Relationship between Energy Consumption and Economic Growth: The Case of Turkey[1]

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Abstract

"Power" phenomenon has always been important throughout the history of mankind. In the past, the territory of the countries that they have the power, as measured by the colonies or the army, these parameters gave place as well as a stable economy and have owned the most effective utilization of resources. Definitely, the most recently prominent sources are energy. In this context, energy has a strategic importance for the countries, and that is used to measure the wealth and development.

Turkey, has an important position as the Middle East's, Asian countries', the Mediterranean's and the Caspian region's rich oil and natural gas resources is transmitted to centers of demand in the West by "energy corridor". Due to its geopolitical position, Turkey must perform all policies including growth policies with energy policies harmonizingly. The world's energy consumption is expected to increase and the majority of consumption is satisfied from in this region including Turkey. In this context, Turkey is a bridge as well as a market in order to transport Central Asia's production to the world's market due to the geographical and geopolitical position of Turkey. However, despite all these advantages, Turkish economy depends on foreign markets for energy. For this reason, the energy in the case of Turkey is becoming more and more important. Therefore, combining the issue of energy and growth, a long-term plan is needed.

In the light of the foregoing, taking into consideration for the period of 1980-2011 in Turkey was aimed to analyze the relationship between energy consumption and economic growth in this study. In this analysis was benefited from the unit root test, VAR analysis, as well as the causality tests.

The empirical findings for this period in Turkish economy show that not the relationship between energy consumption and economic growth is bidirectional in Granger causality test, mutually affect each other and feedback hypothesis is not available. When the feedback hypothesis is available, policy-makers must take into consideration feedback effect of economic growth on the energy in the event of reducing energy consumption. A bidirectional causality between energy consumption and economic growth or feedback evidence represents increasing economic growth causes to raise energy consumption. According to this view, energy-saving policies aimed at the reduction in energy use must reduce the demand for energy without causing adverse effects on economic growth. It would be achieved through a suitable

combination of energy taxes and energy substitution. Policy makers should encourage the industry to adopt technologies for reducing pollution.

Keywords: Energy Consumption, Economic Growth, Turkish Economy, Granger Causality Test, Feedback Hypothesis

1. Introduction

Besides having energy resources, being able to reach them easily and uninterruptedly is of the most important energy policies of countries. In this frame, it is necessary to diversify energy resources. The countries having energy resources, together with technological transformation, attempted the effort to use the energy more effectively. In this scope, providing energy saving; realizing sustainable development, and minimizing the environmental effects of energy use constitute important titles of many discussions in recent years. The discussions in parallel with this shift from planning based on energy supply and energy generation to planning approach protecting the balance of energy economy – ecology carefully. In addition, models of energy safety considering the diversity of resource and geopolitical realities are also the most highlighted issues in recent times (Pamir, 2005:2).

The main problem on energy use is that the policies of energy saving to be applied will affect the economic performance of country in what direction and how. On this point, the relationship of causality gains importance. The relationship of causality expresses which of two variables will appear earlier over time. With moving from here, studying the relationship of causality between the use of energy and growth gains impotence in terms of energy policies to be applied. As a matter of fact, introducing the relationship between energy consumption and economic growth is an important indicator in orientating energy polices in the energy depended counties, including Turkey. Beside this, also depending on the direction of causality, the energy policies to be applied will be different.

Attracting attention to the issue energy corresponds to post - industrial revolution period. Energy is s necessary input that is obligatory to use in the production, and necessary to be able to raise the welfare levels of societies. 1970s, due to the fact that it is so cheaply available and it abounds, it could be used in country economies in large rates. Because of energy shocks experienced, beginning from 1970s, that energy prices raise very rapidly, affected the growth rate of world economies in negative direction. This situation made obligatory the application of energy saving processes. After the pain process specified, in the developed and developing countries, the relationship energy consumption and economic growth has begun to occupy the agenda. In the passing 30 years 'period, this issue was heavily considered in academic studies.

Energy is one of the most important issues in the development of Turkey. In this context, the use of energy constitutes a base besides improving the quality of life and for economic and social development in Turkey. Along with the increase seen in population and industrialization rapidity in Turkey, the energy demand is increasing every passing day.
Turkey continuing he process of EU membership insistently, for the sake of proving adaptation process, principally the polices of infrastructure, environment, energy, and growth, realizes important transformations in a number of areas. Also, Turkey is an indispensable energy corridor for transporting the energy such as oil and natural gas,

produced in Middle East, Asia, Mediterranean, and Caspian Sea Region, to Europe. Increase is expected in the energy consumption of world, but in near future, a large part of energy consumption will be met from this area including Turkey as well. In other words, Turkey, due to its geographical and economic position, is a both market and bridge for the transportation of the production in Central Asia to the world markets. In addition to all of these, from the view point of Turkey, completely foreign – dependent in supplying energy, the important of energy issue is increasingly much more. Hence, in Turkey, there is a need for long termed plan blending the energy and growth.

In the light of those mentioned above, the main purpose of this study, in addition to introducing the relationship between energy consumption and economic growth in terms of Turkish economy, is to make offers for policy. In order to realize this aim, after the concepts of energy consumption and economic growth are considered, in the frame of literature, the relationship energy consumption – growth will be analyzed.

2. Clarification of the Concepts of Energy and Growth

The word energy is a Greek originated is a word and the words of "en" (internal) and "ergon" (work) are constituted. Later, the word gained a social attribute and was begun to be used synonymously with the ability to produce work, dynamism, force, power, and activity (Demirbaş, 2002:1). Energy having an important place in terms of both supply and demand is a consumable material that a consumer decided to purchase for maximizing his/her utility. from the viewpoint of demand (Chontanawatt et al., 2008: 137) For the commonly using areas of energy as a consumable material, cleanup, travel, and listening to music can be given as an example. Energy, from the viewpoint of supply, is a basic production inlet in addition to raw material, labor, and capital (Chontanawatt, et al., 2008: 138). In this scope, energy resources have three remarkable characteristics in the way that it emerges from environmental pollution, depending on scarcity, worldwide unequal distribution, and use.

As the amount of energy used in industry, when it is assumed that the amount of production, in turn, output will increase, in the frame of single sectored neoclassic production technology, capital, labor force, and energy are defined as separate inlets (Aytaç, 2010: 483) This situation neglected until oil crises experienced in 1970s, beginning from the years ıf crisis, introduced the importance of energy, as a separate production inlet form labor and capital. Now, while the output in production function is explained, beside labor and capital, energy was also begun to take place as a production input. Setting out from a neoclassic perspective, in order to introduce the factors reducing and increasing the relationship between energy consumption and economic growth, the equation of production function can be expressed as in Equation (1) (Stern, 2003: 21-22):

$$(Q_1,.........,Q_m = f(A, X_1,......, X_n, E_1,........, E_p) \qquad\qquad (1)$$

In the equation above, Q_1 represents output; X_1, the inputs such as labor and capital; , E_1, the inputs such as coal and oil; and A, technology, defined by total factor productivity With moving from here, the relationship between energy and GDP is influenced from the substation relationship between energy and the other inputs, variation occurring in A, technological change, variation in the composition of energy input, and in the composition of GDP (Stern, 2003: 22).

With moving from energy consumption, the relationship energy consumption and economic growth is described based on Medlock and Soligo (2001). In Medlock and Soligo (2001), energy consumption (ec_t) is expressed as a function of income pe capita (y_t), energy prices (p_t), and technology (A_t) as in Equation (2):

$$ec_t = f(y_t, p_t, A_t) \qquad (2)$$

In Equation (2), technology is assumed to be a function of energy prices and income level. By moving from here, the function associated with energy consumption can be expressed as in Equation (3):

$$ec_{t,j} = f(y_t, p_{t,j}, A(y_t, p_{t,j})) \qquad (3)$$

where subscript j represents final use related to household, commercial transportation, industry, and the other sectors and is obtained from the variable income. In addition, to simplify, it is assumed that technology may be for labor- capital.

3. Literature

Some of the studies that are remarkable in the literature presenting the relationship between energy consumption and economic growth are considered as follows:

Akarca and Long (1980), in their studies including in the period 1950-1970, using the method of Sims Causality Test, analyzed the relationship energy consumption – growth. According to the results of analysis, they did not meet any relationship between energy consumption and economic growth.

Yu and Hwang (1984),in their studies, utilizing the variables energy consumption and employment, conducted Sims Causality Test. They identified that there was no relationship between energy consumption and growth.

Erol and Yu (1987), in their analyses they carried out, using the data of national income and energy, they determined that there was no relationship between energy consumption and economic growth.

Hwang and Gum (1991) studied the relationship energy consumption- economic growth for Taiwan. As a result of analyzes, where Granger causality test was regarded, they determined that there was a double directional causality relationship from consumption to growth and from economic growth to energy consumption.

Stern (1993), using the variables of GDP, energy consumption, labor, and capital, via the econometric methods of Granger Causality Test and VAR, considered the relationship between the variables of interest. As a result of analyzes, they determined that there was a causality relationship from energy consumption to growth.

Hondroyiannis et al. (2002), using the variables of total energy consumption, hosing energy consumption, industrial energy consumption, and consumer price index via the methods Johansen and Juselius co-integration test and ECM, analyzed the relationship between energy consumption and economic growth. The results of analysis showed that

there was a double directional relationship between energy consumption and economic growth.

Paul and Bhattacharya (2004), using the variables of national income, commercial energy consumption, gross fixed capital formation, and population, via Johansen co-integration test and Granger causality test, analyzed the relationship between energy consumption and economic growth. The results of analysis revealed that there was a double directional causality relationship between energy consumption and growth.

Hatemi and Irandoust (2005), with the variables of real GDP, and energy consumption, consumer price index, utilizing Leveraged Bootstrap Simulation Approach, considered the relationship between energy consumption and economic growth. According to this, they identified that there was a causality relationship between the variables, and that the direction of relationship was from economic growth to energy consumption.

Tehranchian (2006), for Iran, analyzed the variables of real GDP, total energy consumption, natural gas consumption, and hydraulic energy consumption via Johansen Co-integration Test and VECM analysis. As a result of analyses, a relationship was determined from economic growth to energy consumption.

Mucuk and Uysal (2007), for Turkey economy, studied the relationship between energy consumption and economic growth, using co-integration and Granger causality tests. Empirical findings showed that the variables were co-integrated and that Granger causality was from energy consumption to economic growth.

Jobert and Karanfil (2007), in Turkey, analyzed the relationship between energy consumption and national income in the level of both macro and industry. According to Johansen co-integration test, it was determined that there was no relationship in long period between real GDP and energy consumption, and between industrial energy consumption and industrial added value.

Erdal et al. (2008), for Turkey, moving from the data of the period 1970 -2006, analyzed the relationship between energy consumption and GDP. The results of Johansen co-integration and Pair-wise Granger causality tests revealed that there was a interrelation between the variables considered.

Kar and Kınık (2008) analyzed the relationship between industrial electricity consumption, household electricity consumption, and total energy consumption and economic growth .The results of Johansen co-integration test, showed, in long period, that there was a relationship between industrial, household, and total energy consumptions and economic growth; and Vector Error Correction Model (VECM) also showed that the direction of causality realized from electricity consumption to economic growth. It was only determined that there was a double directional relationship between household electricity consumption and economic growth.

Bartleet and Gounder (2010) for New Zeeland, with the variables of GDP; total energy consumption, energy prices, using ARDL and Granger causality test, studied the relationship between energy consumption and economic growth. According to the results of analysis, it was determined that there was a single directional causality relationship from energy consumption to growth.

Çoban and Yorgancılar (2011) analyzed the relationships between renewable energy consumption and sustainable economic growth. According to the results of analysis, it was determined that all variables associated with renewable energy consumption had a positive directional effect on the growth.

4. Methodology

In this study, in Turkey, the relationship between energy consumption (Energy) and economic growth (Growth) was analyzed. In analyses, the annual data belonging to the period 1980 – 2011, obtained from TÜİK (Turkish Statistical Institute) as well as Ministry of Energy and Natural Resources, were used.

Analysis,unit root test, VAR analysis andGranger causalitytest is used. The first step in constructing time series data is to determine the non-stationary property of each variable. We must test each of the series in the levels and in the first difference. All variables were tested in levels using the Augmented Dickey-Fuller (ADF) Test. If the stationary test is significant, the variable series is stationary and does not have a unit root test. Thus, the null hypothesis will be rejected, but the alternative hypothesis will be accepted. However, if the stationary test is not significant, the variable series is non-stationary and has a unit root test; thus, null hypothesis will be accepted (Shaari et al., 2013: 21).

Variance decomposition decomposes the variation in one of the internal variables as separate shocks affecting all internal variables. In this sense, variance decomposition gives information about dynamic structure of the system. The aim of variance decomposition is to reveal the effect on error structure of the prediction for the next periods of each random shock While which one is the most effective variable on a macroeconomic growth is determined via variance analysis, whether or not these variables that are detected effective are usable as political instrument and cause –effect functions are identified (Sarı, 2008: 4). The relationship between two economic variables and the answer of question of whether or not these affects to each other are first studied by Granger (1981). In the causality test incorporated to literature by Granger, Notation (1) is referred (Çoban ve Yorgancılar, 2011: 9):

$$\gamma_t = \alpha + \beta_{xt} + \varepsilon_t$$

In this equation, Granger put forward that in order to be able to make a contact between the exploratory and explained variables, and both sides of equality should be consistent. For example if *yt* is a seasonal variable, *xt* must also be a seasonal variable and in such a situation, *εt* is in the position of white noise.

In identifying the causality in the sense of Granger, while x is datum null hypothesis (H_0: α = 0) is set as "*X does not Granger cause Y*". This means that both and delays in cointegration vector influence y. In causality test, null hypothesis is tested by using F test and in case that one or both of two factors expressed together influence y, hypothesis is refused (Çoban, 2002: 38; Çoban, 2004: 8; Çoban et al, 2008).

5. Analyses and Results

In this study, firstly, in order to determine whether the variables used in analyses are stable or mot, ADF unit root test developed by Dickey-Fuller was referred to (Table-1).

Table- 1: ADF Test Results for Unit Roots

	Level (Intercept)	Prob.*	First differences (Intercept)	Prob.*
Energy	1.120296	0.9968	-5.424374	0.0001
Growth	-6.335408	0.0000		

*MacKinnon (1996) one-sided p-values.

According to Table 1, it was determined that the variable growth becomes stable in the level of I(0), while the variable consumption becomes stable in the level I(1). The findings obtained point out that for the variables taking place in the scope of study the rank of integration is I(0,1).

Before passing to Granger causality test, it is necessary to determine the lag belonging to autoregressive model. The most important method used in assigning lag value is the method of comparing the values of Akaiki information criterion in VAR analysis. According to VAR method, the best lag was calculated by Akaiki Information Criterion as 1. The primary hypothesis (H_0) and alternative hypothesis (H_1)) that are established according to the energy consumption, are as follows:

H_0:. Energy consumption is not the cause of economic growth.
H_1: Energy consumption is the cause of economic growth.
The hypotheses established according to economic growth are:
H_0: Economic growth is not the cause of energy consumption.
H_1: Economic growth is the cause of energy consumption.
With moving from these hypotheses, the results of dual Granger causality test are as in Table 2.

Table- 2: Granger Causality Test Results

Pairwise Granger Causality Tests			
Date: 01/24/13 Time: 17:04			
Sample: 1980 2011			
Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Probability
Growth does not Granger Cause Energy	30	0.0623	0.9377
Energy does not Granger Cause Growth		0.08512	0.7727

According to Table 2, in the significance level of 10%, the probabilities belonging to F-statistical values are not significant. Therefore, there is not any causality relationship

between energy consumption and growth. Thus, our results of Granger causality tests do not support the feedback hypothesis.

6. Discussion and Conclusion

In this study, in Turkey, the relationships between energy consumption and growth were analyzed. In the analyses, annual data belonging to the period 1980-2011. In Turkey, in recent years, also depending on economic stability, an important process of growth is experienced. The resources of this process should be determined. In this context, while energy demand is rapidly increasing, energy consumption remained in the highly back of energy demand. However, the energy produced and consumed by Turkey presents a structure different from each other in terms of its subtypes. As a matter of fact, in Turkey, energy demand is met from the resources imported such as oil and natural gas and energy production is from lignite and renewable energy far away from meeting the demand of country. In such a situation, foreign dependency of Turkey increases, and in any case that there is any problem, leads economic growth to be influenced negatively.

All causes expressed above emphasizes that, for Turkish economy, determining whether or not there is a causality relationship between energy consumption and economic growth is so important. However, in the study we carried out for this aim, it was determined that there was no causality relationship between energy consumption and economic growth and thus, that the feedback hypothesis was not supported. When considering from this point of view, the results of our study overlap with the results of the studies by Akarca and Long (1980), by Yu and Hwang (1984), and by Erol and Yu (1987), by Inbert and Karanfil (2007).

As a conclusion, in our study, even though a causality relationship between energy consumption and economic growth revealed, the importance of energy in terms of economic development cannot be ignored. In this meaning, policymakers and decision mechanisms should pay attention the relationship between two variables. When the policies for energy saving toward reducing energy intensity, promoting the use of alternative renewable energy resources, increasing energy efficiency, the investments on technological development improving energy efficient and developing the feasibility of renewable energy resources are under consideration, it can be said that economic growth will not be negatively affected from decrease of energy consumption.

7. References

Akarca, A. T.,& Long, T.V. (1980). On the relationship between energy and GNP: a reexamination. *The Journal of Energy and Development, 5(2),* 326-331.

Bartleet, M.,& Gounder, R. (2010). Energy consumption and economic growth in New Zealand: results of trivariate and multivariate models. *Energy Policy, 38(7),* 3508-3517.

Chontanawat, J., Hunt, L.C., & Pierse, R. (2008). Does energy consumption cause economic growth? evidence from systematic study of over 100 countries. *Journal ofPolicy Modelling, 30,* 209-220.

Çoban, O. (2002). Econometric analysis of the relationship between money supply, inflation and interest rates in Turkish and German economies. *Ataturk University Journal of Economics and Administrative Sciences Faculty, 16 (5–6),* 32–41 (in Turkish).

Çoban, O. (2004). The effects of human capital on economic growth: the case of Turkey. *Journal of Istanbul University, 30,* 131-142 (in Turkish).

Çoban, O., Doganalp, N., & Uysal, D. (2008). The macroeconomic effects of public internal borrowing in Turkey. *Journal of Selcuk University Social Sciences Institute, 20,* 245-257 (in Turkish).

Çoban, O.,& Yorgancılar, F. (2011). Relationship between renewable energy consumption and sustainable economic growth: the case of Turkey. *2011 Barcelona European Business&Economics Conference*, Juni 6-9, Barcelona, Spain.

Erdal, G., Erdal, H., & Esengün, K. (2008). The causality between energy consumption and economic growth in Turkey. *Energy Policy, 36(10),* 3838-3842.

Erol, U.,& Yu, E.S.H. (1987). Time series analysis of the causal relationships between us energy and employment. *Resources and Energy, 9(1),* 75-89.

Hatemi, A.,& Irandoust, M. (2005). Energy consumption and economic growth in Sweden: a leveraged bootstrap approach, 1965-2000. *International Journal ofApplied Econometrics and Quantitative Studies, 2(4),* 87-98.

Hondroyiannis, G., Lolos, S., & Papapetrou, E. (2002). Energy consumption and economic growth: assessing the evidence from Greece. *Energy Economics, 24(4),* 319-336.

Hwang, D.,& Gum, B. (1991). The causal relationship between energy and GNP: the case of Taiwan", *Journal of Energy and Development, 16(2),* 219–226.

Jobert, T.,& Karanfil, F. (2007). Sectoral energy consumption by source and economic growth: the case of Turkey. *Energy Policy, 35(11),* 5447-5456.

Kar, M.,& Kınık, E. (2008). Türkiye'de elektrik tüketimi çeşitleri ve ekonomik büyüme arasındaki ilişkinin ekonometrik bir analizi. *Afyon Kocatepe ÜniversitesiİİBF Dergisi*, *10(2),* 333-353 (in Turkish).

Mucuk, M.,& Uysal, D. (2007). Türkiye ekonomisinde enerji tüketimi ve ekonomik büyüme. *Maliye Dergisi, 157,* 105-115 (in Turkish).

Pamir, N. (2005), Enerji politikaları ve küresel gelişmeler. *Türkiye 5. Enerji Sempozyumu Bildiriler Kitabı*, Ankara, 57-83 (in Turkish).

Paul, S.,& Bhattacharya, R.N. (2004). Causality between energy consumption and economic growth in India: a note on conflict results. *Energy Economics, 26,* 977-983.

Shaari M.S., Hussain, N.E., & Ismail, M.S. (2013). Relationship between energy consumption and economic growth: empirical evidence for Malaysia. *Business Systems Rewiev, 2(1),* 17-28.

Stern, D.I. (1993). Energy and economic growth in the USA- a multivariate approach. *Energy Economics, 15(2),* 137-150.

Stern, D.I. (1999). Is energy cost an accurate indicator of natural resource quality?.*Ecological Economics, 31,* 381–394.

Stern, D. I. (2000). A multivariate cointegration analysis of the role of energy in the U.S. Macroeconomy. *Energy Economics, 22(2),* 267-283.

Stern, D.I. (2003). Energy and economic growth, Retrieved February 02, 2013, from http://www.localenergy.org/pdfs/Document%20Library/Stern%20Energy%20and%20Economic%20Growth.pdf.

Tehranchian, A.M. (2006). On the relationship between energy consumption and real GDP in Iran: an application of VEC model. *Iranian Economic Review, 11(16),* 141-147.

Yu, E.S.H. & Hwang, B.K. (1984). The relationship between energy and GNP: further results", *Energy Economics, 6(3),* 186-190.