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# The Effects of Oil Price Fluctuations on Foreign Trade Performance: Evidence from Turkey as an Emerging National Economy

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Nowadays, while globalization has become a prominent phenomenon and gained great importance, foreign trade has started playing a critical role for economic success of countries with the extinction of closed economy concept and shrinking distances among countries as a result of the technological advancements and fascinating continuous growth of the national economies. Many academicians and practitioners agree that the sudden and considerable oil price fluctuations recently experienced led to substantial effects on economies, especially the emerging economies through affecting their foreign trade performance negatively, or positively. Therefore, this paper is aimed at arguing and researching such effects by using the relevant data from Turkey as an emerging economy via some econometric analyses focusing on the investigation of the effects of changes in oil price on export volume and its volatility. For this purpose, several cointegration and volatility modeling studies have been carried out in which oil price, export volume and some other control variables that are assumed to possibly affect export volume are the major variables considered, using the monthly data scanning the period between January 1998 and September 2015. The empirical results provide some robust evidence about the presence of significant relationship and interaction between oil prices and export performance.

*Keywords:* Foreign trade performance, crude oil prices, export volume, oil shocks and crises, volatility

*JEL Code:* F10, G15, Q41, Q43.

## Introduction

Following the Industrial Revolution, production activities turned out to be more machine-based where human force began to be utilized to a less extent while the world economies have been confronted with some magnificent changes and developments resulting from industrial automation efforts so far. With the advent of crude oil as an energy source and its use in production, it was observed remarkable changes in the existent economic views that would significantly affect the future of regional economies (Tasman, 1949). By passage of time, use of crude oil for machines utilized in manufacturing, as well as for transportation vehicles, became indispensable, which made crude oil a critical energy and power source during the previous century. Today, the importance of crude oil is relatively more considerable as compared to in the recent centuries. It is also estimated that crude oil will very likely persist to be crucial within next 20 years. Resultantly, oil price fluctuations have yielded heavy effects on regional economies owing to rapidly intensifying economic relations among the countries composing the world economy, When those countries are categorized as oil exporters and oil importers, it can be undeniably said that they should be influenced differently by oil price fluctuations in terms of their macroeconomic indicators such as inflation, growth rate, foreign trade balance and scale of borrowings. As for other countries, Turkey also has been passing through such a process leading to significant changes and effects in its economic view, especially effects on its foreign trade performance and export volume.

This study aims to argue and investigate what influences oil price fluctuations could have on the foreign trade performance of Turkey, also considering other major factors that are supposed to affect foreign trade. So, some cointegration and volatility modeling studies are presented with their significant results and conclusions.

## Literature Framework

Among the first studies that were carried out subsequent to the petroleum (oil) crisis in 1970s emphasizing the effects of oil price fluctuations on various macroeconomic variables are the empirical papers written by Hamilton (1983), Jacoby and Paddock (1983), Burbidge and Harrison (1984), Balassa (1985), Gisser and Goodwin (1986), Kiseok (1995), Hooker (1996). Then, the relationship between oil price and economic growth was researched also by Papapetrou (2001), Doroodian and Boyd (2003), Rodríguez and Sanchez (2005), Babusiaux et al. (2006), Lardic and Mignon(2008), Kilian and Hicks (2013). Although there are an enormous number of studies concerning the interaction between oil prices and economic growth, few studies have focused on the relationship between oil price fluctuations and foreign trade balance, in most of which current balance has been taken as the dependent variable. Since foreign trade balance corresponds to an important part of current account balance, the main point of interest in those studies was the linkage between current account balance and oil prices. For instance, Rebucci and Spatafora (2006) conclude that oil price shocks significantly affect current account deficit in the short run. Also, Chuku et al (2011) point out a short-term effect of oil price changes on current account balance in Nigeria which is treated both as an oil exporter and as an oil importer. In addition, Allegret et al (2014) suggest that oil price increases lead to improvements in current account balance, referring to the results of their study covering 27 countries exporting oil while Schubert (2013) states that a permanent rise in oil prices causes a J-curve shaped effect on the current account balance of relatively small economies, which means that oil price increases disturb current balance at first, but then the economy tends to recover towards the equilibrium.

The first paper focusing on the connection between oil prices and foreign trade balance belongs to Agmon and Laffer (1978). They provide some evidence that oil crises initially disturb the foreign trade balance of developed countries, but by the passage of time, the economies suddenly recover to the equilibrium. As one of the marginal studies concerning the relationship between oil prices and current account balance, Jackson (2011) shows that oil price increases enlarge current account deficit in the US,, but with contraction in demand for oil import, both oil prices and current deficit start undergoing a decreasing trend. On the other hand, Lawrence (2014) claims that any increases in oil supply lead oil price to go down, thereby narrowing deficit in current account.

Looking at the studies on Turkey, Aksoy and Coskun (2004) in their empirical study aiming to explore the factors affecting changes in the foreign trade of Turkey present a comparison of Turkey's export-import profile to those of several countries since 1990s and provide some explanations and reasoning for the relative position of Turkey in the global trade. Besides, Bayrac (2005) concentrates on the characteristics of the oil market, its evolution and the effects of oil price fluctuations on both the Turkish economy and other national economies.

In the other relevant studies focusing on Turkey's foreign trade, the relationship between oil prices and current account deficit is the core issue to be dealt with. For example, Demirbas et al (2009) provide some empirical findings that suggest increases in oil price worsen current account deficit in Turkey. Moreover, Erdogan and Bozkurt (2009) attract attention to their suggestion that oil prices create enormous effects on both the foreign trade balance and current account balance. Also, Bayat et al (2013) have reached the conclusion that there is a statistically significant cointegration relationship in medium term from real oil prices toward foreign trade balance.

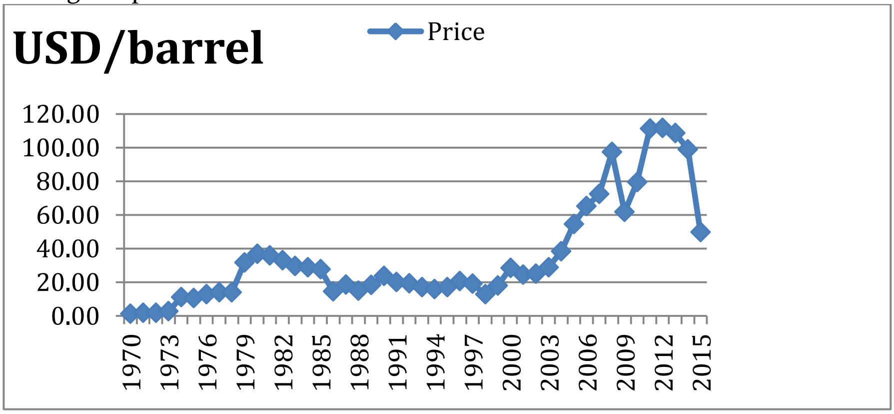
Polat and Sancar carried out an empirical study in 2015 in which they conclude an important effect by oil price fluctuations on the foreign trade deficit of Turkey. In a relatively divergent study prepared by Altintas in 2013, the triangle interactions among oil prices, export and real foreign exchange rates were investigated by modeling export volume based on such independent variables as oil prices and some other control variables that are supposed to influence export through the Autoregressive Distributed Lag (ARDL) method and causality tests. Eventually, Deniz and Sumer (2015) as one of the latest studies on the relevant issue have analyzed the data of several Eurasia countries including Turkey and conclude that any increase in oil price leads to a parallel change in the export volume of the oil exporter countries whereas it simultaneously draws up manufacturing costs and commodity prices in the oil importing countries like Turkey.

As can be inferred, it is obvious that there are a few number scientific studies concentrating on the relationship between export volume and oil price fluctuations in Turkey, which is the main motive for the preparation of our current paper.

## A Historical Look over Oil Price Fluctuations

From the past to the present, oil prices have been very volatile because of various reasons stemming from global interactions among countries, creating sharp effects on national economies. Since 1970 when oil was deemed to be a vital material, there happened great oil price fluctuations (shocks) which were considered the important oil crises as well as relatively less considerable fluctuations in short run. The oil crises experienced Within the historical era between 1970 and 2013 were accompanied merely with tremendous price rises. Subsequent to those shocks, price volatility became more evident and persistent even though oil prices sometimes underwent a progress of stabilization, causing a habitual mess in the oil markets.

Graph 1 below helps us seize how volatile oil prices have been in the period between 1970 and 2015. The points in the graph refer to the annual average oil prices during the period. Despite a relatively stable trend, at relatively low levels, in oil prices from the World War II to 1970, it can be inferred that many frequent and dramatic price changes were observed during the period.




Graph 1: Oil Price Fluctuations between 1970 and 2015
*The averages in this chart are year based.

Source: BP Statistical Review of World Energy Full Report 2009 and 2015, www.statista.com

The first oil crisis occurred as a result of the OECD's decisions for contracting oil supply and laying embargo on it whereby oil price jumped up from $ 11,24 in 1972 to $ 20,18 in 1975, corresponding to a 80 % increase. The second important rise in oil prices was encountered in 1979 following the Iran Islamic Revolution, but the peak was reached in 1981 at $ 53,74 due to the war between Iran and Iraq, which represents a 173 % rise if considering its level of $ 19,67 in 1979. The third crisis was 10 years later caused by the occupancy of Kuwait by Iraq when the price went up to the level of $ 24,55 from its previous level of $ 16,62. However, oil prices revealed a decreasing trend for a while during 1990s and hit a quietly low level of $ 12 just after the 1997 Asian Crisis. Subsequent to an increasing trend as a consequence of the decision taken by Russia and OPEC to decrease petroleum supply, the next important price shock happened due to the USA-Iraq War and rising tension in the Mideast region, in which the oil price went up to $ 15,90 in 1998 from its initial level of $ 11,27 in the same year and then to the level of $ 26,72 in 2000. The prevalent policy of decreasing the oil supply commonly applied through 2002 along with expansion in the demand for oil arising from global economic growth accelerated those price increases. These trendy increases continued till the 2008 Crisis. In 2009, the latest upward trend appeared as a result of rapid improvement in the development performance of developing countries (Ozsagir et al, 2011).

The eventual oil market shock that first occurred in 2014 currently still continues to retain its importance. The main difference of this oil market shock from the past shocks is that it has manifested as rapid decreases in oil price. Considering the reasons underlying the existence of this negative shock, it is better to evaluate them separately as the factors related with oil demand and the ones related with oil supply. The former include the development rate of the global economy which was lower than expected, the expectation about the continuity of low development performance for the European economies, and the recession in Japan causing a decrease both in oil demand and, of course, in oil price. The latter include the invention of new oil reserves as well as increases in oil production through nonconventional techniques especially in the US (Yanar, 2014).

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## Impact of Oil Price Fluctuations on the Global Economy and Foreign Trade

The formation of equilibrium prices in an economy is fundamentally a result of microeconomic operations in that economy. Equilibrium exists where total demand for any economic item equals its total supply, so all the microeconomic dynamics shaping demand and supply also are supposed to influence equilibrium price (Ozbugday, 2014). Moreover, the past changes, especially unexpected changes, in oil prices as one of those dynamics have directly or indirectly led to impacts on the global economy by all means.

Considering the past upward changes in oil prices, it is clear that these changes have always resulted in escalations in general price levels caused by increases in total costs because of both their upward pressure on the prices of inputs indispensable for an economy and the fact that petroleum is solely an important input for many industries (Bayrac, 2009). For instance, the global inflation rate increased from its level of 6,1 % in 1972 to 14,4 % in 1974, following the first oil shock in 1973. Looking at the inflation rate statistics in USA within the identical time period, a similar trend was observed. The US inflation rate was only 3,8 % at the beginning of the year 1973, just before the shock, it rose to 12 % till the beginning of the year, 1975. Following 1975, the rate stepped down in a decreasing trend to a relatively ordinary level.

Oil price fluctuations are supposed to have great impacts on the GDP performance of countries, thereby affecting their growth potentials due to changes in oil demand throughout the world. To exemplify, the global growth rate which had been 5,5 % on average during the period between the years 1970 and 1973, declined to 1,9 % through 1975 in the wake of the first oil shock. On the other hand, a 46 % increase in the oil demand during the recession in 2001 was accompanied by a poor growth performance at 1,6 % for the global economy (CGES, 2004).

Another important economic dynamic indirectly affected by oil price fluctuations is employment. In theory, high oil prices are expected to contract aggregate supply of goods and services due to rises in total costs and thus bring about more severe inflationary conditions. Moreover, the real income levels in the countries importing more oil are to be deteriorated because of changes in aggregate demand. On the other hand, the real income levels of the oil-exporter countries are positively affected through income transfer from the oil-importer countries to the oil-exporter ones, which leads to unfavorable influences on global economic growth and then results in higher unemployment rates (Economic Review, 2005).

High oil prices pave the way to decreases in the real income levels of oil-importer countries because it is not possible to cut down oil consumption to compensate for a rise in oil prices so as not to have to lower the proportions of real income devoted to expenditures other than for petroleum (Ozkaya, 2001). The magnitude of the effect of oil price fluctuations on real income depends on both the proportion of oil import and export in real income and the extent to which a country's economy relies on oil consumption. Furthermore, upward price movements also may create significant influences on the macroeconomic results of the policies implemented to harmonize with oil price fluctuations. In the economies which merely use oil as an important input in production, costs generally climb up as a response to increases in oil price, which then affects general price levels unfavorably, resulting in an upward trend in the wholesale and consumer price indices.

From the viewpoint of oil-exporter countries, it can be said that upward changes in oil price is expected to bring expansion in export incomes and consequently improve national income since the economies of such countries are a function of government expenditures mainly driven by oil prices. Thus higher oil prices lead to higher levels of government expenditures that normally eventuate in more jobs and greater per capita income (Yanar, 2014).

In case of downward movements in oil prices, the oil-exporter countries are anticipated to enter a recession and experience decline in their economic growth rates if such price changes have become persistent in the long run. Continuation of that situation very likely results in economic shrinking and lower foreign trade income. On the other hand, the oil-importer countries are supposed to be positively affected by oil price decreases because this downward trend is expected to yield a ground suitable for achieving lower inflation rates. Depending on interest rate decreases, the aggregate outputs of those countries could be positively affected, thereby contributing to global economic growth.

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## Foreign Trade Performance of Turkey during Oil Price Fluctuations

According to the data released and published in 2014 by the Energy Market Regulatory Authority, Turkey was portrayed as a country highly dependent on outside energy sources. With numbers, it was reported that Turkey had to import 75 % of its energy requirements paying approximately $ 55 billion in the year 2014. Therefore, the oil price shocks did directly and suddenly reflect to Turkey's economy. As a developing country which has been continuously trying to facilitate industrial expansion and growth since 1950s to be able to keep up with global developments and is a major consumer of oil as a fundamental material for that industrialization process, Turkey has always been exposed to the risks and hazardous effects associated with oil price volatility.

As some of the empirical studies focusing on the forward-backward connectional effects of oil price changes on the major economies clearly show, since the energy sector in Turkey is the industrial segment that supplies crucial inputs to other industrial segments, the other sectors are dependent on the energy sector and it can be deemed to be the leading sector in the Turkish economy (Ozdemir, 2005). In light of this fact, it is undeniable that the major macroeconomic indicators of Turkey such as inflation rate, GDP, interest rate, economic growth and employment are directly or indirectly influenced by oil price fluctuations if both its distinctive position among the items being imported and income or welfare shift from the oil-importers to the oil-exporters especially in case of upward price changes are taken into account (Atiker, 2004 and Bayrac, 2009). Turkey as an oil-importer country has been influenced in the way that the theory suggests. In other words, oil price increases generally accelerate energy consumption costs in oil-importer countries and resultantly cause bigger foreign trade deficit if the export prices of oil-importer countries have remained constant (Ozdemir, 2005).

The fact that the domestic oil prices in Turkey are indexed on the oil prices in the Milano market is helpful in explaining the vulnerability of the Turkish economy to the global oil market (HSBC, 2003). Also, upward fluctuations in the prices of other energy materials such as natural gas negatively pass through to the economy and trade balance in general. In this context, Table 1 briefly shows the connection between the oil import statistics of Turkey and its foreign trade indicators with the help of some relevant data for the period between the years 2000 and 2014. Regarding the presented data, it can be inferred that the money paid by Turkey for oil mounted from an initial amount of $ 4,2 billion in 2000 to a relatively huge amount of $ 12,7 billion in 2014, which suggests persistent increases in trade balance deficit across the years.

While the total oil consumption in Turkey for the period between the years 1998 and 2008 had been around 23 million tons on average, it decreased to the level of 14 million tons in 2009 in the wake of the global crisis. But the consumption level again rose to 18 million tons through 2014. Talking in monetary terms, it is observed that the total oil consumption of Turkey increased by almost 10 times from 1998 through 2007. However, in 2009, there was a decline to the level of $ 6 billion as a result of the precautionary austerity policies implemented against the sharp oil price increases during the global economic crisis. With the stabilization of oil prices, the consumption costs started moving around $ 10 billion on average. Taking into account the information that Turkey meets approximately 27 % of its energy requirement from oil and imports 93 % of its oil consumption, it is argued that any $ 10 change in oil price may lead to a change of $ 4,5 to 5 billion in its current account balance.

**Table 1:** Oil Import and Trade Balance Statistics of Turkey (million tons, million $)

| Years | 2000 | 2005 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|
| Oil Import (tons) | 21.362 | 23.389 | 14.219 | 16.873 | 18.049 | 19.479 | 18.554 | 17.481 |
| Oil Import ($) | 4.208 | 8.649 | 6.415 | 9.647 | 14.888 | 16.133 | 14981 | 12.683 |
| Trade Deficit ($) | 26.728 | 42.926 | 38.785 | 71.661 | 105.934 | 84.083 | 99.858 | 84.566 |
| Total Foreign Debt ($) | 119.600 | 169.726 | 268.948 | 292.043 | 303.931 | 339.042 | 389.183 | 402.441 |
| Current Account Deficit ($) | -9.920 | -22.088 | -12.010 | -45.312 | -75.008 | -48.535 | -64.658 | -46.531 |
| Oil Import ($) / Trade Deficit | 0,16 | 0,20 | 0,16 | 0,13 | 0,14 | 0,19 | 0,15 | 0,15 |
| Oil Import ($) / Total Foreign Debt | 0,03 | 0,05 | 0,02 | 0,03 | 0,05 | 0,04 | 0,04 | 0,03 |
| Oil Import ($) / Current Account Deficit | 0,42 | 0,38 | 0,53 | 0,21 | 0,20 | 0,33 | 0,23 | 0,27 |

Source: www.bumko.gov.tr; www.tuik.gov.tr

As can be understood from Table 1, despite the contraction in oil import during the global crisis, the oil import constituted 53 % of the current account deficit in 2009. This proportion never fell below 20 % along the entire 15-year period. Moreover, the ratio of oil import to trade deficit was about 16 % in 2009 whereas the average of that ratio for the latest 5 years was calculated as 15 %.

The eventual big oil crisis which started at the beginning of 2014 and has manifested itself as price decreases with its continuing effects on the national economies can be said to have ended up with some results favorable for the Turkish economy. As one of the reasons why problems with high inflation persist in Turkey is that Turkey is very dependent on the foreign sources of oil which is one of the major inputs consumed in production, the Turkish economy is so fragile against oil price fluctuations (Ozdemir, 2005). Falling oil prices are expected to result in decreases in the prices of other goods and services by facilitating lower inflation and consequently enhancing purchasing power improvement as well as positive effects on current account balance and economic growth (Demirci and Er, 2007). Even though Turkey realized the historically highest volume of oil import in 2014, its export revenues climbed up more, thereby maintaining export/import ratios of 65,1 % and 69,5 % in 2014 and 2015 respectively which represent the highest points in comparison to the period before the global crisis term. For the countries like Turkey highly dependent on other countries for oil, it can be said that price decreases are supposed to shrink import volume and meanwhile increase export volume, enabling the gradual termination of trade and current account deficits.

In the subsequent sections of the paper, the details and findings of an empirical study that is aimed at exploring the effects of oil price fluctuations on the export volume and volatility in Turkey as an emerging economy are mentioned and presented.

## Empirical Study

In this section of our study, an economic investigation to argue and examine the possible effects of oil price variations on foreign trade volume and volatility is presented with its empirical findings and evidence that can be regarded as an essential contribution to the related existing literature in that it is concerned especially with how export is influenced by oil price changes. Fists of all, the basic methodology and the hypotheses to be tested are being mentioned and then, the significant results of the study are given in detail accompanied with their economic interpretations.

## Purpose of the Study and Research Hypotheses to Test

The primary purpose of this empirical part of the paper is to unveil any effects of oil price fluctuations on Turkey's export volume and volatility. Deviating from the past research carried out on the issue in Turkey, this study can be considered a distinctive work because almost none of the previous research has directly focused on the connection between oil price and export volume. They, instead, are concerned with the relationship between oil price and trade balance. Export is one of the critically important macroeconomic parameters for Turkey in terms of its trade performance because of the undeniable fact that most of the inputs used in production as well as oil are bought from abroad, so export volume becomes, maybe, the only performance measure against Turkey's continuously increasing volume of import. This is the main motive for the paper to be prepared in such a relatively different perspective. Within this context, cointegration and volatility analyses have been undertaken using two control variables in addition to the variable of oil price which all are assumed to affect export volume in order to ascertain any meaningful connections among them.

In theory, it is suggested that increases in input prices also raise nominal prices of goods and services produced and sold in the country. High price levels likely make these goods and services unattractive for foreign buyers as depending on their levels of demand elasticity and therefore, the export volume tends to decline. In light of the empirical findings of this part, the hypothesis that oil price changes affect export volume in reverse direction is being tested. In addition, the effects of such control variables included as GDP and the TL / $ FX rate are also argued and investigated. Theoretically, economic growth (GDP rises) is expected to foster domestic demand and yield upward changes in commodity prices, thereby negatively affecting foreign demand for domestic products, which means export volume decline. So, the second hypothesis to be tested is that GDP increases negatively influence export volume. Moreover, the theoretical opinion that upward variation of FX rate leads export volume to change in the same direction is another hypothesis of interest to our study. On the other hand, arguing and testing whether there is a stronger causal effect from each explanatory variable to export volume is one of the foremost concerns of this empirical research. Also, it is aimed through volatility models to test the hypothesis that oil price fluctuations are an important determinant of export volume volatility.

## Model Variables and Data Collection

Export volume (Exp), Gross Domestic Product (GDP), TL/$ FX rate (FXRate), and oil price (OilPrice) are the variables included in the analyses carried out. The data consist of monthly statistics and cover the period between January 1998 and September 2015. While the data on export volume, GDP and the FX rate have been collected from the official websites of the Turkish Statistical Institute (TUIK), the Central Bank of Turkey (TCMB) and the General Directorate of Budget and Fiscal Control (BUMKO), the oil price statistics have been obtained via the website of United States Department of Energy (DOE). Due to the frequency disconformity that the GDP data are quarterly, but the FX rate data are daily while the export volume and oil price data are monthly, data harmonization through appropriate transformation was strictly needed. For this purpose the quarterly data of GDP denominated in US dollar were converted to monthly data by using the average of effective TL/$ exchange rates considering the number of days in each quarter while the daily data of FX rate were also restated on monthly basis simply by calculating their arithmetic mean for each month. In the end, we end up with 213 observations for each of the variables included in the study.

## Methodology and the Econometric Techniques Undertaken

Prior to modelling, a descriptive analysis has been conducted to evaluate the distributional appropriateness of each variable for normality. In this context, it has been tested whether the data are normal in light of the skewness and kurtosis statistics obtained through the Jarque-Bera test. In cases of non-normality, we have transformed the series using natural logarithm to approximate the data series to normal distribution, if possible.

To justify the stationarity of the data which is a fundamental assumption of causality and cointegration analyses, we apply both single and group-based unit root tests separately on the variables included. Moreover, to argue the lag-lead relationships between the variables of interest, cross correlation analysis is carried out. In the stage of unveiling any potential long-term relationships between the variables, we undertake cointegration analysis in a binary pairing manner for exploring the relationship between the variables of export volume and oil price, and also in a multiple manner for the relationships among the variable of export volume and other variables. Before conducting cointegration analysis, proper lag lengths have been determined via VAR modeling as well as the evaluation of variable exogeneity through the Granger Causality and Block Exogeneity Wald tests. At the further step, some cointegration equations have been produced to represent equilibrium relationships between the variables using Johansen Cointegration technique.

To test and measure the strengths of reciprocal causality relationships between the variables and to determine their directions, the Granger causality tests are undertaken for at most 5 periods of lag. In light of the findings obtained, it is aimed to emphasize the effects of other variables especially on export volume. Furthermore, a variance decomposition analysis is applied to ascertain what proportions of the variance of each variable can be explained by changes in each of the other variables. In addition, the response of export volume to changes in each of the other variables has been searched using impulse-response graphs.

Eventually, some volatility models have been constructed using the TARCH (a,b,c) technique assuming one ARCH component (a=1), one GARCH component (b=1) and one component for asymmetric effect (c=1) in the model so as to uncover any effects of the explanatory variables included on the volatility of the export volume variable. To do that, ARCH-LM test is employed to argue the availability of the variables data for volatility modeling in which the variables other than export volume take place as exogenous independent variables. Considering the results of the TARCH (1,1,1) model, we try to derive some conclusions about how the volatility of export volume is affected by both its own changes and changes in the others. To criticize the accuracy of the model, the error terms are tested by a further ARCH-LM test.

## Empirical Findings

### Descriptive Statistics and Distribution Tests

Table 2 shows the descriptive statistics of the original data categorized by variable to conclude if or not each variable can be assumed to be normally distributed. As can be interpreted from the findings, all the variables other than FX rate should be assumed not normally distributed and relatively flat because the tail probability of Jarque-Bera for each of these variables has been calculated very close to zero with a kurtosis statistic smaller than 3. While the variables of export volume and oil price seem to be skewed to the right, the other two can be regarded as skewed to the left.

**Table 2:** Descriptive Statistics for the Original Data by Variable

| | Exp | GDP | FXRate | OilPrice |
|---|---|---|---|---|
| **Mean** | 7406346. | 44208752 | 1.403545 | 58.72404 |
| **Median** | 7561696. | 45829204 | 1.462190 | 59.00000 |

| | | | | |
|---|---|---|---|---|
| **Maximum** | 14680111 | 73434180 | 3.013500 | 133.8800 |
| **Minimum** | 1883315. | 14949837 | 0.211619 | 11.35000 |
| **Std. Dev.** | 4049433. | 19433945 | 0.557020 | 30.85535 |
| **Skewness** | 0.064350 | -0.078067 | -0.225583 | 0.222796 |
| **Kurtosis** | 1.526317 | 1.443292 | 3.391790 | 1.859403 |
| | | | | |
| **Jarque-Bera** | 19.42121 | 21.72350 | 3.168821 | 13.30818 |
| **Probability** | 0.000061 | 0.000019 | 0.205069 | 0.001289 |
| | | | | |
| **Sum** | 1.58E+09 | 9.42E+09 | 298.9550 | 12508.22 |
| **Sum Sq. Dev.** | 3.48E+15 | 8.01E+16 | 65.77745 | 201835.2 |
| | | | | |
| **Observations** | 213 | 213 | 213 | 213 |

Since the GDP and export volume variables apparently are not normally distributed, we prefer to perform natural logarithmic transformation on these two variables also in order to eliminate their magnitude differences from other two variables. Table 3 below contains the descriptive statistics of all the variables, but reproduced for the transformed GDP and export volume variables. Unfortunately, we observe distributional problems with the variables except FX rate still continue. In Graph 2, the data are also visually presented convincing us about the presence of an increasing trend in the course of time for each of the variables.

**Table 3:** Descriptive Statistics for the New Data Set

| | **ln(Exp)** | **ln(GDP)** | **FXRate** | **OilPrice** |
|---|---|---|---|---|
| **Mean** | 15.62617 | 17.48808 | 1.403545 | 58.72404 |
| **Median** | 15.83861 | 17.64043 | 1.462190 | 59.00000 |
| **Maximum** | 16.50200 | 18.11190 | 3.013500 | 133.8800 |
| **Minimum** | 14.44854 | 16.52021 | 0.211619 | 11.35000 |
| **Std. Dev.** | 0.662912 | 0.507320 | 0.557020 | 30.85535 |
| **Skewness** | -0.400814 | -0.408512 | -0.225583 | 0.222796 |
| **Kurtosis** | 1.621645 | 1.628249 | 3.391790 | 1.859403 |
| | | | | |
| **Jarque-Bera** | 22.56443 | 22.62440 | 3.168821 | 13.30818 |
| **Probability** | 0.000013 | 0.000012 | 0.205069 | 0.001289 |
| | | | | |
| **Sum** | 3328.374 | 3724.962 | 298.9550 | 12508.22 |

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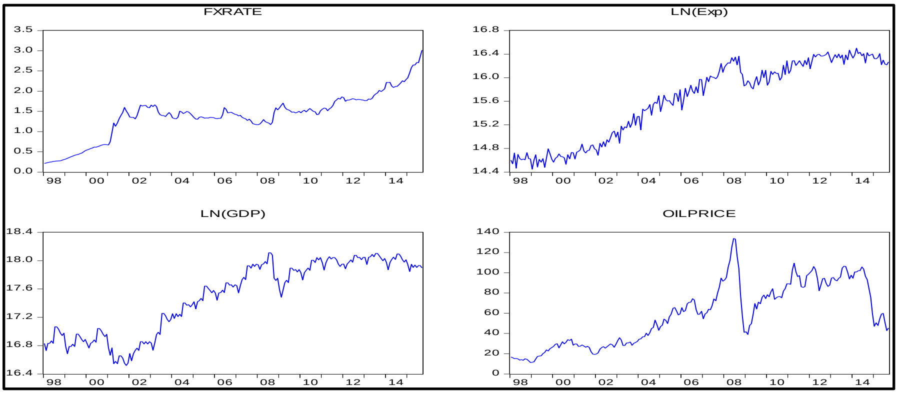
| | | | | |
|---|---|---|---|---|
| **Sum Sq. Dev.** | 93.16403 | 54.56326 | 65.77745 | 201835.2 |
| | | | | |
| **Observations** | 213 | 213 | 213 | 213 |




Graph 2: Line Graphs

## Unit Root Tests

The findings of the single and group-based unit root tests carried out separately for the set of export volume and oil price variables and for all the variables as a group are presented in Table 4 and Table 5. According to the group-based test statistics in Table 4, all the variables are not stationary at the level because the tail probabilities of the test statistics all are significantly over zero. Additionally, the same is concluded when considering the single variable unit root test statistics presented in Table 5. On the contrary, the variables become stationary if taking their first and second differences at 5 %. For this reason, the first-differenced values of all the variables are used in the remaining analyses and modelling studies. On the other side, Table 6 illustrates the descriptive statistics of the first-difference series of each variable. With respect to these results, it can be concluded that the only normally distributed variable is ln (Exp). The line graphs of the final data sets also are provided in Graph 3.

**Table 4**: Group-Based Unit Root Tests Results

| Group Statistics for the Variables "ln(Exp)" and "OilPrice" | | |
|---|---|---|
| **Method** | **Test Statistic** | **Probability** |

| | | |
|---|---|---|
| Levin, Lin and Chu t | -1,78586 | 0,0371 |
| Im, Pesaran and Shin W-stat | -0,76064 | 0,2234 |
| ADF – Fisher Chi-Square | 4,92706 | 0,2949 |
| PP – Fisher Chi-Square | 3,42883 | 0,4888 |
| **Group Statistics for the Variables ln(Exp), OilPrice, ln(GDP), and FXRate** | | |
| **Method** | **Test Statistic** | **Probability** |
| Levin, Lin and Chu t | -0,68940 | 0,2453 |
| Im, Pesaran and Shin W-stat | 0,33694 | 0,6319 |
| ADF – Fisher Chi-Square | 6,16523 | 0,6287 |
| PP – Fisher Chi-Square | 4,27588 | 0,8314 |

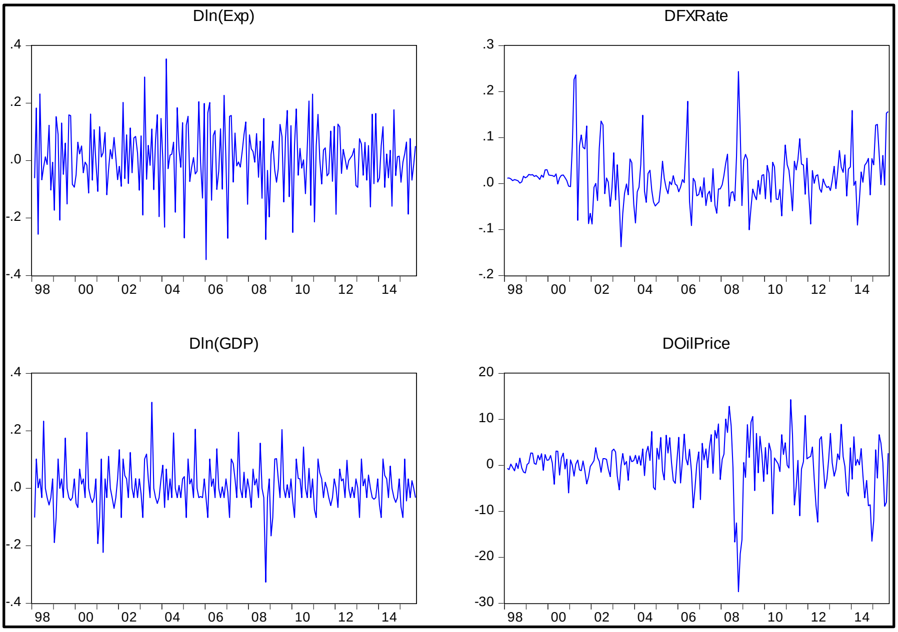
**Table 5**: Univariate Unit Root Tests Results

| VARIABLE | LEVEL | | 1.DIFFERENCE | | 2.DIFFERENCE | |
|---|---|---|---|---|---|---|
| | Test Stat. | Prob. | Test Stat. | Prob. | Test Stat. | Prob. |
| **Ln(Exp)** | -1,737635 | 0,4108 | -4,574648 | 0,0002 | -7,249536 | 0,0000 |
| **OilPrice** | -2,199323 | 0,2073 | -9,498735 | 0,0000 | -20,68099 | 0,0000 |
| **FXRate** | -0,001141 | 0,9566 | -9,795524 | 0,0000 | -11,45077 | 0,0000 |
| **Ln(GDP)** | -1,438173 | 0,5629 | -2,964077 | 0,0401 | -12,90963 | 0,0000 |

**Table 6**: Descriptive Statistics for the First-Differenced Data Series

| | **Dln(Exp)** | **DFXRate** | **Dln(GDP)** | **DOilPrice** |
|---|---|---|---|---|
| **Mean** | 0.007855 | 0.013216 | 0.005030 | 0.135660 |
| **Median** | 0.009805 | 0.008676 | 0.000000 | 0.785000 |
| **Maximum** | 0.353430 | 0.243627 | 0.299452 | 14.28000 |
| **Minimum** | -0.344788 | -0.137500 | -0.326847 | -27.50000 |
| **Std. Dev.** | 0.116718 | 0.056722 | 0.077805 | 5.425886 |
| **Skewness** | -0.172210 | 1.128051 | 0.187137 | -1.210830 |
| **Kurtosis** | 3.070375 | 5.933540 | 5.525019 | 7.061067 |
| | | | | |
| **Jarque-Bera** | 1.091601 | 120.9782 | 57.55625 | 197.4842 |

| | | | | |
|---|---|---|---|---|
| **Probability** | 0.579378 | 0.000000 | 0.000000 | 0.000000 |
| | | | | |
| **Sum** | 1.665305 | 2.801881 | 1.066403 | 28.76000 |
| **Sum Sq. Dev.** | 2.874487 | 0.678865 | 1.277312 | 6211.890 |
| | | | | |
| **Observations** | 212 | 212 | 212 | 212 |




**Graph 3:** Line Graphs of First-Differenced Data Series

## Cross Correlation Results

The results of cross correlation tests conducted to explore lag-lead relationships between the variables up to 5 periods of lag are summarized in Table 7, Table 8, and Table 9. According to these results, the FXRate variable is a variable leading to export volume and the correlation between them is mostly negative, but weak. On the other hand, the connection between GDP and export volume is relatively strong and the export volume variable behaves as a leading variable from the standpoint of the GDP variable, especially up to 2 periods of lag, but the direction of this connection differs at different lag lengths. For instance, for 1 period of lag, the correlation coefficient takes negative sign whereas for 2 and 3 periods of lag, it takes positive sign. On the other hand, if considering the relationship between oil price and export volume, export volume weakly leads oil price for 1 period of lag while this lead-lag relationship reverses for 2 periods of lag.

**Table 7**: Cross Correlations for Export Volume and FX Rate

| Dln(Exp),DFxRate(-i) | Dln(Exp),DFxRate(+i) | i | lag | lead |
|---|---|---|---|---|
| .\|. \| | .\|. \| | 0 | 0.0315 | 0.0315 |
| *\|. \| | *\|. \| | 1 | -0.0563 | -0.0672 |
| *\|. \| | .\|. \| | 2 | -0.0495 | 0.0055 |
| *\|. \| | *\|. \| | 3 | -0.0621 | -0.0526 |
| .\|. \| | .\|. \| | 4 | -0.0148 | -0.0098 |
| .\|. \| | .\|. \| | 5 | 0.0104 | 0.0004 |

**Table 8:** Cross Correlations for Export Volume and GDP

| Dln(Exp),Dln(GDP)(-i) | Dln(Exp),Dln(GDP)(+i) | i | lag | lead |
|---|---|---|---|---|
| .\|** \| | .\|** \| | 0 | 0.1712 | 0.1712 |
| ****\|. \| | .\|* \| | 1 | -0.3848 | 0.1024 |
| .\|*** \| | .\|. \| | 2 | 0.3463 | 0.0322 |
| .\|. \| | *\|. \| | 3 | 0.0449 | -0.0727 |
| *\|. \| | .\|. \| | 4 | -0.0785 | 0.0384 |
| .\|. \| | .\|. \| | 5 | -0.0281 | 0.0480 |

**Table 9:** Cross Correlations for Export Volume and Oil Price

| Dln(Exp),DOilPrice(-i) | Dln(Exp),DOilPrice(+i) | i | lag | lead |
|---|---|---|---|---|
| .\|* \| | .\|* \| | 0 | 0.1304 | 0.1304 |
| .\|* \| | .\|* \| | 1 | 0.0576 | 0.0762 |

| | | | | |
|---|---|---|---|---|
| .\|* \| | *\|. \| | 2 | 0.1257 | -0.0480 |
| .\|. \| | .\|. \| | 3 | 0.0034 | -0.0214 |
| .\|* \| | .\|* \| | 4 | 0.0880 | 0.1254 |
| *\|. \| | .\|. \| | 5 | -0.0727 | -0.0132 |

## Examination of Appropriate Lag Lengths and Distribution Tests on Residuals

In assessing cointegration relationships, the export volume variable is first paired with the variable of oil price in order to examine the relationship between them on binary basis. Then, all the variables are pooled on multiple bases to investigate any long term relationships among them. Therefore, the proper lag lengths are determined for our binary analysis and multiple examinations separately. Table 10 and Table 11 represent the results of these lag length examinations.

The proper lag length for the binary case where export volume is related to oil price has been determined to be 13 periods as the majority of the criteria suggest (see Table 10) while the proper length of lag is 14 periods in case of multiple variables (see Table 11).

**Table 10**: Lag Length Statistics for Export Volume and Oil Price

VAR Lag Order Selection Criteria
Endogenous variables: Dln(Exp) DOilPrice
Exogenous variables: C
Sample: 1998M01 2015M09
Included observations: 197

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -469.5485 | NA | 0.411289 | 4.787294 | 4.820626 | 4.800787 |
| 1 | -423.0455 | 91.58957 | 0.267147 | 4.355792 | 4.455788 | 4.396271 |
| 2 | -408.3087 | 28.72564 | 0.239562 | 4.246788 | 4.413449* | 4.314254 |
| 3 | -405.2667 | 5.867768 | 0.241912 | 4.256515 | 4.489839 | 4.350966 |
| 4 | -394.8093 | 19.95922 | 0.226577 | 4.190958 | 4.490946 | 4.312395 |
| 5 | -387.1295 | 14.50193 | 0.218292 | 4.153599 | 4.520252 | 4.302023* |
| 6 | -380.7629 | 11.89302 | 0.213142 | 4.129573 | 4.562889 | 4.304982 |
| 7 | -378.1824 | 4.768091 | 0.216280 | 4.143983 | 4.643964 | 4.346379 |
| 8 | -377.4889 | 1.267262 | 0.223724 | 4.177552 | 4.744197 | 4.406934 |
| 9 | -374.7668 | 4.919062 | 0.226723 | 4.190526 | 4.823835 | 4.446894 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | -371.5183 | 5.804403 | 0.228556 | 4.198156 | 4.898128 | 4.481510 |
| 11 | -353.8367 | 31.23462 | 0.199018 | 4.059256 | 4.825892 | 4.369596 |
| 12 | -348.7623 | 8.860875 | 0.196980 | 4.048348 | 4.881648 | 4.385674 |
| 13 | -342.5331 | 10.75080* | 0.192711* | 4.025717* | 4.925682 | 4.390030 |
| 14 | -339.6695 | 4.884234 | 0.195110 | 4.037254 | 5.003882 | 4.428552 |
| 15 | -339.3803 | 0.487376 | 0.202796 | 4.074927 | 5.108219 | 4.493211 |

**Table 11:** Lag Length Statistics for all the Variables

VAR Lag Order Selection
Criteria
Endogenous variables: Dln(Exp), DFXRate, Dln(GDP),
DOilPrice
Exogenous variables: C
Sample: 1998M01 2015M09
Included observations: 197

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | 57.69970 | NA | 6.81e-06 | -0.545175 | -0.478511 | -0.518189 |
| 1 | 142.8473 | 165.9729 | 3.38e-06 | -1.247180 | -0.913860* | -1.112250* |
| 2 | 166.7465 | 45.61479 | 3.12e-06 | -1.327376 | -0.727399 | -1.084501 |
| 3 | 176.5275 | 18.27111 | 3.32e-06 | -1.264239 | -0.397606 | -0.913419 |
| 4 | 194.6282 | 33.07748 | 3.25e-06 | -1.285566 | -0.152277 | -0.826802 |
| 5 | 210.2121 | 27.84523 | 3.27e-06 | -1.281341 | 0.118604 | -0.714633 |
| 6 | 236.8211 | 46.46457 | 2.95e-06 | -1.389047 | 0.277554 | -0.714395 |
| 7 | 271.0829 | 58.43631 | 2.46e-06 | -1.574446 | 0.358811 | -0.791849 |
| 8 | 284.5332 | 22.39448 | 2.53e-06 | -1.548561 | 0.651352 | -0.658020 |
| 9 | 292.9133 | 13.61228 | 2.75e-06 | -1.471201 | 0.995368 | -0.472715 |
| 10 | 319.5818 | 42.23642 | 2.48e-06 | -1.579511 | 1.153715 | -0.473081 |
| 11 | 343.6199 | 37.09427 | 2.31e-06 | -1.661115 | 1.338766 | -0.446741 |
| 12 | 384.5811 | 61.54577 | 1.81e-06* | -1.914529 | 1.352009 | -0.592210 |
| 13 | 398.0998 | 19.76335 | 1.88e-06 | -1.889338 | 1.643856 | -0.459074 |
| 14 | 416.9460 | 26.78649* | 1.85e-06 | -1.918233* | 1.881617 | -0.380026 |
| 15 | 430.2943 | 18.43025 | 1.93e-06 | -1.891313 | 2.175193 | -0.245161 |

* 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

In Table 12 and Table 13 are the findings suggesting that the residuals of the VEC models relating export volume (Component 1) are normal, which is satisfactory for our analysis.

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**Table 12**: Normality Test for the Error Terms of the VEC Model for Export Volume and Oil Price

| Component | Skewness | Chi-Square | df | Prob |
|---|---|---|---|---|
| 1 | -0,089346 | 0,263432 | 1 | 0,6078 |
| 2 | -0,308035 | 3,131231 | 1 | 0,0768 |
| **Component** | **Skewness** | **Chi-Square** | **df** | **Prob** |
| 1 | 2,578512 | 1,465633 | 1 | 0,2260 |
| 2 | 3,803667 | 5,328509 | 1 | 0,0210 |
| **Component** | **Jarque-Bera** | **df** | **Prob** | |
| 1 | 1,729065 | 2 | 0,4212 | |
| 2 | 8,459740 | 2 | 0,0146 | |
| **Joint** | 10,18880 | 4 | 0,0374 | |

**Table 13**: Normality Test for the Error Terms of the VEC Model for all the Variables

| Component | Skewness | Chi-Square | df | Prob |
|---|---|---|---|---|
| 1 | -0,120838 | 0,479426 | 1 | 0,4887 |
| 2 | -0,034328 | 0,038691 | 1 | 0,8441 |
| 3 | -0,661231 | 14,35562 | 1 | 0,0002 |
| 4 | -0,141620 | 0,658510 | 1 | 0,4171 |
| **Component** | **Skewness** | **Chi-Square** | **df** | **Prob** |
| 1 | 3,320617 | 0,843779 | 1 | 0,3583 |
| 2 | 4,031391 | 8,731754 | 1 | 0,0031 |
| 3 | 4,461586 | 17,53492 | 1 | 0,0000 |
| 4 | 3,378993 | 1,179012 | 1 | 0,2776 |
| **Component** | **Jarque-Bera** | **df** | **Prob** | |
| 1 | 1,323205 | 2 | 0,5160 | |
| 2 | 8,770445 | 2 | 0,0125 | |
| 3 | 31,89054 | 2 | 0,0000 | |
| 4 | 1,837521 | 2 | 0,3990 | |
| **Joint** | 43,82171 | 8 | 0,0000 | |

## Results of Causality and Exogeneity Tests

Since cointegration models require that included variables be endogenous, it is necessary to test if variables are endogenous as compared to one another. Therefore, we have conducted Granger Causality and Block Exogeneity Wald test on the data before constructing cointegration equations. The results of these tests are provided in Table 14 and Table 15. As to the results in the tables, the variables of export volume and oil price prove to be endogenous for one another in the binary evaluation. However, in the pooled analysis, it is concluded that endogeneity condition is satisfied for oil price with export volume and for FX rate with GDP. Naturally, these results can be considered favorable for our cointegration models in which the export volume variable is taken as dependent variable.

**Table 14**: Block Exogeneity Wald Tests Results (All the Variables)

Dependent variable: D(Dln(Exp))

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(DFXRate) | 8.002493 | 14 | 0.8892 |
| D(Dln(GDP)) | 9.629788 | 14 | 0.7887 |
| D(DOilPrice) | 27.75180 | 14 | 0.0153 |
| All | 83.90416 | 42 | 0.0001 |

Dependent variable: D(DFXRate)

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(Dln(Exp)) | 12.31428 | 14 | 0.5811 |
| D(Dln(GDP)) | 26.65831 | 14 | 0.0213 |
| D(DOilPrice) | 15.34741 | 14 | 0.3548 |
| All | 50.92600 | 42 | 0.1626 |

Dependent variable: D(Dln(GDP))

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(ln(Exp)) | 26.34166 | 14 | 0.0234 |
| D(DFXRate) | 56.34996 | 14 | 0.0000 |
| D(DOilPrice) | 29.12550 | 14 | 0.0100 |
| All | 137.6177 | 42 | 0.0000 |

Dependent variable: D(DOilPrice)

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|

| | | | |
|---|---|---|---|
| D(Dln(Exp)) | 30.32795 | 14 | 0.0069 |
| D(DFXRate) | 22.99165 | 14 | 0.0604 |
| D(Dln(GDP)) | 29.27980 | 14 | 0.0096 |
| All | 55.53494 | 42 | 0.0787 |

**Table 15**: Block Exogeneity Wald Tests Results (Export Volume – Oil Price)

Dependent variable: D(Dln(Exp))

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(DOilPrice) | 37.79573 | 13 | 0.0003 |
| All | 37.79573 | 13 | 0.0003 |

Dependent variable: D(DOilPrice)

| Excluded | Chi-sq | df | Prob. |
|---|---|---|---|
| D(Dln(Exp)) | 36.66717 | 13 | 0.0005 |
| All | 36.66717 | 13 | 0.0005 |

Subsequent to the Wald tests, we have conducted Granger Causality tests up to 5 periods of lag on the data and the results of these tests are given in Table 16. For all lags up to 5 periods of lag, it is evidenced a stronger and statistically significant effect (relation) at 5 % from oil price to export volume. Meanwhile, at all lag lengths, a relatively stronger and significant effect relationship from GDP to export volume. No evident strong effect from export to GDP could be found in contrary to what the theory suggests. On the other side, there is no evidence for any significant causality effect either from FX rate to export, or from export to FX rate. The results show statistically significant effects at 1 % from all the variables, except FX rate, to export volume at all the lag lengths.

**Table 16:** Granger Causality Test Results

| | LAG LENGTH | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 MONTH | | 2 MONTHS | | 3 MONTHS | | 4 MONTHS | | 5 MONTHS | |
| | F-stat | Prob | F-stat | Prob | F-stat | Prob | F-stat | Prob | F-stat | Prob |
| **Dln(Exp) => DOilPrice** | 0,15481 | 0,6944 | 0,98617 | 0,3748 | 0,90045 | 0,4419 | 2,11322 | 0,0805 | 2,11948 | 0,0647 |
| **DOilPrice => DlnExp)** | 4,38417 | 0,0375 | 8,56004 | 0,0003 | 6,74316 | 0,0002 | 7,41745 | 1.E-05 | 7,07181 | 4.E-06 |
| **Dln(Exp) => Dln(GDP)** | 3,54976 | 0,0609 | 3,23424 | 0,0414 | 2,12751 | 0,0979 | 0,85907 | 0,4895 | 1,00555 | 0,4156 |
| **Dln(GDP) => Dln(Exp)** | 29,2141 | 2.E-07 | 14,0673 | 2.E-06 | 11,8818 | 3.E-07 | 11,0989 | 4.E-08 | 9,51665 | 4.E-08 |
| **Dln(Exp) => DFXRate** | 1,40893 | 0,2366 | 0,90442 | 0,4064 | 1,10618 | 0,3477 | 0,96586 | 0,4273 | 0,87798 | 0,4968 |
| **DFXRate => Dln(Exp)** | 0,52462 | 0,4697 | 1,21986 | 0,2974 | 1,91226 | 0,1288 | 1,92903 | 0,1070 | 1,78115 | 0,1184 |

## Results of Variance Decomposition and Impulse-Response Analysis

Table 17 presents the findings of variance decomposition and impulse-response analyses carried out for export volume compared with oil price. Up to 10 lag periods, changes in oil price can explain 11,43 % of variation in export volume while changes in export volume are sufficient in explaining 10 % of oil price variation. This finding is in conformity with the results obtained in our Granger Causality tests.

**Table 17**: Results of Variance Decomposition (Export Volume – Oil Price)

| Period | S.E. | Dln(Exp) | DOilPrice |
|---|---|---|---|
| Variance Decomposition of Dln(Exp): | | | |
| 1 | 0.078355 | 100.0000 | 0.000000 |
| 2 | 0.095534 | 97.49473 | 2.505275 |
| 3 | 0.096625 | 96.60326 | 3.396740 |
| 4 | 0.096903 | 96.41731 | 3.582694 |
| 5 | 0.098515 | 93.43563 | 6.564367 |
| 6 | 0.100957 | 90.14538 | 9.854619 |
| 7 | 0.102043 | 89.39826 | 10.60174 |
| 8 | 0.102202 | 89.41921 | 10.58079 |
| 9 | 0.102872 | 88.65882 | 11.34118 |
| 10 | 0.102988 | 88.56905 | 11.43095 |
| Variance Decomposition of DOilPrice: | | | |
| Period | S.E. | Dln(Exp) | DOilPrice |
| 1 | 5.051623 | 2.309578 | 97.69042 |
| 2 | 5.319377 | 2.585044 | 97.41496 |
| 3 | 5.468467 | 3.365878 | 96.63412 |
| 4 | 5.542999 | 5.931984 | 94.06802 |
| 5 | 5.666661 | 9.992262 | 90.00774 |
| 6 | 5.672717 | 10.11256 | 89.88744 |
| 7 | 5.771992 | 9.952543 | 90.04746 |
| 8 | 5.829802 | 9.809156 | 90.19084 |
| 9 | 5.876947 | 10.14892 | 89.85108 |
| 10 | 5.911759 | 10.03796 | 89.96204 |
| Cholesky Ordering: Dln(Exp) DOilPrice | | | |

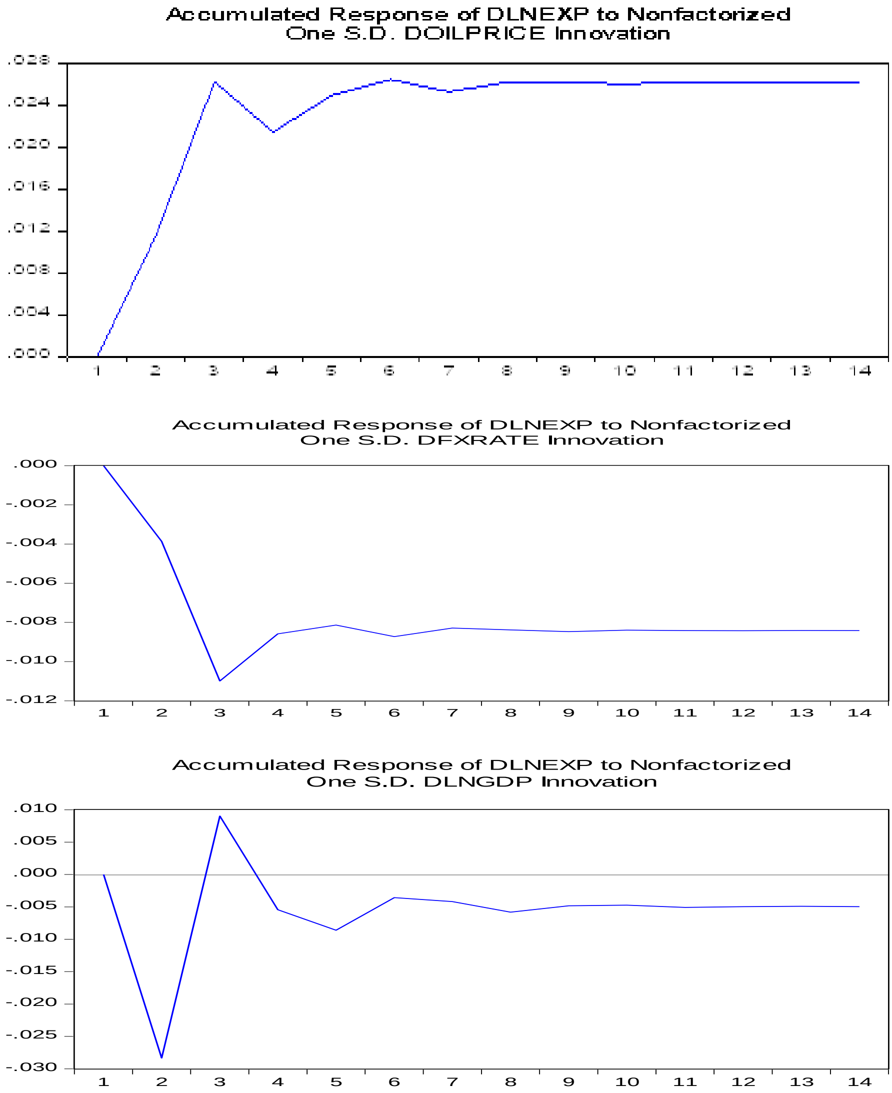
Our variance decomposition results regarding all the variables (see Table 18) suggest that the variation in oil price can explain 12,08 % of all the variation in export volume. This rate is only 3,87 % for GDP and 1,83 % for FX rate. As can be understood for these findings, the effect of oil price changes on export volume variation is more apparent when compared to those of GDP and FX rate.

**Table 18:** Results of Variance Decomposition (All the Variables)

Variance Decomposition of Dln(Exp):

| Period | S.E. | DlnExp) | DFXrate | Dln(GDP) | DOilPrice |
|---|---|---|---|---|---|
| 1 | 0.077484 | 100.0000 | 0.000000 | 0.000000 | 0.000000 |
| 2 | 0.093358 | 95.65506 | 0.009344 | 1.336416 | 2.999181 |
| 3 | 0.096028 | 92.52033 | 0.085283 | 3.780733 | 3.613655 |
| 4 | 0.096580 | 91.55567 | 0.686753 | 3.740044 | 4.017536 |
| 5 | 0.098999 | 87.31073 | 0.654009 | 4.340518 | 7.694745 |
| 6 | 0.101329 | 85.21172 | 0.690252 | 4.157295 | 9.940731 |
| 7 | 0.102978 | 85.18365 | 0.686591 | 4.031224 | 10.09853 |
| 8 | 0.103893 | 85.14323 | 0.696909 | 3.996365 | 10.16349 |
| 9 | 0.105289 | 83.14563 | 1.415501 | 3.895506 | 11.54337 |
| 10 | 0.105900 | 82.23145 | 1.829268 | 3.865119 | 12.07416 |

Graph 4 includes the impulse-response visual results which suggest that the export volume variable reacts more to sudden shocks in oil price as compared to its reactions to shocks in the other variables and this response becomes stable in approximately 5 periods.




Graph 4: Impulse-Response Results

## Results of Cointegration Analyses

Table 19 presents the findings of our cointegration analysis conducted on export volume and oil price. The results suggest a two-way cointegration relationship between the variables. This assumed long-term equilibrium relationship is reverse.

The assumed negative relationship between export volume and oil price may be viewed as a result of decreasing external demand for domestic goods and services stemming from increases in domestic prices driven by upward trend in costs. The cointegration equation suggests that a 1 unit change in oil price is expected to cause a reverse change of 0,02 in lnExport..

**Table 19**: Cointegration Results (Export Volume - Oil Price)

| Hypothesized Number of CEs | Eigenvalue | Trace Statistic | 5 % Critical Value | Probability |
|---|---|---|---|---|
| None | 0,105469 | 30,74522 | 15,49471 | 0,0001 |
| At most 1 | 0,042877 | 8,676977 | 3,841466 | 0,0032 |
| **Cointegration Equation(s) Log-Likelihood:** -345,8924 | | | | |
| **Dln(Exp) = -0,021357(DOilPrice)<br>(0,00381)** | | | | |

The findings of our cointegration analysis that involves all the variables are summarized in Table 20. They point out at most two cointegration relationships significant at 5 % among the variables. The fist equation shows a significant cointegration relationship from the other variables to the variable of export volume while the second assumed relationship is from GDP and oil price to FX rate and export volume.

**Table 20:** Cointegration Results (All the Variables)

| Hypothesized Number of CEs | Eigenvalue | Trace Statistic | 5 % Critical Value | Probability |
|---|---|---|---|---|
| None | 0,131716 | 64,60464 | 47,85613 | 0,0006 |
| At most 1 | 0,102743 | 36,78099 | 29,79707 | 0,0067 |
| At most 2 | 0,066881 | 15,42356 | 15,49471 | 0,5120 |
| At most 3 | 0,009029 | 1,786719 | 3,841466 | 0,1813 |
| **1 Cointegration Equation<br>Log-Likelihood:** 411,9038 | | | | |
| **Dln(Exp) = -0,876324(DFXrate) -0,934651(Dln(GDP)) -0,020008(DOilPrice)<br>(0,58061) (0,77654) (0,00426)** | | | | |

| **2 Cointegration Equations**<br>**Log-Likelihood:** 422,5826 |
|---|
| **DFXrate = -0,556297(Dln(GDP)) + 0,0023237(DOilPrice)**<br>**(0,62914) (0,00548)**<br>**Dln(Exp) = -1,422147(Dln(GDP)) + 0,000355(DOilPrice)**<br>**(0,30637) (0,00267)** |

It can be inferred from the results in the table above that the export volume variable is negatively affected by the changes in the other variables. Putting another way, GDP reversely affect both export volume and FX rate, the effect of oil price changes on it is positively linear.

## Volatility Model and Results

A TARCH (1,1) model has been constructed to examine how the volatility of the export volume variable is affected by its own variation and the other variables and whether negative shocks in export volume create substantially more distinguishable effect on its own volatility in comparison with positive shocks. Before modelling, we have applied ARCH-LM test to argue the presence of autocorrelation and heteroscedasticity in the export volume series taking the optimum length of lag as 13 periods. Table 21 gives the details of the test results. The tail probabilities for the test statistic both are very close to 0, which is sufficient evidence to assume autocorrelation in the export volume series. This finding supports the convenience of volatility modeling for the variable.

**Table 21**: Results of ARCH-LM Test

| Variable | ARCH-LM Statistics | | | |
|---|---|---|---|---|
| | F | Prob | Obs*R-sqrd | Prob |
| **Dln(Exp)** | 4,899187 | 0,0000 | 50,96395 | 0,0000 |

According to the summary results presented in Table 22, it can be concluded that the model does not prove to be accurate and applicable since the coefficients $\alpha_1$ and $\beta_1$ both have positive sign and tail probabilities over 5

% which represent ARCH and GARCH effects in the model. Moreover, the coefficient of θ1 is found insignificant at 5 %, meaning the absence of asymmetry effect in the series. In other words, no remarkable difference between the effects of negative and positive shocks on volatility can be mentioned.

Looking at the coefficients of the other variables, because they all have negative sign, we can say that they all influence volatility of the export volume variable reversely, but that influence is significant at 1 % for GDP and at 10 % for FX rate while insignificant for oil price. Additionally, the significant ADF and ARCH-LM statistics for error terms can be assumed to be important evidence that autocorrelation is not the case and the residuals series is stationary. Eventually, we can conclude that the error terms are normally distributed as the Jarque-Bera statistic has a tail probability value over 10 %.

**Table 22**: TARCH (1,1) Volatiliy Model Summary

$$\sigma^2_t = \alpha_0 + \alpha_1\varepsilon^2_{t-1} + \theta_1 S_{t-1}\varepsilon^2_{t-1} + \beta_1\sigma^2_{t-1} + \beta_2 DFXrate + \beta_3 D\ln(GDP) + \beta_4 DOil$$

| Variance Equation | | | | |
|---|---|---|---|---|
| **COEFFICIENT** | **VALUE** | **STANDARD ERROR** | **t-statistic** | **Prob** |
| $\alpha_0$ | 0.005912** | 0.002298 | 2.572253 | 0.0101 |
| $\alpha_1$ | 0.358417*** | 0.184961 | 1.937792 | 0.0526 |
| $\theta_1$ | 0.185956 | 0.312016 | 0.595982 | 0.5512 |
| $\beta_1$ | 0.212672 | 0.164923 | 1.289527 | 0.1972 |
| $\beta_2$ | -0.019505*** | 0.011323 | -1.722556 | 0.0850 |
| $\beta_3$ | -0.038815* | 0.014506 | -2.675838 | 0.0075 |
| $\beta_4$ | -2.84E-06 | 0.000193 | -0.014765 | 0.9882 |
| | | | | |
| **T-DIST.DOF** | 410.8083 | 25828.38 | 0.015905 | 0.9873 |

| | |
|---|---|
| ARCH-LM (5) | F-Statistic: 0,609901 Prob: 0,6924 |
| ARCH-LM (15) | F-Statistic: 2,050815 Prob: 0,0142 |
| ADF Statistics | Level : -4,574648 (0,0002)<br>1.Difference : -7,249536 (0,0000)<br>2.Difference : -17,75991 (0,0000) |
| Residuals Normality Test | Jarque-Bera: 4,433060 (0,108987) |

* significant at 1 % ** significant at 5 % *** significant at 10 %

## Conclusions

The analyses and modellings that we have carried out in this paper primarily to unveil any significant connection between oil price and export volume provide some significant evidence that supports our opinion about the presence of such a relationship. Within the scope of this study, the effect of oil price changes on export volume has been investigated using such macroeconomic indicators as GDP and FX rate as control variables. Besides descriptive analysis, some econometric techniques such as cointegration, variance decomposition, Granger causality analysis, impulse-response analysis, and volatility modeling have been applied to achieve this purpose.

Our empirical findings suggest relatively significant effects from GDP, FX rate and oil price to export volume. Oil price changes prove to be the pioneer factor in explaining export volume changes as compared to the other variables. Also, some important findings have been obtained which suggest reverse, but statistically significant two-way cointegration relationships between export volume and oil price changes. Significant cointegration relationships also have been detected from FX rate and GDP to export volume.

The volatility model developed for the export volume variable provides interesting findings suggesting that GDP and FX rate changes are negatively correlated with export volume volatility, but no significant effect of oil price changes on volatility.

All the findings briefly mentioned above are satisfactory for the purpose of this study in that they support our assumption that oil price is an important determinant over export volume. We recommend further investigations for the influence of oil price changes on import volume and the ratio of export to import.

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