Full Length Research Paper

Industrıal sector energy consumptıon ın Turkey- the relatıonshıp between economıc growth (1970-2010)

Yusuf BAYRAKTUTAN[1], Ibrahim ARSLAN[2]*, Dr. Gökçen Sayar ÖZKAN[2] and Filiz Sanal ÇEVİK[1]

[1]Department of Economic, Faculty of Economics and Administrative Sciences, Kocaeli University, Kocaeli, Turkey.
[2]Department of Economic, Faculty of Economics and Administrative Sciences, Gaziantep University, Gaziantep, Turkey.

Economic growth is one of the most important macroeconomic targets, due to its relatively important effects on the other macroeconomic variables. Among many others, productivity of labor, accumulation of capital, technological improvements, enhancement of human capital, existence of natural resources are considered to be the most important factors affecting economic growth. In this study, the effect of energy usage on industrial production is examined. The contribution of energy on industrial production is beyond any dispute. The use of energy is impulsive for technological improvement and the most important component of the increase in labor productivity. Machines and capital equipments can not be made use of, unless necessary energy input is obtained. In this paper, the relationship between energy consumption of industry and economic growth for 1970 to 2010 period in Turkey is examined using regression analysis.

Key words: Turkish economy, ındustrial energy consumption, economic growth.

INTRODUCTION

In globalizing world, energy is accepted as an input that is compulsorily used in industrial manufacturing enterprises and also is accepted as a fundamental parameter of economic development as a service instrument to improve economic level of society. The amount of consumption in industrial enterprises of energy that is an important factor in global economies is directly proportional to the economic development levels of countries.

In order to prevent the disruption of economic growth; providing sufficient, in quality and reliable energy that is on-site, on time and at a low cost, and evaluation of energy resources efficiently with technologies that is compatible with modern development are necessary. Taking required measures to avoid bottlenecks in the general energy and electricity, opening of the obstacles to private sector investments in energy and creating a more efficient working environment must be some of the energy strategies of Turkey.

Sustainibility of industrial production process and an increase in the level of economic prosperity depend on the energy in contemporary conditions because the economic development of a country depends on increase in the labor demand, the growth of total supply, improvement of income distribution by everyone's receiving a share and providing external balance with more production to increase the country's export capacity. Energy use which is so important for a stable economic growth constitutes the base of the study. In this study, of these factors, the effect of both technological development and energy consumption that can be included in natural resources on Turkey's economic growth is examined.

With the use of energy, the fact that the transition from the limited production which is made by hand power in the industrial revolution to mass production is extremely effective is indisputable. In this perspective, growth in Turkey and the relationship between energy use in industry and the growth rate is examined by using the unit root, regression and causality analysis for the period, 1970 to 2010.

*Corresponding author. E-mail: arslan@gantep.edu.tr.

In economic literature, there are two periods focused on growth theories. First of these is the period including the late 1950s which resulted in the emergence of neo-classical growth theory and the 1960s. The second period is the late 1980s and the period of The New Growth Theories which began as a reaction to some shortcomings in the neo-classical theory in 1990s and which was attempting to explain long-term growth rate by internal changes, also known as the period of the endogenous growth theory.

Neo-classical theory, especially with subsequent theoretical developments, emphasizes that economic growth may continue theoretically in spite of the limitedness of the energy sources. Energy resources are entries which is non-critical in production; energy demand is a derived demand and in spite of the contribution of the energy resources to production, causality runs from economic growth to energy consumption. Binding energy supply constraints can be overcome by means of more efficient use of existing energy sources, starting to use new energy sources and substitution of labor and capital inputs with energy (Stiglitz, 1997).

With an alternative perspective, Ecological Economics School consider energy resources as a factor limiting the growth of modern economies (Stern and Cleveland, 2004). This approach is skeptical about technical substitution of technological development and factors of production of the neo-classical theory. Substitution of energy with labor and capital is limited to physical depen-dence of various inputs. Maintenance and construction of capital elements and production of substitute goods requires more energy input. Technological development and obtaining the qualified labor inputs are also factors that increase the demand for energy.

Neo-classical theory and Ecological Economics School agree that there may be a long-term relationship between energy resources and economic growth despite of the different perspectives. However, both short and long term direction of the relationship may be different.

Growth models in the 1990s was closely interested in the relationship between theory and data; empirical studies are worked out intensely. A lot of empirical studies have been conducted to examine the relationship between energy and economic growth. The first empirical study was made by Kraft in 1978. Kraft and Kraft have reached the conclusion that there is a one-way causal relation from GNP to the energy and that economic growth has a positive effect on energy consumption by means of the study that they did by using gross energy consumption of the U.S. for the period 1947 to 1974 and GNP data (Kraft and Kraft, 1978).

In the empirical studies made after 1978, Granger causality test, panel data analysis and time series was used by examining different countries. Akarca and Long (1980), Abosedra and Baghestani (1991), Masih and Masih (1997), Soytas and Sari (2003) have reached different conclusions in their study with data belonging to one or more countries. With all these studies whose number can be increased, although a relationship between energy consumption and economic growth is detected, different results were obtained in terms of the direction of the relationship with short and long run conditions. The differences in outcomes vary depending on the terms of the country, the healthiness of data, the selected periods and econometric methods used. Due to the lack of consensus in the literature, country-specific studies should continue.

According to Yamak and Gungor (1998), in their study in which the residential electricity demand in short and long run was estimated by stability test of price and income elasticity for the period 1951 to 1994, have reached the conclusion that electricity demand is elastic against income and inelastic against price in long run and the residential electricity demand is inelastic against income and price in short run. According to Karagol et al. (2007), in the study in which they examined the relationship between economic growth and electricity consumption, the short and long run relationship between electricity consumption and economic growth for Turkey with the data between the years of 1974 to 2004 with bound test approach was analyzed. A positive relationship between electricity consumption and economic growth emerged in short run and a negative relationship emerged between them in long run.

In the study which is worked out by Kar and Kinik (2008), taking into account the types of electricity consumption in Turkey; the relationship between electricity consumption and economic growth in Turkey between the years 1975 to 2005 were tested with the Johansen cointegration test and a causality between all electric consumption types (residential, industrial, total) and economic growth has been identified. The fact that the direction of causality is from electricity consumption to economic growth was found by means of vector error correction mechanism (VECM).

Ozturk et al. (2010) examined the relationship between the energy consumption of 51 countries and economic development between 1971 and 2005 by the panel data analysis; classified countries as low-income, lower-income and middle-income countries according to income groups depending on the GDP; and reached the conclusion that there is no strong relation between the energy consumption and growth.

Sharma (2010) in his study of 66 countries covering the years 1986 to 2005, separated countries into 4 groups as South - East Asia and the Pacific, Central Asia and Europe, Latin-Caribbean and Sub-Saharan Africa, North Africa and the Middle East; the regions were examined on the basis of the classical growth model and the relationship between energy and growth was different in all regions.

Zhixin and Xin (2011), in their study in which they examined the relationship between energy consumption and growth for the city Shandong of China, found the
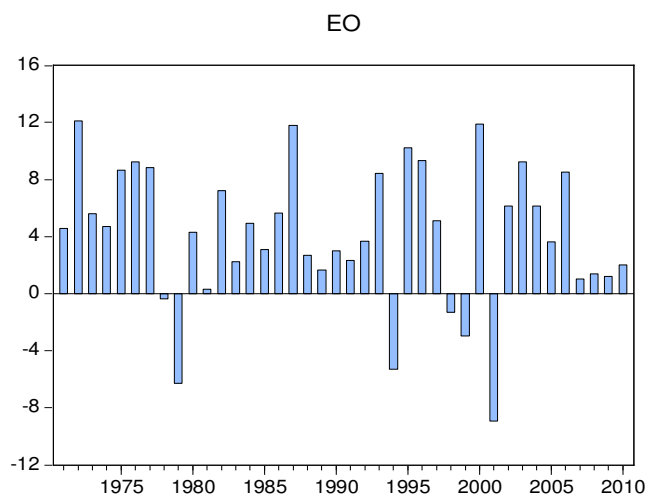
Figure 1. The progress of the energy consumption rates (EO) in Turkey.

long-term two-way causality between energy consumption and growth, and also identified that positive correlation and economic growth depends highly on energy consumption by means of the least squares method and the Granger causality test.

According to Belke et al (2011), energy consumption price is inelastic and that there is a two-way relationship between energy consumption and economic growth by applying the basic components analysis to real GDP and energy prices of 25 OECD countries in the years between 1981 and 2007 and taking into account the effects of international progresses in long-term.

Cong et al. (2011) in their study made in order to examine the relationship between energy consumption and China's economic growth, stated that economic growth is largely dependent on energy consumption, that China's energy consumption is disproportionate and that China's economic growth faces energy bottleneck.

Lee and Chang's (2007) m study of Taiwan for the years 1955 and 2003, concluded that existence of a reverse U-shape relationship between economic growth and energy consumption was characterized in Taiwan by determining the linear and nonlinear effects between economic growth and energy consumption.

Jobert and Karanfil (2007), in theior study to determine the relationship between energy consumption and economic growth in Turkey, identified one-way causality from energy consumption to economic growth by the Granger causality test and a correlation between energy consumption and income in the same period, primarily over all sectors and then for the industrial sector.

ECONOMETRIC METHODOLOGY

Previously in this study, the relationship between economic growth and energy consumption has already been examined by the

theoretical and empirical literature. Here, regression analysis is introduced and the focus is on the data set and model of the study. In addition, obtained empirical evidences are evaluated. The relationship between energy consumption and economic growth is analysed using the data for over the period of 1970 to 2010, by making an evaluation on these two variables. Regression analysis is used to explain the relationship between energy consumption and economic growth.

By using the regression analysis method, the effects of the explanatory variable(s) on a dependent variable can be determined. Classical regression model is as follows:

$$Y_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it}$$

Here, there are some representations such as: The dependent variable by Y_{it}, explanatory variables by X_{it}, the slope coefficient by β, vector of error terms by ε_{it}, the constant coefficient by α. Constant term (α) varies according to time and cross-sections (a company or a sector); the coefficient of the independent variable (β) only depends on cross-sections. In the model, $i = 1,2, ..., n$ denotes the number of cross-sections, and $t = 1,2, ..., n$ denotes the time interval of the each unit cross-section.

Data set and model

The following regression model was estimated by using data from the period 1970 to 2010 to see the effect of energy consumption in industrial sector on economic growth in Turkey:

$$BO_{,t} = \alpha_0 + \alpha_1 EO_{,t-1} + u_{i,t}$$

In the model, BO denotes economic growth rate, and EO denotes energy consumption.

EMPIRICAL EVIDENCE

Graphical evaluation

According to Figure 1, it can be seen that there is a a positive relationship between economic growth and energy consumption. It is observed that both variables decreased in the same parallelism especially in times of crisis in 1980, 1994, 1999 and 2001. The simple observation of the chart derived from data set reflects parallel progress of the growth performance and energy use in industry in terms of Turkey's economy.

According to Figure 1 showing the distribution of energy consumption rates in Turkey, especially in times of crisis, a negative trend can be seen in energy consumption rates.

According to Figure 2 showing the distribution of growth rates in Turkey, especially in times of crisis, a negative trend can be seen in economic growth rates. Because the main effect of crisis on economy is seen on economic growth in a short run, it can be seen from both Figures 1 and 2 that in times of crisis, both are pursuing the same progress.

Regression analysis

In Table 1, the results of regression analysis are given. t-Values show that the model is statistically significant. t Values have a statistical significance of 1%. Energy consumption in industry, in the period in which positive coefficient value reflected, has a positive impact on economic growth.

In Table 1, emergence of the value of R^2 0.728992 expresses that independent variables can explain 72% of changes in the dependent variable, and the result of F statistic expresses that the
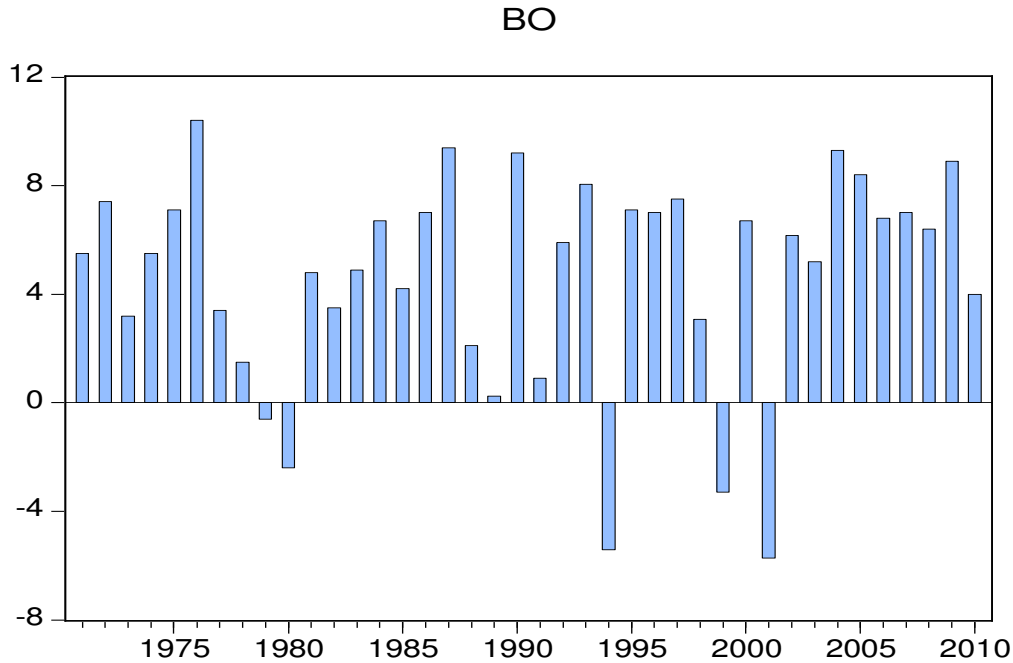
BO

Figure 2. The progress of the economic growth rates (BO) in Turkey.

Table 1. The evidences of the regression analysis.

Dependent variable: Economic growth
Method: The least squares(1970-2010)
Independent variable: Energy consumption (EO)

Variable	Coefficient	Standard error	t-test	Possibility
EO	0.805013	0.083040		0.0000
R^2	0.728992	Mean Dependent Var		4.677250
Modified R^2	0.742541	S.E. Dependent Var	9.694234	3.968097
Regression of Standard error	3.3464251	Sum squared residual		5.320559
Sum of squares	4.138253	Durbin –Watson Statistics		5.293603

model is significant as a whole. The empirical results show that there is a positive and statistically significant correlation between economic growth and energy consumption (Figure 3).

RESULT

Growth has various dynamics and/ or resources set out in the regarding literature as requirements for increasing economic welfare. In particular, production performance of the industrial sector requires, in terms of other entries, the supply of appropriate energy resources in adequate and cost-effective conditions.

For economic growth, using the relative importance of increasing heaviness of the industrial sector, the expectation that ascending use in energy which is one of the fundamental inputs for industrial sector increase the

country's growth performance has been confirmed by analytical evidences.

When the results obtained from the econometric analysis were evaluated, in the discussed period, it was noticed that economic growth in Turkey has a relationship with industrial energy consumption. Therefore, for continuous and sustainable growth, particularly for the industrial sector, the fact that Turkey should increase energy supplies and make conditions of energy usage more favorable, thereby reducing energy costs by promoting alternative energy sources is seen as policy recommendations which is worth been discussed.

Turkey is potentially rich in terms of energy resources, especially renewable energy resources. Due to its sustainability, low cost benefits, health and enviroment-ally friendly characteristics, renewable energy is relatively
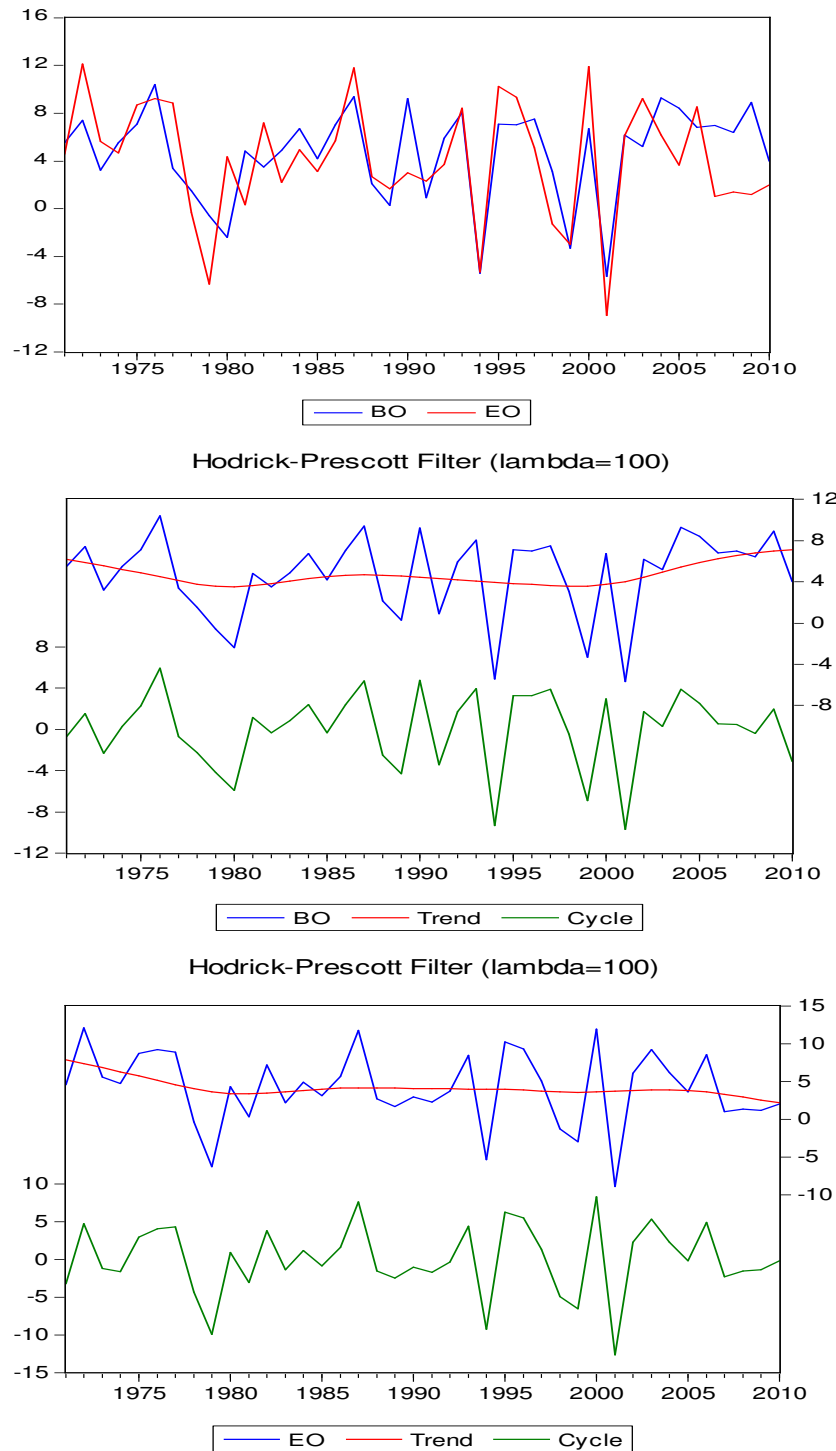
Figure 3. Economic growth (BO)and energy consumption (EO) in Turkey.

adventageous compared to other energy sources. Turkey is not only hosting 8% of geothermal energy resources of the world but also has an advantage of having high numbers of sunny days. Considering the growth rate of the country and therefore increasing energy needs, renewable energy resources gain more importance.

REFERENCES

Abosedra S, Baghestani H (1991). New Evidence on the Causal Relationship United States Energy Consumption and Gross National Product, J. Energy Dev., 14: 285-292.

Akarca AT, Long TV (1980). On the Relationship between Energy and GNP:A reexamination, J. Energy Dev., 5: 326-331

Belke A, Dobnik F, Dreger C (2011). Energy consumption and economic growth: New Insights into the cointegration relationship, Energy Economies, article in press.

Cong W, Aidong W, Chongqi W (2011). Analyze the relationship between energy consumption and economic growth in China, Energy Procedia, 5: 974-979.

Jobert T, Karanfil F (2007). Sectoral energy consumption by source and economic growth in Turkey, 35: 5447-5456.

Kar M, Esra Kınık (2008). The relationship between electricity consumption and economic growth in Turkey, the econometric analysis of variations, University of Afyon, FEAS J., 10: 2

Karagöl E, Erbaykal E, Ertuğrul MH (2007). Relationship Between Economic Growth and Electricity Consumption in Turkey: Cross-Test Approach, Dogus University J., 8(1): 72-80.

Kraft J, Karft A (1978). On the Relationship between Energy and GNP, J. Energy Dev., 3: 401-403.

Lee CC, Chang CP (2007). The impact of energy consumption on economic growth: Evidence from linear and non linear models in Taiwan, Energy, 32: 2282-2294.

Masih M, Masih R (1997). On the Temporal Causal Relationship between Energy Consumption, Real Income and Prices: Some New Evidence from Asian-energy Dependent NICs based on Multivariate Cointegration/Vector Error Correction Approach, J. Policy Model., 19: 417-440.

Ozturk I, Aslan A, Kalyoncu H (2010). Energy consumption and Eceonomic Growth relationship: Evidence from panel data for low and middle income counries, Energy Policy, 8: 4422-4428.

Sharma SS (2010). The relationship between energy and economic growth: Emprical Evidence from 66 countries, Appl. Energy, 87: 3565-3574.

Soytas U, Sari R (2003). Energy Consumption and GDP: Causality Relationship in G-7 Countries and Emerging Markets, Energy Econ., 25: 33-37.

Stern DI, Cleveland CJ (2004). Energy and Economic Growth, Rensselaer Working Papers in Economics', 410: 1-29.

Stiglitz JE (1997). Reply:Georgescu-Roegen versus Solow/Stiglitz, Ecol. Econ., 22: 269-270.

Yamak R, Güngör B (1998). Residential Electricity Demand Equation Estimation: The Case of Turkey, 1950-1991, Economic Approach, 9 (31): 71-78.

Zhixin Z, Xin R (2011). Causal Relationship between Energy Consumption and Economic Growth, Energy Procedia, 5: 2065-2071.