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OIL CONSUMPTION AND ECONOMIC GROWTH: EVIDENCE FROM TURKEY

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ABSTRACT

This paper examines the causal relationship between oil consumption and the real GDP for Turkey, using annual data covering the period 1970-2007. Our estimation results show that while oil consumption has a negative effect on economic growth in the long run, no short run relationship exists between the variables.

Keywords:
Economic Growth; Oil Consumption, Causality; Error Correction Model

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INTRODUCTION

Oil is the world's most critical energy resource supplying about 40% of the world's primary energy and nearly all of the fuel for the world's transportation systems [1]. Due to technological development and the increase in the world's population, the demand for oil increases. According to the projections of the International Energy Agency (IEA), it is estimated the world energy demand will reach 17.7 million tons Equivalent Petroleum (***TEP***-1 ***TEP*** = 11.626 KWH) from 11.4 million TEP between the years 2005-2030. Due to the ongoing energy policies and energy supply preferences, and with an oil reserve life of 42 years, the present resources in the world are taken into account with their proved reserves and yearly production amounts. Notably, oil met 35.6% of the world energy demand by the year 2007 [2].

Contrary to the shortening of the production areas, the consumption rate rapidly grows. Increasing prices of oil also increase the costs of the other user sectors like aluminum and steel.

Higher oil prices inevitably affect the balance of payments negatively. Foreign trade deficits grow because of the increasing oil prices. This causes unemployment and economic crises by raising the inflation rate and input costs, resulting in big differences between expected and actual inflation rates.

As well as increasing demand for oil in countries, regional disputes drive up prices and cause crises. Gasoline demand of Asian Countries, USA, and China, and the conflicts in the Middle East have contributed to higher prices, while oil costs keep raising import bills.

The discovery of an oil area in Batman in 1945 has shown the potential presence of oil in Turkey. Generally, oil areas have been discovered in the Southeast of Turkey expanding from Kilis to Siirt, which includes the Adıyaman-Diyarbakır-Batman area. The Turkish Petroleum Corporation (TPAO) currently has ongoing investigations in Batman and Adiyaman, while ongoing investigations in the Black Sea Region and the Mediterranean Region have been stalled due to the lack of budget. Thrace has a potential of natural gas and Salt Lake has the potential of oil. The recent findings of oil in Manisa and Alaşehir in the Aegean Region however is important, as it is the first time oil has been discovered in this particular region.

Turkey's crude oil production from the beginning of the research activities to September-2008 was calculated as 130.1 million tons. [2] In 2008, 3 million 200 thousand barrels of oil were produced from 184 wells in Adıyaman producing 30% of Turkey's total production [3]. Almost 1 million tons of oil have been discovered up to now, but it is estimated that the 15% of this amount is productable [4].

The TPAO and the French Firm, Perenco, have discovered that the biggest oil reserve in the Diyarbakır-South Kırtepe area has the capacity of nearly 16 million barrels. Turkey now has the biggest oil reserve in Diyarbakır. Besides the results of the investigations in Batman and Adıyaman, there are also hopeful areas in the Black Sea Region and Mediterranean Region. For the research and production activities in the Black Sea Region, negotiations between the TPAO and American Exxon-Mobile, Chevron and Mitsubishi are occurring.

Approximately 70% of oil production of Turkey is provided by the TPAO. The other Turkish and foreign firms - N.V. Turks, Eperenco, Alaaddin Middle East and Petroleum Exp. Med. make up the remaining part [4]. The processing of crude oil and production of oil products are occurring in the refineries owned by the Turkish Petroleum Refineries Corporation (TUPRAS). The refineries in Izmit produce the annual capacity of 11.5 million tons, Izmir-Aliaga produces 10 million tons, Kirikkale Middle East produces 5 million tons and Batman produces 1.1 million tons. The only refinery established by foreign capital is Mersin-Atas with the production capacity of 4.4 million tons [5].

As a result of its strategic geopolitical location, Turkey is a natural energy corridor between the Caspian, Middle Asia, Middle East Countries and European Markets, aiding its development in its geopolitical power with current oil pipeline projects. The oldest pipeline in Turkey is the Iraq-Turkey Pipeline transmitting Kirkuk's oil to the West. The other pipeline is Baku-Tiflis-Ceyhan Pipeline transmitting Azerbaijan's oil to Ceyhan over Georgia.

The purpose of this paper is to investigate the causality between oil consumption and, as an indicator of economic growth; the real GDP. It is obvious that there is a causal relationship between the oil consumption and the real GDP, but the major question is, which one takes precedence and which one stimulates the other?

There are a number of studies investigating the causal relationship between energy consumption and the GDP. Altinay and Karagol [6] investigate this for the years 1950-2000 in Turkey, finding no evidence of causality. Lise and Van Montfort [7] examine the same relationship for the years 1970-2003 and establish causality runs from the GDP to energy consumption unilaterally. Soytas, et al. [8] investigate the relationship for the years 1960-1995 and find causality runs from energy consumption to the GDP. To the best of our knowledge, there have been no studies specifically addressing the casual relationship between oil consumption and economic growth for Turkey.

DATA AND EMPIRICAL RESULTS

This empirical study uses Turkey's time series data for oil consumption and real GDP. The data set comprises yearly observations over the period 1970-2007, and comes from The BP Statistical Review of World Energy and World Development Indicators respectively.

In this paper, we convey oil consumption in terms of million tons and transform nominal GDP into real GDP using a GDP deflator (using 2000 as the base year).

Table 1: The Results of Unit Root Tests

Variable	ADF Test		PP Test	
	Levels	First Differences	Levels	First Differences
OIL	2.880 (0)	-4.497 (0) *	2.493 (2)	-4.440 (2) *
OIL(c,t)	-2.925 (0)	-5.755 (0) *	-2.930 (1)	-5.758 (2) *
GDP	6.681 (0)	-1.895 (1) **	6.681 (0)	-3.351 (4) *
GDP(c,t)	-2.723 (0)	-5.987 (0) *	-2.819 (1)	-5.987 (0) *

Notes: The numbers inside brackets show optimum lag lengths.
C,t indicate the constant and trend.
*, ** indicate rejection of the null hypothesis of unit root at the 5% and 10% level respectively.

For the first step of the analysis, we tested orders of integration of variables using augmented Dickey-Fuller [9] and Philips-Perron [10] unit root tests. Table 1 reports the results of the unit root tests both with and without constant and linear trends. OIL represents the natural logarithm of oil consumption and GDP represents the natural logarithm of the real GDP. We used Schwarz Information Criterion (SIC) to select the optimum lag length for the ADF unit root test, and employed Newey-West for bandwidth selection for the PP unit root test. Results of both tests indicate that the series are not stationary. However, we obtained stationary status by running the same tests on the first differences of the variables. Hence, the integration of both series of order one, i.e. I (1).

For the second step, we continued to test whether the two series are co-integrated over the sample period since the integration of the two series is of the same order.

Table 2 presents the results of the Johansen test [11]. We employed the SIC as the lag order selection criteria for VAR. According to maximal eigenvalue and trace tests, the likelihood ratio (LR) tests reject the hypothesis of no co-integration. Beginning with the null hypothesis that there is no co-integration among the variables, that is $r = 0$, the maximal eigenvalue statistic is 26.872 which is above the 95 per cent critical value of 19.96. The trace test is 19.005, which is above the 95 percent critical value of 15.67. Hence we can reject the null hypothesis of $r = 0$. However, we cannot reject the null of at most one co-integration vector. So, we can conclude that there is only one co-integration vector between the variables.

Table 2: Results of Johansen co-integration test

H_0	Statistic	5% Critical Value
Maximal Eigenvalue Test		
r=0	26.872*	19.960
$r \leq 1$	7.867	9.240
Trace Test		
r = 0	19.004*	15.670
$r \leq 1$	7.8676	9.240

Note: r is the number of co-integrating relations.
* denotes rejection of hypothesis at 5% significance level.
We obtained the critical values from Osterwald-Lenum[12].

We report the estimation of the co-integration equations in Table 3. We interpret the results as normalizing the vectors on the dependent variable. The numbers in the parentheses show the likelihood ratio test for the significant which we compare with the $\chi^2(r)$ test statistic. Here r shows the number of the co-integrating vectors which equals 1 in our situation. In Model 1, we interpret all the variables to be significant. Focusing on the coefficient of the OIL, we state that oil consumption has a negative effect on the economic growth of Turkey in the long run. When we concentrate on the Model 2, we conclude that the economic growth has no effect in the long run on oil consumption since we found the coefficients insignificant.

Table 3: Estimation of Co-integrating Coefficients.

	GDP	OIL
Model 1	-1*	1.366*
	(4.374)	(4.974)
	OIL	GDP
Model 2	-1	0.73162
	(2.078)	(1.708)

Note: The critical value is 3.841 for the X^2 statistic at the 5% level.
* shows the statistical significance at the 5% level.

Since there is a long-run relationship between the series, we estimate the Vector Error Correction Model (VECM) to capture dynamic relationship. The results of the VECM in Table 4 indicate that there is no short-run causality either from oil consumption to real GDP or from real GDP to oil consumption. We find the coefficient of the ECT to be significant in both equations with a positive coefficient, implying that a deviation from the equilibrium value is not corrected.

Table 4: Results of VECM

Dependent Variable	Source of causation (independent variable)		
	ΔGDP(-1)	ΔOIL(-1)	ECT
Δ GDP	-0.038	-0.035	0.101*
	(-0.198)	(-0.115)	(-0.021)
Δ OIL	-0.325	0.187	0.103*
	(-0.302)	(-0.175)	(-0.033)

Notes: Values in the parentheses show the standard errors.
* indicates the statistical significance at the 5% level.

CONCLUSION

The purpose of this study was to investigate the causal relationship between oil consumption and real GDP for Turkey, and to obtain policy implications of the results. Prior to testing for causality, we used the ADF and PP unit root tests and Johansen co-integration test to test for unit roots and co-integration.

While we found there are no short run relationships between the variables, there exists a long run relationship between the oil consumption and economic growth for Turkey. By focusing the coefficient of the variables in the co-integration equations, we conclude that, in the long run, oil consumption decreases economic growth.

Less than 9% of petroleum consumption is met by domestic production in Turkey [6]. 90% of Turkey's oil need is met by imports especially from the Middle East, Saudi Arabia, Iran, Libya, Russia and the Middle Asia Turkish Republics. Nearly 9% of total import is crude oil and 2.27% of the GDP is expended for oil import. Imported oil is 20-24 million tons [5]. The cost of imported oil was 4 milliard 88 million dollars in 2002, 4 milliard 777 million dollars in 2003, 6 milliard

92 million dollars in 2004, 8 milliard 649 million dollars in 2005, and 10 milliard 870 million dollars in 2006. When we analyse the general energy equilibrium in 2006 we see that the domestic product was 2284 TEP, while the import was 37356 TEP that year. The data for 2007 showed that the domestic product was 2241 TEP, and the import was 38233 TEP. [2]. The economic growth rate was 7% and 5% in 2006 and 2007 respectively.

Thus the obvious conclusion is that the oil consumption in Turkey highly depends on the import. This situation has two effects on the economic growth:

1. Turkey's blooming industry sector and rapidly increasing population will cause energy demand to reach high levels.

2. The high ratio of import will inevitably lead to increasing foreign trade deficits that will negatively affect Turkey's budget and economic growth.

Turkey's energy sector needs restructuring. Electricity Market Law (2001), Natural Gas Market Law (2001), Petroleum Market Law (2003), LPG Market Law (2005), Law of Providing Electricity From Renewable Energy Resources (2005), and the Energy Productivity Law (2007) are the recent developments in the forensic area. But the lack of planning in the sector, the low level of research and development expenditures, and the insufficiency of technological development are the ongoing problems still needing to be solved.

The ultimate goal for Turkey must be to reduce its energy foreign dependency in order to encompass the negative effects on economic growth, foreign trade rates and on the economy as a whole. This will not only contribute Turkey's competition policy but will also aid the welfare of the country.

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