IMPACT OF OIL PRICE ON TURKISH MACROECONOMIC VARIABLES

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ABSTRACT

Turkish economy is heavily dependent on oil and natural gas, as the latest figures from International Energy Agency (IEA) show that Turkey imports 90% of its total liquid fuels. Therefore a more volatile oil price can have consequences on macroeconomic variables in Turkey. It is empirically evident that an increase in oil prices followed by deterioration in macro economic variables while a decrease in oil price has relatively lower expansionary effect on macro economic variables. This paper analyzes the economic effects of oil price on the major Turkish macro economic variables, including Gross Domestic Product (GDP), Consumer Price Index (CPI) and Real Effective Exchange Rate (REER) on the basis of quarterly data from 2003Q1 to 2015Q3. Firstly, ADF, KPSS, PP unit root tests and Zivot-Andrews, Lumsdaine Papell unit root tests allowing for structural breaks are used to characterize the time series. Additionally, Granger causality test is performed to give a clearer picture of how these variables are related. The results show that Gross Domestic Product, Oil Price and Consumer Price Index are stationary, while Real Effective Exchange Rate have unit root in Turkey. Test results indicate that, there is a casual relationship from oil price to GDP and to CPI. Furthermore, there exist a bidirectional causality between GDP and CPI in Turkey.

Keywords: *Causality, consumer price index, oil price, real effective exchange rate, Turkey*

1. INTRODUCTION

Turkish economy is heavily dependent on oil and natural gas, as the latest figures from International Energy Agency (IEA, 2015) show that Turkey imports 90% of its total liquid fuels. Therefore a more volatile oil price can have consequences on macroeconomic variables in Turkey. It is empirically evident that an increase in oil prices followed by deterioration in macroeconomic variables additionally, from the theoretical point of view, it is important to examine the impact of oil prices on economic growth and the relationship between oil price and macroeconomic variables. Many scholars studied the relationship between oil price and macroeconomic variables such as Gross Domestic Product (GDP), Consumer Price Index, interest rate, unemployment, stock price, and etc. The results differed from each other due to methodologies, variables, and data. This study examines the economic effects of oil price on the major Turkish macroeconomic variables, including Gross Domestic Product (GDP), Consumer Price Index and Real Effective Exchange Rate from the period of 2003Q1 to 2015Q3. Firstly, ADF, KPSS, PP unit root tests and Zivot-Andrews unit root test allowing for structural breaks are utilized to characterize the time series.

Additionally, Granger and Toda Yamamoto causality tests are performed to give a clearer picture of how these variables are related. The rest of the paper is organized as follows. The second section presents the literature review. The third section presents the data. The fourth section shows the methodology and empirical results. The fifth concludes.

2. LITERATURE REVIEW

There is vast empirical literature on the relationship between oil prices and exchange rate. Amano and Van Norden (1998) investigate the relationship exists between oil price shocks and the US real effective exchange rate for the period of 1972M2-1993M1 for US. The results show that oil prices may explain the real exchange rate shocks during this period. Camarero and Tamarit (2002) test the determination of the equilibrium real exchange rate of the peseta bilateral real exchange rate vis-à-vis a group of EU countries and found that oil price is among of important determinants of Spanish exchange rate. Chen and Chen (2007) examine the long-run relationship between real oil prices and real exchange rates utilizing panel tests for the period of 1972M1- 2005M10 for G7 countries. They found that real oil prices deeply affect real exchange rate movements. Additionally, there exist relationship between real oil prices and real exchange rates. Akram (2004) investigate the probability of a non-linear relationship between oil prices and the Norwegian exchange rate for the period 1971M2–2000M4. They found significant evidence of a non-linear negative relationship between Norwegian exchange rate and oil price. Huang and Feng (2007) investigate the impact of oil price shock on China's real exchange over the period of 1990M1- 2005M10 using structural VAR model. They found that oil price shocks caused a relatively modest appreciation of the real exchange rate in the long run. Cifarelli and Paladino (2010) test the relationship between oil prices, stock prices and US dollar exchange rate utilizing a behavioral ICAPM approach for the period of 6 October 1992 to 24 June 2008 for US. The results present that oil prices cause stock price and exchange rate changes negatively.

Lizardo and Mollick (2010) investigate the effects of oil price shocks in determining the value of the USD. They found that while an increase in real oil prices lead to a significant depreciation of the USD against net oil exporter currencies, such as Canada, Mexico, and Russia, the currencies of oil importers, such as Japan, depreciate relative to the USD when the real oil price rises. Chaudhuri and Daniel (1998) test the real oil price behavior to the

nonstationary behavior of real US dollar for 16 OECD countries over the post-Bretton Woods period applying cointegration and causality tests. They found that oil price behavior is the cause of the nonstationary behavior of US dollar real exchange rates. Issa, Lafrance and Murray (2008) investigate the relationship between the Canadian-US dollar real exchange rate and real energy prices over the 1973Q1–2005Q4 sample period. They found an evidence of a negative relationship between the Canadian real exchange rate and real energy prices.
Habib and Kalamova (2007) examines the impact of real oil price has an impact on the real exchange rates on Norway, Russia and Saudi Arabia. While they found a a positive long-run relationship between the real oil price and the real exchange rate for Russia, in the cases of Norway and Saudi Arabia they hardly find any evidence in favor of the impact of the real oil price on the real exchange rates of Norway and Saudi Arabia.Basher, Haug and Sadorsky (2016) examines the impact of oil shocks on real exchange rates for a sample of oil exporting and oil importing countries utilizing Markov-switching models They found evidence that oil supply shocks influence exchange rates. They provide evidence in the existence of regime switching for the effects of oil shocks on real exchange rates. Turhan, Hacihasanoglu and Soytas(2013) examines the impact of oil prices on exchange rates using daily data series from January 3, 2003 to June 2, 2010 for selected emerging countries' including Turkey. The results show that an increase in oil prices makes a significant appreciation of emerging economies' currencies.
Jayaraman and Choong (2009) examine the effects of oil price on economic growth for Pacific Island countries (Samoa, Solomon Islands, Tonga and Vanuatu) utilizing the ARDL bounds testing methodology. The empirical results reveal that oil price, gross domestic product and international reserve are interrelated in these countries. Additionally, they found that there exists a uni-directional relationship from oil price and international reserves to economic growth. Hanabusa (2009) examines the relationship between oil price and economic growth from the period of 2000 to 2008 utilizing an exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model for Japan. The results show that the economic growth rate Granger-causes oil price changes.
Prasad, Narayan and Narayan (2007) investigate the relationship between real GDP and oil prices over the 1970–2005 sample period. The results exhibit that an increase in oil price has a positive, inelastic, effect on real GDP, inconsistent with the literature.
Darrat, Gilley and Meyer (1996) examine the presence of causality between oil prices, oil consumption, real output using VAR model for the period of 1960 to 1993 for USA. The results show that there exist mixed results between variables, additionally; the oil price changes are not a major cause of U.S. business cycles. Lardic and Mignon (2008) investigate the long-term relationship between oil prices and GDP utilizing asymmetric cointegration for the period of 1970M1 to 2004M3 for U.S., G7, Europe and Euro area countries. They provide evidence for asymmetric cointegration between oil prices and GDP. Aydın and Acar (2011) investigated the effect of oil price changes under three scenarios utilizing TurGEM-D. The simulation results show that in both low and high oil prices have an important effect on Turkish macroeconomic indicators.

3. DATA

Data used in this study extracted from different sources. Turkish Consumer Price Index (CPI), and seasonally adjusted Gross Domestic Product (GDP) in 1998 prices and Reel Effective Exchange Rate of Turkish Lira obtained from Central Bank of Turkey, while crude oil prices is extracted from International Energy Agency. An increase in REER implies an appreciation of the Turkish Lira. Furthermore, all variables are converted into natural logarithms. All series are shown in Figure 1. The shaded areas in the figures denote 2007-2009 Housing Bubble and Financial Economic Crisis.

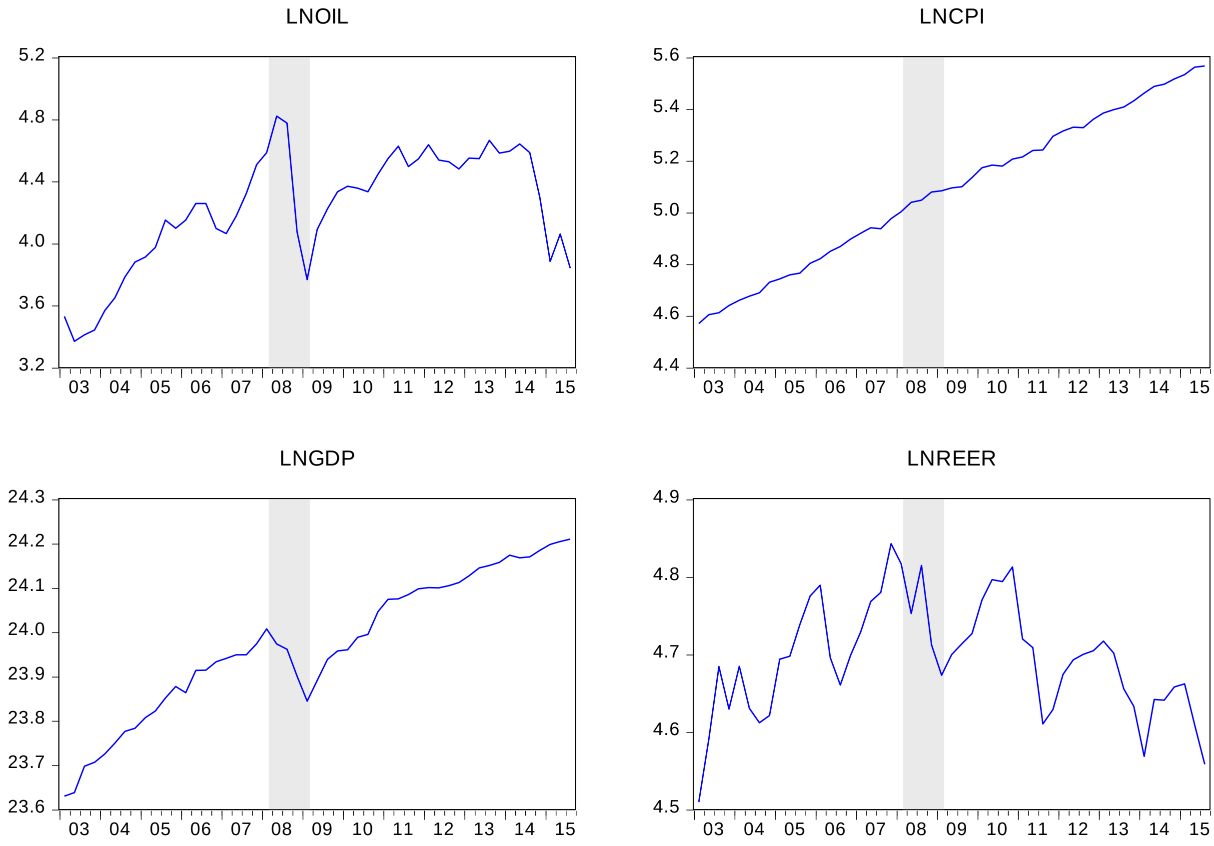

Figure 1 - Series used in the analysis

4. METHODOLOGY AND EMPIRICAL RESULTS

Firstly, we utilize Augmented Dickey Fuller (ADF), Kwiatkowski-Shin-Philips-Schmidt (KPSS), Phillips-Perron (PP) unit root tests and Zivot-Andrews (ZA) unit root test allowing for structural breaks to characterize the time series. Additionally, Granger and Toda Yamamoto causality tests are performed to give a clearer picture of how these variables are related. In ADF unit root test we follow methodology outlined in Enders (2008). Accordingly, in ADF test we evaluate the integration order of the series based on the models,

Model A: $\Delta Y_t = \phi_1 + \delta Y_{t-1} + \phi_3 t + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + u_t$

Model B: $\Delta Y_t = \phi_1 + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + u_t$

Model C: $\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + u_t$

Table 1 - ADF test results

	ADF								
	Model A			Model B			Model C		
Series	k	t	Φ_3	k	t	Φ_1	k	t	
lnoil	1	-2.228484	3.961071	1	-2.805419***	3.985523*	1	0.072719	
lngdp	1	-3.071.266	5.366045	1	-1.823992**	5.244421**	0	3.631602	
lncpi	1	-2.718195	3.863197	6	-1.875327**	30.35135***	8	1.339916	
lnreer	1	-2.713092	4.673401	1	-2.523179	3.188781	1	-0.131903	

In the light of the unit root test methodology chosen, our ADF test results are given in Table 1. ADF test results show that lnoil exhibits a level stationary nature as we can reject the null of unit root with 90% confidence. Furthermore, lngdp and lncpi series show similar characteristics with that of lnoil, since we can reject unit root hypothesis at 5% and 1% significance levels in Model B, respectively. On the other hand, lnreer is found to be nonstationary in both three models. Therefore, ADF test results indicate that lnoil, lngdp, lncpi and lnreer are I(0), I(0), I(0), and I(1), respectively.

Table 2 - PP and KPSS test results

	PP							
	Model A		Model B		Model C		KPSS	
Series	Bandwith	t	Bandwith	t	Bandwith	t	η_τ	η_μ
lnoil	5	-1.042345	4	-2.036741	5	0.097547	0.189612**	0.579762**
lngdp	1	-2.554098	0	-1.813214	1	3.334884	0.089031	0.916341***
lncpi	7	-3.759155**	14	-1.894993	18	15.49929	0.221855***	0.958121***
lnreer	0	-3.089515	1	-3.018443**	2	0.098191	0.238879***	0.257900

PP and KPSS test results are presented in Table 2. PP and KPSS unit root tests give mixed results compared to ADF test results. In particular, PP and KPSS test results show that lnoil and lngdp are integrated order of 1. Because the period 2003-2015 witnessed serious global economic crisis and structural changes, to have a better idea on the characteristics of the series we apply Zivot Andrews (ZA) unit root test allowing single endogenous structural break in level, trend, and both in level and trend. The result of ZA unit root test are shown in Table 3.

According to ZA test result we can reject the null of unit root hypothesis for lngdp and lncpi, giving rise to the conclusion that both series are integrated order of zero. Besides, corresponding break dates in level and in both level and trend for lngdp series are 2008, coinciding with the Housing Bubble and Financial Economic Crisis. On the other hand, unit root test results show that lnoil and lnreer series are still integrated order of one, even after considering single endogenous break in the series. However, because we focus on a period in which more than one endogenous break might have occurred, we apply another unit root test which considers two endogenous structural breaks in the series. Therefore, Lumsdaine Papell (LP) unit root test is used. Table 4 exhibits the LP test results.

Table 3 - Zivot Andrews unit root test results

		Zivot Andrews				
Model	Level		Trend		Both	
Series	Statistics	Time of Break	Statistics	Time of Break	Statistics	Time of Break
lnoil	*-3.03147*	2013:04	-4.00242	2013:04	-3.97151	2013:03
lngdp	*-13.2042****	2008:04	-9.99705***	2005:04	-15.8460***	2008:04
lncpi	*-4.27474*	2006:02	-5.01487***	2008:03	-5.33212**	2009:02
lnreer	*-3.77383*	2005:03	-4.38402	2008:01	-4.48159	2008:04

Considering two structural breaks gives totally different picture regarding the characteristics of the series. Accordingly, we find that all the series are integrated order of degree zero with the exception of lnreer, which is found to be I(1). It is noteworthy that the results of LP unit root test are highly in parallel with ADF test results. Hence we conclude that lnoil, lngdp and lncpi are I(0), while lnreer is I(1).

Table 4 - LP unit root test results

	Lumsdaine Papell					
Model	Level		Trend		Both	
Series	Statistics	Time of Break	Statistics	Time of Break	Statistics	Time of Break
lnoil	*3.7851*	2008:03 2013:03	-4.7975	2005:04 2013:04	-8.1504**	2008:03 2013:04
lngdp	*-17.2331****	2008:03 2013:03	-15.1302***	2007:04 2009:03	-21.4490***	2008:03 2011:01
lncpi	*-6.1714***	2006:01 2010:02	-6.0689	2009:01 2011:02	-6.6481	2008:01 2011:03
lnreer	*-4.8391*	2010:04 2013:02	-4.2034	2008:01 2010:04	-5.5048	2008:03 2010:04

After determining the integration degrees of the variable, we proceed to unearth the casual relationships between these variables. To this end, we utilize Granger causality test. The lag structure of the model is determined by Akaike Information Criteria (AIC) as 4. Granger causality test results are shown in Table 5. According to the results, there is a unidirectional Granger causality from oil prices to GDP at 5% significance level. As expected, we reject the null hypothesis that oil price does not Granger causes CPI with 95% confidence. On the other hand, according to the results, we observe a bidirectional Granger casual relationship between CPI and GDP at 10% significance level.

Table 5 Granger causality test results

Null Hypothesis:	Lag	F-Statistic	Prob.
LNGDP does not Granger Cause LNOIL	4	2.07461	0.1033
LNOIL does not Granger Cause LNGDP		3.71442**	0.0120
LNCPI does not Granger Cause LNOIL	4	0.91937	0.4627
LNOIL does not Granger Cause LNCPI		2.90390**	0.0343
DLNREER does not Granger Cause LNOIL	4	0.65542	0.6268
LNOIL does not Granger Cause DLNREER		1.10871	0.3670
LNCPI does not Granger Cause LNGDP	4	2.24944*	0.0818
LNGDP does not Granger Cause LNCPI		2.48387*	0.0598
DLNREER does not Granger Cause LNGDP	4	0.75522	0.5610
LNGDP does not Granger Cause DLNREER		1.00010	0.4198
DLNREER does not Granger Cause LNCPI	4	0.30919	0.8700
LNCPI does not Granger Cause DLNREER		0.60240	0.6633

5. CONCLUSION

This paper examines the economic impact of oil price on the major Turkish macroeconomic variables, including Gross Domestic Product (GDP), Consumer Price Index (CPI) and Real Effective Exchange Rate (REER) for the period of 2003Q1 to 2015Q3. Firstly, ADF, KPSS, PP unit root tests and Zivot-Andrews, Lumsdaine Papell unit root tests allowing for structural breaks are used to characterize the time series. In addition, Granger causality test is performed to give a clearer picture of how these variables are related. The results show that Gross Domestic Product, Oil Price and Consumer Price Index are stationary, while Real Effective Exchange Rate have unit root in Turkey. The test results indicate that there is a unidirectional Granger causality from oil prices to GDP at 5% significance level. As expected, we reject the null hypothesis that oil price does not Granger causes CPI with 95% confidence. On the other hand, according to the results, we observe a bidirectional Granger casual relationship between CPI and GDP at 10% significance level.

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