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OIL PRICES AND TRADE IN TURKEY: A WAVELET CONTINUOUS TRANSFORM ANALYSIS[*]

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Abstract

Since the beginning of the Great Recession, the conceptuality of the economic literature has been going through an unprecedented change at a rate which is mind-boggling. The flaws of the DSGE model that let to its breakdown, the existence of a zero lower bound for a period that is much longer than expected, the important and intriguing models that the literature on nowcasting offers, heterodox beliefs of yesterday that became orthodox notions such as the non-linearity of all variables used in empirical analysis as well as the role of measurement errors in these variables as the main cause of continuous fluctuations have all been at the forefront of this wave of new research in economics to build robust (or at least not flawed) models that are somewhat capable of explaining the nature of human behavior that has been shaped by the global technological advances which hardly has been a part of the past conventional economic analysis. Moreover, questions surrounding the models used to employ expectation formation of individuals and the shifting focus to company culture rather than just a representative agent have added additional fuel to a debate which seems to be only at its infant stages. Nonetheless, there are still important topics which are much simpler to tackle with that are left unattended by the literature among all this chaos that dominates the research and the empirical applications. One of them is the literature between the relation of oil prices and trade deficit. This paper studies the oil price-trade deficit relationship in the emerging market of Turkey, employing one of the recent unconventional methods that take into account the non-linear nature of the variables, the wavelet methodology. Our findings show that these two variables are definitely positively related and oil prices are leading the trade deficit, especially during the periods of turmoil and fluctuations.

Keywords: Global Trade, Oil Prices, Emerging Market, Financial Crisis, Wavelet Analysis

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1. Introduction

Energy has always been at the core of the economic growth theory after the Industrial Revolution. This presence has considered different energy sources overtime but the importance and contribution of energy to mankind's efforts of continuous growth that should lead to higher levels of development and welfare has always been occupying the central role in economic analysis. However, since the end of 1940s, the importance of oil has increased significantly like no other resource. After the two oil price shocks, there were efforts to find new sources of energy that is renewable and some economies have invested heavily in this mindset. Nonetheless, oil has been the main reason of the two Gulf Wars and still dominates the energy paradigm like no other source. Naturally, the shocks that have caused major fluctuations in the world economy due to the increasing volatility in energy (and mainly oil) prices has become a common concept.

Energy prices have decreased sharply since the middle of 2014 and it is expected that oil prices will remain weak during the following years. Especially, oil prices have declined by more than 40 percent due to large increases in supply and a weakening global demand.The effects of changes in oil prices on developing (used interchangeably with emerging) economies have rather severe consequences than the effects on other (developed) economies due to their heavy dependence on oil trade. Oil-importing developing countries need more than twice as much oil to produce a unit of output as developed (used interchangeably with advanced) countries. Developing countries are also more vulnerable to financial turmoil that is caused by higher oil-import costs (IEA, 2006).

High dependence on oil trade is likely to raise the trade deficit which overtime limits the economic growth to a certain band, usually termed as the middle-income country trap. This leads to low levels of growth (and hence no chance for further development) as the country is left with no policy that would take it out of a vicious cycle which is mainly due to the dependence on imports (oil constituting the main portion) for exports. Given that the small open economy is following an export-oriented strategy and produces low value added goods that it exports, the current account deficit only decreases if the economy goes into a recession (or stagnates at a certain low level of growth) for a long period of time. Hence, the need to use oil for the production of manufacturing goods that have relatively low value added in a world where services dominate most of the production leaves small open economies vulnerable to shocks with no easy solution for the policy makers who would always focus on policies that would lead sustained higher levels of growth and jump to development levels that are much better than the past.

One of the most interesting economic stories in the world economy in the recent decades is the emerging market of Turkey. Following an import substitution policy for a period of time with almost no international reserves and a highly dominant underground economy, Turkey has changed its course after the financial liberalization efforts coupled with opening up its market to the global world by devaluing its currency. These efforts have caused an improvement in Turkey's foreign trade from the mid-1980s. The structure of exported goods started to change gradually from agricultural products and raw materials to relatively higher value added industrial products. On one side, this transformation still continues with increasing exports of transportation vehicles, office equipment and machinery. On the other hand, this pattern is leading the Turkish economy deeper into the middle-income trap with GDP per capita hardly changing since the Great Recession although growth rates have been higher than most of the other emerging markets. The current account deficit which has been hovering in a band of 5-7 percent of the GDP is arguably difficult to sustain in the long term given the decreasing levels of capital flows around the globe since the Great Recession. Oil is one of the most important import items for the Turkish economy and in such a setting energy prices have important consequences for the macroeconomic structure. The continuous changes in oil prices, the never-ending fluctuations in the Turkish lira against its trading partners' currencies and the ever-increasing trade deficit clearly emphasize the importance of the trade channel and oil relationship for the future of the Turkish economic path. It is well known that Turkey's trade deficit has reached 10.58 percent of its GDP in 2014 according to the official statistics.

Hence, the resilience of Turkish economy to the increase in oil prices and the sustainability of current levels of growth are important issues for policy makers and economic agents that are related to Turkey by any means. Therefore, this paper revisits the impact of oil price shocks on the trade balance in the Turkish economy through a new econometric methodology and for an unprecedented period dominated by turmoil and fluctuations throughout. Section 2 includes discusses the movement of energy prices and their respective effects on the trade deficit in Turkey as well as providing a brief theoretical introduction. Section 3 includes the data set and sources while also explaining the unconventional methodological framework. Section 4 has the empirical results with interpretations. Conclusions and policy implications are given in Section 5.

2. An Overview of Energy Prices and Trade

In this section, our aim is twofold. First, we provide a general survey of the energy prices and trade deficit for the Turkish economy with special emphasis on the historical developments in the world economy. Second, we present a brief literature survey that uses the common theoretical framework to analyze trade and oil prices relationship.

2.1. Energy Prices and Trade Channel in Turkey

It is well known that oil is the most important energy component that the world economies depend on as well as being an item that is very crucial for commodity market participants. However, in recent decades, oil prices have become quite volatile due to the Asian financial crisis, the war in Iraq and the terrorist attacks on oil facilities in the Middle East. In Asian Crisis, oil prices have gone down at first but then have risen sharply in a short period afterwards. Crude prices reached to $78 per barrel in 2006. Moreover, before the global economic crisis in 2008, oil prices were about $140 per barrel.

Energy prices have declined since the middle of 2014 and it is estimated that they will not follow an upward trend for a considerable period of time in the future. Especially, an increase in oil production by the US contributed to excess supply in the market and the dollar has appreciated against all major currencies since. Figure 1 clearly displays the dramatic movements in the crude oil prices in the last two decades for the world economy.
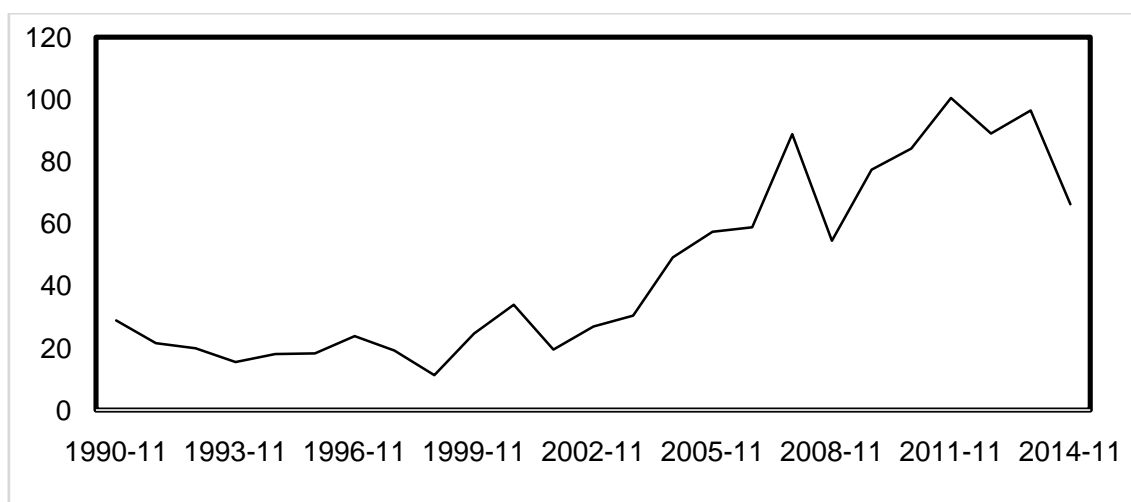

Figure 1. Crude Oil Prices
Source: Investing.com, (2015)

However, the FED has only raised the interest rates once this year contrary to the expectations of 3 (or more rate hikes) and the economic performance of the US economy has been considerably questioned. In such a setting, only one more rate hike is almost a consensus

among all the market players but that possible increase is considered to be no sign of future FED behavior and the growth rates in advanced economies are supposedly to follow a stagnant pattern throughout a very long period.

Oil prices will play a crucial role in the future paths of the world economic growth rates and given that they stay at the levels which do not create any inflationary pressure on the advanced economies, the interest rate hikes will be unlikely and low levels of growth rates would be a norm rather than a temporary case for most of the world economies. So, oil prices attain a crucial role in reflecting the information content about the current growth stance of the world economy, both from the industrialized economies like US and Japan and the emerging markets like China and India.

Turkey's economy experienced an important improvement in its foreign trade since the beginning of 1980s with the financial liberalization efforts. The small open economy started to interact with the rest of the world and many reforms were made so that the market would be able to function as well as capital inflows would accelerate. The low savings rate and small domestic market has left no choice but to choose an export-oriented strategy. Gradually, the structure of exported goods has changed from agricultural products and raw materials to relatively higher value added industrial goods and commodities. However, the balance of payments crisis of 1994 and the banking crisis of 2001 have prevented the economy from establishing a continuous pattern of growth which would lead to higher levels of development. The transformation started to take shape with increasing exports of transportation vehicles, office equipment and machinery especially after the 2002 period when the world economy has experienced the period of global liquidity abundance. Nonetheless, the current account deficit has been the main concern for Turkey since and it was recorded as 5.7 percent of GDP in 2014. Figure 2 shows that Turkey's current account deficit decreased during the Great Recession and both current account deficit and the trade deficit continued to fluctuate after 2009.
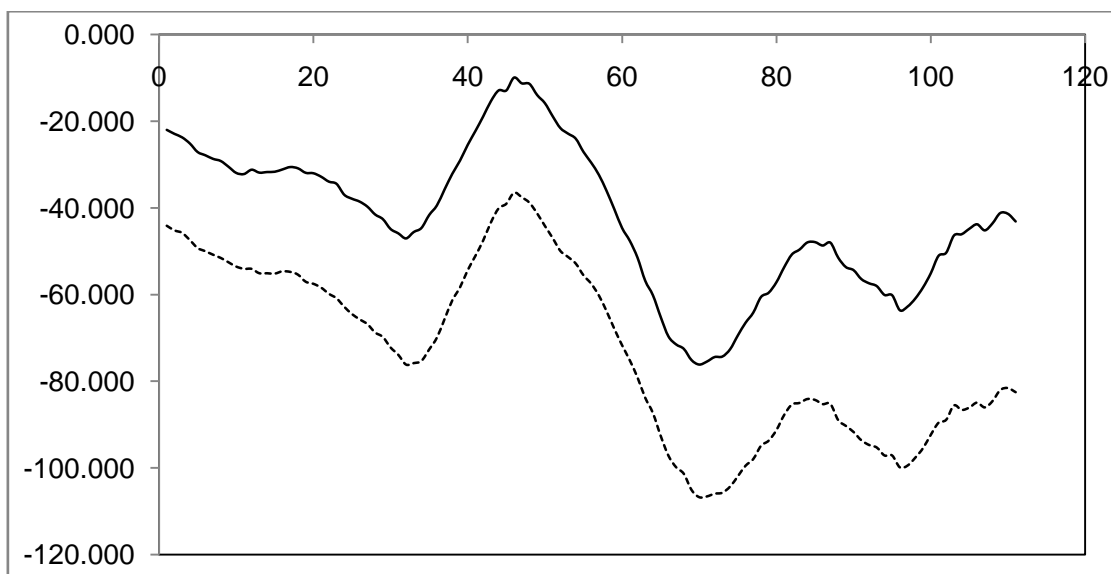
Figure 2. Current Account and Trade Balance
Source: Turkey Data Monitor, (2016)

Imports in energy contribute to Turkey's foreign trade imbalances. Figure 3 clearly indicates that the trade deficit in Turkey since 2000 (in terms of USD) has been increasing and reached a peak between 2001 and 2008. Similarly, energy deficit has been increasing since 2001. According to World Bank (2014), the annual deficit accounts for 58 percent of the merchandise trade deficit while average annual energy imports account roughly about 23 percent of merchandise imports. Therefore, energy imports play an important role in increasing the trade deficit in Turkey.
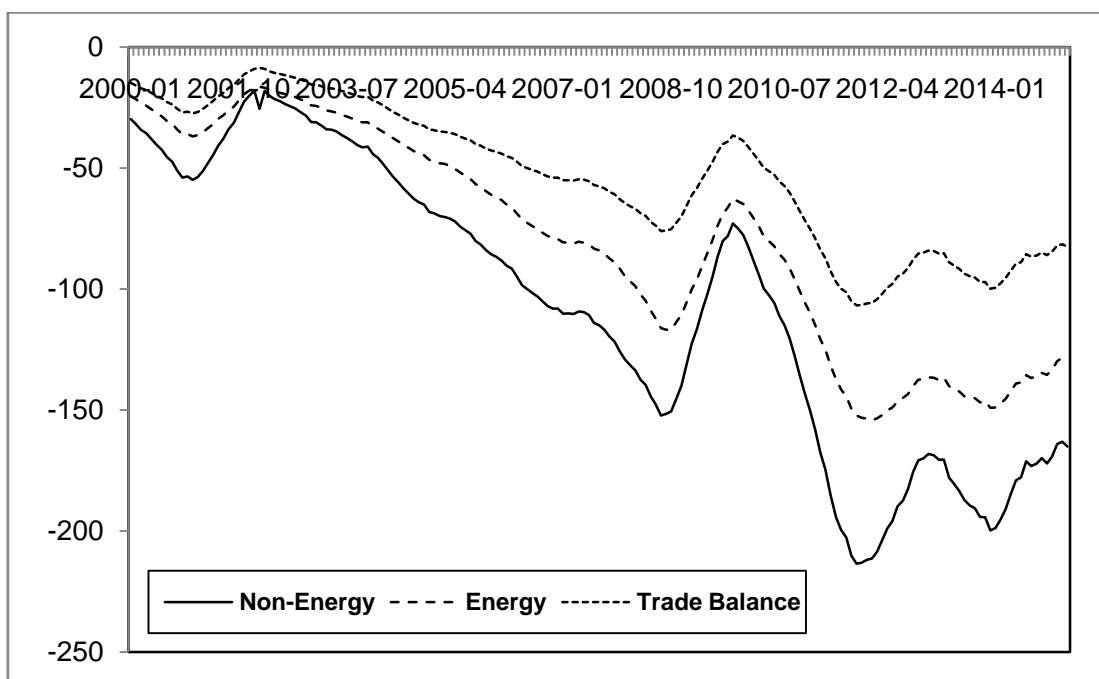
Figure 3. Trade Balance: Energy/ Non-Energy
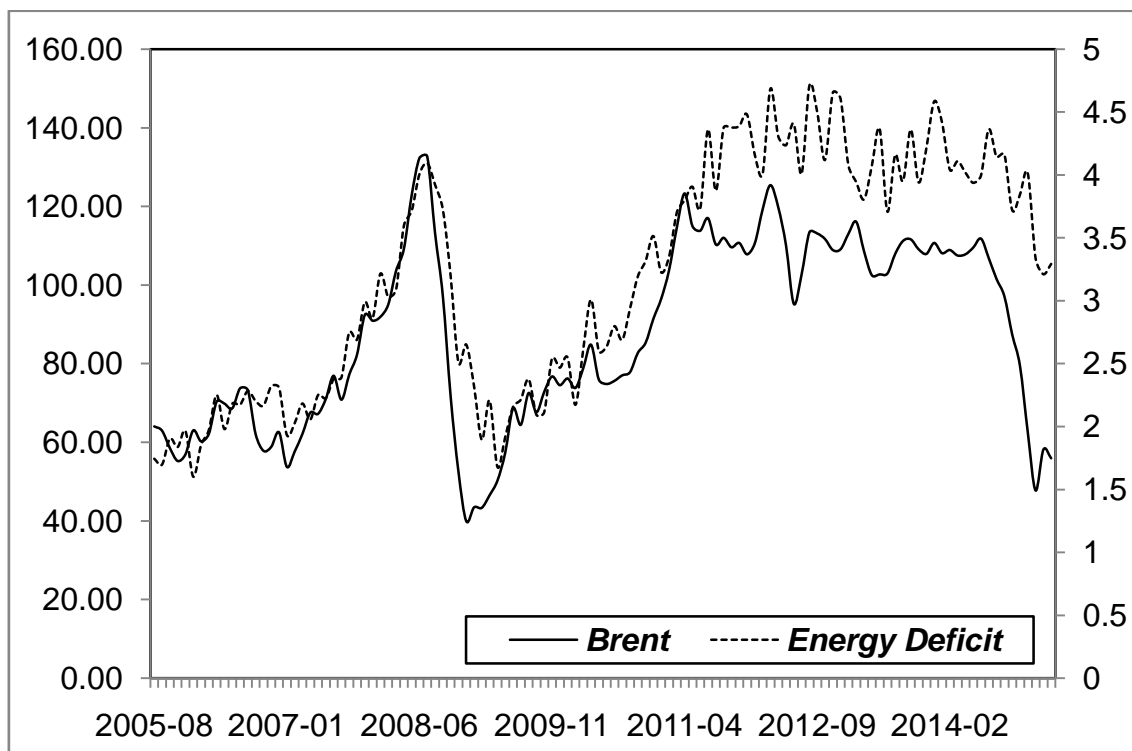**Source:** Turkey Data Monitor, (2016)

Turkey imports crude oil from Iran, Iraq, Saudi Arabia, Kazakhstan and Colombia (MFA, 2015).Table 1 lists the crude oil imports between 1996 and 2015 and demonstrates that the imported quantity did not vary much from 1996 to 2008. However, the crude oil imports decreased significantly to 14 million tons in 2009 as displayed in Table 1. After the crisis, imports of crude oil started to increase again but still are not at the levels of the 1990s and early 2000s.

Table 1. Imports of crude petroleum, 1996-2015 (as of July 2015)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Imports (in millions of tons)	23	23	24	23	21	23	24	24	24	23
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Imports (in millions tons)	24	23	22	14	16	18	19	19	17	11*

Source: Turkish Statistical Institute (TUİK, 2015)

Although the quantity of crude oil did not change between 1996 and 2008, energy deficit and the trade deficit continued to increase because of the oil prices as Figure 4 demonstrates. The outcomes were actually better for 2015 as Turkish economy achieved a higher than expected growth rate with oil prices dipping further than the estimation of $70 bbl. The $40-$50 bbl level would always be ideal for Turkey to achieve a minimum rate of 4 percent growth. However, this rate even is not enough for an economy that has a major young population with positive rates of population growth. Hence, the reduction in current account deficit should be supported by policies that provide certain advantages to sectors that have great potential to create higher future rates of growth.

Figure 4. Energy Trade Deficit and Oil Prices
Source: Turkey Data Monitor, (2016)

Another important sector for Turkey would is its main service sector, namely tourism, which needs to be reformed so that the per capita spending of tourists will increase overtime as well as the number of tourists, both domestic and foreign. In addition, Turkey needs to present clearly the advantages of its geography, nature, seas and mountains so that it can be a four-season tourist destination rather than just a few months with very populated touristic areas which are not welcomed by high per capita spending tourists. Hence, in terms of tourism sector, oil prices would still be important with the role in transportation and the mobility of domestic and foreign tourists.

2.2. Literature Survey with Theoretical Perspective

Shocks in oil prices can have effect on the foreign trade via both the financial and the trade channel (Le and Chang, 2013). A rise in the price of oil is related to adverse trade shock (Backus and Crucini, 2000). There are several studies examining the economic effects of oil price on economic growth and consumer prices (Hamilton 2005 and Tiwari 2013). Le and Chang (2013) conclude that developments in trade are statistically significantly related to the rising oil revenues. Additionally, the effect of rising oil prices on oil trade deficit depends on the nature of the demand for oil. Zaouali (2007) argues that increasing oil prices have modest effects on the current account since the economy could attract foreign capital and investment for China. Tsen (2009) examines the effect of the oil price shock and the terms of trade on the trade deficit in Asian countries of Japan, Singapore and Hong Kong for 1960 to 2006. The results demonstrate that the effect of prices on the trade deficit differs from country to country. The effects of a permanent shock of rising oil prices cause the terms of trade to fall, whereas the opposite is not detected for a continuous period of time. In general, the variations of terms of trade and oil price shock (either permanent or temporary) affect the trade deficit, both in the short and in the long run. Tiwari and Olayeni (2014) analyze the relationship between oil prices

and Indian's trade deficit from January 1980 to December 2011. Using the wavelet analysis and monthly data, they conclude that oil prices respond negatively to the trade deficit.

There are a few studies which are based on oil prices and trade deficit and other variables in Turkey. One of them checks the effects of oil prices on the balance of payments in Turkey and finds a significant effect of oil price shocks exist in the short-run (Özlale and Pekkurnaz, 2010). Another study by Aydın and Acar (2011) demonstrate that oil prices have significant effects on macro indicators in Turkey. Recently, Bayat *et al.* (2013) examine the relation between real oil prices and foreign trade deficit in Turkey. Their findings show that there is non-linear causality from real oil price to foreign trade deficit but not the opposite. However, the linkage exists only for the medium-term and the effect disappears in the long run.

3. Data and Methodology

This section is composed of the introduction of the data set and a brief explanation of the methodology used in the current study so that the relationship between oil prices and the trade balance can be properly examined and hopefully some original policy implications can be derived through the empirical results.

3.1. Data

Data for oil prices is obtained from the International Monetary Fund website and is in units of USD per barrel. We calculate the simple average of the spot prices of Brent, West Texas Intermediate and The Dubai Fateh. Data on the trade balance for Turkey is obtained from the Turkish Statistical Institute website (www.tuik.gov.tr) and is also in terms of USD. Our study covers the period January 1997 – December 2014. We use monthly growth rates of both series so that we can thoroughly assess the effect of any change in one variable on the other. We display the data for oil prices in Figure 5a and the data for trade balance in Figure 5b.
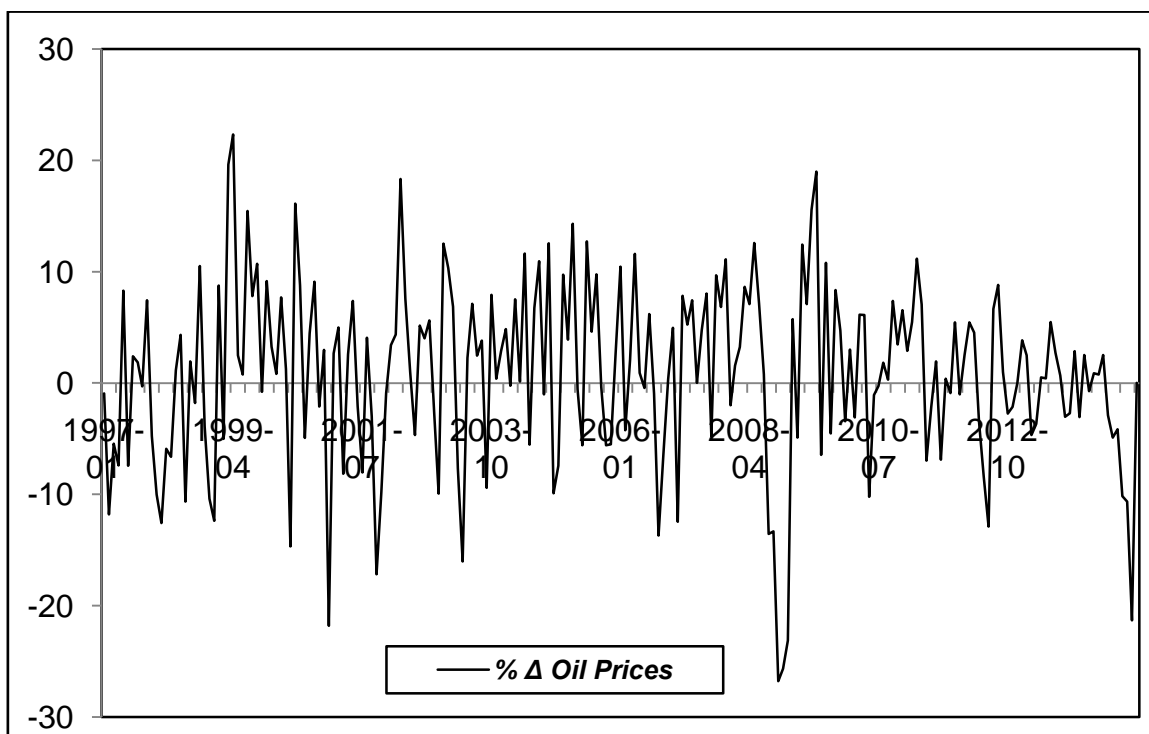
Figure 5a. Oil Prices
Source: International Monetary Fund, (2015)
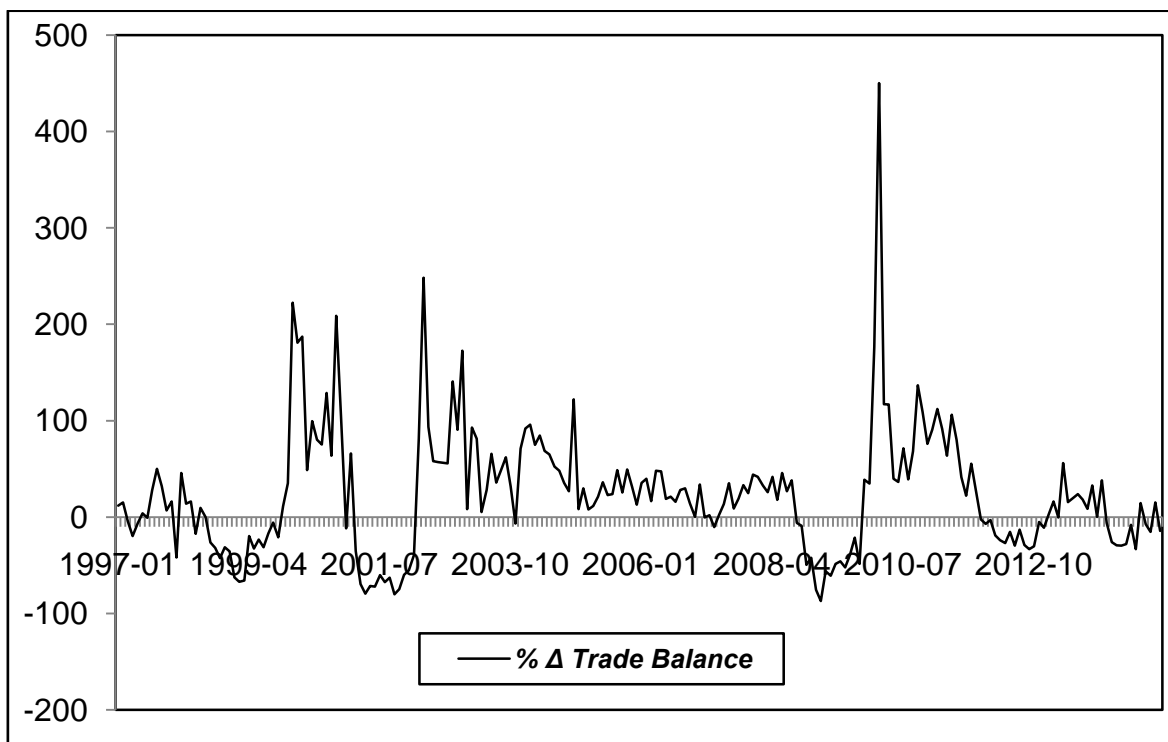
Figure 5b.Trade Balance
Source: Turkish Statistical Institute (TUİK, 2016)

3.2. Methodology

As the econometric methodology we choose to use the wavelet analysis. It is well known that a wavelet transform decomposes a time series. Wavelets have finite energy and compact support and wavelet transforms are comparable across scales and time series. Continuous wavelet transforms were developed to observe the power and test the statistical significance of these characteristics for two variables that are nonlinear in nature as well as comparing the forecasting performance of these two variables.

The three well known ones are the cross-wavelet power, the cross wavelet transform and the cross wavelet coherence (see Torrence and Compo (1998)) for a detailed methodological explanation).

The phase difference gives us the information "on the delay between the two time series (Aguiar-Conraria *et al.* 2008).[†]By using the methodological framework of continuous wavelet transform, we aim to approach a nonlinear relationship from a correct measurement perspective and discover and compare the dynamics of the oil prices-trade analysis in the emerging market of Turkey, different than any previous study according to our knowledge.[‡,§]

4. Empirical Analysis

In this part, we present the results and try to interpret their meanings. Moreover, we offer some policy implications that could be significant for the Turkish economy and policy makers as well as investors and households.

[‡]We do not go into specifics to save space but see Grinsted *et al.* (2004) for details.
[§] The description of CWT, XWT and WTC is from Grinsted *et al.* (2004). We are grateful to Grinsted and co-authors for making the MATLAB codes available for our use.

4.1. Results of Continuous Wavelet Analysis (CWT)

The wavelet power results of both trade and oil are in Figure 7. The analysis presents the scale specific variance that is related to the time series like Tiwari *et al.*(2013). The black contour designed denotes the 5 % significance level and the cone of influence indicates the region affected by the edge effects. For power, the color code goes from low power (black) to high power (white). Y-axis measures frequencies and X-axis represents the time period.

Figure 6 includes the information about the wavelet power. The WPS (wavelet power spectrum) of OIL shows a highly significant power that is valid for the period of 2008 to 2010 probably because of the global financial crisis. For oil, we also find that there is a solid power distribution during the early 2000s, 2005 and 2010 except for a few occasions. It is apparent that these effects are dominated by the oil prices increases during the 1999 as the Asian economies were recovering from the financial crisis.

In Figure 6, the wavelet power spectrum of TRADE shows a highly significant power in the period from 2010 to early 2011 at 0.25~1 month time scales. This is probably again due to the Great Recession and the reforms that have been induced during the crisis to help the economy so that the adverse effects are somewhat diminished.

In addition, we observe a strong variance at the beginning of the 2000s at 2-4 month time scales. This is clearly due to the banking crisis in Turkey that has left an unprecedented effect on the whole economy with interest rates rising to 7500% at some level and the fixed exchange rate regime had to be abandoned for a floating one that would help the markets observe fluctuations and respond rather than wait for the public to dominate the economy and attain the role of the major player which results in devastating results as seen throughout the economic history of many countries.
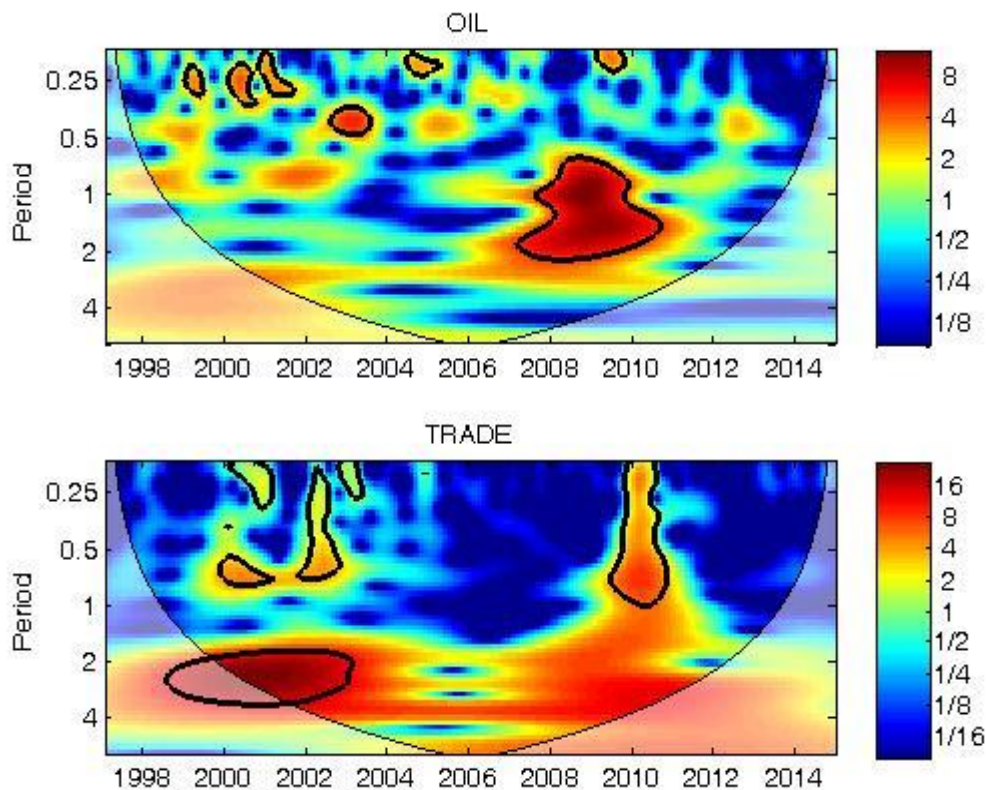

Figure 6. Continuous Wavelet Power Spectrum of Both Trade and Oil
Source: Authors' calculations

4.2. The Results for Cross Wavelet Transform (XWT)

Figure 7 shows the results for the cross wavelet transform. In this figure, arrows indicate the phase difference between the two variable of concern. Moreover, arrows going to the right mean that the two variables are in phase. On the other hand, if the arrows go to up and right, this shows that the oil prices are lagging the trade. However, if the arrows move down and to the right, this is the sign that the oil prices are leading the trade balance. In addition, arrows pointing to the left mean that the two variables are out of phase, hence, they do not follow the same cycle. Finally, when the arrows are going up and to the left, this means that the trade deficit is leading but the two variables are not in phase.

Figure 7 displays that the relationship between trade and oil is significant at around 3 bands. The phase angle indicated by arrows show that the two variables are correlated and this is a positive and statistically significant correlation. Oil prices are leading around 2000 and 2002. Time to time the arrows move right and up or up and left this means that oil prices are both leading and lagging the trade deficit. Nevertheless, there is not any consistent relation established for the rest of the frequencies. So to summarize, oil prices and trade deficit seem to be dependent on each other around the periods 2000-2002 and 2008-2010. Nonetheless, points in the cross spectrum can create spurious correlation and cross wavelet power spectrum could fail to qualify as a test that correctly detects the relationship between the two time series under question. Therefore, we use the wavelet coherence to discover the true nature of the relationship between the two series.
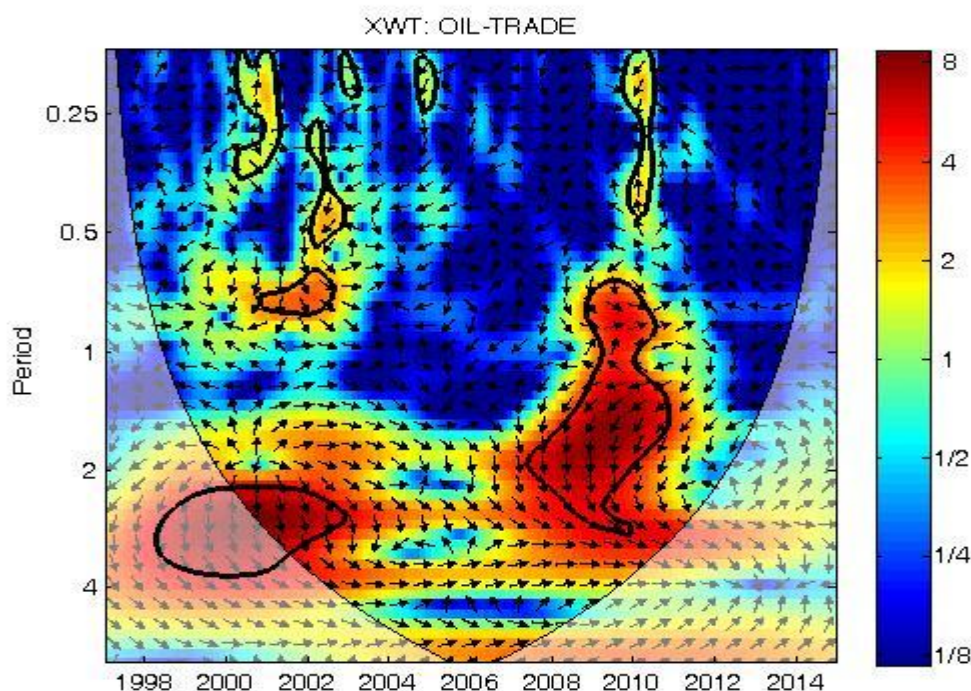

Figure 7.Cross Wavelet Transform
Source: Authors' calculations

4.3. The Results of Wavelet Coherence (WTC)

Wavelet coherence results are demonstrated in Figure 8. Results indicate that the relationship is a significant in statistical terms between the variables in the short term at around 1~2 months and 2-4 months. Nevertheless, the relation breaks off during 2003 - 2008. However, the significant relation is positive at 2-4 month time scales in 2002 and oil prices are leading the

trade deficit during 2008-2010 and then oil prices are lagging the trade deficit after 2010. At these intervals, the variables are out of phase and they have anti-cyclical effects on each other. It is easily detected that the reforms of the government motivated trade after the crisis and this has caused the trade deficit to move independently from the oil price. Furthermore, the low levels of growth and decreasing oil prices have resulted in a non-significant outcome after 2011.
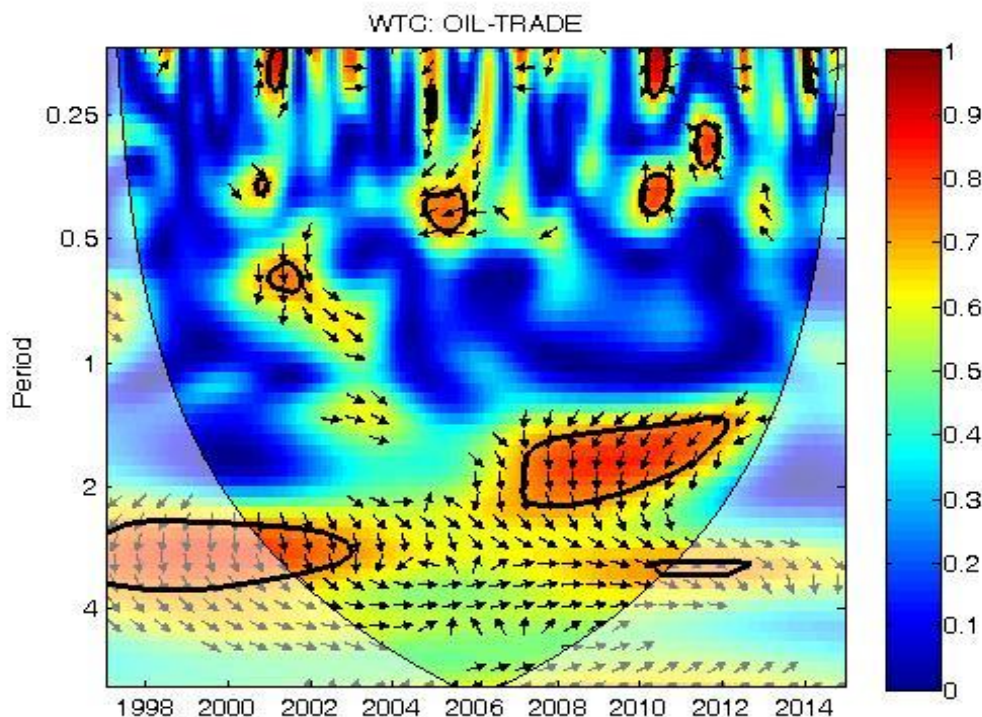
Figure 8. Wavelet Coherence
Source: Authors' calculations

5. Conclusion

This study examines the relationship between trade and oil prices for Turkey employing wavelet analysis. Results for trade balance using the continuous wavelet show that it is high and statistically significant at 0~1 months' and 2~4 months' scales. These results approve the strong power at different time scales during the financial crisis. For oil prices, nevertheless, we find relatively homogeneous power distribution during early 2000s, 2005 and 2010, except for a few occasions. During that time span, oil prices increased as the Asian economies were recovering from the financial crisis and there were the terrorist attacks on oil facilities in the Middle East and the Second Gulf War. The under-investment in the oil industry is probably the other major reason for our outcomes and the upward trend in oil prices during 2008-2010 is to be attributed to the Great Recession.

Moreover, we have checked the relationship between our variables using the XWT analysis. It is vital to underline that both oil and trade balance moves together in the same direction. However, the arrows move right and up or left and up frequently. This indicates that oil prices are both leading and lagging trade balance. Nevertheless, it is not possible to argue that any consistent relationship has been established for most of the frequencies. Our findings lend support to the dependence of oil prices and trade on each other around the periods, 2000-2002 and 2008-2010.

Given the limitations of XWT, as a third method, we have also employed the wavelet coherence test for assessing the relationship between oil prices and the trade balance. Our

findings indicate that the trade balance and oil prices experience a strong statistical relationship that corresponds to a frequency of 2~4 months during 2001-2002 and 1~2 months during 2008-2010. More importantly, oil prices are always leading the trade balance. Hence, it is probably appropriate to argue that the trade-oil prices nexus exists in the short-run for the Turkish economy. Moreover, our results show the statistically significant relationship and displays robust characteristics during the crises times of 2001 and 2008 in the Turkish economy.

Turkey's reliance on oil imports is very crucial in terms of its trade composition, especially during the turmoil periods. It is neither possible to change production techniques nor start using new and advanced technology immediately in an economy that exports mainly manufacturing goods. Therefore, in times of stability, producers are able to make decisions that do not lead to non-optimal outcomes. However, increasing risk and the uncertainty that always exists in emerging markets makes Turkish exporters rather vulnerable at times of volatility, especially if the composition and magnitude of volatility is unprecedented like the 2001 Turkish banking crisis and the spillover effects of the Great Recession that have caused a huge decline in the demand for Turkish exports. On the other hand, Turkish economy seems to be more resilient to shocks that are temporary or do not bring the need to change or shift the policy strategies for especially medium and small enterprises which attain an important role in both producing for the domestic market as well as trying to grow and be exporters in the medium to longer term.

Another policy implication of our study is the need to relate oil prices with other variables than the trade balance and current account deficit so that the transmission mechanism of oil price changes in the Turkish economy is outlined in a macroeconomic model. It is well known that oil is one of the heavily taxed items in Turkey and therefore changes in oil prices would definitely affect the fiscal policy decisions due to the tax revenue that the Turkish producers and consumers create. Moreover, monetary policy is also relevant in this aspect due to the imported inflation from oil price changes given that Turkey imports oil with USD. Thus, the actual inflation, inflationary expectations and both nominal and real exchange rates become crucial variables to consider when there are continuous fluctuations in oil prices in the world markets.

Consequently, Turkish economic growth path depends on the level and changes of oil prices probably more than the characteristics and composition of many other goods and/or services that it exports or imports. Unless, Turkey is able to produce enough energy for its exports with oil being denominated to a secondary role, the policy makers should track the oil prices and build scenarios for the future paths of oil prices so that compatible economic decisions could be made. In the meantime, Turkey should consider alternative energy sources that are cheaper and/or easier to be domestically produced so that it could expand into a level where the growth rates are much higher than the 4-5 per cent band and unemployment decreases to levels that are unprecedented in the Turkish economic history so that the potential output and actual output gap declines to a negligible level.

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