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Oil Price Fluctuations and Trade Balance of Turkey

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Abstract: The relationship between oil price fluctuations and the trade balance of Turkey is the main concern of this paper. Economic growth performance of Turkey depends on imported capital goods as well as imported oil. Oil price increases bring a heavy burden for Turkish economy. Therefore, it is important to analyze the effects of oil price increases on external balances as well as on economic growth rate. We aim to examine the effects of imported oil price fluctuations on Turkey's trade balance using structural vector autoregression (VAR) model. The variables used in this model are imported crude oil price, imports of crude oil, industrial production index, and trade balance to GDP ratio. Monthly data set for the period of September 2009-June 2014 is used in this study. The results show that the oil price shock creates a negative impact on trade balance and this effect continues while declining for more than 10 months. Most of the variation in forecast error of trade balance ratio is explained by the shock on itself and only a limited variation, around 4%, is explained by oil price for a 10 months period.

Keywords: Oil price; trade balance; structural VAR; Turkish Economy

JEL classification: F14, C32, F41

1. Introduction

The relationship between increasing oil prices and macroeconomic indicators such as economic growth rate, inflation rate, and external balances has been an important area of study in economics. The interest on the topic mainly started after the drastic oil price increases experienced during the oil shocks of 1970s. Inıtial studies after 1970s focused on the effects of increasing oil prices on macroeconomic performance of industrialized economies. As expected, ıt was mainly concluded that increasing oil prices lowered the GDP growth rate and contributed to inflation problem.

Studies showed that the degree of oil price impact on macroeconomic variables varied over time. Hamilton (1983) showed that while the negative impact of oil prices on explaining US recession

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during 1949 – 1972 was significant, its size weakened in 1973 – 1980. Later studies argued that not all oil shocks were the same in terms of their nature and also in terms of their effects on related economies. Some of the studies agreed that oil shocks of 1970s and early 1980s were supply side shocks while the ones after 1980s including the ones after 2000 were demand side shocks [Archanskia et al., 2012; Hamilton 1983] in which oil prices are determined endogenously. However, other studies reached to different results for the same periods [Kilian, 2002; Kilian 2009]. For the oil shocks experienced after most of the studies agreed on the opinion that these shocks are not supply side shocks [Archanskaia et al., 2012; Hamilton, 2009; Kilian 2009]. Determining the nature of oil price increase and therefore the nature of the shocks is important for the policymakers to take appropriate precautionary actions for their economies in a timely manner.

The issue of increasing oil prices and oil price fluctuations captured the attention of economists one more time after the year 2000 as oil prices started to fluctuate considerably one more time. Small number of studies conducted on emerging economies during this period. The response of economic growth rate and inflation rates of oil importing countries to the surge in world oil prices was one of the related research .topics during this period [Ghosh, 2009; Barsky and Kilian 2004; Hamilton, 2005]. Studies on the external balances of oil importing countries were very limited in numbers [Bodenstein et al., 2011; Kilian et al., 2009; Narayan et al., 2014]. Ghosh (2009) estimate the relationship between import demand of crude oil and economic growth for India by using the autoregressive distributed lag (ARDL) model.

As Turkey moved to export oriented growth strategy after 1980, external balances, trade and current account balances namely, gained importance in evaluation of Turkey's economic performance. According to the new growth strategy, export became the new engine of growth in Turkey. As an oil importing developing country, oil price fluctuations have always created significant results for Turkey. Moreover, Turkish growth experience showed that there is a significant correlation between Turkish economic growth rate and imports. This fact made trade and current account deficits quite serious problems for the economy.

This paper is organized as follows. Section 2 reviews the previous literature on oil shocks and their effects on macroeconomic indicators such as growth rate and external balances. Section 3 gives brief information about the empirical methodology used in the paper and the main findings. Section 4 includes the concluding remarks.

2. Literature Review

The results of oil shocks for both oil exporting and oil importing countries as well as the main factors behind oil shocks are studied especially after oil shocks of 1970s. As the oil price stayed relatively stable during the period of 1985 to 2000 the interest on the subject subsided. As the oil prices started to increase again after 2002 the interest on the topic of the effects of oil prices on macroeconomic variables is on the rise again.

Most of the literature consists of studies analyzing the association between external balances of developed economies such as the US and the world oil prices. Le and Chang (2013) differs from this tradition and includes Malaysia as an oil exporter, Singapore with oil refinery and Japan as an oil importer to see the oil price increase on countries with different economic conditions relating oil.

Archanskaia, Creel, and Huert (2012) wanted to determine the driving force behind oil shocks in 1970-2006 with the distinction of supply side and demand side shocks in their model. They argued that while supply side oil shocks have created negative external balance effects, demand driven oil shocks did not have such negative effects.

Kilian (2010) uses five variables which are the percent change of world production of crude oil, the measure of global real economic activity, the real price of imported crude oil, the real price of gasoline in the U.S., and the percent growth rate of the quantity of gasoline consumed in the U.S.

Kilian and Murphy (2014) argue unobservable shifts in expectations about future oil demand and supply conditions must be reflected in shifts in the demand for above-ground crude oil inventories. They find that traditional estimates of the short-run price elasticity of oil demand are downward biased because of ignoring the endogeneity of the real price of oil.

Peersman and Robays (2011) analyzed the effects of oil price shocks on macroeconomic indicators using various countries. They concluded that the impact of oil shock depends on the nature of the shock on one hand and show different results depending on the country whether oil importer or exporter as expected.

Turkey is an oil-importing emerging economy. Strong dependence on imported oil as an important energy source contributes to high trade deficit problem of Turkey. This issue of oil prices and economic growth relationship is covered by a number of studies [Erdal et al., 2013; Ozlale and Pekkurnaz, 2010; Aydın and Acar, 2011; Sozen and Nalbant, 2007; Lise and Van Montfort, 2005].

Erdal et al. (2013) questioned the nature of the energy consumption and economic growth performance using Granger causality framework. They found a bidirectional relationship between energy consumption and economic growth for the period of 1970-2006. Similar conclusion was reached by Lise and Montfort (2005) as the found a co-integration between oil price and GDP for the period of 1970-2003 and concluded that it possibly shows a bi-directional causality relationship between these two variables. Irhan, H. B. et al (2011) could not find any significant effect created by oil price on Turkey's trade balance based on 1990-2007 quarterly data using ARDL bounds testing analyses. Ozlale and Pekkurnaz (2010), after controlling for exchange rate misalignment and output gap, based on 1999-2008 monthly data, concluded that oil price shocks played a role on affecting Turkish current account balance but it was short term in nature. Ugurlu and Unsal (2009) studied on 1971-2007 to see the relationship between crude oil import and economic growth for Turkey and found no long run relationship between these variables.

3. Empirical Methodology

Structural Vector Autoregressions (SVARs) are a multivariate, linear representation of a vector of variables on its own lags. This approach is used by econometricians to recover economics shocks from variables by imposing a minimum of assumptions compatible with a large class of models.

Kilian et al., (2009) propose a decomposition of shocks to the real price of crude oil into three components as follows:

$$e_t \equiv \begin{pmatrix} e_t^{\Delta prod} \\ e_t^{rea} \\ e_t^{rpo} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} e_t^{\text{oil supply shock}} \\ e_t^{\text{aggregate demand shock}} \\ e_t^{\text{oil specific-demand shock}} \end{pmatrix}$$

where $\Delta prod$ is the percent change in global crude oil production, rea denotes the index of real economic activity and rpot defers to the real price of oil. The author finds that oil price increases due to surging global demand produce and positive but small effect on real economic activity.

Kilian (2010) decompose the error as follows:

$$e_t \equiv \begin{pmatrix} e_t^{\Delta global\ oil\ production} \\ e_t^{global\ real\ economic\ activity} \\ e_t^{real\ price\ of\ crude\ oil} \\ e_t^{real\ U.S.\ price\ of gasoline} \\ e_t^{U.S.gasoline\ consupmtion} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{54} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{oil\ supply\ shock} \\ \varepsilon_t^{aggregate\ demand\ shock} \\ \varepsilon_t^{oil-market\ specific\ demand\ shock} \\ \varepsilon_t^{refinery\ shock} \\ \varepsilon_t^{gasoline\ demnd\ shock} \end{pmatrix}$$

3.1 Data

For this study, monthly data is collected that cover the sample period of 2009:01- 2014:06. We investigate the effect of crude oil import price on trade balance. As an oil-importing emerging economy oil prices play a crucial role in Turkey's economic performance. Turkey has a high unemployment and high trade deficit problems. In order grow at desirable and sustainable rates Turkey has to depend on imported capital goods and oil.

While studying the oil price and trade balance dynamics, GDP performance of the country is also imported as total imports, oil imports play a significant role in determining Turkish GDP. To capture the production activity we choose to use Industrial Production Index (IPI) as a proxy. IPI is also useful since GDP values are not available on a monthly basis. We use crude oil import (COI), industrial production index (IPI), crude oil price (COP) and trade balance (TB) as important variables of the model. See Appendix for the detailed definition and the source of data.

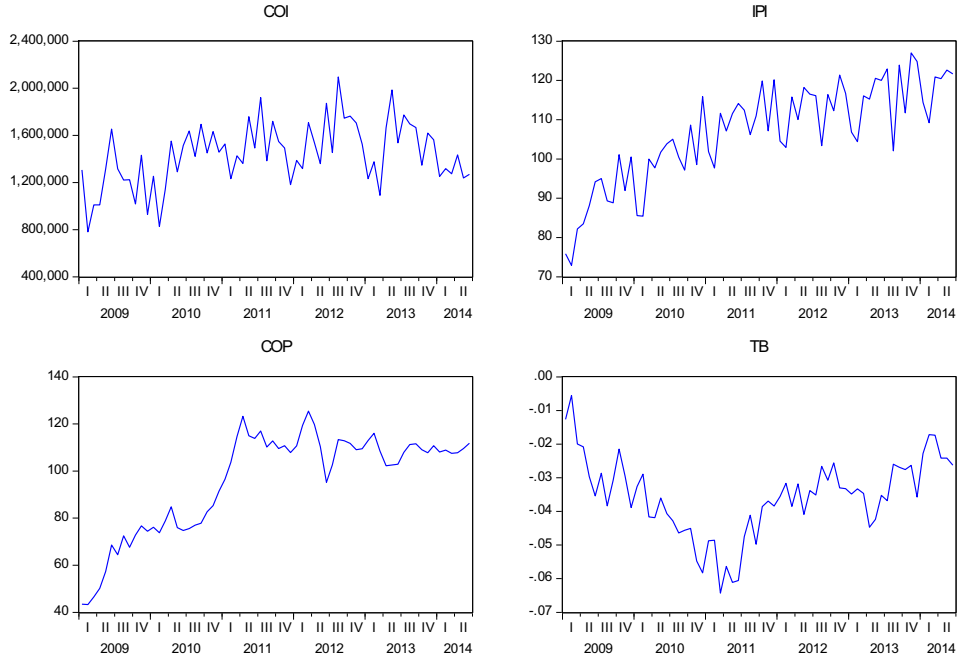

Figure 1

3.2 Unit Root Tests

Time series properties of our data are investigated by using ADF and DF-GLS tests. Table 1shows the results of unit root tests. The null hypothesis of existence of unit root is rejected for COI and TB variables in level thus these variables are stationary. The other variables, namely COP and COI are non-stationary. We concluded that IPI and TB are I(0) and COP and COI are I (1).

Table 1: Unit Root Tests Results

		Level		First Difference	
Variable	Model	ADF	DF-GLS	ADF	DF-GLS
COI	Constant	-3.0565(1)**	-1.7326(1)	-15.3418(0)***	-4.8383(2)***

IPI		-1.9258(1)	-1.4377(1)	-6.2519(10)***	-14.2207(0)***
COP		-2.5200(0)	-0.2005(0)	-7.4265(0)***	-2.3874(0)***
TB		-3.0306(0)**	-2.8192(0)	-13,5153(0)***	-3.1433(0)***
COI	Constant +Trend	-3.1239(1)	-2.8170(1)	-15.2954(0)***	-6.5781***
IPI		-6.6772(0)***	-4.0868(1)***	-6.0803(10)***	-14.3071(0)***
COP		-2.0157(0)	-1.3638(0)	-7.6222(0)***	-3.9253(0)***
TB		-3.8800(0)**	-3.1430(0)**	-13.4749(0)***	-12.0322(0)***

Values between parentheses show the value of lag in terms of SIC criterion. ***,**,* shows that rejection of H_0 in 1%, 5% and 10% significance level respectively. Null hypothesis is "the series has a unit root"

3.3 The Model

Structural VAR models require imposing two kinds of restrictions on the system of equations which are short-run and long-run restrictions. Previous researches imposed on short run restrictions on residuals. We use crude oil import variable as an oil supply and following Kilian (2009), the oil import (supply) shocks are defined as unpredictable innovations to global oil production.

Before the SVAR model is estimated VAR model must be constructed. We estimate VAR model with 1 lag length based on SIC (See: Appendix).
The structural VAR representation is as follows:

$$C_0 z_t = \alpha + \sum_{i=1}^{p} C_i z_{t-i} + \varepsilon_t$$

where p is the lag length ε_t denotes the vector of serially and mutually uncorrelated structural innovations. Given the identifying assumptions above C_0^{-1} has a recursive structure. Thus the reduced form errors (e_t) is as follows: $e_t = C_0^{-1}\varepsilon_t$

Then we employ only short-run restrictions on residuals as follows:

$$e_t \equiv \begin{pmatrix} e_t^{\Delta COI} \\ e_t^{IPI} \\ e_t^{\Delta COP} \\ e_t^{TB} \end{pmatrix} = \begin{bmatrix} c_1 & 0 & 0 & 0 & 0 \\ c_2 & c_3 & 0 & 0 & 0 \\ c_4 & c_5 & c_6 & 0 & 0 \\ c_7 & c_8 & c_9 & c_{10} & 0 \end{bmatrix} \begin{pmatrix} \varepsilon_t^{oil\ supply\ shock} \\ \varepsilon_t^{aggregate\ demand\ shock} \\ \varepsilon_t^{oil\ price\ shock} \\ \varepsilon_t^{?trade\ shock} \end{pmatrix}$$

Table 2 shows the estimates of coefficients of A_0^{-1} matrix.

Table 2: Structural VAR Estimates

	Coefficient	Std. Error
C(1)	246843.1***	21484.94
C(2)	0.330996	1.047295
C(3)	8.505045***	0.740269
C(4)	0.802635	0.636456
C(5)	-0.715162	0.629541
C(6)	5.089349***	0.442971
C(7)	-0.000819	0.000847
C(8)	-0.002846***	0.000807
C(9)	-0.001083	0.000762
C(10)	0.006143***	0.000535

***,**,* shows ; 1%, 5% and 10% significance level respectively.

Source: Authors' calculations

Table 2 shows that c2, c4, c5, c7, c9 are not statistically significant. Then oil supply (c2) has no effect on Industrial Production Index, itself, crude oil import (c4) and IPI (c5) have no impact on oil import price, crude oil import (c7) and crude oil import price have no effect on crude oil price.

3.4 Impulse Responses

After the model was estimated, responses to a shock in the crude oil price are examined through impulse response functions by using error-terms of the model.

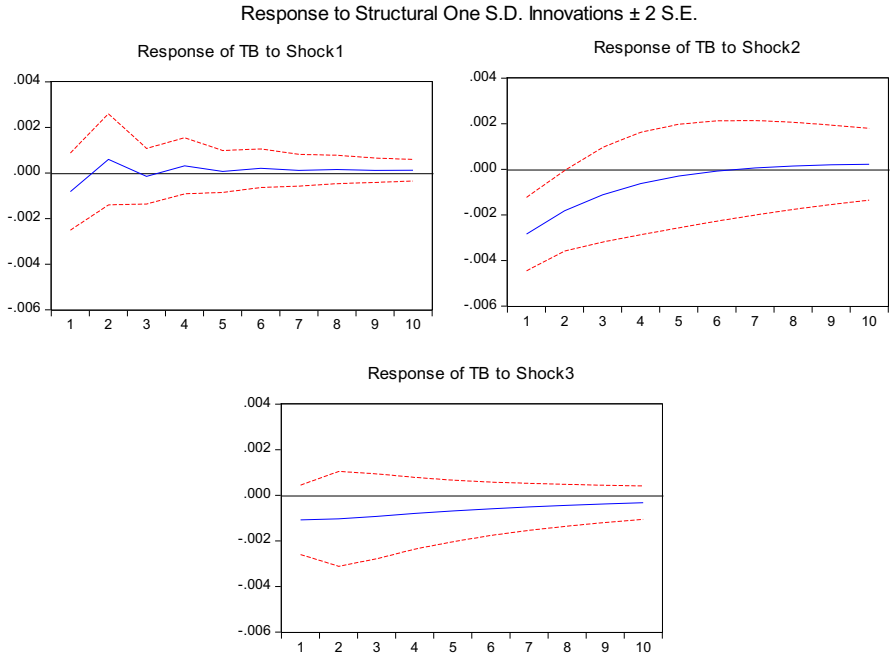

Figure 2: Impulse Response Functions

Source: Authors' Calculation

Figure 2 shows that the response of Trade Balance (TB) to shocks of other variables: crude oil import (COI), industrial production index (IPI), and crude oil price (COP).
Response of TB to crude oil import shock shows a negative effect in the first month and turns into a positive effect in the second period and stays positive but at a very low level after the 4th period. Shock of IPI has a negative but declining effect until the 7th period and stays at a positive but very low level for more than 10 months. Response of TB to crude oil price shock stays always negative. This negative effect is the highest during the first period and gradually declines for the 10 months period.

3.5 Variance Decomposition Analysis

In addition to impulse response functions, variance decomposition analysis can be carried out in structural VAR models as in VAR models. Variance decomposition determines which variable is the most effective in explaining the variation in the forecast error for the model under investigation.

Table 3: Variance Decomposition

Variable	TB			
Period	Shock1	Shock2	Shock3	Shock4
1	1.405077	16.98784	2.460597	79.14649
2	1.286806	14.36913	2.830862	81.51320
3	1.041880	12.63608	3.100812	83.22123
4	0.996234	11.38398	3.260545	84.35924
5	0.919658	10.54433	3.383520	85.15249

6	0.901920	9.976387	3.467889	85.65380
7	0.877778	9.606863	3.531703	85.98366
8	0.870946	9.367587	3.577322	86.18414
9	0.863332	9.216827	3.611302	86.30854
10	0.860844	9.122899	3.635960	86.38030

Source: Authors' calculation

Shock 1, shock 2, shock 3 and shock 4 refer to shocks given to the crude oil import, industrial production index, crude oil price and trade balance. Most of the variation in the forecast error of TB comes from shocks to itself which is %79 in the first period and increases to %86 in the tenth period. Second variable which effects on TB is IPI with %17 in the first period and decreases to %9 by the 10th period. Price shock has only a very limited effect of the variation in the forecast error of TB with 2.4% in the first and 3.63% in the tenth period.

4. Conclusion

In this paper we investigate the relationship between imported oil price and trade balance of Turkey for the January 2009 – June 2014. We use the trade balance (TB), crude oil import (COI), industrial production index (IPI), and crude oil price (COP) as the variables of the model in the interested question of effects of oil price shocks of trade balance dynamics.

The empirical application is started with the unit root tests. Based on the unit root tests, we use difference of COI and COP and the level of IPI and TB. After the structural VAR model was constructed, the impulse response function and variance decomposition results are evaluated.

These results show that imported oil price shock has a negative effect on TB. The trade balance values of Turkey were all negative during the investigated period. Meaning all monthly trade deficit values showed a trade deficit. Therefore, the negative effect meant that the trade deficit was worsened. Most of the variation in the trade balance is explained by itself. IPI was the other variable with the second highest explanatory power. The variation explained in the trade balance by the oil price was very low. We can conclude that oil price fluctuations have a negative but weak effect on Turkish trade balance in the short run.

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Appendix

Definition and Source of the Variables		
IPI	Industrial Production Index (2010=100)(TÜİK)(Monthly)(NACE REV.2)	TCMB
COI	Imports of crude petroleum, 1996-2014	TÜİK
COP	Europe Brent Spot Price FOB (Dollars per Barrel)	EİA
GDP	Gross Domestic Product (Quarterly) (Current) (Thousand TL)	TCMB
ER	USD Exchange Rate (Sale) Monthly	TCMB
TBraw	Foreign trade by months Balance (Thousand US$)	TÜİK
TB	TBraw/(GDP*ER)	Authors Calculation

VAR Lag Order Selection Criteria						
Endogenous variables: D(COI) IPI D(COP) TB						
Exogenous variables: C						
Sample: 2009M01 2014M06						
Included observations: 66						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1180.098	NA	4.50e+10	35.88177	36.01448	35.93421
1	-1096.265	154.9639	5.77e+09	33.82623	34.48976*	34.08842
2	-1066.479	51.44962*	3.82e+09*	33.40845*	34.60281	33.88040*
3	-1054.270	19.60850	4.35e+09	33.52333	35.24851	34.20503
4	-1041.935	18.31472	4.99e+09	33.63441	35.89041	34.52586
5	-1026.540	20.99357	5.31e+09	33.65273	36.43956	34.75394
6	-1012.009	18.05386	5.94e+09	33.69724	37.01490	35.00821
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						