption toward energy consumption.

Najarzadeh et al., (2015), used panel data techniques to examine the impact of international trade on energy consumption in a sample of ten OPEC countries during 1985 to 2009. The results showed that a statistically significant relationship between energy consumption and trade.

Razali et al., (2015), investigated both the short and long term relationship between energy consumption, trade openness, urbanization and economic growth in Malaysia. The study focused on the period 1971-2013. Cointegration test showed that long run relationship between the variables. The empirical results confirmed long run and short run dynamic relationship between energy consumption and economic growth in Malaysia.

Siddique and Majeed (2015), investigated the impact of energy consumption, trade and financial development on growth in five South Asian countries over 1980-2010. The panel cointegration approach and granger causality analysis was employed. Consequently panel cointegration test expressed a long run

relationship between growth, energy, trade and financial development. Also finding of study showed that financial development, energy and trade positively affect economic growth. In long run bidirectional relationship existed among growth and energy unidirectional causality runned from trade and financial development to growth.

III. MODEL AND METHODOLOGY

The main title is divided into three sections. In the first part, model used in this study has been introduced. In the second part, econometric methods used in this study has been mentioned. The third part, describes some of the empirical results.

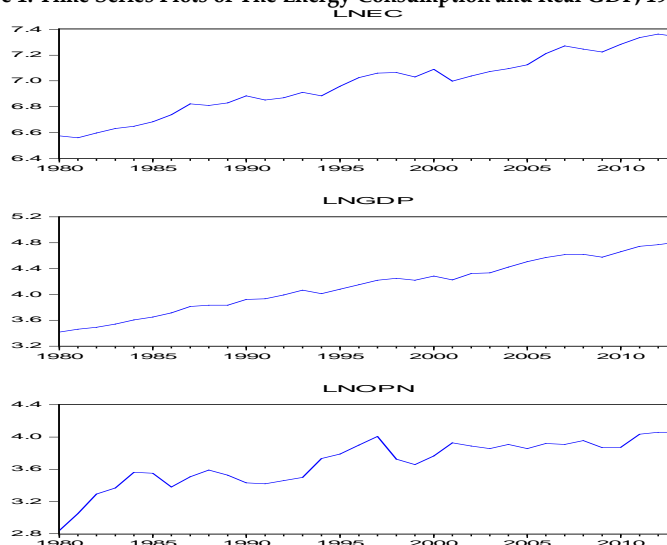
A. Model

In this study, our model is as follows:

$$LEC_t = \beta_0 + \beta_1 LGDP_t + \beta_2 LOPN_t + u_t \quad (1)$$

Where LEC, LGDP and LOPN represent natural logarithms of energy consumption, real GDP and trade openness. u_t is represent the error term. The data used in this study are annual time series data from 1980 to 2013. Data series have been obtained from the World Bank's world development indicators (WDI).

Figure 1. Time Series Plots of The Energy Consumption and Real GDP, 1980-2013.



B. Econometric Methodology

In this paper, we use the recently developed ARDL-bounds testing approach - based on Perasan and Shin (1999) and Perasan et al. (2001) to examine variables. ARDL bounds testing approach has several advantage: (i) the short run and long run parameters of the model are estimated simultaneously. (ii) Some of the cointegration techniques are sensitibe to the sample size, but in the small samples, ARDL approach can be appropriate. (iii) The ARDL approach can be suitable irrespective of the order of integration whether the variables under consideration are purely I(1), purely I(0) or fractionally integrated.

The ARDL bounds test involves two steps. In the first step, the Schwartz-Bayesian Criterion (SBC) is used to determine the order of lags of the differenced variables. As the optimal lag has been determined, the next step is to apply the bounds F-test in order to establish a co-integration relationship between variables. If the computed F-statistic exceeds the upper critical bounds value then the null hypothesis of no cointegration (H_0) is rejected, that implies to cointegration. If the F-statistic is below the lower critical bounds value, the alternative hypothesis of cointegration (H_1) is rejected that implies no cointegration. Lastly if the computed F- statistic falls between the critical lower and upper bounds values, then no conclusion can be reached about cointegration status.

The ARDL model used in this study can be expressed as follows:

$$\Delta \ln EC_t = \alpha_0 + \sum_{i=1}^m \alpha_{1i} \Delta LEC_{t-i} + \sum_{i=0}^m \alpha_{2i} \Delta LOPN_{t-i} + \sum_{i=0}^m \alpha_{3i} \Delta LRGDP_{t-i} + \sum_{i=0}^m \alpha_{4i} LEC_{t-i} + \alpha_{5i} LOPN_{t-i} + \alpha_{6i} LRGDP_{t-i} + \varepsilon_t \quad (2)$$

$$LEC_t = \alpha_0 + \sum_{i=1}^m \alpha_{1i} LEC_{t-i} + \sum_{i=0}^m \alpha_{2i} LOPN_{t-i} + \sum_{i=0}^m \alpha_{3i} LRGDP_{t-i} + \varepsilon_t \quad (3)$$

$$\Delta LEC_t = \alpha_0 + \sum_{i=1}^m \alpha_{1i} \Delta LEC_{t-i} + \sum_{i=0}^m \alpha_{2i} \Delta LOPN_{t-i} + \sum_{i=0}^m \alpha_{3i} \Delta LRGDP_{t-i} + \beta ECT_{t-1} + \varepsilon_t \quad (4)$$

In the model Δ shows the difference in the first degree. ECT is the error correction term in this model. The coefficient of this term if between 0 and -1, it is uniformly rapprochement comes to long-term equilibrium value.

C. Empirical Findings

In this study, we have used test of unit root to determine the order of integration between variables. Actually, there are several unit root test available to solve the problem of stationarity however we have used Augmented Dickey Fuller(ADF) test at level and at first difference. We have presented the empirical results of the study. The result show that trade openness is stationary at I(0) whereas energy consume and real GDP are not stationary I(0). This implies that all variables are non stationary at levels but stationary at the first differences.

Table 1. Results of ADF Test

Name of Variable	Level		1 st Difference	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
EC	-0.726 (-2.954)	-2.936 (-3.552)	-6.331* (-2.957)	-6.245* (-3.557)
OPN	-3.005* (-2.954)	-4.341* (-3.557)	-4.879* (-2.957)	-4.865* (-3.557)
RGDP	-0.657 (-2.954)	-3.336 (-3.552)	-7.229* (-2.957)	-7.146* (-3.557)

Note: * denote 5% level of significance.

Based on the results reported in table 2, we may conclude that there is a cointegration relationship between energy consumption, trade openness and economic growth. This finding is confirmed by the calculated F-statistic which is found to be higher than the upper bound critical value reported in Pesaran et al.(2001) at the 5 % level. Consequently we may conclude that there is a long run relationship variables.

Table 2. ARDL Bounds Test for Cointegration

Variables	F-Statistics	Cointegration
f(EC/RGDP,OPN)	5.487*	Cointegration
Critical Value	Lower Bound	Upper Bound
5 %	3.79	4.85
10 %	3.17	4.14

Note: *denote 5 % level of significance.

In this section we present the estimated long run coefficient using the ARDL approach. Table 3 shows long run coefficient results all variables are in logarithmic transformation so this table results also give long run elasticities. The results show that trade openness has positive and insignificant relationship with energy consume. The results show that increase of 1 percent trade openness energy consume increase by 0.13 percent in Turkey. Real GDP has positive and significant relationship with energy consume. This results show that increase of 1 percent real GDP energy consume increase by 0.50 percent in Turkey.

Table 3. Long Run Coefficient

Dependent Variable=EC			
Variables	Coefficient	Standart Error	Ratio (Prob)
Constant	4.311685	0.273562	15.761267(0.0000)
RGDP	0.505086	0.032767	15.414601(0.0001)*
OPN	0.130089	0.083906	1.550402(0.1817)

Note: *denote 5 % level of significance.

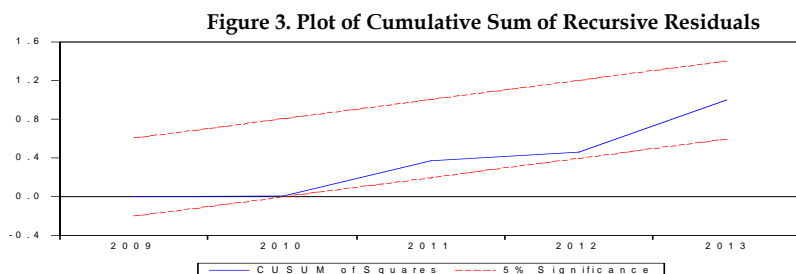
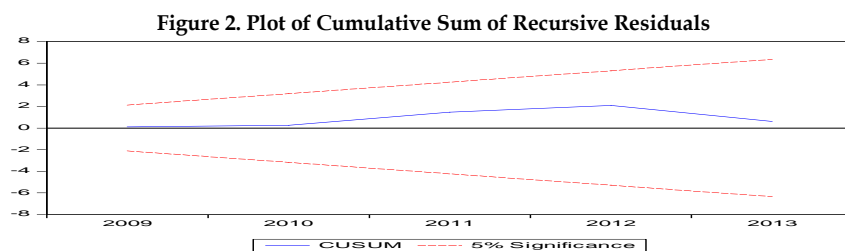
The short run results are presented in table 4. The results show that trade openness has positive and significant relationship with energy consumption. The results show that increase in the trade openness by 1 percent leads to 0.22 percent increase in energy consumption. Real GDP has positive and significant relationship with energy consumption. The results show that increase in the real GDP by 1 percent leads to 0.88 percent increase in energy consumption. Table 4 shows that the estimated lagged error correction term (ECM-1) is negative and statistically significant. A coefficient of -0.583434 shows that there will be about 58.34 percent speed of adjustment toward long run equilibrium when there is any imbalance in the short run.

Table 4. Short Run Coefficient

Dependent Variable=EC			
Variables	Coefficient	Standart Error	Ratio (Prob)
dRGDP	0.888431	0.153200	5.799174(0.0021)*
dOPEN	0.226972	0.084099	2.698861(0.0428)*
ECM _{t-1}	-0.583434	0.722855	2.190528(0.0080)

Note: *denote 5 % level of significance.

The stability of the estimated models is checked by using cumulative sum (CUSUM) and cumulative sum of squares (CUSUMQ) stability test. This test employs recursive residuals. As the figure 2 and figure 3 have shown that all coefficients in the estimated models are stable. Because of the plots of CUSUM and CUSUMQ statistics are within the 5% critical bounds.



CONCLUSION

Energy as a important input in the manufacturing sector, has a special role in growth and economic development. In this study, we estimate the relationship between energy consume, trade openness and economic growth in Turkey during 1980-2013. We employed the autoregressive distributed lag (ARDL) bounds testing approach by Pesaran et al (2001). The results show that trade openness has positive and insignificant relationship with energy consume in long term. Real GDP has positive and significant relationship with energy consume. The short run results show that trade openness has positive and significant relationship with energy consumption. Real GDP has positive and significant relationship with energy consumption. The coefficient of ECM is -0.583434 which is significant at 5 percent of significant level. The plot of the CUSUM is within the line and significant at 5 percent and the plot of the CUSUMQ is within the line and significant at 5 percent. This ensures the stability of long run and short run coefficients.

REFERENCES

- BELKE, Ansgar; DREGER, Christian and HAAN, Frauke (2014). "Energy Consumption and Economic Growth New Insights into the Cointegration Relationship". *Ruhr Economic Papers*, N.190, p.1-22.
- BOZKURT, Cuma and AKAN, Yusuf (2014). "Economic Growth, CO2 Emissions and Energy Consumption: The Turkish Case". *International Journal of Energy Economics and Policy*, N. 3, p.484-494.
- CHAUDHRY, Imran; SAFDAR, Noreen and FAROOQ, Fatima (2012). "Energy Consumption and Economic Growth: Empirical Evidence from Pakistan". *Pakistan Journal of Social Sciences (PJSS)*, N. 2, p. 371-382.
- FARHANI, Sahbi; CHAIBI, Anissa and RAULT, Christophe (2014). "A study of CO2 Emissions, Output, Energy Consumption and Trade". *IPAG Business School Working Paper Series*, N.56, p.1-21.
- KAPLAN, Muhittin; ÖZTÜRK, İlhan and KALYONCU, Hüseyin (2011). "Energy Consumption and Economic Growth in Turkey: Cointegration and Causality Analysis". *Romanian Journal of Economic Forecasting*, N. 2, p.31-41.
- KWAKWA, Paul (2012). "Disaggregated Energy Consumption and Economic Growth in Ghana". *International Journal of Energy Economics and Policy*, N.1, p. 34-40.
- NAJARZADEH, Reza; REED, Michael; KHOSHKHO, Azam and GALLAVANI, A. (2015). "Trade and Energy Consumption in the OPEC Countries". *Journal of Economic Cooperation and Development*. N.1, p. 89-102.
- NASREEN, Samia and ANWAR, Sofia (2014). "Causal Relationship Between Trade Openness, Economic Growth and Energy Consumption: A panel Data Analysis of Asian Countries". *Energy Policy* , N.69, p. 82-91.
- PAO, Hsiao; LI, Yi and FU, Hsin (2014). "Causality Relationship Between Energy Consumption and Economic Growth in Brazil". *Smart Grid and Renewable Energy*, N.5, p.198-205.
- RAZALI, Radzuan; SHAFIE, Afza; HASSAN, Abdul and KHAN, Habib (2015). "A Multivariate Study of Energy Consumption, Urbanisation, Trade Openness and Economic Growth in Malaysia". *ARPN Journal of Engineering and Applied Sciences*, N.21, p.10275-10280.
- SAATÇI, Mustafa ve DUMRUL, Yasemin (2013). "The Relationship Between Energy Consumption and Economic Growth: Evidence From A Structural Break Analysis For Turkey". *International Journal of Energy Economics and Policy*, N. 1, p.20-29.
- SADORSKY, Perry (2011). "Trade and Energy Consumption in the Middle East". *Energy Economics*, N.33, p. 739-749.
- SAFAYNIKOU, Hamid and SHADMEHRI, Mohammad (2014). "Relationship Between Energy Consumption, Economic Growth Financial Development and Trade Openness in Iran". *International Research Journal of Finance and Economics* , N. 122, p.121-132.
- SIDDIQUE, Muhammad and MAJEED, Muhammad (2015). "Energy Consumption, Economic Growth, Trade and Financial Development Nexus in South Asia". *Pakistan Journal of Commerce and Social Sciences*. N.2, p. 658-682.
- ZHIXINA, Zhang and XINB, Ren (2011). "Causal Relationships between Energy Consumption and Economic Growth". *Energy Procedia*. N. 5, p. 2065-2071.