# Electricity Consumption and Economic Growth: A Long-Term Co-integrated Analysis for Turkey

**Abstract**

Energy and especially electricity consumption is a variable that can be also considered as the indication of the social development as far as economic growth is concerned. Energy, as the input of the industry and other production branches, is an indication for the production increase; and also for consumption with regards to raising the living standards of the consumers. In literature with its situation, it is argued that the electricity consumption is included the mutual causality relation with the growth data in a long-term. As there are several empirical studies that support this hypothesis, in some economies, especially it may sometimes be concluded that the data of the energy utilization in the production area can negatively affect growth in the long-term. Therefore, the literature does not come to the agreed results for the relation between these two variables. In this study, the causality relations have been analyzed by dividing the electricity consumption into three categories; residential, industrial and others, based on the data of the Turkish economy. In the lights of the obtained findings, it is concluded that in long term, there is at most one long-term co-integrating vector between GDP and electricity consumed in residential and industrial areas and also two-way causality relation between GDP and electricity consumed in these sectors. In this case, electricity consumption can be considered as an indicator for both growth and social development.

**Keywords:** Economic growth, Electricity consumption, Industrial consumption, Residential consumption.

**JEL Class.:** C22, O40, O43.

## 1. Introduction

Whereas electricity is an economic value which is increasingly required for the improvement of human living conditions, some of the methods of generating power are at the center of critiques since they have reached the levels that threaten such human living conditions. Energy consumption has a wide literature in terms of both aspects. While industrial demand for energy is directly proportional to economic growth; consumer demand is directly proportional to economic development. Dhungel (2008) defines these two issues together as "national economic and social development". A similar point of view is expressed by Leung and Meisen (2005) that increase in power consumption …

However, the studies made afterwards and those basic studies referred to almost in every studies can be shown as Akarca and Long (1980), Yu and Choi (1985), Erol and Yu (1988), Abosedra and Baghestani (1989; 1991), Hwang and Gum (1991, 1992), Cheng (1995), Masih and Masih (1997), Glasure and Lee (1997), Soytaş, Sarı and Özdemir (2001), Soytaş and Sarı (2003), Lee (2005), … Joyeux and Ripple (2007), Joyeux and Ripple (2010) and different findings are obtained in many studies such as these due to the direction of causality in particular, the differences that may evolve out of different country and groups of countries and development levels of countries and their macroeconomic conjuncture .

## 2. Theory and Literature

In theory, increase in the amount of energy consumption in a closed economy, as well as the increases either in households or industrial sectors, can be considered as the indicators of economic and social development….

### *2.1. Energy Consumption*

Although it can be mentioned about an economic and social development for the increase in energy amount in an open economy as well; it may end up with the reflection (Kibritçioğlu and Kibritçioğlu, 1999) of … Whereas the theoretical

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**Açıklama [BK17]:** APA sample

relation between growth and energy consumption involves a linear relation especially in neo-classical economy (Hamilton, 1983; Burbridge and Harisson 1984; Ghali and Sakka, 2004); the point of view which deals with energy as the most efficient factor on growth and refers to it as biophysics considers labor and capital as collateral factors. Such point of view deals with economy as a sub-thermodynamic system (Cleveland et al., Aytaç, 2010 narrating from 1984).

## 3. Data Set and Method

Based on the data of Turkish Economy, Although it is …

## 4. Findings

Unit root analyses for the series are executed thereby using three different tests. It is initially carried out for Additional Dickey-Fuller (ADF) Test. … Results are indicated in Table-1.

**TABLE 1:** *ADF, PP and KPSS Unit Root Test Results*

| | GDP (0) | GDP (1) | resident (0) | resident (1) | industry (0) | industry (0) |
|---|---|---|---|---|---|---|
| | 2,979738 | -5,654487 | 0,987704 | -5,894409 | -2,0555337 | -2,429787 |
| | (-1,948886) | (1,949097) | (-1,948886) | (-1,949097) | (-1,948886) | (-1,949609) |
| **ADF** | **1,553112** | **-6,505076** | **-1,706041** | **-6,004486** | **0,048548** | **-5,964103** |
| **Test** | (-2,933158) | (-2,935001) | (-2,933158) | (-2,935001) | (-2,933158) | (-2,935001) |
| | *-0,647342* | *-7,301912* | *-2,180316* | *-6,032341* | *-2,451416* | *-5,965028* |
| | (-3,520787) | (-3,523623) | (-3,520787) | (-3,523623) | (-3,520787) | (-3,523623) |
| | 3,544457 | -5,860955 | 0,968976 | -5,881088 | -2,0533552 | -5,548644 |
| | (-1,948886) | (-1,949097) | (-1,948886) | (-1,949097) | (-1,948886) | (-1,949097) |
| **PP** | **1,939396** | **-6,535308** | **-1,706041** | **-6,004486** | **0,102907** | **-5,953762** |
| **Test** | (-2,933158) | (-2,935001) | (-2,933158) | (-2,935001) | (-2,933158) | (-2,935001) |
| | *-0,533400* | *-7,320672* | *-2,322447* | *-6,032717* | *-2,433009* | *-5,951890* |
| | (-3,520787) | (-3,523623) | (-3,520787) | (-3,523623) | (-3,520787) | (-3,523623) |
| | **0,689160** | **0,455716** | **0,737722** | **0,114703** | **0,755769** | **0,260740** |
| | (0,463000) | (0,463000) | (0,463000) | (0,463000) | (0,463000) | (0,463000) |
| **KPSS** | *0,190231* | *0,073973* | *0,085944* | *0,042989* | *0,154820* | *0,168131* |
| | (0,146000) | (0,146000) | (0,146000) | (0,146000) | (0,146000) | (0,146000) |

**Notes:** First lines for ADF and PP are unstable-without trend; Dark colored values are stable; values in italics are stable-trended results. All values in the parenthesis Show critical values in 5 %

As a result of tests performed for each three series, although they include unit root as of their levels, series become stationary as a consequence of taking their first difference. All three levels become stationary at the same level. This situation indicates that series are integrated at I(1) level. Therefore, prerequisite is ensured for investigation of whether or not there is co-integration and long term relation between them. Lag length is calculated for LR, FPE, AIC, SC, and HQ criteria and 1 lag length is obtained to be the proper lag.

In order to determine long term relations of variables, two-staged Eangle-Granger (1987) co-integration test is performed. In first step, regression equations are constructed between variable pairs which are assumed to be related in long term. In second step, ADF, PP and KPSS unit root tests are performed for error terms of regressions and it is anticipated that level of value of error term series are stationary at [I(0)]….

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**Açıklama [BK20]:** All tables must be enumarated sequentally.

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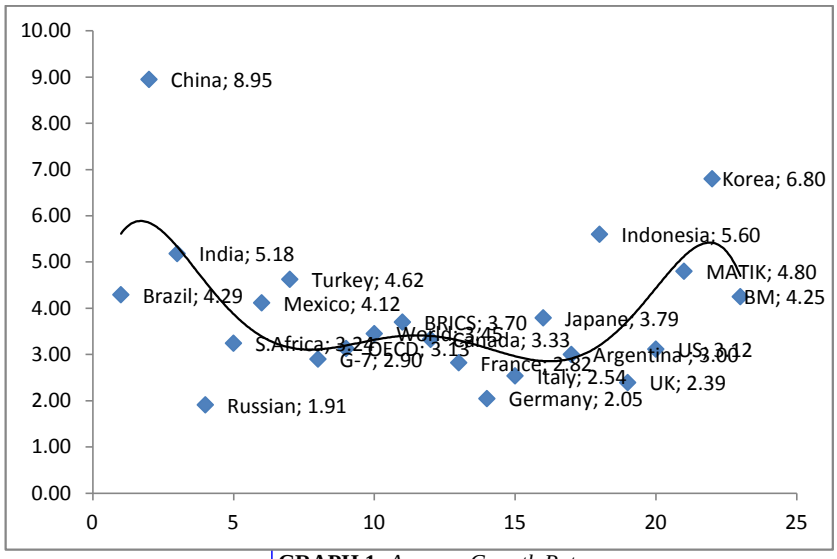
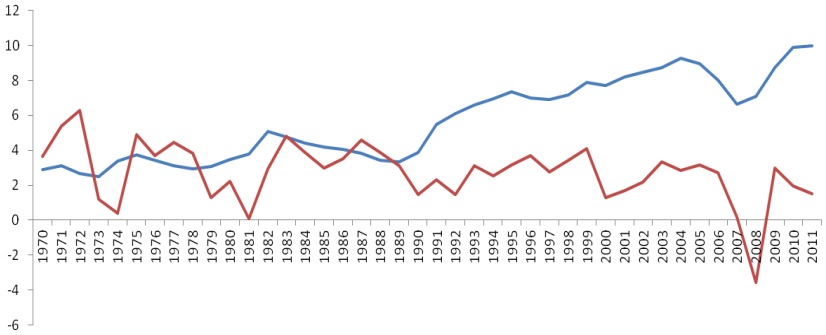



**GRAPH 1:** *Average Growth Rates*

When Trace and Max-Eigenvalue statistics are analyzed, "There is co-integration" hypothesis will be true as long as such statistics are higher than 0.05 of significance level….




**GRAPH 2:** *Average Growth Rates*

When Trace and Max-Eigenvalue statistics are analyzed, "There is co-integration" hypothesis will be true as long as such statistics are higher than 0.05 of significance level.

$$\Delta Y_t = \beta_1 + \beta_2 t + \beta_3 Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-i} + u_t \qquad (3)$$

When Trace and Max-Eigenvalue statistics are analyzed, "There is co-integration" hypothesis...

## 5. Conclusion

By the analyses carried out thereby using annual data that belong ….

## References

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Abosedra, S., & Baghestani, H. (1989). New evidence on the causal relationship between U.S. energy consumption and gross national product. *Journal of Energy Development*, 14, 285-292.

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Agenor, P. R., & Montiel, P. J. (1996). *Development Macroeconomics*, Princeton University Press.

Agir, H., & Kar, M. (2010). Relationship between electricity consumption and level of economic development in Turkey: A cross-section analysis. *Sosyoekonomi*, Special Edition, 149-176.

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

Al-mulali, U., & Fereidouni, H. G. Lee, J. Y. M. (2014). Electricity consumption from renewable and non-renewable sources and economic growth. *Renewable and Sustainable Energy Reviews*, 30, 290-298. http://dx.doi.org/10.1016/j.rser.2013.10.006

An Investigation of cointegration. (2014, July 20). *The Washington Post)*. p.15.

Australian Bureau of Statistics. (1991). *Estimated Resident Population by Age and Sex in Statistical Local Areas*, New South Wales, June 1990 (No.3209.1). Conberra, Australian Capital Territory: Author.

Bjork, B. S. (1995). An adaptive mechanism in human memory. In H. L. Roediger and F. I.M. Craik (Eds.), *Varieties of memory and consciousness (pp.309-330). Hillsdale, NJ*:Erlbaum.

Cheng, B. S. (1995). An Investigation of cointegration and causality between energy consumption and economic growth. *Journal of Energy Development*, 21, 73-84.

Cheng, B. S. (forthcoming). An Investigation of cointegration and causality between energy consumption and economic growth. *Journal of Energy Development*, 21, 73-84.

Devlet Planlama Teşkilatı (2005). *Ekonomik ve Sosyal Göstergeler (1950-2004).* Ankara, Devlet Planlama Teşkilatı.

Glasure, Y.U., & Lee, A.R. (1998). Cointegration, error-correction and the relationship between GDP and energy: The case of South Korea and Singapore. *Resource Energy Economics* 20, 17-25. http://dx.doi.org/10.1016/S0928-7655(96)00016-4

Harrop, J. (2000). *The Political Economy of Integration in the European Union*. *Third Edition*, E. Elgar, Cheltenham.

Johnson, R. S. (2010). *An Investigation of cointegration and causality between energy consumption and economic growth*, 27 January, San Diego, CA.

Mankiw, N. G. (2009). *Makroekonomi*, (Çev. Ed. Ö. F. Çolak). Ankara: Efil Yayınları (İngilizce Orijinali, 2007).

Mitchell, T. R. and Larson, J. R. (1987). *People in organizations (Third edition).* New York:Mc Graw-Hill.

Montiel, P. J. (1996). *Development Macroeconomics*, Princeton University Press.

Solow, R. M. (2014). Ekonomik Büyüme Teorisine Katkı (Çev. B. Kargı). Journal of Economics and Political Economy, 1(2), 20-41. (İngilizce Originali, 1945).

Riske, S. T. (1993). Social cognition and social perception. *Annual Review of Psychology, 44*, 155-194.

Ross, D. R. (2010). An Investigation of cointegration and causality between energy consumption and economic growth, *Doctoral dissertation*, Cornell University.

Türk Dil Kurumu (2010). *Türkçe Sözlük (genişletilmiş baskı).* Ankara: TDK.

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