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CHANGES IN FUEL OIL PRICES IN TURKEY: AN ESTIMATION OF THE INFLATION EFFECT USING VAR ANALYSIS

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ABSTRACT: In the past, the Turkish economy went through a long period of hyperinflation. In recent years, inflation has fallen to 8-10% due to the government's "price stability" policy. In the last decade the gradual rise in global crude oil prices has increased expectations of a possible inflationary effect in Turkey which is an oil importer. In this study, the relationship between the consumer price index and the fuel oil price index in Turkey was examined in the time interval monthly data of 2005-2010 using the Vector Error Correction Model. Study results revealed that a 1% increase in fuel oil prices caused the consumer price index to rise by 1.26% with an approximate one year lag. Moreover, the change in fuel oil prices was found to be the one-way Granger cause for changes in the consumer price index.

KEYWORDS: Oil prices, inflation, Turkish economy, time series, Error Correction Model.

JEL Classification: C22, E 31, Q 43

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Introduction

The Turkish economy has witnessed constant fluctuations in fuel oil prices during the last decade as a result of the fluctuations in crude oil prices in international markets. Therefore, continuously changing crude oil prices also caused fluctuations in fuel oil prices in Turkey. Especially in the aftermath of the financial crisis we experienced in 2001, changing fuel oil prices hampered the success of the anti-inflation program executed by the Central Bank of the Turkish Republic. This study aims to examine the effect of monthly changes in the fuel oil price index including the market prices of commonly consumed unleaded fuel and diesel between, 2005:1 and 2009:12 on inflation in the same period. Determining the possible effects of continuously changing fuel oil prices in Turkey on the "price stability" policy, which the central bank considers a priority, has become a significant issue in terms of providing policy makers with definitive information.

In line with the above-mentioned objective, the first part of this article introduces the developments in the international oil market and the Turkish economy; the second part summarizes the literature on the subject; the third part presents the data and econometric estimations and results; and the final part introduces a general evaluation of the study's findings.

Relationship between Oil-Fuel Oil Prices and Inflation

Positive or negative developments that occurring in the international oil market creates certain effects, especially on the economies of nations like Turkey where large portions of their oil needs are imported. Unfavorable developments, such as international oil bottlenecks and extreme price increases, have a negative effect on national production as well as on the balance of international payments to countries. For example, manufacturing industries use oil intensively, especially to fulfill their transportation needs; when they experience an increase in production costs (cost-push inflation), there is a rise in inflation index values in the oil industry and in energy production (M. Cavollo, 2008). During the first oil crisis experienced in the early years of the 1970s, many countries were adversely affected considerably by increasing oil prices. Conducting research on the effects of oil-dependent developments on national economies became an attractive subject.

Serious increases in oil prices began to be observed in the early 1970s. Trust in Keynesian policies, which until then held a pivotal position in the field of macroeconomics, began to be lost as a result of inflation and unemployment. After this period, the theory of Monetary Macroeconomics, which rejected the existence of a significant relationship between unemployment and inflation in the long term,

gradually became dominant, and understanding the original Philips curve was considered to be invalid in the long-run.

Inflation is defined as the continuous increase of general price levels in a country. Inflation may arise as a result of the pressure of demands in an economy or pressure caused by an increase in production costs. According to the Classical Macroeconomics approach, an increase in money supply does not affect real variables like national income, employment and interest rate in an economy, but it does cause a rise in inflation in the same ratio as seen in the Fisher Equation. According to the Keynesian approach, on the other hand, it is assumed that an increase in demand in economy will trigger inflation which rejects the Fisher Equation that stability in the circulation rate of money and national income at full employment levels prevents inflation. In line with the monetarist view adopted by Friedman, the most important cause of inflation is when increases in the money supply exceed the economic growth rate. According to Friedman, the money supply should be increased at the ratio of economic growth to prevent inflation. According to the Rational Expectations theory, which is based on the assumption that individuals are rational beings and therefore will not make systematic mistakes, inflation is a consequence of the economic policies applied by governments. This theory argues that the best politics is "policy-free politics".

As revealed by the brief summary of the approaches to inflation in macroeconomic theory presented above, increases in general price levels tend to occur as a result of economic factors, such as production costs, excessive increases in demand, money-finance policies employed and finance methods used to deal with public deficits. It has been reported that inflation in developing countries is caused by monetary developments (Sargent and Wallace 1981), adverse balance of payments and foreign exchange rate policies adopted (Liviatan and Piterman 1986), budget constraints (Bruno and Fisher 1990), supply shocks resulting in increased production cost (Ball and Mankiw 1995), or fixed exchange rate regimes (Loungani and Swage 2001). Burbidge and Harrison (1984), in their study on the causes of inflation, established a positive relationship between the inflation index and increases in oil prices. Ball and Mankiw (1995) noted that oil supply shortages will have a negative impact on inflation due to production costs. LeBlanc and Chinn (2004) determined that the inflationary impact of increases in oil prices was higher in the European Union than in the United States and Japan.

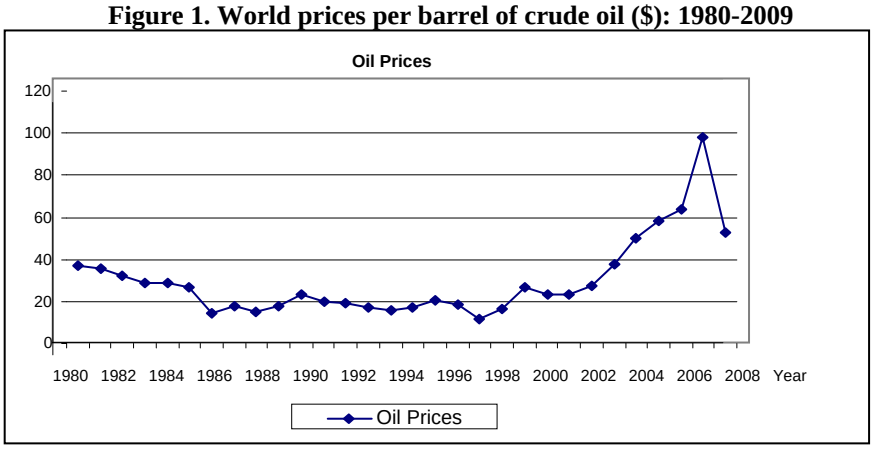
Few studies are available in literature on the inflationary effect of fuel oil price which is considered as "final goods" in economic terms. Studies conducted on Turkey with regard to this issue are noteworthy. Some of these studies include

those by Kibritçioğlu and Kibritçioğlu (1999), Berument and Taşçı (2002), Çelik and Çetin (2007).

Oil Market and the Turkish Economy

Serious fluctuations in oil prices were not observed between the Second World War and the first oil crisis. However, due to the embargo imposed by Arab states when the Arab-Israeli War started in the early 1970s, prices per barrel of crude oil increased from approximately 3 $ to 12 $. Oil prices were fixed at about 12 $ between 1974-1978, but they started to rise again with the tension created by the Iran-Iraq war. The price of crude oil, which was about 14 $ per barrel in 1978, increased to 35 $ in 1981. Since the Organization of Petroleum Exporting Countries (OPEC) failed to assure stability in the market, oil prices hit the bottom in 1986, and the price per barrel fell below 15 $. Low oil prices increased again in 1991 with the Iraq- Kuwait War, and, they rose to about 30 $ after a considerably period of time. Increased oil production in the following year led to a decrease in prices, but prices increased again when Russia reduced oil production in 1997. A decrease in oil prices was observed in 2001 following the decline in the American economy, but oil prices showed a continuous increase until 2008 when the price per barrel of crude oil broke a record and reached about 100 $. This was due to a number of factors such as OPEC did not increase its oil production, and China's oil demand increased considerably. By the end of 2008, oil prices dropped, and the price per barrel fell to about 70 $ due to the decrease in total production rates and a decrease in oil demand, an effect of the global financial crisis. The changes observed in oil prices after 1980 are shown in Figure 1 below.

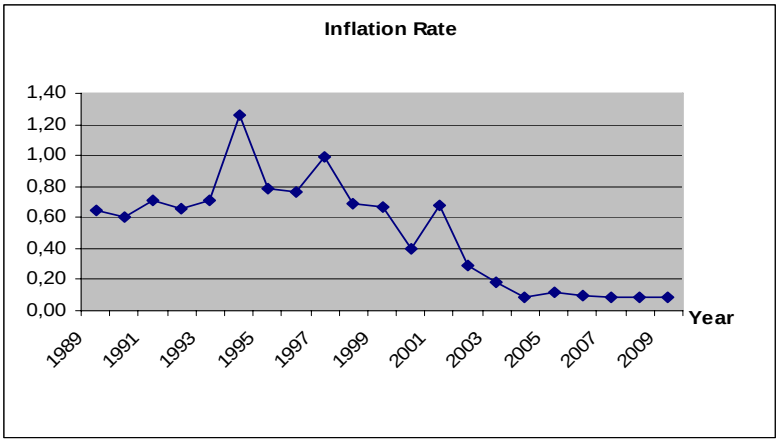
Figure 1. World prices per barrel of crude oil ($): 1980-2009



Source: BP historical oil price data.

Regarding developments in the Turkish economy, the rate of inflation in Turkey increased noticeably, especially after the first oil crisis. Inflation was seen to rise to three-digit figures from 1979 to 1980 when the second oil shock shook the world. During the period when these developments occurred, Turkey was able to meet only about 5% of its total oil needs in terms of production. As a result of economic policies implemented after the 1980s when foreign expansion started in Turkey as it did all over the world, the inflation rate fell from 100% to 30-35%. This decline in the inflation rate gave way to a further rise again as from 1987 onwards. Although global oil prices hit bottom in 1986, it was determined that decreasing oil prices did not have a significant effect on economic growth rates in Turkey and several other countries. The studies conducted in this period concluded that increased oil prices didn't coincide with a decrease in their effect on the economy; this effect was asymmetric in nature (Mork 1989, Bohi 1991, Hamilton 2001).

Figure 2. Inflation in Turkey (%): 1989-2009



Source: TÜİK (Turkish Statistics Institute), Annual Statistics, 2009.

Due to the economic crisis experienced in Turkey in 1994, the inflation rate again reached three-digit figures; this situation continued until 2003. As shown in Figure 2, the "anti-inflation program" implemented in 2003 resulted in a decline in inflation rates in 2006-2007 down to a single-digit figures like 9% in Turkey where inflation rates had not dropped below two-digit figures for more than 30 years. In addition, at this time crude oil prices exceeded 100 $ per barrel in the international markets. With the impact of recent developments and the global financial crisis, the inflation rate in Turkey has again risen to two-digit figures. Despite the fact that some oil sources were discovered in Turkey during this period, Turkey is still in the position of being a country which can only meet 10% of its total oil needs from

its own sources. This situation has increased the possibility of rising oil prices affecting inflation rates in Turkey, where, in particular, the changes in fuel oil prices have recently been automatically bound to developments in international markets.

Data and Econometric Estimation

Monthly time series for the period between 2005:1 – 2009:12 were used in this study to determine the relationship between fuel oil prices and inflation in Turkey. To study inflation rates, monthly index values introduced by TUIK (Turkish Statistics Institute) were considered. Gasoline (95 octane) and Euro diesel prices were found by calculating the monthly average prices of the OPET fuel oil distribution firm. Gasoline and diesel prices were converted to real values by dividing them by the CPI index (Consumer Price Index); a fuel oil price index (FUELINDEX) was formed by the weighted average of two variables as the values of these two variables increased and decreased concomitantly. A natural logarithm was calculated for the variables used in the research.

In several studies where time series were used, it was observed that these series included a unit root and were not stationary (Engle and Granger 1987, Enders 1995). Conscious of the fact that results obtained from analyses performed with an unstable time series could be spurious, unit root test results of data used in this study are given below:

Table 1. Unit Root Test Results (Augmented Dickey-Fuller Test)

	ADF t-stat. Intersection (C)	*Critical values*	*ADF t-stat. Int. (C) and Trend (T)*	*Critical values*
Variables		Level		
LNCPI	-0.13	1% -3.54 5% -2.91	-2.76	1% -4.13 5% -3.49
LNFUEL INDEX	-0.79	10% -2.76	-1.44	10% -3.17
		1st.Difference		
LNCPI	-6.90*	1% -3.54 5% -2.91	-6.82*	1% -4.13 5% -3.49
LNFUEL INDEX	-6.01*	10% -2.76	-6.01*	10 % -3.17

Note: Augmented Dickey-Fuller (ADF) test results show that level values of variables include the unit root. According to Schwarz Information Criterion (SIC) the maximum lag length was taken as 10. According to ADF test results the first difference of the variables does not include unit root at 1%.

Using the Augmented Dickey-Fuller (ADF) test, we determined whether the variables to be used in the model included a unit root. While the ADF test was being performed, maximum lag length was taken as 10 according to Schwarz Information Criterion (SIC). The Tramo-Seats method was used to clear the variables of seasonal effects. The Augmented Dickey-Fuller (ADF) test results revealed that the level values of variables included a unit root. According to the results of the ADF test performed with the first differences of variables, all three variables had stationary characteristics in the trend and intersection sections as shown in Table 1.

Table 2 demonstrates the results of the test performed to determine the optimal lag length in the VAR model used in our predictions.

Table 2. Analysis of lag length selection criteria of VAR model

Delay	LogL	LR	FPE	AIC
0	103.8853	NA	4.49e-05	-4.335543
1	308.2045	382.5551	8.92e-09	-12.85976
2	310.4558	4.023726	9.62e-09	-12.78535
3	310.9123	0.777012	1.12e-08	-12.63457
4	312.9900	3.359559	1.22e-08	-12.55276
5	316.0703	4.718835	1.28e-08	-12.51363
6	321.9973	8.575234	1.20e-08	-12.59563
7	330.9034	12.12740	9.87e-09	-12.80440
8	336.1156	6.653976	9.58e-09	-12.85599
9	340.6058	5.349927	9.67e-09	-12.87684
10	347.5617	7.695909	8.85e-09	-13.00262
11	349.0878	1.558582	1.03e-08	-12.89735
12	359.8111	7.207025	8.23e-09	-13.18345
13	368.2793	10.03882*	7.34e-09*	-13.37359*
* shows the lag length according to criterion				
LR: LR test statistics (each test at 5%)				
FPE: Final prediction error criterion				
AIC: Akaike information criterion				

As seen in Table 2 above according to all 3 criteria the lag length to be selected for use in the VAR model should be the 13th lag. Before establishing our VAR model

prediction, a Johansen-Jeselius maximum likelihood cointegration analysis was performed to test the existence of a long-term relationship between our series whose first differences were stationary; the obtained results are given below.

Table 3. Johansen-Jeselius Maximum Likelihood Co-integration analysis results

Trace test results:				**Max. Eigen value test results:**			
H_0	H_1	Statistics	95% crit. value	H_0	H_1	statistics	95% crit. value
$r = 0$	$r \geq 1$	34.30*	15.49	$r = 0$	$r = 1$	31.28*	14.26
$r \leq 1$	$r \geq 2$	3.02	3.84	$r \leq 1$	$r = 2$	3.02	3.84

*:Trace test statistics and Eigen value test statistics results show that the series are I(1) cointegrated at 5%.
AIC information criterion was taken into consideration in determining the optimal lag length in the analysis.

As seen in Table 3 above, the results of the Trace and Maximum Eigen Value test statistics are higher than 95% critical value results. In short, the H_0 hypothesis which denies first degree cointegration between the series was rejected because that test results were higher than 95% critical values. Thus, the fact that there is a I(1) degree cointegration between the series was adopted as the alternative hypothesis. As series were integrated in the same order 1, we proposed using the multivariate vector autoregression (VAR) approach developed by Johansen (1988) and Johansen and Jeselius (1990) to investigate if there was a long-run relationship between the LNCPI and LNFUELINDEX series. The VAR methodology is a better approach for investigating the long-run relationship because it approximates well the unknown model of true economic structure by taking dynamic interactions among the variables in the system into consideration.

The long-term cointegration vector coefficients and t-statistics values of these coefficients (the error correction term) are introduced in the equation below. In this long-term equation, which shows the effect of oil prices on the consumer price index, the coefficient value given before oil prices is positive, as expected, and statistically significant. In accordance with this equation, it is observed that a 1% change occurring in oil prices is reflected in the consumer price index in the ratio of 1.26% in the long term.

$$LNCPI = -4.0395 + 1.2556\ LNFUELINDE\ X$$
$$(-9.642)$$

In addition, t-statistics, with reference to the coefficient at the beginning of the error correction term, equal to -2,38 and have a statistical significance of 5%. The magnitude of the coefficient equals to -0.069826 and is quite small, which means that it will take a very long time to remove long-term balance deviations or to achieve long-term balance after short-term shocks. The table below gives the results of the Granger causality test on the vector error correction model performed to determine whether changes in fuel oil prices cause inflation.

Table 4. Granger Causality Test on Vector Error Correction Model

H_0 hypothesis:	Chi-sq Statistics	Likelihood
LNFUELINDEX is not the Granger cause of LNCPI	20.19	0.09**
LNCPI is not the Granger cause of LNFUELINDEX	12.13	0.51

**: H_0 hypothesis at 10% level is rejected.

The vector error correction model and the Granger causality test results are presented in Table 4. As seen in Table 4, in the Chi-sq test at a 10% significance level, the H_0 hypothesis that LNFUELINDEX is not the Granger cause of LNCPI was rejected, whereas the hypothesis that LNCPI is not the Granger cause of LNFUELINDEX was not rejected. Therefore, it is understood that changes in oil prices cause inflation, and the opposite view is incorrect. In other words, there is a one-way causality.

The following results were obtained from a comparison of research results with other studies conducted on Turkey. Kibritçioğlu and Kibritçioğlu (1999) reported in their study, conducted for the period of 1986-1998, that increases in fuel oil prices had no significant effect on wholesale price index. Although our study focused on a different period, it should be noted that instability in oil prices was considerable, especially after 2001. Berument and Taşçı (2002), on the other hand, concluded in their study, based on the input-output table data for 1990, that increases in oil prices had a negative effect on inflation in cases in which factor revenues were adapted to changes in inflation. Berument and Taşçı calculated the inflationary effect of changes in global crude oil prices rather than fuel oil prices. Finally, Çelik and Çetin (2007) reported in their study, conducted on three months series in the period 1997-2006, that increases in oil prices had a negative impact on the CPI index in Turkey.

Conclusions

Continuous fluctuations are observed in fuel oil prices in the Turkish economy because fuel oil distribution firms have recently adjusted their prices in accordance with developments in the international oil market. As a result of these fluctuations, changes in the prices of fuel oil products used intensively in sectors like production, transportation, the chemical industry and agriculture are expected to cause an inflationary effect. In our analysis, in order to test this expectation, our estimation results based on the vector error correction model revealed that a 1% increase in fuel oil prices with an approximate one year lag resulted in a 1.26% increase in the CPI index (Consumer Price Index). Furthermore, in accordance with the analysis results we were unable to reject the hypothesis, that an increase in fuel oil prices is also the one-way Granger cause of an increase in CPI.

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