The Fragility of Turkish Economy from the Perspective of Oil Dependency

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In an emerging economy, energy is a crucial input. Turkey as an oil dependent country, the volatility of oil price might affect more than thought. In this study, the impact of oil price changes in Turkish macroeconomy has been examined. A VAR model is built by using quarterly data from the first quarter of 2003 to the first quarter of 2013. Variables used in the model are Brent oil price, gross fixed capital formation, interest rate, US GDP and inflation. We believe that the analysis has demonstrated the fragility of Turkish economy to oil price volatility with its significant results in the relationship between oil price and main macroeconomic indicators. This study also shows the incredible need of sustainable energy policies to make a country's economy stable.

Key Words: oil price shocks, oil dependency, Turkey, macroeconomy, vector auto regressive model, gross fixed capital formation, inflation, interest rate

JEL Classification: O13, Q13, N75, P48, Q47

Introduction

The relationship between oil prices and macroeconomic performance has long been centre of attention in the literature. The literature has focused on different aspects of oil price and macroeconomy relationship. Early researches, inspired by the oil price shocks of the 1970s and 1980s and subsequent recession, concentrated mainly on developing theoretical models aiming at measuring the effects of higher energy prices on macroeconomic variables such as GDP, inflation, or productivity. Pierce and Enzler (1974), Mork and Hall (1980), and Hamilton (1983) investigated the negative relationship between oil price increases and the macroeconomic indicators. Nevertheless, this approach was questioned in mid 1980s when the sharp drop in energy prices did not lead to an improvement in economic activity. Accordingly, Mork (1989) argued for the

presence of asymmetry and showed that while oil price increases restrain real GDP growth, oil price falls do not cause any statistically significant effect. Lee, Ni, and Ratti (1995) provided evidence on the existence of asymmetry and showed that the effects of oil price increases were considerably higher in an environment of stable oil prices compared to an environment of volatile oil prices. Kumar (2005) support the validity of asymmetric impact of oil price changes on economic activities. More recently Zhang (2008) found that a rising trend in oil prices had more effect on growth than the impact of positive oil price shocks in Japan.

Theoretical studies have also examined the transmission channels of oil price changes to macroeconomy. Though providing significant insight about the channels, they did not present clear evidence whether oil prices have substantial impact on the macroeconomy. Several channels have been identified in the literature, namely supply side, wealth transfer, inflation, real balance and sector adjustment (Brown and Yucel 2002).

The impact of oil price changes varies depending on countries stage of development, composition of its economy and institutional structure. In the oil-importing countries, oil price shocks tend to have significant effects on macroeconomic variables. In these countries, increase in oil prices not only causes a rise in inflation and input costs, but also leads to a decrease on the demand of non-oil products, reflecting the lower purchasing power. Manufacturing and transportation is especially affected by the rise in costs. As weaker economic growth decreases labour demand, energy shocks could also have a negative effect on employment levels, particularly in the short term. On the fiscal side, government expenditures rise on the one hand and tax revenues drop on the other, leading to an increase in the budget deficit and interest rates. All in all, oil-importing small open economy countries are sensitive to the oil price shocks. Hence, the examination of the impact of oil price shocks on the macroeconomic variables is important in oil dependent, middle-income countries like Turkey. Given Turkey's high dependence on oil as main source of energy, its inadequate oil reserves and most of production process related to oil, one would expect that its economy would be affected through various channels. This study aims to analyse response of macroeconomic variables to oil price shocks in Turkey.

The average crude oil price (Brent) reached $108.66 in 2013 when the oil consumption of Turkey was 719 thousand barrels per day (figure 1 and figure 2). Being known that there has been crisis in the history related to the shortage of oil supply and the oil price shocks, the rising trend

FIGURE 1 Brent Oil Price (US Dollars; adapted from British Petroleum 2014)

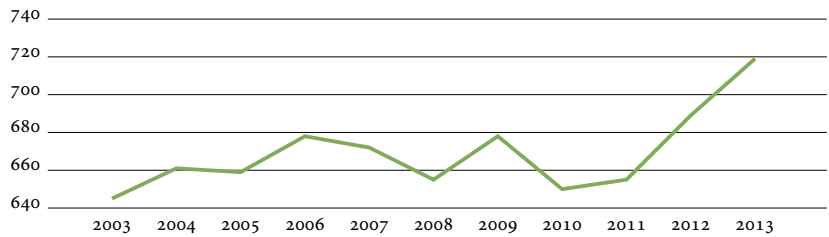

FIGURE 2 Oil Consumption of Turkey (thousand bbl/day; based on data from EIA, http://www.eia.gov)

of oil prices in the recent years has become centre of attention. As an oil importer country, Turkey has been expected to be sensitive to the changes in oil prices. This research aims to answer the vital question whether the macroeconomic indicators are significantly affected by the volatility of oil prices.

The remainder of this paper is organized as follows. The second section discusses the empirical evidence from the literature. The third section presents the data empirical methodology. The fourth section reveals the empirical results and the fifth section concludes.

Literature Review

Burbidge and Harrison (1984) studied the impact of oil prices on economic activity of US, Japan, the Federal Republic of Germany, the United Kingdom and Canada. The authors used monthly data considering the period between January 1961 and June 1982 by applying vector autoregresion (VAR) model. The results showed that there is a uni-directional causality running from oil price shocks to macroeconomic variables which covers consumer prices index, total industrial production, short-term interest rate, currency and demand deposit and average hourly earnings in manufacturing although the results of some countries are unclear. Ferderer (1996) investigated the relationship between oil price volatility

and macroeconomy in US for the period between 1970 and 1990 by using VAR model. The author measured oil price volatility by using monthly standard deviations of daily oil prices and found that oil price volatility has a negative impact on US output. DePratto, Resende, and Maier (2009) questioned how changes in oil prices affect the macroeconomy in Canada, United Kingdom and the United States covering the period from 1971 to 2008. According to the results of their study, while higher oil prices have lower impact on supply side, they decrease the GDP level permanently. Tang, Libo, and Zhang (2010) investigated the effects of oil price shocks on China's macroeconomy by using Structural VAR model for the period between June 1998 and August 2008. Their results showed that while an increase in oil price has negative impact on output and investment, it has a positive impact on both inflation and interest rate. Ng (2012) investigated the relationship between oil price volatility and macroeconomy relationship in Singapore by using quarterly data from the second quarter of 1983 to the second quarter of 2009. According to the VECM results, a 1% increase in oil price adversely affects the investments (GFC) and decreases the GDP with 0.45% in the long-run. Besides, in the short-run the oil price volatility has a negative impact on investment, GDP and inflation. Ju et al. (2014) studied the impact of oil price shocks on macroeconmy of China by using Hilbert-Huang transform (HHT) and event study methodologies. Data covers the monthly period from 1983 to 2012. The results showed that while oil price shock has negative impact on GDP and exchange rate, it affects CPI positively in China. Katircioglu et al. (2015) investigated the relationship between oil price changes and the macroeconomic variables of gross domestic product (GDP), consumer price index (CPI) and unemployment for twenty-six OECD countries. The sample consists of the period between 1980 and 2011. By using Durbin-H panel cointegration tests, the authors revealed that oil price changes have statistical and negative effect on GDP, CPI and unemployment in many of the OECD countries.

The impact of oil price shocks on the economic activity of oil-exporting countries is rather different. For example, Iwayemi and Fowowe (2011) analysed the effects of oil price shocks on the macroeconomy of a developing oil-exporter country, Nigeria. The authors used Granger-causality, impulse response and variance decomposition methods by using the quarterly data from 1985:Q1 to 2007:Q4. Real GDP, government expenditure, inflation, real exchange rate and net exports were used as macroeconomic variables. Their results conclude that oil price shocks do not have

a major effect on the macroeconomic variables of Nigeria. While there is no causality running from oil shocks to output, government expenditure, inflation and real exchange rate, there is a uni-directional causality running from oil shocks to net-exports. Demachi (2012) studied the impact of oil price change and volatility on the macroeconomic variables of Nigeria. The author used Structural Vector Auto Regression (SVAR) model for the monthly period between January 1970 and May 2011. Macroeconomic variables that were taken into consideration were Nigeria's exchange rate, money supply, consumer price index and the policy interest rate. According to the results, both the oil price changes and price volatility is affecting exchange rate of Nigeria and as oil price increases, money supply increases.

In the literature there are also studies that investigate the asymmetric relationship between oil price shocks and macroeconomic variables. For example, Gilbert and Mork (1986) was the first that provide the asymmetry of oil price shocks on macroeconomy. The author investigated the impact of oil price changes on macroeconomy of seven OECD countries; the United States, Canada, Japan, Germany, France, the United Kingdom covering the period between 1967:3 and 1992:4. The results showed that, there is a negative correlation between oil price increases and GDP growth beside the presence of asymmetry. Their results vary from country to country. For example, while for the United States, both the increase and the decrease in oil prices affect the business cycle, an increase in oil prices negatively affects the economy in Japan. Furthermore, the economy of Norway bloom up with oil price increases and slows down with oil price decreases. Huang, Hwang, and Peng (2005) analysed the effect of oil price shocks on industrial production and real stock returns for United States, Canada and Japan covering the monthly period between January 1970 and September 2002. The authors used multivariate threshold model and found that the oil price changes are better to explain the macroeconomic variables compared to oil price volatility whereas oil price volatility are better to explain stock returns compared to a change in industrial output. Kumar (2005) investigated the impacts of oil price shocks on macroeconomy of India covering the period between first quarter of 1975 and third quarter of 2004 using VAR model. According to the results, there is a Granger causality running from oil prices to macroeconomic activities and oil price shocks affect industrial production growth negatively, which supports the presence of asymmetric impact hypothesis.

TABLE 1 Cointegration Test Results

Source	SS	*df*	MS		No. of obs.	41
Model	899.641	4	224.9103		$F(4, 36)$	1.3800
Residual	5871.43	36	163.0953		Prob > F	0.2606
Total	6771.07	40	169.2768		R^2	0.1329
					Adj. R^2	0.0365
					Root MSE	12.771

Variable	Coef.	Std. err.	t	$P > t$	95% conf. int.	
usgdp	2.94680	3.74590	0.79	0.437	−4.6502	10.5438
interestrate	0.10701	0.19224	0.56	0.581	−0.2828	0.4969
inflation	0.42905	2.86455	0.15	0.882	−5.3805	6.2386
gfcf	0.50015	0.44821	1.12	0.272	−0.4089	1.4092
_cons	0.97091	6.57348	0.15	0.883	−12.3607	14.3026

NOTES MacKinnon approximate p-value for $Z(t)$ = 0.000. Test statistics = −5.559. Dickey-Fuller test for unit root, 40 observations. Critical values for $Z(t)$: −3.648 (1%), −2.958 (5%), −2.612 (10%).

Data and Methodology

The main questions of this research have structured the hypothesis of research. The null hypothesis is that oil price changes have no impact on macroeconomic indicators such as growth, inflation or interest rate. The alternate hypothesis suggests the rejection of null hypothesis where it seeks for a relation between macroeconomic indicators and oil price.

A quarterly five-variable vector autoregression model (or simply; VAR) is used in this study. Taking into account that simple vector autoregression models provide better results than a cointegrated VAR in the short run (Naka and Tufte 1997; Engle and Yoo 1987; Clements and Hendry 1995; Hoffman and Rasche 1996), the suitability of the model was tested. Engle and Granger (1987) suggested a two-step process to test for cointegration (an OLS regression and a unit root test), the EG-ADF test, which is also carried out in this study. No cointegrating relationships was observed; so unrestricted VAR is found appropriate (see table 1).

The variables selected for the model are real gross fixed capital, consumer price index (CPI), interest rate, US real GDP, Brent crude oil price.

Econometrics model specifications are as follows:

$$gfcf = f(brenttl, interestrate, inflation, usgdp)$$
$$= \beta_0 + \beta_1 inflation + \beta_2 interestrate + \beta_3 brenttl$$

$$+\beta_4 usgdp + \varepsilon, \tag{1}$$

where *gfcf* is Real Gross Fixed Capital Formation (First Differenced and Seasonally Adjusted), *interestrate* in Interest Rate (Seasonally Adjusted), *inflation* is Comsumer Price Index (First Differenced and Seasonally Adjusted), *brenttl* is Brent Crude Oil Price (First Differenced and Seasonally Adjusted), and *usgdp* is US GDP.

The data mentioned above have been seasonally adjusted by computing a centred moving average. According to Bernanke et al. (1997), Hamilton and Herrera (2004) not only the oil price changes, but also other macroeconomic variables such as money supply, global developments affect an individual country's economy. For this reason, we put US GDP as a control variable to eliminate its affects. All variables are converted into Turkish Liras and data contains information from 2003 first quarter to 2013 first quarter. The starting date choice is motivated by the main incidents in the World. In 2003, the invasion of Iraq occurred, and the production of oil decreased due to the instability of the country. Therefore, the crude oil price increased sharply. In the analyzed period there are some other shocks originating from the global economic crises of 2008 that deepened after the corruption of Lehman Brothers.

Different databases are mined while building the model. Hence, Brent oil prices are taken from Bloomberg, where real gross fixed capital formation CPI, interest rate and inflation are taken from Datastream. Moreover, real US GDP is taken from St. Louis FED database.

Before studying the impacts of oil price changes on macroeconomic indicators, the stochastic properties of the data considered in the model was examined by analyzing their order of integration on the basis of a series of unit root. The stationarity properties of the time series data were examined yet purpose of the orders of integration in the all series is a crucial part of the research. Former studies have proved that mostly time series data are non-stationary at first level but become integrated (stationary) of order 1 (Engle and Granger 1987). A stationary time series practice then is one which has a constant first and second moments and whose probability distribution is stable over time. Stationarity in the data series needs to be ascertained because the estimation technique for the analysis is the Vector Autoregressive (VAR) model, which accepts all the variables in the system are stationary. Therefore, to evade false results and to guarantee that the variables fit into the estimation techniques, as in Etornam (2015), this study will conduct unit root test generally used in

TABLE 2 Unit Root Test

Variable	$Z(t)$	p^*
brenttl (level)	0.9361	−0.220
inflation (level)	0.9990	2.415
gfcf (level)	0.4008	−1.759
interestrate (level)	0.0002	−4.563
usgdp (level)	0.0076	−3.517
brenttl (first differenced)	0.0000	−5.053
inflation (first differenced)	0.0000	−5.690
gfcf (first differenced)	0.0277	−3.085

NOTES * MacKinnon approximate p-value for $Z(t)$. Dickey-Fuller test for unit root, 40 observations. Critical values for $Z(t)$: −3.648 (1%), −2.958 (5%), −2.612 (10%).

TABLE 3 Phillips Perron Test

Variable	$Z(\rho)$	$Z(t)$	p^*
brenttl (level)	−0.385	−0.203	0.9381
inflation (level)	0.594	2.613	0.9991
gfcf (level)	−4.229	−1.817	0.3723
interestrate (level)	−6.853	−4.271	0.0005
usgdp (level)	−18.776	−3.476	0.0086
brenttl (first differenced)	−26.347	−5.016	0.0000
inflation (first differenced)	−32.240	−5.677	0.0000
gfcf (first differenced)	−15.213	−3.016	0.0334

NOTES * MacKinnon approximate p-value for $Z(t)$. Phillips-Perron test for unit root; 40 observations; 3 Newey-West lags. Critical values for $Z(\rho)$: −18.220 (1%), −12.980 (5%), −10.500 (10%). Critical values for $Z(t)$: −3.648 (1%), −2.958 (5%), −2.612 (10%).

the VAR model to examine stationary properties in time series data. The Augmented Dickey-Fuller (ADF) test is used while investigating the stationarity of the variables. The results show that all of the variables follow a trend as evidenced by the previous literature except interest rate and US GDP. The first differences of the variables are taken to eliminate the trend at 5% confidence level as appear in table 2. For robust purposes, one can find Phillips-Perron test results in table 3.

Because of the probability of missing critical information with too low lag order and growing estimation errors in a prediction with too high order (p), it is generally required in an autoregression to choose

TABLE 4 Lag Estimation Results

Lag	LL	LR	*df*	*p*	FPE	AIC	HQIC	SBIC
0	−465.277				75436.7	25.4204	25.4971*	25.6381*
1	−435.907	58.739	25	0.000	60429.4*	25.1842	25.6447	26.4903
2	−414.030	43.754	25	0.012	77354.9	25.3530	26.1972	27.7476
3	−385.827	56.407	25	0.000	80417.1	25.1798	26.4078	28.6629
4	−355.818	60.017*	25	0.000	97082.7	24.9091*	26.5208	29.4806

lag order that offsets the trade. The study uses five different information criteria namely; Likelihood Ratio (LR), Final Predict Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn information criterion (HQIC) to select the ideal lag length. To determine the optimal lag length from the five criteria, an arbitrary choice of a maximum lag was chosen. As a result, 4 lags have been used, following the Akaike Information Criterion as in Bernanke et al. (1997), Lutkepohl (1982) which can be examined in table 4.

Results

In this section, the relation between the Brent oil price changes and economic activity is mainly discussed. In this multivariate model, it is essential to understand the direct impact of a variable as well as the indirect impact through third variables. So firstly Granger causality test was run. In fact, results show that there is significantly high correlation between all variables at least in one direction and the null hypothesis was rejected that the variables do not granger cause one another (see table 5). As could be seen from the impulse response function in figure 1, gross fixed capital formation and interest rate response a shock both in Brent oil price and USGDP; however, inflation does not response any of them.

For oil-importing countries like Turkey, one would expect that growth will suffer from the rise in crude oil prices. The results seem to be consistent with expectations. In the short run, even if one can observe a slightly positive movement, after one lag, it turns to negative and the affect dies by the 5th lag. As most of the production processes use oil as an input, an upward trend in oil prices cause goods to be more costly. Moreover, an increase in oil prices may result a decline in non-oil products due to lower purchasing power.

On the other hand, the insignificant correlation between crude oil price

TABLE 5 Granger Causality Wald Tests

Equation	Excluded	χ^2	df	Prob. > χ^2
gfcf	*inflation*	12.963	4	0.011
	interestrate	30.958	4	0.000
	brenttl	26.320	4	0.000
	usgdp	27.463	4	0.000
	all	91.260	16	0.000
inflation	*gfcf*	11.134	4	0.025
	interestrate	4.530	4	0.339
	brenttl	14.403	4	0.006
	usgdp	14.396	4	0.006
	all	41.054	16	0.001
interestrate	*gfcf*	5.900	4	0.207
	inflation	7.403	4	0.116
	brenttl	12.403	4	0.015
	usgdp	17.587	4	0.001
	all	44.521	16	0.000
brenttl	*gfcf*	3.511	4	0.476
	inflation	5.467	4	0.243
	interestrate	1.815	4	0.770
	usgdp	3.403	4	0.493
	all	32.895	16	0.008
usgdp	*gfcf*	3.685	4	0.450
	inflation	21.102	4	0.000
	interestrate	3.099	4	0.541
	brenttl	14.965	4	0.005
	all	35.105	16	0.004

and inflation could be explained with the efficient monetary policies. The Central Bank of Turkey (CBRT) put inflation target during those years and has successfully implied. CBRT has different means to reach their target, where interest rate is one of them.

When the Brent oil price goes upwards, an increase in interest rate may have balanced the expected negative impact of crude oil price against inflation. Disinflationary policies might have tempered the negative effect of high-energy prices on the inflation. Hence, in the impulse response

TABLE 6 Tests for Stability Condition

Eigenvalue	Modulus
0.3534563 + 0.5782148*i*	0.67769
0.3534563 − 0.5782148*i*	0.67769
0.6338675 + 0.1804856*i*	0.65906
0.6338675 − 0.1804856*i*	0.65906
0.0859971 + 0.6187699*i*	0.62472
0.0859971 − 0.6187699*i*	0.62472
−0.3098156 + 0.3781089*i*	0.48883
−0.3098156 − 0.3781089*i*	0.48883
−0.3688598	0.36886
−0.1025409	0.10254

function graph, shocks in oil price cause an increase in interest rate. This indicates that CBRT has successfully used interest rate as a means of their disinflationary policies.

In the model, USGDP was put as control variable. Turkish macroeconomy positively responds to the global developments, when there is a rise in US GDP, the positive impact stays till the fourth lag before it dies afterwards. However, interest rate policies cannot be interpreted by the global developments, as the responses can be both positive and negative.

The model can also be tested if it is stable by checking all eigenvalues of modulus less than 1 (Lütkepohl 2006). A stable process is one that will not diverge to infinity. An important fact is that stability implies stationarity thus it is sufficient to test for stability to ensure that a VAR process is both stable and stationary. The stability of the equation was so tested with Eigen value and concluded that all the Eigen values stand inside the unit circle (see table 6). Hence, VAR results satisfied the stability and stationarity condition.

Conclusion

In 2013, the average crude oil price, precisely Brent oil price reached $108.66 (British Petrolium 2014) and the oil consumption of Turkey was 719 thousand barrels per day (Energy Information Administration 2014). The average oil production of Turkey was 58.1 (Energy Information Administration 2014) in the same year, which shows the huge gap between production and consumption.

The aim of this study is to demonstrate the possible risks of a country's dependence on an energy source. In the recent environment, where

alternative means of energy besides fossil fuels is the centre of attention, macroeconomic indicators was seen to be responsive to the volatility of fossil fuel price shocks. In this sense, the impact of oil price changes in Turkish macroeconomy has been examined by using seasonally Brent oil price, gross domestic product (GDP), gross fixed capital formation, interest rate, US GDP and inflation based upon the data set which covers the quarterly data from the first quarter of 2003 to the first quarter of 2013.

The impacts of oil price increases on the Turkish economy are analyzed by using a VAR model. Based on the results of our analysis, a meaningful relationship of oil prices with gross fixed capital formation and interest rate is examined. However, it is observed that inflation does not response to a rise in oil prices. This could be explained by mitigating effect of disinflationary polices implemented during the analysed period.

The results of our study underline the fragility of Turkish economy to the oil price increases. Reducing oil dependency could increase the resilience of Turkish economy. Like in the portfolios in stock markets, for the economy it could be useful to diversify the energy resources to reduce the negative impacts. Exploring these sources and their potential impacts to the Turkish economy could be the subject of further studies.

The volatility of oil price has reached another level at the time this study is being conducted. Hence, another further research question was raised due to the downward movement of the oil prices. The negative impact of the oil price upward movement was observed in this study; however, possible existence of an asymmetry is still an unanswered question. Anybody who is interested in that area would contribute to the literature by investigating if a downward trend in oil prices has a positive impact on macroeconomic indicators and if the magnitude is similar.

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