The Effects of Energy Imports: The Case of Turkey

erdogdu, oya safinaz

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Oya S. Erdogdu[1]

Abstract:

It is seen that many developed nations are taking serious actions to use domestic rather than imported energy resources. Contrary, Turkey -a developing country- is getting more dependent on imported resources of energy, such as natural gas. This study analyses the consequences of this policy on some macroeconomic variables. Granger causality test statistics are calculated to search for relations between total energy consumption / imported energy resources and gross domestic product, industrial production index or private sector fixed investment. The results indicate that although total and imported quantity of energy affects gross domestic product, the national income, the origin of energy resource –such as being domestic or not – does not effect industrial production. As for the determinants of energy imports the test statistics indicate that private sector investment Granger causes energy imports.

Keywords: Energy consumption, Granger causality, VAR
JEL Codes: Q43, C32

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[1]Ankara University, Faculty of Political Sciences, Department of Economics, Cebeci / Ankara
Tel: (312) 319 7720 – 383, Fax: (312) 3197736
E mail: ose301@gmail.com, oerdogdu@politics.ankara.edu.tr

1. The policy of importing energy resources: reasons and consequences:

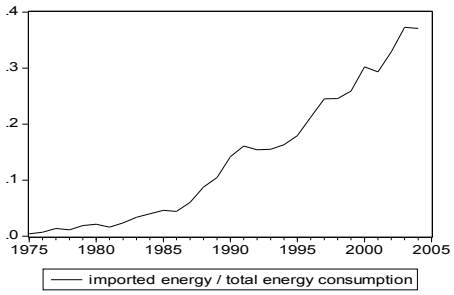
21st century can be seen as an era of energy wars. Developed countries –especially European countries - follow new strategies and form alliances to secure energy routes and increase efficiency in energy generation.

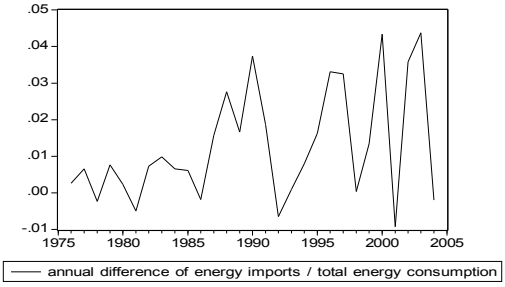
The energy strategy of developed nations – such as Europe and United States of America (USA) - is twofold. Besides searching for new sources of energy, they develop technologies for efficient usage of existing energy resources.[2] The environmental concerns, a cartel controlling oil price and quantity (in which a price / quantity shock can lead to serious recessions and high inflation rates) and Russia's strategy of controlling natural gas resources and importing routes, forces countries to use domestic and renewable (especially wind, water, coal and etc.) rather than imported energy resources (like oil and natural gas for many countries).

Contrary to this strategy followed by USA, Europe and even China, Turkey is getting more dependent on imported energy – mainly natural gas – rather than using his own energy resources.[3] Kilic and Kaya (2007), Yilmaz and Uslu (2007) and Demirbas (2001) notes this change in Turkey's energy policy after the second half of 1980's. These studies mention that the strategy of using domestic energy resources after the petroleum crises of 1973 and 1979, had shifted to depending more on imported resources after the second half of 1980's.[4] The increase in imported energy resources –excluding oil is seen in Figure 1.

Figure 1: Level and Annual Difference of Energy Imports excluding oil to Total Energy Consumption

[2] The energy plans of Germany, United State of America and Canada is based on the strategy of depending more on domestic resources of energy like coal, lignite and nuclear energy.
[3] Turkey is importing power – mainly natural gas – from Russia, Georgia, Iran and Bulgaria.
[4] Yilmaz and Uslu (2007) note the privatization strategy -followed after late 1980's- as one explanation for this change in energy policy. "After 1987 the policy of realization of thermal power plants projects by private sector began to be implemented. Therefore, public sector investments decreased, new projects of lignite-fired power plants were cancelled, the share of imported sources in meeting energy demand increased" (Yilmaz and Uslu, 2007).





The strategy of depending heavily on imported energy has consequences in terms of quantity and price of energy. As Turkey experienced in the last couple of years, energy exporting country can stop supplying the resource or country can pay much for that energy.[5] For that reason, Kilic and Kaya (2007), Yilmaz and Uslu (2007) notes that "the increasing share of imported energy resources –mainly natural gas- in new power plant capacity development plan of Turkey after 1980's is ranging the bells of danger".[6]

Energy supply shortage may be one reason for depending heavily on imported energy. Kilic and Kaya (2007) argue that the improved economic conditions and high growth rates of Turkey are the reasons for the increase in imported energy. However, an empirical analyzes for Turkey by Sari and Soytas (2003) indicates a unidirectional causality running from total energy consumption to growth (growth of gross domestic production (GDP)) for the time period of 1950 -1992. That is, their results indicate that energy shortage may harm economic growth but not vice versa.

For Turkey natural gas (besides oil of course) is the primary imported energy resource. Environmental and economic concerns were crucial arguments for the usage of (and hence increased imports of) natural gas rather than coal and lignite. However, as of today, the argument of natural gas being environment friendly (argued that natural gas is less polluting than coal, lignite or oil) is loosing its validity with new techniques developed for extraction and efficient usage of -even low quality - coal.[7] Besides, rather than lignite and coal, Turkey's renewable energy resources, like hydro, biomass, wind, biogas, geothermal and solar are waiting to be extracted and to be used to generate energy.

Leaving aside the technical question of how to use domestic resources to generate energy, this empirical study is searching for the possible causality relations between macroeconomic variables and energy dependency (calculated as the ratio of primary sources of energy imports to total energy consumption) as well as causality relations

[5] Turkey had experienced that kind of problems with Iran and Russia for natural gas imports
[6] As of today "…Turkey is facing several challenges such as increasing energy production by using its natural resources, reducing the economic burden of energy imports, protecting and improving the environment while enhancing socio economic development." (Demirbas, 2001)
[7] The official reports indicate that Turkey has low quality coal.

between energy consumption and macroeconomic variables. There is a huge empirical literature on the relation between energy and growth. Some of which are Asafu-Adjaye (2000), Ghali and El-Sakka (2004), Masih and Masih (1997), Narayan and Smith (2005) and Yu and Jin (1992).[8]

Empirical studies generally use growth rate of gross domestic product (GDP) and total energy consumption (or data on various types of energy consumption) to study the relation between economic growth and energy consumption / production. This empirical study uses industrial production index and private sector investments as well as gross domestic product (GDP) to capture the causality relations between energy / energy imports and macroeconomic variables [9]

The data, methodology and the estimation results of the analysis of Turkey for the time period of 1975- 2005 – the period at which the country is importing primary resources of energy – is given in the following section. Section Three is devoted to last words.

2. Data and Estimation Results:

Gross domestic production (GDP) in 1987 prices, total energy consumption, total imported primary sources of energy excluding oil, industrial production index and private sector fixed investment series for Turkey for the time period 1975-2005 are used to analyze the macroeconomic impacts of energy consumption / production and energy imports. The data on total energy consumption and imported primary sources of energy excluding oil, gathered from the World Energy Statistics Series of World Energy Council. GDP, industrial production index and private sector investment series are from the web pages of Government Planning Organization (DPT) and the Central Bank of Turkey. $\mathcal{Y}$, $\mathcal{S}$ and $\mathcal{I}$ represents the growth rate of GDP, the first differences of the growth rate of industrial production index and the private sector fixed investment series.[10] The annual

[8] Mozumder and Marathe (2007) document a very detailed literature review on causality relation between energy and growth. It is seen that the causality relation between energy consumption / production and growth (and also employment) is not robust. The empirical results are sensitive to the time period and differ between countries.

[9] Based on theoretical models like (Rotemberg and Woodford (1996), Finn (2000) and Benhabib and Farmer (1996)), all these variables can be used to analyze the possible causality relations between energy and macroeconomic variables. Theoretical studies model energy as a factor of production. Hence, the effects of energy on real economy variables are answered via producer's optimization problem. Note that given input prices, a producer's optimization problem is to solve for the quantity of energy as well as the quantity of capital and labor, for a production function such as:

$$\mathcal{Q} = f(K, L, e)$$

where, $\mathcal{Q}$ is for output and K , L and e represents capital, labor and energy respectively.

[10] Hodrick - Prescott filter is used to decompose the series into trend and cycle components and the same analysis is repeated with detrended growth rate series of industrial production index and private sector fixed investment. Similar Granger Causality results obtained.

difference of total energy consumption (e) and the annual difference of the ratio of total imported primary sources of energy excluding oil, to total energy consumption (e_{oilexc}) are the energy variables in the system.

Augmented Dickey Fuller and Phillips Perron unit root test statistics given in Table 1 indicates that y , s , I , e and e_{oilexc} are all I(0) variables.

Table 1. Unit Root Test Statistics:

	y	s	I	e	e_{oilexc}
Augmented Dickey-Fuller					
τ	-6.42	-4.20	-5.23	-5.74	-8.08
τ_μ	-6.27	-4.05	-5.11	-6.02	-8.33
Phillips –Peron					
τ_μ	-6.27	-4.77	-5.12	-6.18	-26.83

To search for the causality relations between real sector variables and energy imports, 6 vector autoregression (VAR) models are formed. A dummy variable to capture for the impact of economic crises in 1994 and 2001 is included in models of e and a dummy variable to capture the change in energy policy in 1975 – 1985 time period is included in models of e_{oilexc} . The relations between y and e , s and e and I and e are modeled with a dummy variable given lag length 1, 2 and 3 respectively. Similarly, the relations between y and e_{oilexc} , s and e_{oilexc} and I and e_{oilexc} are modeled with a dummy variable given lag length 1, 2 and 3.[11]

The results of the Granger causality test statistics are given in Table 2. The first column of Table 2.a lists test statistics calculated for models of e and the second column is devoted to the estimation results of models of e_{oilexc} .

Table 2.a. Granger Causality Test Statistics:

Dependent Variable	e	e_{oilexc}
y	0.18 (0.66)	0.03 (0.87)
s	3.59 (0.16)	0.78 (0.67)
I	3.87 (0.14)	10.75 (0.02)

Table 2.b. Granger Causality Test Statistics:

[11] The lag lengths for every model are determined by Schwarz lag length selection criteria.

Dependent Variable	y	s	I
e	3.90 (0.04)	14.79 (0.01)	1.05 (0.59)
e_{oilexc}	7.86 (0.09)	3.61 (0.16)	4.54 (0.21)

*the values in parantehesis are p values.

The Granger causality test statistics in Table 2.a indicate exogeneity of energy in the estimated systems of variables. Neither income nor production and investment have explanatory power on total quantity of energy. However, the test statistics in Table 2.b support Sari and Soytas (2003) that energy shortage may harm the growth rate of GDP, that is income (y).

Similar bidirectional causality is running from energy imports to income. Energy imports Granger causes the growth rate of income but, neither income nor production do have an explanatory power on energy imports.

Two conclusions can be drawn from Table 2.a and 2.b. First, the Granger causality test statistics indicates that energy is vital for industrial production, but not the origin of energy resources -that is imported energy-. Secondly, it is seen from Table 2.b that neither energy nor energy imports have an explanatory power on the growth rate of private sector investment (I). However, investment Granger causes energy imports, which do Granger causes the growth rate of income.

3. Conclusion

Based on studies on causality relations between energy and growth, this empirical analyses searches for possible relations between total energy / energy imports and some selected macroeconomic variables. That is, the study asks if the designation of origin of energy as well as the total quantity of energy is important for economic performance of a country and vice versa.

The Granger causality test statistics shed some light on the macroeconomic determinants of energy imports. The statistics calculated for models in question indicate that macroeconomic variables like growth rate of GDP and industrial production index do explain neither the ratio of energy imports nor total energy consumption. However, it is concluded that the private sector fixed investment do explain the ratio of imports in total energy consumption (but not total energy consumption).Therefore, it can be said that energy is imported to satisfy investment demand of private sector.

The Granger causality test statistics also indicate that industrial production is free of the origin of energy resources. Contrary to the conclusion that energy is vital for income and production, it is seen that imported energy hurt national income but not industrial production.

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