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The Empirical Role of Real Crude Oil Price and Real Exchange Rate on Economic Growth: The Case of Turkey

Reel Petrol Fiyatları ve Reel Döviz Kurunun Ekonomik Büyüme Üzerindeki Rolü: Türkiye Örneği

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ABSTRACT

Mostly national economies need petroleum which is the basic weighted input of the energy day by day. The general price level and production are influenced as a result of the fact that changes in petroleum prices have an impact on input prices. At the same time, fluctuations in the real exchange rate have an important effect on national economies. The aim of this study is to analyze the relationships between economic growth and real crude oil prices and economic growth and real exchange rate and to compare out-of sample forecasting performances of several models. In this context, we use the Gregory and Hansen cointegration method which allows a structural break in the relationship during the period between 1984:1 and 2010:4. Consequently, we find a negative relationship between the real crude oil price and economic growth also negative relationship between the real exchange rate and economic growth in Turkey. We use cointegration equations to establish error correction models, and we obtain forecasts to find which model can characterize of the data better. It is seen that there is a difference between models in terms of out-of sample forecasting performances.

Keywords: Real Crude Oil Price; Real Exchange Rate; Economic Growth; Cointegration Analysis.

ÖZET

Ulusal ekonomiler gün geçtikçe enerjinin temel girdisi olan petrole ihtiyaç duymaktadırlar. Genel fiyat düzeyi ve üretim, girdi fiyatları üzerinde bir etkiye sahip olan petrol fiyatlarındaki değişimlerin bir sonucu olarak etkilenmektedir. Aynı zamanda, reel döviz kurunda meydana gelen dalgalanmalar ulusal ekonomiler üzerinde önemli bir etkiye sahiptir. Bu çalışmanın amacı, ekonomik büyüme ile reel ham petrol fiyatları ve ekonomik büyüme ile reel döviz kuru arasındaki ilişkiyi analiz etmek ve elde edilen modellerin örneklem dışı öngörümleme performansını karşılaştırmaktır. Bu kapsamda, 1984:1 – 2010:4 dönemleri arasında yapısal kırılmaya izin veren Gregory ve Hansen Eşbütünleşme testi kullanılmıştır. Sonuç olarak, ekonomik büyüme ve reel ham petrol fiyatları, ekonomik büyüme ve reel döviz kuru arasında negatif yönlü bir ilişki bulunmuştur. Hata düzeltme modellerini elde etmede eşbütünleşik denklemler kullanılmış ve veri setini hangi modelin daha iyi karakterize ettiğini belirlemek için öngörüler elde edilmiştir. Örneklem dışı öngörümleme performansları açısından modeller arasında bir farkın olduğu görülmektedir.

Anahtar Kelimeler: Reel Ham Petrol Fiyatları; Reel Döviz Kuru; Ekonomik Büyüme; Eşbütünleşme Analizi.

1. INTRODUCTION

The analysis of the impact that asymmetric shocks occurring as a result of uncertainty in exchange rates and oil prices have on economic growth have become a crucial topic among academicians and policy makers in recent years. Economic development has a great importance for less developed countries. A key factor in the economic growth of a country is to increase efficient usage of its economic sources. When the law of supply and demand is considered, the improvement of economic growth must be achieved positively and currently to stabilize the economy. For this reason, the effect of both oil prices and exchange rates on economic growth plays a significant role in economic analysis.

There are actually two types of exchange rates. One of them is the nominal exchange rate showing the relative price of two currencies. The other is the real exchange rate which is one of the indicators used to measure international competition and which

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reflects relative prices of goods and services produced in foreign country in terms of goods and services produced in domestic country. The depreciation of exchange rates increases exports while decreasing imports. However, the appreciation of exchange rates negatively affects exports, while positively affecting imports. Therefore, the depreciation of exchange rates causes income transfer from import countries to export countries. By this way, economic growth of both importation and exportation countries is affected in this case (Aliyu, 2009). When considered in this respect, the issue of exchange rates regime attracts attention as one of the important problems for many developing countries. Mostly, the choice of the fixed, flexible and sustainable exchange rates regimes gives rise to this issue.

In developing countries, there are still discussions about what constitutes a reasonable exchange rate policy. These discussions focus on the degree of the fluctuations in exchange rates in the presence of internal and external shocks. Kandil et al. (2007) stated that exchange rate fluctuations affect national economic performance. The exchange rate regime may affect output growth via an increase in the total factor productivity rate or the factor accumulation rate (Gosh et al., 1997).

It follows from the above discussion that the analysis of oil prices in Turkey's economy is really important because, as Koopmann (1989) points out, changes in oil prices influence economic welfare even if those changes do not reflect on transactions in the oil market. It is well known that the price of crude oil showed only a small nominal change from the Second World War to 1970s. However, afterwards, in the early 1970s, increases in the price of oil had a significant impact on the world economy. The oil crisis of 1973-1974 and the second energy crisis of 1979-1980 were followed by the 1985-1986 inverse shocks. These crises generated substantial interest in understanding oil price fluctuations. The idea that a large rise in the price of oil has a negative effect on the economy is based on the relationship between drops in the economy and times when oil price deviations occurred.

It is widely held in the literature that the volatility of oil prices has important consequences for economic activities (Rodriguez and Sanchez, 2004). These consequences are expected to be different between oil exporting countries and oil importing countries. When oil prices rise, it is clearly to the advantage of oil exporting countries but it is to the disadvantage of oil importing countries. As it is well known that oil prices have an impact on economic activity through the transmission mechanism and supply-demand channels. When we look at supply-side effects, crude oil is the basic input to production and consequently a rise in oil prices causes an increase in production cost and a corresponding decrease in companies' production. At the same time, the volatility of oil prices has demand-side effects on consumption and investment. Also, the volatility of oil prices has an important impact on the exchange market, inflation, real economic activities and employment. Oil price fluctuations and shocks are also important elements in explaining changes in stock prices (Eryiğit, 2009). In this context, Gökçe(2013) states that the impact of structural crude oil price shocks on quarterly economic growth is negative. Edirneligil and Mucuk(2014) point out that the relationship between oil price shock and gross domestic product is negative in the short-run.

The aim of this study is to analyze the effects of oil price and the exchange rate fluctuations in Turkey's economy using a time series model. The importance of oil prices for the developing countries, such as Turkey, has been discussed for many years. Oil price fluctuations are regarded as an important effect on Turkish economy. Otherwise, the exchange rate is one of the broadest measures of country's economic health. For all these reasons, we suggest guidelines for economic policy to accelerate economic development.

This remainder of the paper is organized in the following way. Section 2 explains the role of oil prices and exchange rates in Turkey and the World. Section 3 dwells on literature review. Section 4 of the paper, presents our dataset. Section 5, covers our methodology. Section 6 shows the results and Section 7 discusses what conclusions can be drawn from our results.

2. Real Crude Oil Price and Real Exchange Rate

In this part of the paper, we focus on the impacts of the crude oil price and the exchange rate on the World economy and Turkish economy.

2.1. The Impact of Real Crude Oil Price on Economy

In recent years, the importance of the energy sector in any economy is on the increase and many companies have made their investments to the energy sector because of the world's increased energy needs. Petroleum makes up the lion's share of the primary energy consumption. The importance of the effects of oil price changes on an economy where structural changes are regularly taking place depends on how the relationship between economic growth and oil price is modeled. The following graph shows fluctuations in the average price of oil in the world from 1946 to 2013:

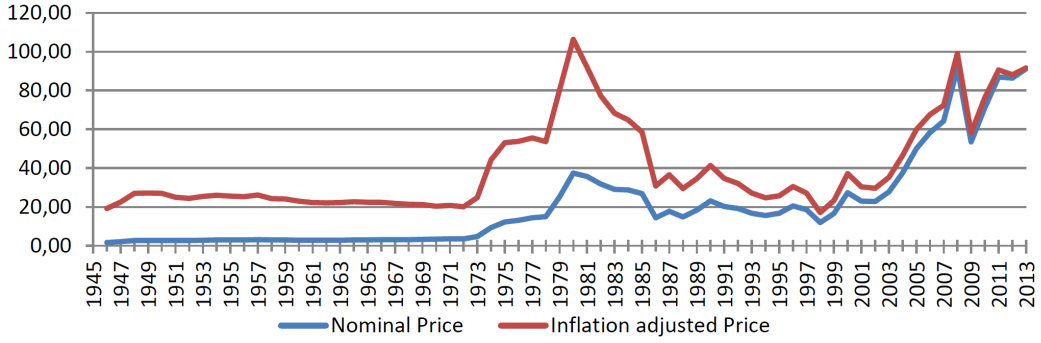

Figure 1: The Average Crude Oil Prices in the World (in US$/Barrel).

As can be seen in Figure 1, crude oil prices have gradually increased over time. The effects of this upward tendency on economic growth have been spotlighted for researchers. Figure 1 also shows that a long period of oil price stability ended in 1973 and oil prices are now more volatile. For this reason, the literature has numerous studies about this subject. These studies do not offer perfect apples to apples comparisons because they use different methodologies and study periods. However, they may help to determine the direction of relationship between oil price and economic growth.

Hooker (1994) shows that oil price fluctuations have an impact on economic development. He also finds that a 10% increase in oil prices would cause a 0.6% decrease in GNP. Mork et al. (1994) demonstrate that there is a negative relationship between a rise in the oil price and GDP growth for all countries except Norway. For other studies, see Mork (1989), Lee et al. (1995) and Hamilton (1996) who state that there is a Granger causality from oil prices to growth before 1973, but no Granger causality between 1973 and 1974. They also find that there is negative relationship between oil price fluctuations and economic downturn. Papapetrou (2001) indicates that variations in oil price have a negative impact on industrial production and employment. Miguel et al. (2003) show that oil prices have a negative effect on the welfare of a country. Notably, Lardic and Mignon (2006) reveal that there is negative relationship between oil price and GDP in nearly all industrialized economies. Jin (2008) determines that while a rise in oil prices has a negative effect on economic growth in Japan and China which are oil importing countries, there is positive effect on economic growth for Russia, an oil exporting country. Gosh (2009) examines the long term relationship between crude oil importation and economic growth. The dataset used in the study includes the annual crude oil import amount, the real GDP and the price of crude oil imported for the time span 1970-1971 to 2005-2006. The empirical results in the study show that the long term income elasticity of imported crude oil is 1.97 and long term or short term income elasticities are statistically significant. At the same time, there is a unidirectional Granger causality from economic growth to crude oil import.

The oil price effects on global growth are inevitable. From the study by Berument and Taşçı (2002), when oil prices rise, inflation also rises. In order to hold inflation to be globally mobilized steady without producing destructive effect, producers should reflect their cost to productions without impacting consumer satisfaction. To manage these dynamics, political conditions must be considered by each country and in its own political situation. This is not only important for developing countries in overcoming crises, but also has vital importance for Turkey.

Inflation activation depends on the types of intervention methods and how supply will be shaped. The interest rate in a country has an impact on determining the direction of this inflation activation. It is very important that the fall of inflation maintains its own continuity under the pressure caused by the high oil prices in Turkey. The oil prices affecting production in developing countries such as Turkey should be considered as direct factor in macroeconomic planning. State intervention is important as well as world oil prices and exchange rates for rising oil prices in Turkey. It is known that a rise in oil price leads to increased inflation when compared to the world economy and a current account deficit because of imports. Therefore, it is mentioned that Turkey, which implements economic program that is conducted with inflation struggle, and which has significant current account deficit, may face a threat to existing economic stability because of rise in oil prices.

The effects of rising oil prices on Turkey's economy are summarized as follows. Many countries which want to be minimally affected by unexpected rising oil prices follow a protective policy with respect to trade balances. Hence, Turkey reduces its export demand. This causes balance of payments problems and revenues to fall in Turkey. It is also seen that total imports of crude oil for Turkey in 2008 were 21.4 million tones, but there was a significant decline from 21.4 million tons in 2008 to 14.19 million tons in 2009 (Petroleum Market Sector, 2010). With oil prices increasing rapidly in the recent past, although Turkey exports less crude oil, they have been obliged to pay more than its real price. For this reason, the balance of payments will run into problems. It is not surprising that changes in oil prices have been considered as having an important role in economy. Figure 2 shows the history of the price of a barrel of oil for Turkey.

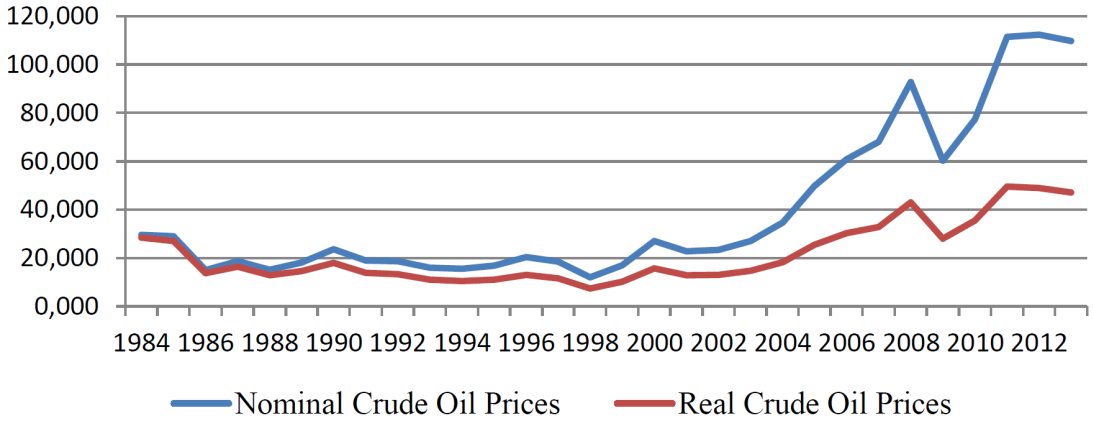

Figure 2: Crude Oil Barrel Average Price in Turkey(US$).

As seen in Figure 2, although the two series move similarly, nominal crude oil prices appear to be considerably higher than real crude oil prices. Figure 3 also shows that the crude oil price has increased dramatically since 2001. In 2009, it is clear from Figure 2 that there was a sharp decline in oil prices because of the global crisis in 2008.

2.2. The Impact of the Exchange Rate on Economy

The other important point of this study is to analyze the effects of the real exchange rate on economic growth. Domaç and Shabsigh (1999) reveal that the long run deviations of the current exchange rate have an inverse impact on economic growth. Razin and Collins (1999) discover that the real exchange index correlates negatively with economic growth for a pooled sample of 93 developed and developing countries. Eichengreen and Leblang (2003) determine that there is a negative relationship between exchange rate stabilization and economic growth for twelve countries over a 120 year period. Jin (2008) establishes that real exchange rate appreciation leads to positive economic growth in Russia and a negative economic growth in Japan and China. Gosh et al. (2009) find out that there is a little relationship between real exchange rate and economic development. Aliyu (2009) states that a

10 percent exchange rate increase will cause a 0.35 percent GNP increase for Nigeria.

On the basis of these above studies, we can conclude that the effects of exchange rate on a country's economy are very important for the country's economic future. This is why we must understand the concepts of exchange rate, nominal exchange rate and real exchange rate and also analyze the effects of exchange rate volatilities.

The exchange rate expresses one currency's is interchangeability with another currency. The real exchange rate is a measure of the competitiveness of a country. External and internal shocks cause deviations from the real exchange rate's long run value. These deviations can reach large magnitudes in serious crisis situations.

Volatilities in exchange rates affect economic stabilization. From the point of view of economic stabilization, the persistence of exchange rate volatility is a indicator of economic destabilization. The following Table 1 shows the real exchange rate index for different regions of the world.

Table 1: Real Exchange Rate Index for Some Countries (2010 = 100)

Country	1990	2000	2009	2014
North America	109.24	117.93	105.15	97.82
Latin America	115.99	99.52	104.24	93.22
South America	104.94	94.46	76.82	66.88
Europe	104.45	131.52	95.14	94.84
EU New 13	293.97	146.05	87.24	85.03
Asia and Oceania	86.77	94.86	93.81	91.09
Africa	139.59	103.72	81.44	76.91

Resource: ERS International Macroeconomic Data Set.

When the data provided in Table 1 regarding the real exchange rate index is analyzed, it is clearly seen that the real exchange rate index in 1990 is higher than the index in 2014 for North America, Latin America, South America, Europe, EU New 13 and Africa. This result shows that there was an excessive appreciation of the currency in 1990. It is quite clear that there is an appreciation of the currency in 2014 for only Asia and Oceania when comparing 1990 to 2014.

The results in Table 1 show the number of countries exposed to fluctuations in the real exchange rate. These fluctuations can cause problems in providing economic stabilization. Many politicians take a lively interest in the behavior of the nominal and real exchange rates. One of the most important reasons of this concern is that nominal exchange rate volatility affects the inflation rate and changes in the real exchange rate have an impact on households' welfare and resource allocation. Changes in the real exchange rate are related to the domestic inflation rate, taxes, changes in factor productivity, subventions and nonprice restrictions. For this reason, the effects of changes in the real exchange rate on Turkey's economy are considered throughout the study. Figure 3 presents the real exchange rate fluctuations between 1970 and 2014 in Turkey.

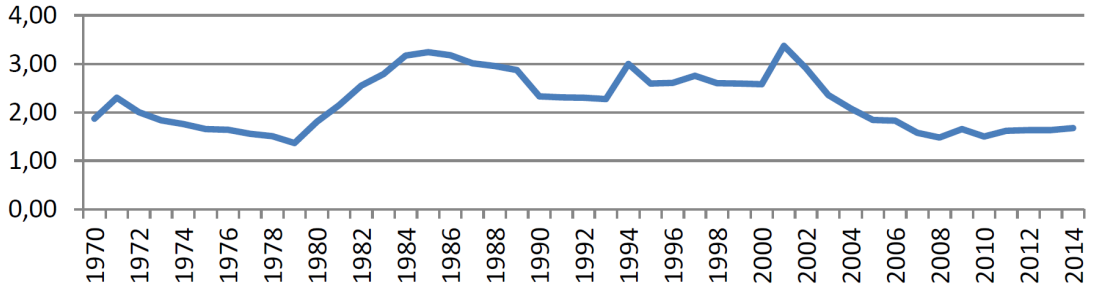

Figure 3: Real Exchange Rate between 1970 and 20014 in Turkey (2010 =100).

As Figure 3 shows, the real exchange rate in Turkey seems to be on the decline after 2001. This drop in the real exchange rate is a considerable reason for Turkey's foreign trade deficits.

3. Literature Review

In this section, the literature review consists of two distinct parts. The first part is about the relationship between crude oil price and economic growth in Turkey. The second part is intended for the impact of the exchange rate on economic growth in Turkey.

Aydın and Acar (2011) discuss that the oil price shocks have a negative impact on economic growth, and they find that the effects of oil price shocks on Turkish economy are negative and very large. Yıldız and Ulusoy (2013) provide evidence on the existence of the negative relationship between the crude oil price changes and Turkish economy. Güney and Hasanov (2013) find that oil price increases caused the negative effects on output growth in Turkey during the period of 1990Q1-2012Q3. Çatık and Onder (2013) analyze the relationship between oil prices and output using two-regime Threshold VAR model. They show that the oil shocks have larger impact on output when oil price change exceeds the optimal threshold level. Gokmenoglu, Azin and Taspinar (2015) indicate that during the period 1961-2012, oil price changes have significant effect on industrial production of Turkey. Ozturk (2015) shows that there is a negative relationship between oil price volatility and industrial production in Turkey over the period 1990Q1-2011Q4.

Berument and Dincer (2004) find that the increase in exchange rate risk has a negative effect on output. Uğurlu (2006) examines the relationship between exchange rate and economic growth. The findings of his study show that an overvalued domestic currency has detrimental effect on output in the long-run. Kandil, Berument and Dincer (2007) investigate the effects of exchange rate fluctuations on economic activity in Turkey. They find that there is an adverse relationship between the growth of real output and exchange rate appreciation. Özbilgin (2015) states that when the exchange rate stays at a competitive and stable level, it can be regarded as a key role of achieving the essential progression in the fundamental determinants of growth. Ünlü (2016) analyze the relationship between exchange rate volatility and economic growth in Turkey. In this respect, he finds that the real exchange rate volatility has significantly negative effect on the real gross domestic product.

4. Data Definitions

In this study, we use monthly data covering 1984:1-2010:4 such as crude oil price, the real exchange rate and the industrial production index. We choose industrial production index instead of gross domestic product because of studying monthly data. As seen in dataset, all observations are observed as starting in 1984. As military Coup d'etat period ended and civil one party governance came into power by 1983 elections, 1984 was chosen as starting year. We can clearly see that a number of earlier studies on the subject of forecasting performance focused on the sample size. Granger (1993) emphasized that at least 20 percent of the data must be used for out-of-sample forecasting performance assessed using nonlinear forecasting models. For this reason, we obtain observations until the date of 2010. The crude oil prices are adjusted by using the consumer price index. Also, both real oil prices and the industrial production index are seasonally adjusted because the use of monthly data. These data are obtained from the Turkish Statistical Institute (TUİK) and the Central Bank Electronic Data Delivery System. Similar to the previous studies, all the variables are expressed in logarithmic form. Generally speaking, taking the logarithmic forms of the variables is done to reduce their scale before considering the relationship between them. The notations of these variables are as follows:

LNIP = Logarithmic Industrial Production Index
LNRCOP = Logarithmic Real Crude Oil Price
LNRER = Logarithmic Real Exchange Rate

Economic time series are typically non-stationary series. Non-stationarity is important for the methods used in this study. Stationarity means that the mean, variance and covariance are all constant over time and the covariance between different lags is constant. If economic time series show time-changing levels or variances, it means that there is non-stationarity in the variables. It is seen in the literature that there are different types of unit root tests. After a unit root test, the cointegration test is applied to identify long term relationship between two variables. In the context of this paper, the Agumented Dickey Fuller unit root test and the Gregory-Hansen cointegration test that allows for a possible structural break are used.

The results of the unit root tests and Gregory-Hansen cointegration method are discussed in the next section. In these sections, all datasets will be analyzed whether or not they have unit roots because it is vital to know whether they are stationary.

5. Research Methodology

In studies related to time series, the cointegration tests are used to estimate long run relationship between time series variables. If a time series is non-stationary and has a trend over time, then this time series is a random walk series. It is important to note that we need to test whether the time series is stationary or not before using the cointegration test. The most common test for determining the order of integration is the Augmented Dickey-Fuller test (ADF) introduced by Dickey and Fuller (1979).

The cointegration technique assumes that cointegrated variables will be attracted to their long run relationship. This also means a long term relationship between conintegrated variables exists and that this relationship is stationary (Mezra, 2007). To sum up, if the linear combination of non-stationary variables is stationary, the cointegrating relationship between variables exists.

In this paper, the relationship between two variables is estimated by using the Gregory-Hansen cointegration test. What we wish to do in this section is to test the following hypotheses:

H_0 : There is a long-run relationship between economic growth and real crude oil price

H_A : There is no long-run relationship between economic growth and real crude oil price

H_0 : There is a long-run relationship between economic growth and real exchange rate

H_A : There is no long-run relationship between economic growth and real exchange rate

Gregory and Hansen (1996) study cointegrating relationship in cases where structural breaks exist. They carry out their procedure for testing cointegration in the case of level, trend and regime shifts. By applying Monte Carlo simulations, they also show that the power of the Engle-Granger test decreases only if the cointegrated variables experience a change or break in their cointegrating relationship. Gregory and Hansen (1996) suggest the following three models called level shift, level shift with trend and regime shift respectively (Cook, 2006).

Model C: $y_t = \mu_0+\mu_1\varphi_{tk}+\alpha x_t+w_t$ (1)

Model C/T: $y_t = \mu_0+\mu_1\varphi_{tk}+\beta t+\alpha x_t+w_t$ (2)

Model C/S: $y_t = \mu_0+\mu_1\varphi_{tk}+\alpha_1 x_t+ \alpha_2\varphi_t x_t +w_t$ (3)

Where y_t is the dependent variable, x_t is the independent variable, t is time, w_t is the error term, k is the break date and is a dummy variable such that:

$$\phi_{tk} = \begin{cases} 0, & t \le k \\ 1, & t > k \end{cases} \quad (4)$$

Gregory and Hansen (1996) suggest that a grid search procedure is useful for calculating k. The above models are estimated with resulting residuals $\{\hat{w}_t\}$ for each value of k and these residuals are saved and employed in the following Dickey-Fuller test equation.

$$\Delta\hat{w}_t = (\rho-1)\hat{w}_t + v_t \quad (5)$$

Also, the augmented Dickey-Fuller test may be employed by adding the lagged values of $\Delta\hat{w}_t$. The t statistics for each of the models are given as the minimum t value of estimated $(\rho-1)$.

6. Empirical Results

In this part of the study, we first focused on the stationary analysis of the variables. These tests show that the industrial production index, real crude oil prices and real exchange rate variables are not stationary, but all variables are said to be difference-stationary after taking first differences. For this reason, all variables are first-order stationary. The following Table 2 shows the results of ADF unit root test.

Table 2: ADF Unit Root Test

	Level		First Difference	
	Intercept	Intercept-trend	Intercept	Intercept-Trend
ADF				
LNIPI	-0.716	-2.952	-11.052*	—
LNRCOP	-2.127	-2.675	-12.836*	—
LNRER	-1.463	-2.565	-14.653*	—

Not: *, ** and *** implies significance at %1, %5 and %10 levels respectively.
— not given because there is no trend after taking difference.

When Table 2 is analyzed, it is clearly seen that none of the variables are stationary in the levels and therefore they are integrated of order I(1). Next the Gregory-Hansen cointegration test is applied to test for possible structural breaks in the aforementioned models. We use two regression equations to estimate the relationship between variables. The reason is because there is a relationship between crude oil price and exchange rate (Doğan *et. al*., 2012; Eryiğit, 2012). We do not calculate regression with multiple independent variables to avoid the multicollinearity. Theoretically speaking, three models are estimated to determine the time of a structural break and to test for the existence of any cointegration relationship between not only economic growth and real crude oil price but also economic growth and real exchange rate.

Regarding the above results, it seems that in spite of the structural breaks, the relationship between economic growth and both the real crude oil price and the real exchange rate still exist during 1984:1-2010:4.

Table 3: Gregory-Hansen Cointegration Test Results

Models	ADF*	Tb	Z_t*	Tb	Z_a*	Tb
Economic Growth- Reel Crude Oil Prices						
C	-3.673	November, 1990	-4.427***	March, 1991	-32.468	March, 1991
C/T	-4.349	September, 1997	-7.574*	February, 1999	-91.494*	February, 1999
C/S	-4.734***	September, 1991	-6.050*	October, 1990	-62.567*	October, 1990
Economic Growth- Reel Exchange Rate						
C	-5.695*	October, 1993	-8.183*	February, 1994	-103.149*	February, 1994
C/T	-4.259	September, 1997	-10.012*	July, 1998	-146.916*	July, 1998
C/S	-5.879*	June, 1994	-8.438*	February, 1994	-109.326*	February, 1994

Not: The critical values are from Gregory-Hansen (1996a).
*, ** and *** implies significance at %1, %5 and %10 levels respectively and rejecting H_0 of no Cointegration.

Table 4: The Relationship Between Economic Growth and Real Crude Oil Price

Variable	Coefficient	Standard Error	t-statistic	Prob.
Cointegration with level shift				
C	4.563	0.065	69.716	0.000
LNRCOP	-0.148	0.024	-6.005	0.000
March, 1991	0.576	0.025	22.272	0.000
Cointegration with level shift and trend				
C	3.886	0.041	93.862	0.000
Trend	0.002	7.70E-05	28.929	0.000
LNRCOP	0.008	0.014	0.635	0.525
February, 1999	0.108	0.021	5.142	0.000
Cointegration with regime shift				
C	4.929	0.062	78.589	0.000
October, 1990	-1.197	0.151	-7.881	0.000
LNRPF	-0.288	0.023	-12.125	0.000
(October, 1990)*LNRPF	0.564	0.047	11.792	0.000

Table 5: The Relationship Between Economic Growth and Real Exchange Rate

Variable	Coefficient	Standard Error	t-statistic	Prob.
Cointegration with level shift				
C	4.619	0.038	119.113	0.000
LNRER	-0.642	0.054	-11.738	0.000
February, 1994	0.178	0.029	5.961	0.000
Cointegration with level shift and trend				
C	4.206	0.021	197.039	0.000
Trend	0.001	5.76E-05	34.537	0.000
LNRER	-0.383	0.026	-14.711	0.000
July, 1998	-0.018	0.014	-1.271	0.225
Cointegration with regime shift				
C	4.621	0.044	103.124	0.000
February, 1994	0.173	0.053	3.242	0.001
LNRER	-0.645	0.063	-10.15	0.000
(February, 1994)*LNRER	0.013	0.125	0.106	0.915

As can be seen in Table 4 and Table 5, both the real crude oil price and the real exchange rate have a negative effect on economic growth.

The results in Table 4 indicate that a rise in the real crude oil price has a negative impact on economic growth. In developing countries like Turkey, an important factor that must be taken into account in macroeconomic planning is that the crude oil price directly affects production. The only condition for oil prices not to reflect on growth rate directly and in a fragile way depends on the successful implementation of the management of the costs' reflection on end products. At this point, the responsibility belongs to both producers and governments. Also, the breaks in October 1990 and March 1991 were largely caused by the Gulf crisis. This period of higher oil prices adversely affected world growth and hence growth in developing countries. Since February 1999,

there have been increases in oil prices in the global economy. The reason for the increases in oil price is that OPEC cut production to revive the crude oil price. It is well known that a rise in oil prices slows the economic growth. As can be seen from Table 4, all of the breaks are statistically significant.

The results in Table 5 show that there is a negative relationship between economic growth and the real exchange rate. This can be interpreted as indicating that a rise in the exchange rate will negatively affect economic growth. It is evident that fluctuations in the real exchange rate have an adverse effect on Turkey's economy. The break in February 1994 points out the financial crisis in Turkey. Turkey's economy experienced GDP tightening because of this crisis. As can be seen in Table 5, this break in the cointegrating relationship is statistically significant.

After estimating and interpreting the cointegrating relationship between economic growth and the real crude oil price and between, economic growth and the real exchange rate, we compare the forecasting performances of the level shift, level shift and trend and regime shift models with respect to their Mean Square Error (MSE) and Mean Absolute Error (MAE). Both MSE and MAE are regularly employed in model evaluation studies. The MSE and the MAE are calculated as follows:

$$MSE = \frac{1}{n}\sum_{t=1}^{n} e_t^2 \quad (6)$$

$$MAE = \frac{1}{n}\sum_{t=1}^{n} |e_t| \quad (7)$$

where e_t is the forecast error at period t and n is the number of observations used in computing the measures.

To forecast the industrial production index, we need to establish an error correction model. We can get the residual series $\{e_t\}$ from the cointegration Equation 1, Equation 2 and Equation 3 (see the estimated parameters in Table 4 and Table 5). After obtaining residual series, we can estimate the error correction models for the relationship between economic growth and the real crude oil price, and also between economic growth and the real exchange as follows:

$$\begin{aligned}
&\Delta LNIPI = -0.0023 + 0.040\Delta LNRCOP - 0.018ECM_{t-1} \rightarrow \text{level shift}\\
&\Delta LNIPI = 0.0056 + 0.037\Delta LNRCOP - 0.129ECM_{t-1} \rightarrow \text{level shift and trend}\\
&\Delta LNIPI = -0.0097 + 0.068\Delta LNRCOP - 0.122ECM_{t-1} \rightarrow \text{Regime shift}
\end{aligned} \quad (8)$$

$$\begin{aligned}
&\Delta LNIPI = -0.0089 - 0.170\Delta LNRER - 0.175ECM_{t-1} \rightarrow \text{level shift}\\
&\Delta LNIPI = 0.0193 - 0.129\Delta LNRER - 0.106ECM_{t-1} \rightarrow \text{level shift and trend}\\
&\Delta LNIPI = -0.0092 - 0.171\Delta LNRER - 0.177ECM_{t-1} \rightarrow \text{Regime shift}
\end{aligned} \quad (9)$$

The most accurate forecast will have the smallest MSE and MAE. The one-period-ahead monthly MSE and MAE for the May 2010-March 2014 period of industrial production index are shown in Table 6.

Table 6: Forecasting Performances of Models

	Relationship Between Economic Growth and Real Crude Oil Price		
	Level Shift	Level Shift and Trend	Regime Shift
MSE	0.0022	**0.0019**	0.0021
MAE	0.0361	**0.0326**	0.0364
	Relationship Between Economic Growth and Real Exchange Rate		
	Level Shift	Level Shift and Trend	Regime Shift
MSE	0.0021	0.0023	0.0021
MAE	**0.0356**	0.0367	0.0358

Empirically speaking, the results of the forecasting performance of models show that level shift and trend model has better out-of sample forecasting performance than other models while using the cointegrating relationship between economic growth and the real crude oil price, but the level shift model performs better out-of sample forecasting performance for the cointegrating relationship between economic growth and the real exchange rate. The resulting forecasts are shown in Figure 4 and Figure 5.

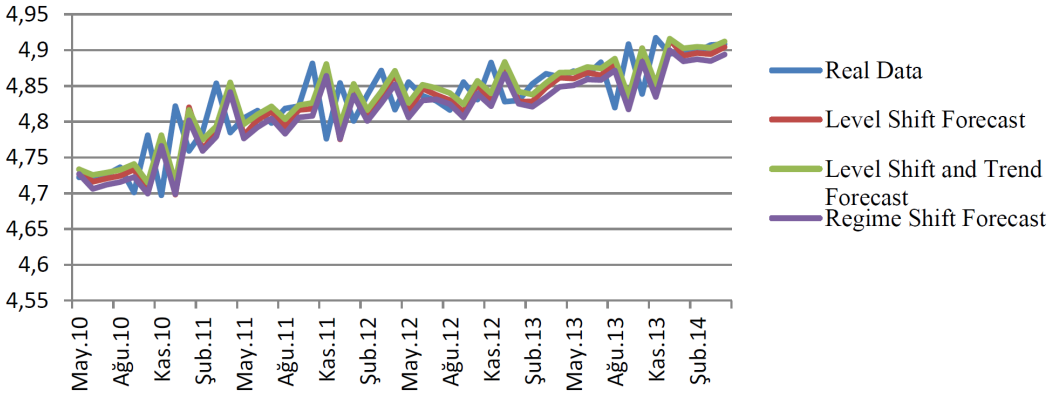

Figure 4: Real and Forecasted Industrial Production Index calculated by Equation 7.

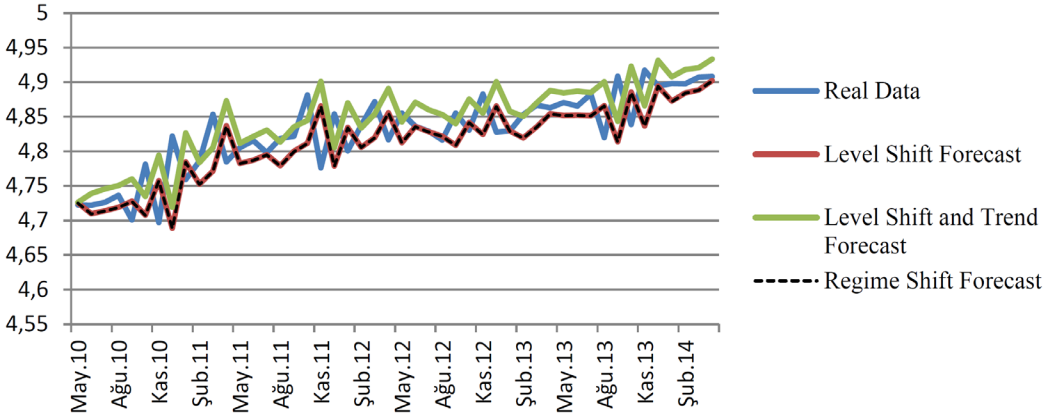

Figure 5: Real and Forecasted Industrial Production Index calculated by Equation 8.

7. Conclusions

In this paper, we have used the Gregory-Hansen cointegration test to estimate the relationship between economic growth and both the real crude oil price and the real exchange rate during the period from January 1984 to April 2010. In accordance with the purpose of the study, the industrial production index is used to represent economic growth.

Our study reveals that there exists a cointegrating relationship between economic growth and both the real crude oil price and the real exchange rate after allowing for structural breaks. At the same time, there are negative relationships between economic growth and both the real crude oil price and the real exchange rate. While the structural breaks yield meaningful cointegrating coefficients for the relationship between economic growth and the real crude oil price, there are only two breaks with an intercept shift and regime shift in February 1994 that yield meaningful cointegrating coefficients for the relationship between economic growth and the real

exchange rate. As seen in the literature, these results are consistent with the findings of other studies related to this topic.

When we consider low oil production in Turkey, it is seen that the oil export level from Turkey to other countries stays low. In this context, Turkey is an oil importing country rather than oil exporting country. As a matter of course, the economic growth of oil importing countries is adversely affected by rising oil prices. Increases in the real crude oil price are detrimental to the growth of Turkey's economy. From the results of this study, the negative relationship between economic growth and the real crude oil price meets our expectations for Turkey. It is well established that as an oil-importing country, Turkey, has been suffering from high oil prices for years. The government of Turkey must implement policy reforms to reduce oil prices because a decline in oil prices will help to the reduce cost of living. Also, Turkey will benefit from declining oil prices because the value of its oil imports will drop. Turkey's large current account deficit will be affected as a result of lower oil prices and this will cause lower financing needs. In summary, when the relationship between economic growth and real crude oil price is taken into consideration, the impact of lower oil prices on Turkey's economy is sizeable.

An increase in the real exchange rate or an over valuation of the Turkish lira has a negative effect on economic growth. It becomes evident that policies which provide for exchange rate stabilization or hot money flows caused over valuation of the Turkish lira must be implemented. The striking suggestion for policy makers is to consider the structure of the fragile Turkish economy while determining macroeconomic policies.

In terms of forecasting results, when a structural break occurs in a cointegrating relationship, the forecasting performance of any model is influenced adversely. To make accurate forecasts, possible structural breaks must be considered in the model. However, the Gregory-Hansen cointegration test allows only one structural break in the cointegrating relationship. For the further studies, both when analyzing the structure of Turkish economy and making forecasts, other tests enabling more than one structural break must be taken into account.

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