INFLUENCE OF WORLD OIL AND COPPER PRICES ON TURKISH PRECIOUS METALS AND FINANCIAL MARKETS

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

GÖKÇE GÜRSEL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION
IN
THE DEPARTMENT OF BUSINESS ADMINISTRATION

AUGUST 2011

Approval of Graduate School of Social Sciences

Prof. Dr. Meliha Altunışık

Director

I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Business Administration.

Assist. Prof. Dr. Engin Küçükkaya

Head of Department

This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Business Administration.

Assoc. Prof. Dr. Uğur Soytaş

Supervisor

Examining Committee Members

Prof. Dr. Ramazan Sarı	(METU, BA)	
Assoc. Prof. Dr. Uğur Soytaş	(METU, BA)	
Assoc. Prof. Dr. Fazıl Gökgöz	(Ankara University, BA)	

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last name: Gökçe GÜRSEL

Signature :

ABSTRACT

INFLUENCE OF WORLD OIL AND COPPER PRICES ON TURKISH PRECIOUS METALS and FINANCIAL MARKETS

Gürsel, Gökçe

MBA, Department of Business Administration

Supervisor: Assoc. Prof. Dr. Uğur Soytaş

August 2011, 68 pages

In this thesis the relationship between Brent oil prices, LME copper prices, Turkish gold and silver spot prices, XU100 index, interest rate and exchange rate is examined. Their long run Granger causality relationship is investigated by looking at Wald statistics. The short run relationship between them is examined by using generalized impulse responses. The data range is from January 2, 2002 to February 24, 2011. Due to the oil crisis in 2008, we divide the data into three periods: January 2, 2002 to December 31 as first period, 2007, from January 1, 2008 to December 31 as second period, 2008 and January 1, 2009 and February 24, 2011 as third period. We conduct each test separately for these periods but in third period we use Toda-Yamamoto procedure since maximum order of integration is 1.

Keywords: Turkish precious metal prices, oil prices, copper prices, XU100 index, lira/dollar exchange rate.

ÖZ

DÜNYA PETROL VE BAKIR FİYATLARININ TÜRK DEĞERLİ METALLER VE FİNANSAL PAZARLARINA ETKİSİ

Gürsel, Gökçe

Yüksek Lisans, İşletme Bölümü

Tez Yöneticisi: Assoc. Prof. Dr. Uğur Soytaş

Ağustos 2011, 68 sayfa

Bu tezde Brent petrol fiyatları, LME bakır fiyatları, Türk altın ve gümüş fiyatları, IMKB100 endeksi, faiz oranı ve lira/dolar döviz kuru arasındaki kısa dönem ve uzun dönem Granger nedensellik ilişkisi incelenmiştir. Uzun dönem Granger nedensellik ilişkisi Wald istatiğine bakılarak incelenirken, kısa donem ilişki genelleştirilmiş tepki fonksiyonlarına bakılarak incelenmiştir. Veri aralığı 2 Ocak 2002`den 24 Şubat 2011`e kadardır. 2008 petrol fiyatlarındaki artiş nedeniyle veri aralığı üçe bölünmüştür. 2 Ocak 2002`den 31 Aralik 2007`ye kadar 1. periyot, 1 Ocak 2008`den 31 Aralık 2008`e kadar 2. periyot ve 1 Ocak 2009`dan 24 Şubat 2011`e kadar 3. periyot olacak şekilde veri seti 3`e bölünmüştür. 3. periyotta değişkenler en fazla 1. dereceden bütünleşik olduğu için Toda Yamamoto prosedürü kullanılmıştır.

Anahtar kelimeler: Türk kıymetli metal fiyatları, petrol fiyatları, bakır fiyatları, IMKB100 endeksi, lira/dolar döviz kuru.

To My Family

ACKNOWLEDGEMENTS

Author wishes to express his deepest gratitude to her supervisor Assoc. Prof. Dr. Uğur Soytaş for his encouragement and guidance.

Author would also want to thank Prof. Ramazan Sarı for his help.

Also, author would want to thank Prof. Dr. Ali Argun Karacabey, Assoc. Prof. Dr. Fazıl Gökgöz, and Dr. Yetkin Çınar for their guidance, help and encouragement.

I am grateful to my family and my friends who supported me during the creation of this thesis. Without their support, I would not create this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

A commodity is a product that cannot be differentiated across the market such as oil, copper and precious metals. These products are same no matter who produces them. They are important in the sense that we need them to sustain our daily lives and to satisfy our needs. In the literature, from the viewpoints of investors, academicians and policy makers three types of commodities stand out with respect to their global trade and their impact on both developed and developing countries: oil, precious metals and copper.

Commodity prices are generally determined by their own supply and demand forces. For instance if demand is increasing for that specific commodity then the value of that commodity across the market is increasing and hence price of that commodity goes up. On the other hand, if the supply for that commodity goes up then, the availability of the commodity is increasing and hence the price of that commodity goes down. However supply and demand relationship is not the only mechanism that determines the price of a commodity. An increasing demand could be caused by increasing user consumption, business cycles, hoarding against the inflation and/or speculating against the currencies in other words hedging purposes.

Commodity markets are in a growing financial importance since mid-1990s. Many banks and investors see them as a source of profit and good hedging class that can improve risk/return performance of a portfolio. In emerging economies, commodities are needed to support the growth of welfare. They need commodities to support their industrial development. Therefore one may argue that a price shock in oil could have a big impact on emerging economies since they need big amounts of that commodity.

In this study we investigate the relationship between world oil and copper prices, Turkish gold prices, silver prices, XU100 index, interest rate and lira/dollar exchange rate. Oil and copper prices are included in this study to see whether oil and copper prices lead local precious metal prices and to investigate this relationship in the case of an emerging market. We do not expect directional relationships from Turkish variables to world oil prices and copper prices since these markets have their own global price dynamics. Turkish gold and silver prices are included in this study since developing country commodity markets are used in hedging, portfolio formation and trade by global actors with increasing intensity. We want to see the relationship between oil and copper prices and Turkish precious metal prices and whether the developing country commodity markets and other financial variables are affected differently than developed countries.

In examining the relationship between world oil and copper prices and Turkish gold and silver prices we also account for XU100 index, Turkish interest rate and exchange rate in this study. Interest rate and exchange rate are mechanisms that determine commodity prices besides their supply and demand. High interest rates mean that investors prefer to invest in bonds and/or stocks rather than commodities since they are more profitable. For the exchange rate side, one may argue that if US dollar depreciates against Turkish lira, the commodity prices quoted in US dollar will increase since sellers would want to compensate the loss coming from depreciating US dollar. The reverse of that phenomenon will be seen in case of appreciating US dollar and high supply. XU100 index is included to see the relationship between world oil and copper prices and Turkish stock market as well as to investigate the relationship between Turkish variables.

The main contribution of this thesis is to focus on an emerging country precious metal markets and financial variables before, during and after the oil crisis in 2008. Risk managers and investors may also benefit from this thesis since dynamics of commodity markets and how they affect XU100 index, gold and silver spot prices, exchange rate and interest rate may provide important information for them in deciding whether to invest and if invest what percentage of their portfolio to invest in Turkish precious metals and stock market. Another party that could benefit from this study is policy makers. Understanding Turkish commodity market dynamics and their relationship with world oil and copper markets is an important point that they have to watch since world oil and copper prices may lead Turkish financial variables and commodity prices. We find some evidence that the price dynamics and relationships between the variables in concern have been subjected to a change before, during and after the 2008 oil crisis.

This thesis is organized as follows: next section is organized as literature review. We divide literature review into two parts. First we talk about researches that use world commodity market data. By doing so, we lay the main framework for our analysis.

Then, we look at the studies that used similar data sets and/or Turkish variables. Data and methodology section explains the data sets and methodology section explains the methods used to investigate relationships between these data sets. Empirical results section provides descriptive statistics of data sets, the results of unit root tests, diagnostic tests for vector autoregression, vector auto regression model and impulse responses. Finally, conclusion briefly summarizes the results, the comparison of literature and results that we find and provides a short discussion about what might be done as a further research.

CHAPTER 2

LITERATURE REVIEW

This section is organized as follows. First we look at the literature that uses world commodity prices to form our expectations about our data sets.

Pindyck and Rotemberg (1990) argued that commodity prices follow a similar fashion together in other words, they rise and fall together. Baffes (2007) examined the effect of crude oil prices on 35 internationally traded primary commodities. Data range is between 1960 and 2005. His paper includes precious metals but gold is not among them. He found that precious metals except gold show a strong response to crude oil prices. A positive oil price shock increased other commodity prices. He also proposed that additional explanatory variables such as industrial production, exchange rate and interest rate can be included for further studies. He also proposed to use a time varying parameter to see the elasticity change over time.

Our research revealed although it is known that world oil prices and gold prices tied up together, there is a little research on how strong their relationship is. Zhang and Wei (2010) argued about that fact and they investigate the interactive dynamics of these markets and why these prices change consistently. They looked at the price co-integration, price causality and price discovery between world oil and gold prices. They use daily data covering the periods between January 4, 2000 and March 31,

2008. To investigate co-integration relationship, they use linear and nonlinear Granger causality test approach and they found a strong co-integration relationship between world oil prices and world gold prices. In other words, they showed that in the long-run these prices affect each other. For these results they show the fact as a reason that these two markets are driven by very similar factors such as exchange rates and some geographic events. To investigate their short term dynamics they use error correction model and found that magnitude of shocks of gold price is five times larger than oil price but shock of oil is more persistent. In terms of linear causality they found the evidence that oil price Ganger causes gold price but not vice versa. They do not found evidence that either gold prices or world oil prices Granger causes each other in a non-linear fashion and deduce that their relationship is more linear. This research is important for this thesis in terms of its method, and showing importance of world oil market.

Narayan, Narayan and Zheng (2010) tried to find the answer to the question of whether or not world oil and gold markets are efficient. They used daily spot price data for the periods between January 2, 1995 and March 6, 2009. They used co integration tests and found that oil and gold markets were co integrated. They argue that gold prices can be used to eliminate negative impacts of inflation in portfolios. They also deduced that oil prices can help to predict gold prices. They suggested that including other commodity prices such as silver and platinum to their variables would be a future research.

Sarı, Hammoudeh and Ewing (2007) investigate the relationships between oil prices and strategic commodity prices. They tried to find impact of oil stronger on prices of other strategic commodities or commodities has more impact on oil price. Moreover, they investigate the dynamic links between them and exchange rates. They use daily data of four different three month futures prices commodity prices oil, gold, silver and copper and two financial variables: interest rates (US Treasury Bill) and exchange rates (US exchange rate versus other major currencies). The data range is between January 2, 1990 and May 1, 2006. They use generalized forecast error variance decompositions and generalized impulse responses developed by Koop et al. (1996) and Pesaran and Shin (1998). They found a relationship between oil prices and the gold and silver futures price. Their further analysis revealed that oil prices and gold and silver futures prices almost have the same effect on each other. They also found strong relationships between gold and silver prices and a weak relationship between these variables and copper prices. They found that copper moves unaffected from prices of other commodities.

Sarı, Hammoudeh and Soytaş (2009) examined the directional and long-run relationship between WTI oil price, gold, silver, platinum and palladium spot prices (quoted as dollar per ounce) and USD/Euro exchange rate. They use daily time series data between January 4, 1999 and October 19, 2007. They use generalized forecast error decompositions and generalized impulse response functions. They found a relatively stronger bi directional relationship from oil to silver and a weak relationship between oil and gold. They pointed out the fact that the oil and gold have inverse motivations for price changes. Oil prices changes in the times of inflation, crises or recession but during that times the demand for gold increases because gold reserve its monetary power. They revealed that gold has a serious impact on silver. Their impulse response analysis revealed that shocks to the system dies out quickly (only after 2 days).

Cortazar and Eterovic (2010) wrote a paper arguing that oil prices could be used to forecast silver and copper prices. They used a multi-commodity model suggested by Cortazar et al. (2008). They used long-term commodity futures contracts in order to estimate another commodity prices with short-term contracts. Daily WTI oil prices, Brent oil prices, copper and silver futures prices are used and they found that oil could help to forecast long term silver and copper prices.

Lescaroux (2009) investigate the short-run dynamics of oil prices, commodity prices and their co-movements. The focus is on agricultural commodities but he did investigate the relationship between oil and copper prices. He found evidence that oil prices and copper prices move together. Also, he argued that influences like herding behaviors or speculations are short-term in other words they lose their effects after a short period of time.

Roberts (2009) investigate the cyclical nature of metal prices. He argued that metal prices have a cycle that can be characterized as rising prices following declining prices and so on. He used monthly data between the periods January, 1947 and December, 2007. Metal prices include LME copper prices and London silver price. He found some regularity in price movements to a degree. This research indicates that although many studies showed evidence that oil prices affect metal prices, these prices could have their own dynamics.

Hammoudeh and Yuan (2007) used different methods then we use in this thesis but their variables are relevant. They argued that oil prices leading the commodity markets and they try to find the volatility behavior of gold, silver, and copper when oil and interest rate shocks are present. They used generalized autoregressive conditional heteroskedasticity approach (GARCH) to that find the results. They found that silver and gold is more volatile than copper and they deduced that gold and silver could be used for hedging purposes but they leave copper out. Also, they found that oil volatility affects negatively gold and silver volatilities.

After the brief literature review we have formed some idea on how the literature views the major commodities in world markets. We know that oil and gold are strongly related and oil has a strong explanatory power over gold. This is also the case for silver but additionally silver has a weak explanatory power on world oil prices. Furthermore, we know that gold and silver prices are affecting each other. As for copper, oil has the dominant power on copper but it seems that world copper markets also have its own dynamics to determine prices. Also, shocks to these systems die out quickly, leaving only a short period of time for speculation. Hammoudeh et al. (2007) pointed out the fact that oil market comes into equilibrium faster than the commodity markets. Therefore, we expect that in GIRF analysis a shock to oil price dies out quickly.

Now we look at the studies that focus on Turkish markets and world markets. To the extent of our research we could not find any studies that bring together all of the variables that we use. There are studies that investigate the oil prices and Turkish precious metal prices, Turkish interest rates, world oil prices and precious metal prices, Turkish XU100 index and world oil prices but no research investigate the short-run and long-run relationships of world oil and copper markets, Turkish gold and silver markets, XU100 index and Turkish interest rates. We start with investigating more comprehensive researches and move on to studies that focuses on XU100 index and interest rates in Turkey.

The central study that we follow in our thesis is by Soytaş, Sarı, Hammoudeh and Hacihasanoğlu (2009). They investigate the dynamic relationships between Turkish spot gold and silver prices, Turkish exchange rate and interest rate and world oil prices. They use daily time series data between the periods May 2, 2003 and March 1, 2007. They argued that there is a strong belief in gold as a safety net in Turkey as well as developed countries. They also argued that silver in Turkey has lost its monetary usage and become more commodity-driven while extending its industrial usage. They also added the fact that in their study interest rate is strategically chosen because it is a link between exchange rate, commodity markets and monetary policy. They used IGE spot prices of gold and silver, Brent oil prices, The Turkish lira/US dollar exchange rate and benchmark bond rate as interest rate. Benchmark bond rate is obtained from Central Bank of the Republic of Turkey, with maturity close to two years. They pointed out the fact that this bond is one of the most liquid and actively traded bonds in Turkish economy and therefore act as a representative of Turkish interest rate. Their initial analysis revealed the fact that the relatively strong relationships between all the data sets except exchange rate. They argued that that is because gold and silver in Turkey is not treated as safety nets in the times of crises, contrary to the case in developed countries. To investigate the long-run relationship between variables they use Toda-Yamamoto procedure (Toda and Yamamoto, 1995). They said that the main reason that they use this procedure is because it does not require a test for co-integration. They construct a VAR model with 4 lags. Then they applied long-run Granger causality test. Their analysis resulted that Turkish variables has no explanatory power over Brent oil price. Also they did not found a Granger causality relationship from world oil price to domestic precious metal prices. Furthermore they found a bi-directional relationship from domestic gold market to domestic silver market and they deduced that the relationship between Turkish gold price and Turkish silver price is stronger than global markets. Finally they applied generalized impulse responses to all the variables. They found a negative short run response to shocks in gold and silver prices from interest rate. They also found as they expected no short run and long run predictive power of interest rate over world oil prices. As for domestic precious metal prices they found a significant response of gold to shocks in domestic silver prices in short run (lasting about 2 months). This was the case for silver as well. They concluded that research by stating the fact that investigating domestic and global precious metal prices would be an interesting topic.

Doğrul and Soytaş (2010) investigate the relationship between oil prices, interest rate and unemployment. They used monthly data between periods January 2005 and August 2009. The oil price and unemployment rate are sourced from IMF's database and interest rate are sourced from Turkish Undersecreteriat of Treasury. To investigate long-run relationship they use Toda-Yamamoto procedure in other words long run Granger causality approach and generalized impulse responses. They found that interest rate has positive and significant response to shocks in oil price but the response dies off quickly.

Soytaş and Oran (2011) analyze the volatility spillover from world oil spot markets to stock index returns in Turkey. This research helps us to understand the relationship between world oil prices and XU100 index. They try to understand the conundrum that between traditional views that rising oil prices causing increasing input prices and thus smaller profit margins versus some firms actually benefiting from high oil prices. They use daily data of XU100 index and spot oil price between the periods May 2, 2003 and January 3, 2007. They looked at the unit root tests to confirm that the data is stationary, Granger causality in mean and variance approaches and generalized impulse responses. Their traditional analysis resulted with no relationship between world oil prices and XU100 index. They do not found any Granger causality relationships from oil prices to XU100 index. Also, the generalized impulse response analysis gave the same result that no response in XU100 to shocks in world oil prices. A similar study made by Sarı and Soytaş (2006) confirmed these results, however they found that as XU100 index is not as immune to oil shocks as Sarı and Soytaş have predicted.

CHAPTER 3

DATA AND METHODOLOGY

DATA

We use daily data of seven different variables: crude Brent oil spot prices, world copper prices, Istanbul Stock exchange national 100 index (XU100), gold spot prices and silver spot prices from Istanbul gold exchange, benchmark bond rate and lira/dollar exchange rate.

Brent oil prices are sourced from U.S. Energy Information Administration website. Crude Brent oil spot prices are expressed in dollars per barrel. Copper prices are sourced from London Metal Exchange (LME) and expressed in dollars per ton. Gold and Silver spot prices are sourced from Istanbul Gold Exchange and expressed in dollar per ones. XU100 index are sourced from Istanbul Stock Exchange. Benchmark Bond rate and exchange rate are sourced from Turkish Central Bank.

Like many emerging countries, in Turkey gold is viewed as a safe haven while the overall economy is not performing very well (Soytaş et. al., 2009). Also, for cultural reasons gold is viewed as a good investment. Zhang and Wei (2010) argued that when markets are in uncertainty such as political issues and economic uncertainties, gold is viewed as a store of value. They also argue that because of risk avoidance and profit offering situation gold market grew as to a large commodity market. Therefore, it can be deduced that no matter what the conditions are there is a demand for gold.

On the other hand, silver has lost its value as an investment. Instead of being used for financial uses, silver is mainly used for industrial purposes and jewelry. In this thesis we focus on industrial usage of silver since silver is not a liquidly trading metal in IGE and its usage is mainly limited to industrial.

In the case of XU 100 index, it may be considered that world oil prices and copper prices will have a serious impact. That is because XU 100 index consists of large 100 stocks that are traded in national market. These firms are chosen as representatives of several segment of the market. Some of these market segments use oil and copper as raw materials. A decline in oil or copper prices can increase their profit margin and hence increasing their stock prices

Benchmark bond rate is sourced from Central Bank of Turkey and it has a maturity close to 2 years. It is the most liquid bond traded in Turkish economy. Therefore this rate is a representative of interest rate in Turkey. Hence, from now on the terms benchmark bond rate and Turkish interest rate is used interchangeably. Baffles (2007) suggested that interest rate can be used as a link between commodity prices and exchange rate.

Exchange rate is again sourced from Central Bank of Turkey. We choose this variable to capture the effect between Turkish variables and world variables. Also, exchange rate is a fundamental of interest rate therefore it would be interesting to see this relationship.

The data period is between January 2, 2002 and February 24, 2011. Total observations for each data set are 2387. Data is arranged to fit in 5 day weeks. Log returns of all data sets are taken. Since the holidays are different for Turkey and world markets, corresponding values for these days are left blank. Since our preliminary test shows that oil dummy for 2008 period is significant we divide the data in three periods: from January 2, 2002 to December 31 as first period, 2007, from January 1, 2008 to December 31 as second period, 2008 and January 1, 2009 and February 24, 2011 as third period. We conduct each test separately for these periods but in third period we use Toda-Yamamoto procedure since maximum order of integration is 1.

Another issue to note is that silver is not traded regularly in IGE therefore originally data consisted of 800 observations. For the sake of the analysis, for the days no trading was made the price is assumed to be the price of a previous date that trading was made and the data set was organized accordingly. This arrangement causes some issues which are explained later. It is originally thought to use copper prices of Turkey but our research revealed that there is no organized market for copper in Turkey. Instead copper prices from LME were used. All variables were chosen selectively based on the literature so that the general effect of world commodity prices to Turkish markets can be analyzed and vice versa.

METHODOLOGY

First of all, in order to get an initial idea about the time series, we look at the descriptive statistics of data sets. Descriptive statistics includes mean, median, standard deviation, skewness, kurtosis and Jarque-Bera statistic. These give a general idea about the properties of data.

Jarque-Bera statistic is a measure of sets whether or not the series is normally distributed and if not how far from a normal distribution. The Jarque-Bera statistic is computed as

$$JB = \frac{n}{6}\left(S^2 + \frac{1}{4}K^2\right) \tag{3.1}$$

where S is skewness of the time series and K is the kurtosis of the time series. Jarque-Bera test assumes a chi-square distribution with 2 degrees of freedom. The null hypothesis is that the series follow a normal distribution. (Jarque & Bera, 1980)

After analyzing descriptive statistics, in order to get reliable results we have to check whether or not data series are stationary. In other words, we have to check whether or not series contain a unit root.

There are 5 different unit root tests generally used in literature: Augmented Dickey-Fuller unit root test (ADF) which is developed by Dickey and Fuller (1979), Dickey-Fuller GLS unit root test (DF-GLS) developed by Elliot, Rothenberg, and Stock

(1996), Philips-Perron unit root test (PP) created by Philips and Perron (1988), Kwiatkowski-Philips-Schmidt-Shin unit root test (KPSS) created by Kwiatkowski, Philips, Schmidt and Shin (1992), Elliot-Rothenberg-Stock unit root test (ERS) and Ng-Perron unit root test (MZα). ERS unit root test was found by Elliot, Rothenberg and Stock (1996) and Ng-Perron test was found by Ng and Perron (1995).

All unit root tests except KPSS have null hypothesis that the series has a unit root; however, KPSS has the null hypothesis that the series is stationary. PP unit root test gives the user flexibility that no lag length needs to specify whereas other unit root tests need lag length specification.

However, it has been found that if Δyt in ADF and PP unit root tests belongs to an ARMA representation which has a large and negative MA component then both tests are distorted and also, PP test has more distortion than ADF test (Schwert, 1989). Furthermore, slight problems are found by Caner and Killian (2001) in KPSS test. Generally, ADF test, PPtest and KPSS test are criticized because they have low power. For this reasons we decided to use Dickey-Fuller GLS unit root test and Ng-Perron unit root test.

Next we apply the Granger causality test. Granger causality test is developed by Granger (1969) in order to see the causality relationships between data sets X and Y. Then Sims (1972) wrote a paper states that while money Granger causes output, output does not Granger cause money. X Granger causes Y means that Y can be explained better not only with its past values but also the current and past values of X. It has the null hypothesis that X does not Granger causes Y. If the computed statistic falls in the rejection region than the null hypothesis is rejected and one concludes that X Granger causes Y. Note that, Toda and Phillips (1993) pointed out that if the series are co integrated than there are some problems in Granger causality test.

There various methods to understand the short-run and long-run relationships of time series. One of them is Granger causality method. With this method, one can analyze which variable affects other and vice versa. In other words, data set X Granger causes data set Y means that Y can be better explained not only using its past data but also with using data set X. So, we may argue that this method shows which variable has explanatory power on other variables. However, this method does not give the complete result of causality since this method analyzes data sets pair wise. Also, if there is a third set of data which Granger causes both X and Y, one may still conclude that X granger causes Y but that result would not be accurate.

Therefore in order to see the complete picture of causality between data sets, we continue our analysis with vector auto regression (VAR). VAR models have the advantage that they show relationships between multiple time series. In these models each variable is analyzed symmetrically. In other words, we use VAR models to see the complete picture of causality relationships.

After we investigate the causality relationships the next question to be answered is how do variables respond to a shock in one variable and how long the effect lasts? To answer these questions we use generalized impulse responses. This method simply gives a shock a data set then investigates the response of the data set in question. If these shocks dies out quickly we cannot deduce that the variable in concern is responsive to a shock in the other. However, if these shocks sustain over a period of time we can talk about a permanent or long lived effect of a disturbance in the other variable. .

After the Granger causality test results are examined, a Vector Auto regression (VAR) model will be established. In order to do this, first optimum lag length should be decided. While deciding optimum lag length 3 information criterions are used: Akaike Information Criterion, Schwarz Information Criterion and Hannan-Quinn information Criterion. Mathematical representations of these criterions are

$$\textit{Akaike Information Criterion} = 2(l/T) + 2(k/T) \tag{3.2}$$

$$\textit{Schwarz Information Criterion} = 2(l/T) + k \log (T)/T \tag{3.3}$$

$$\textit{Hannan-Quinn Information Criterion} = 2(l/T) + 2k \log (\log (T))/T \tag{3.4}$$

where T is the number of observations, l is the log likelihood function and k is the parameters to be estimated.

Moreover we should check whether or not the VAR model is stationary. In order to decide this, one would look at the roots of the AR characteristic polynomial. If all the roots fall in the unit circle then we decide that the VAR model is stationary.

After the lag length is decided and roots are checked, we should also conduct diagnostic tests for our VAR model to be estimated. The first test that we conduct is Breusch-Godfrey test (also known as serial correlation LM test). It designed to detect ARMA error in other words it is a test for serial correlation. The null hypothesis is that up to specified lag length there is no serial correlation. We report observation R square statistic which follows chi-square distribution with specified lag length as degrees of freedom.

The second test that we conduct is that Breusch-Pagan-Godfrey test which is designed to test heteroscedasticity (Breusch-Pagan, 1979 and Godfrey, 1978). The null hypothesis is that there is no heteroscedasticity. It regresses the squared residuals on the original regressors. We report observation R square that follows chi square distribution with degrees of freedom equal to number of variables.

The third test is White heteroscedasticity test with no cross term (White, 1980). The null is again that there is no heteroscedasticity. This test runs an auxiliary regression where it regresses the squared residuals of the original regressors and a constant. We report observation R square which follows chi square distribution with degrees of freedom equal to number of variables minus 1.

Another test that we conduct is Ramsey RESET test (Ramsey,1969). It runs a general regression with a term to detect specification errors. This test is designed to detect specification errors in regression such as omitted variables, incorrect functional form and correlation between independent variables and error terms. The null hypothesis is that error terms follow a normal distribution. We conduct Reset test with 1 fitted term and reported F-statistics. The null hypothesis is that there are no specification errors.

The final test we conduct as a diagnostic test for VAR is Quandt-Andrews (QA) breakpoint test. We use 15% trimming and reported maximum F-statistics. It varies specified variables around break points and report whether or not there is a break in a sample for a specified equation. We again report maximum F-statistics.

Mathematical representation of a VAR model is

$$\boldsymbol{y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + e_t} \tag{3.5}$$

where y(t) is a vector of endogenous variables of size k, x(t) is a vector of exogenous variables of size d, A is coefficients which will be estimated and e(t) is the error terms. We will look at VAR Granger causality / Wald Block test results in order to assess long term Granger causality between variables. These results will be analyzed by using Chi-square critical values and specified degrees of freedom. Two bi-variate regressions are conducted:

$$\begin{aligned} y_t &= \alpha_0 + \alpha_1 y_{t-1} + \ldots + \alpha_l y_{t-l} + \beta_1 x_{t-1} + \ldots + \beta_l x_{-l} + \epsilon_t \\ x_t &= \alpha_0 + \alpha_1 x_{t-1} + \ldots + \alpha_l x_{t-l} + \beta_1 y_{t-1} + \ldots + \beta_l y_{-l} + u_t \end{aligned} \tag{3.6}$$

for all possible pairs (x,y). Then F statistics are calculated which is Wald statistics for the joint hypothesis:

$$\beta_1 = \beta_2 = \ldots = \beta_l = 0 \tag{3.7}$$

for each equation. The null hypothesis is that x does not Granger cause in first regression and in the second regression the null hypothesis is that y does not Granger causes x. Wald test reports Chi square statistics with degrees of freedom equal to specified lag length. We report these variables and if they are significant this means that x Granger causes y in the long run.

Since maximum order of integration is 1 in the third period we use Toda-Yamamoto procedure (Toda and Yamamoto, 1995). This procedure starts with determining the order of integration of variables, say d, and then we decide the optimal lag length, say k. then we run a VAR (k+d). If this VAR model satisfies common assumptions then Wald test on the first k lags of each variable on the joint significance (Soytas, Sarı, Hammoudeh, Hacıhasanoğlu, 2009). This procedure is flexible in the sense that there is no need to test co integration. Also Soytaş et al. (2009) stated that Toda-Yamamoto procedure allows us to run VAR in levels, no need to variables have the same order of integration. Also, there is no information loss because of differencing.

Finally we conclude our analysis by looking at the generalized impulse responses to see how a variable in question responds to shocks in other variables and whether such responses are temporary or permanent. We confirm the results coming from Wald Block test results with generalized impulse response approach.

A shock to some variable in VAR affects not only its own but also all the endogenous variables in the system. Impulse responses record that effect on future and past values of data. Generalized impulses developed by Pesaran and Shin (1998) create an orthogonalized set of vectors that do not dependent on variable ordering. This approach has an advantage over Cholesky approach because of not being dependent on variable ordering. In order to get solid results one should get the same impulse response result over and over again but if the ordering is important this is not the case. To solve this orthogonality problem we use generalized impulse response approach.

Consider another representation for VAR model (Soytas et al.,2009):

$$g_t = A\sum_{i}^{p} \phi g_{t-i} + \varepsilon_t \tag{3.8}$$

where g_t is mx1 matrix of independent variables which are jointly determined, ϕ represents coefficients to be estimated, A is the vector of constants, p is the optimal lag length, t is the time trend and epsilon is mx1 vector with covariance $\sum = \sigma_{ij}$. Then, $(S_n \sum e_j)(\sigma_{ij})^{-1}$ is the generalized impulse response with unit shock to jth variable at time t of g_{t+n} . $S_n = \phi_1 S_{n-1} + \phi_2 S_{n-2} + \cdots + \phi_p S_{n-p},$ with n= 0,1,2.. ; $S_0 = I,\ S_n = 0$ for n less than zero and e_i is the mx1 selection vector with unity as its jth element and zero elsewhere. Note that, all analysis is conducted using the econometric software package E-views.

CHAPTER 4

EMPRICAL RESULTS

Our preliminary tests were conducted by using a dummy variable for Brent oil during 2008. It showed that dummy variable that we used for 2008 oil crisis is significant. Therefore, we decided to divide the data set into three parts: from 2002 to 2008, during 2008 and from 2008 to 2011. By doing so, we aim to isolate oil crisis period and get more stable results. In this part, we give descriptive statistics and unit root test results for each period then we move on to constructing the VAR system by looking at diagnostic test for VAR first, then looking at Wald test results. Finally, we analyze the generalized impulse responses.

PERIOD 1

This period covers between years 2002 and 2008. Firstly, the descriptive statistics are examined. The table of descriptive statistics of log returns is given in Table 1.

Table 1. Descriptive Statistics of Log Returns (Period 1)

	LBRENTOIL	LCOPPER	LGOLD	LSILVER	LXU100	LBOND	LEXCHANGE
Mean	0,001212	0,001020	0,000842	0,002278	0,000823	-0,001072	-0,000169
Median	0,001838	0,001246	0,001211	0,001561	0,001437	-0,001227	-0,000991
Maximum	0,114688	0,110046	0,051242	0,195745	0,117940	0,173900	0,041486
Minimum	-0,090003	-0,091090	-0,041224	-0,126960	-0,133408	-0,125510	-0,036508
Std. Dev.	0,021084	0,016731	0,010277	0,031996	0,020158	0,018375	0,008343
Skewness	-0,096169	-0,216802	-0,216968	0,473060	-0,052316	0,488071	0,696831
Kurtosis	4,256057	7,286741	4,522201	7,315690	6,968010	14,910720	5,706812
Jarque-Bera	105,1555*	1208,991*	163,1639*	1271,261*	1026,113*	9301,028*	6036,516*
Observations	1563	1563	1563	1563	1563	1563	1563

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively.

It can be seen that log returns of Brent oil Prices, Copper prices and XU100 Index are skewed to the left whereas the remaining data sets are skewed to the right. Due to high frequency of data sets high kurtosis is observed. Standard deviation is higher for log returns of Brent oil and silver prices but all in all, not so high for all data sets.

Jarque-Bera statistics is a goodness of fit measure of how much data sets are distant from the normal distribution. The null hypothesis is that the data follows a normal distribution. The critical values are determined from chi-square distribution table. As can be seen from the table the null hypothesis is rejected since all the Jarque-Bera statistics are significant. Therefore, since Jarque-Bera statistics are significant and excess kurtosis is observed we conclude that data sets do not follow a normal distribution.

Second part of the analysis is the investigation of unit roots in data sets. In other words, we should analyze whether or not the data sets are stationary. The unit root test results can be seen on Table 2.

The critical values for Dickey-Fuller GLS unit root test are derived from MacKinnon (1991). The critical values for Ng-Perron unit root test are derived from Ng-Perron (2001). The null hypothesis is that the data set contains a unit root. Test results are reported in Table 2. Unit root test results indicate that we reject the null hypothesis and conclude that all data sets are stationary.

Table 2. Unit root test results (period 1).

		DF-GLS	Ng-PERRON
TREND	LBRENTOIL	-3,359876* (14)	-9,25836* (14)
	LCOPPER	-39,50953* (0)	-718,00* (0)
	LGOLD	-39,51101* (0)	-718,00* (0)
	LSILVER	-18,86243* (0)	-472,267* (0)
	LXU100	-39,51156* (0)	-718,00* (0)
	LBOND	-6,226619* (11)	-28,5412* (11)
	LEXCHANGE	-4,758883* (13)	-16,8070* (13)
TREND & INTERCEPT	LBRENTOIL	-12,85859* (4)	-224,501* (4)
	LCOPPER	-39,51428* (0)	-718,00* (0)
	LGOLD	-39,56910* (0)	-780,998* (0)
	LSILVER	-18,85928* (0)	-472,153* (0)
	LXU100	-39,57194* (0)	-780,998* (0)
	LBOND	-36,66155*(0)	-776,645* (0)
	LEXCHANGE	-19,629553* (2)	-545,118* (2)

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively. To determine lag lengths Schwarz Information Criterion is used.

Next, we estimate a VAR model. In order to do that first we have to decide the lag length. To determine the lag length we have to look at 3 criterions: Akaike Information Criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ). All three criterion point out that the optimal lag length is 1. Also, we need to check the stability of VAR. AR roots graph indicates that the roots lie outside unit circle therefore, we conclude that VAR is stable. However, in order to get valid results, we need to check common regression assumptions. We employ Breusch-

Godfrey test in order to test serial correlation, Breusch-Pagan-Godfrey test and White test with no cross terms to check heteroscedasticity, Ramsey RESET test to check specification errors and Quandt-Andrews breakpoint test to check stability of parameters and to check whether or not there are structural breaks in the sample. In order to obtain these test results, we run OLS equations in each data set in other words we break down the VAR results in seven linear regressions.

Table 3. Diagnostic tests for VAR(1) (period 1).

	BG	BPG	White	RESET	QA
LBRENTOIL	0,108577	11,07107*	26,67373*	0,04698	2,997523
LCOPPER	3,864403	27,62057*	66,8326*	0,414013	3,016728
LGOLD	0,027038	14,87868**	78,30766*	12,29654*	3,568937
LSILVER	1,027764	9,373636	234,9421*	0,12387	7,09
LXU100	1,420934	20,71925*	91,07521*	4,229204*	3,457846
LBOND	4,735923	18,01159*	345,2904*	2,907734	4,061853
LEXCHANGE	6,260624	74,77461*	235,2109*	4,463835*	13,81417

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively.

As can be seen from Breusch-Godfrey test results, there is no serial correlation problem in the sample. However, we cannot say the same for homoscedascity condition, both Breusch-Pagan-Godfrey test and White test indicates that there is a heteroscedasticity problem in all regressions. Heteroscedasticity causes error terms to be biased; hence we will use Newey-West corrected standard errors from now on in our analysis. The other problem is the RESET test results. It seems that some of data is not stable. However, we will show that this will not be a problem for generalized impulse responses. CUSUM test and CUSUM Squares test (not available here, but available upon request) indicate that there is an instability around last quarter of 2006 and early 2007.

After analyzing the diagnostic tests we move on to the long run Granger causality results. In table 3, the Wald test statistics are reported. They follow Chi square distribution with 1 degrees of freedom.

Table 4. Long run Granger causality test results (period 1).

	Variables						
Equations	**LBRENTOIL**	**LCOPPER**	**LGOLD**	**LSILVER**	**LXU100**	**LBOND**	**LEXCHANGE**
LBRENTOIL	-	4,320736**	0,130104	0,210087	0,492966	0,504158	0,0000101
LCOPPER	0,145631	-	0,0000639	0,112938	0,90331	0,127388	0,154463
LGOLD	2,526556	41,61239*	-	0,494624	1,616074	0,365676	3,092591***
LSILVER	0,532572	30,28548*	14,19168*	-	6,09906**	0,410242	1,639614
LXU100	1,218044	2,841246	0,017765	0,175229	-	5,315682**	0,209483
LBOND	0,8158	4,90144**	0,817252	1,629217	92,53816*	-	3,549564***
LEXCHANGE	0,02942	5,258758**	12,93828*	0,000844	136,5761*	493,5713*	-

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively. Significance implies that the column variable Granger causes the row variable.

We see that there is strong bidirectional Granger causality from copper to Brent oil. Also, as expected none of the variables except copper has explanatory power on Brent oil prices. Moreover there is no Granger causality relationship from any of variables to copper prices. Also, we do not see a Granger causality relationship from Brent oil prices to any of variables in the long run. This implies that the dynamics of the oil prices are very different from world copper prices and regional gold and silver prices, XU100 index and Interest and exchange rate in the long run.

We see an interesting Granger causality relationship from copper prices to Turkish gold and silver prices and also interest rate and exchange rate in the long run. This is an important point for policy makers and portfolio managers. It seems that copper leads the Turkish gold and silver prices in the long run.

There is a Granger causality relationship from Turkish gold prices to Turkish silver prices and exchange rate in the long run. Granger causality from domestic gold spot prices to exchange rate is maybe due to investors' action of running away from depreciating lira to gold.

There is no directional relationship from domestic silver prices to any other variables. Infrequent trading in silver market could cause this result.

Furthermore there is Granger causality from XU100 index to domestic silver prices, benchmark bond rate and exchange rate. In Turkey silver is more commonly used for industrial purposes. Maybe a decline in XU100 index causes to silver prices to decline and vice versa. Also, we mentioned the fact that 70% percent of the stocks that are traded in Istanbul stock exchange are belong to corporate that are kept by foreign investors. And for the sake of their business these corporations are closely monitor the interest rate. Therefore, the Granger causality relationship from XU100 index to exchange rate is understandable in this sense.

There is a Granger causality relationship from benchmark bond rate to XU100 index and exchange rate. Soytas et al. (2009) explained the Granger causality relationship from benchmark bond rate to exchange rate due to the fact that the benchmark bond rate is a determinant of local exchange rate. In a similar sense we may argue that benchmark bond rate is a determinant of XU100 index and that explains the relationship between them.

Finally we observe a Granger causality relationship from local exchange rate to domestic gold prices and benchmark bond rate. The relationship between exchange rate and gold is due to the investors' movement from depreciating lira to gold like the case of gold. Also, investors could use this finding by using gold as a safety net in their portfolios to protect against the depreciation of Turkish lira.

After analyzing long run Granger causality results, we turn our attention to short run relationships between data sets. We examine the short run relationships by looking at the generalized impulse responses. We applied one standard deviation shock in 2 standard error bands to each variable.

We do not expect any significant response from Brent oil prices and copper prices to any other shocks from Turkish variables. Like we mentioned before these markets have their own dynamics and they are not affected by local markets.

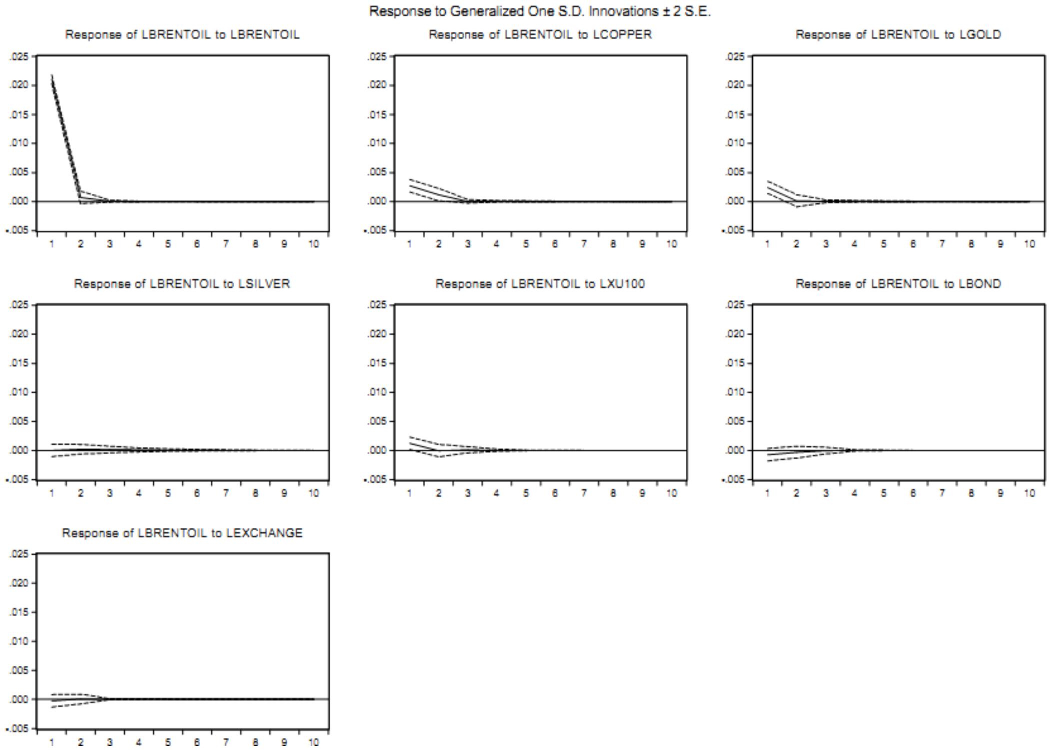

Figure 1. Response of LBrentoil to generalized one S.D. innovations +/- 2 S.E (period 1).

We see a positive initial response from Brent oil prices to shocks in copper prices but the response dies off after the third period. There is a similar response to shocks in domestic gold prices but the response is short lived. There is no significant response apart from to shocks in other variables apart from world copper prices, domestic gold prices and XU100 index is observed.

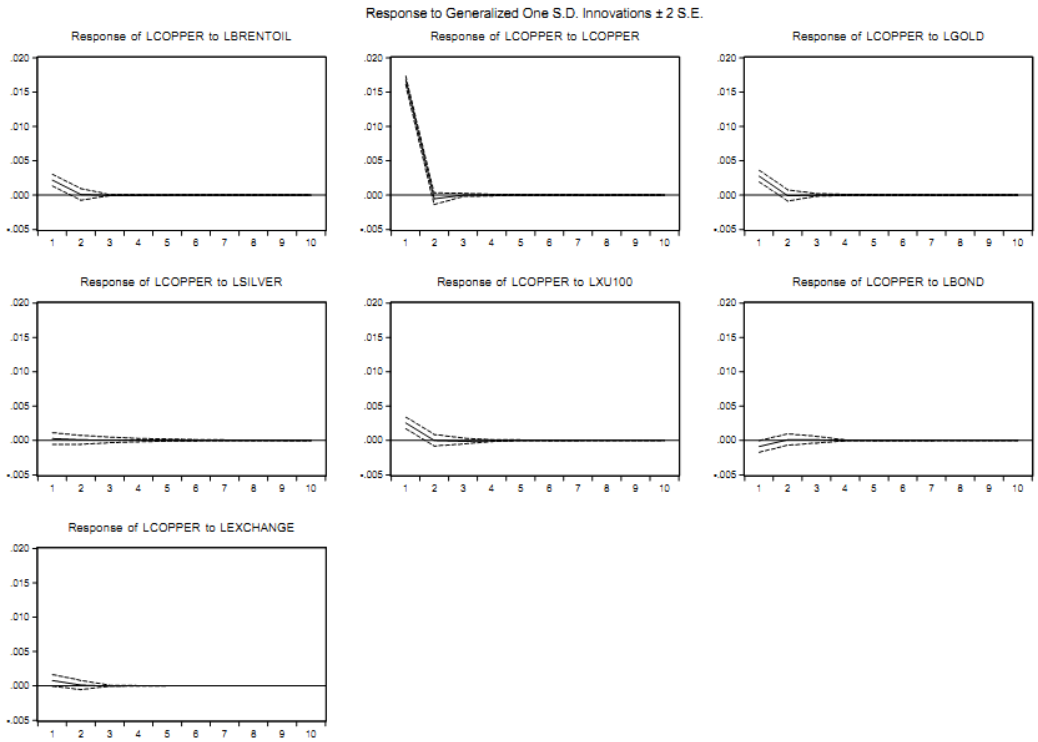

Figure 2. Response of LCopper to generalized one S.D. innovations +/- 2 S.E (period 1).

A positive initial response from copper to shocks in Brent oil is observed as in the case of Brent oil. The response dies of after the second period but it seems that in the short run world copper prices and Brent oil prices have predictive power on each other. A positive initial response from world copper prices to shocks in domestic gold prices and XU100 index is also observed as in the case of Brent oil.

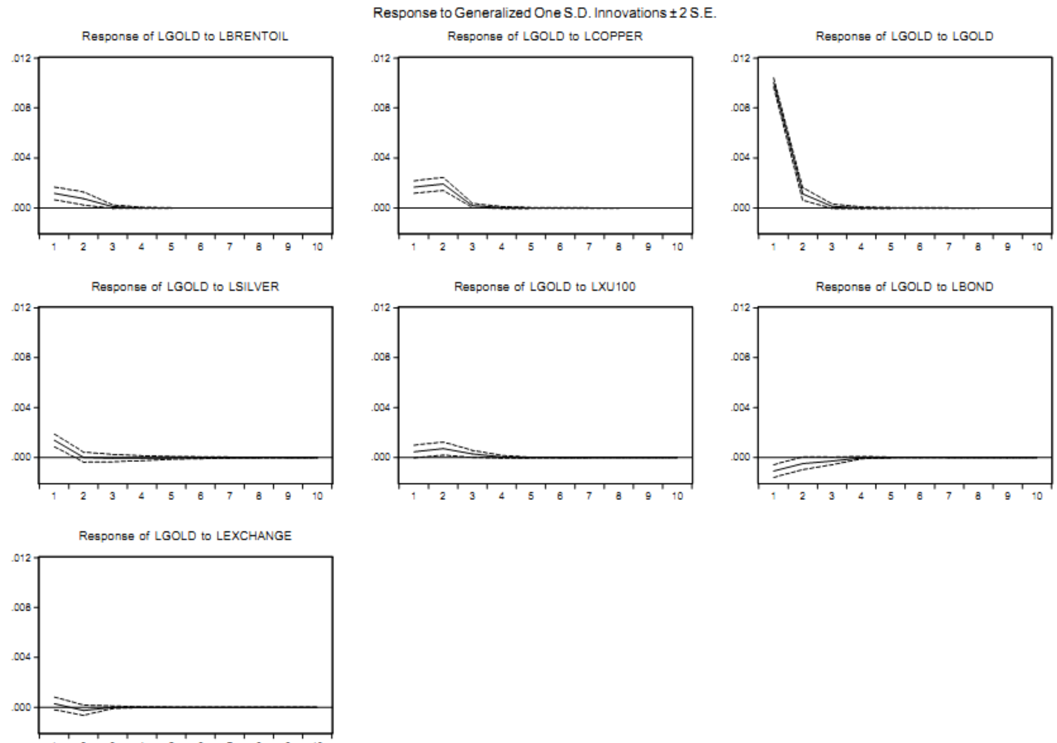

Figure 3. Response of LGold to generalized one S.D. innovations +/- 2 S.E (period 1).

As for the responses of IGE Gold spot prices we see positive initial responses to shocks in Brent oil prices and LME Copper prices. Also a positive initial response from domestic gold prices to shocks in domestic silver prices and XU100 index is observed. The response of domestic gold prices to shocks in benchmark bond rate is initially negative and the response dies of after the fourth period. This indicates that when there is a positive shock to the interest rate, investors move away from the gold only temporarily.

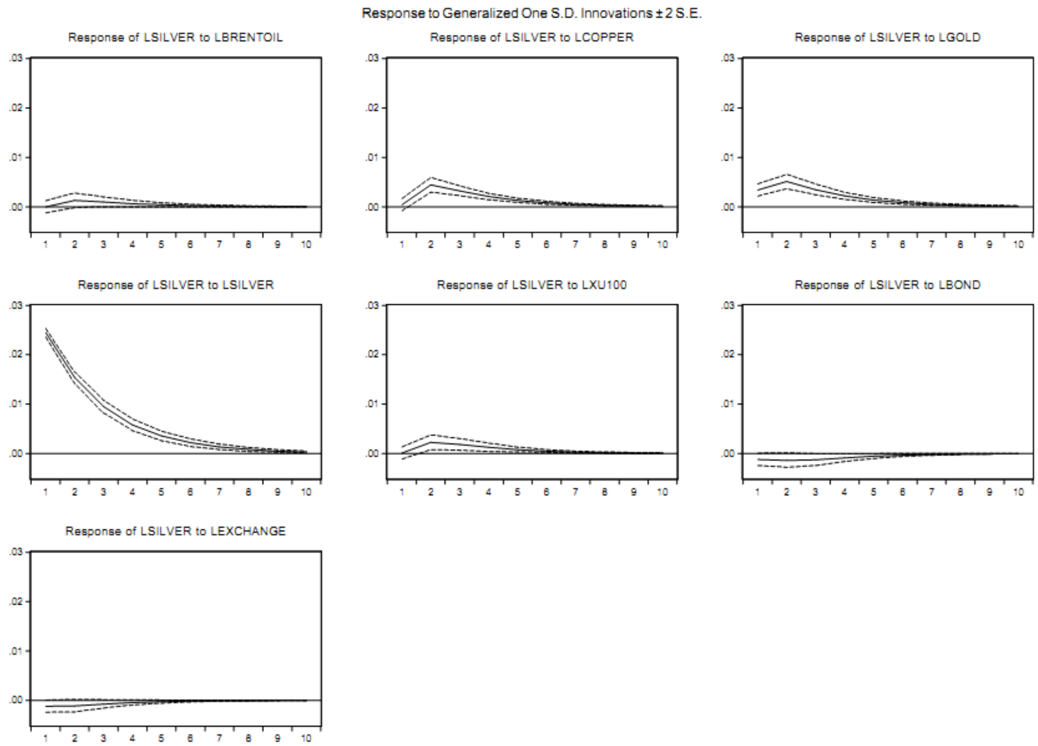

Figure 4. Response of LSilver to generalized one S.D. innovations +/- 2 S.E. (period 1)

We see a positive initial response of silver to shocks in Brent oil, copper, gold prices and XU100 index. The response of silver to gold shock is worth noting. The response sustained for a period, after that it declines and eventually dies. Furthermore, there is a positive response to the shocks in copper prices. This is an interesting finding. Since silver is used as raw material, its prices become more sensitive to world copper prices which are an indicator to industrial development. The responses of silver to shocks in XU100 index and benchmark bond rate is insignificant however, shocks to XU100 index causes silver to initially respond positively.

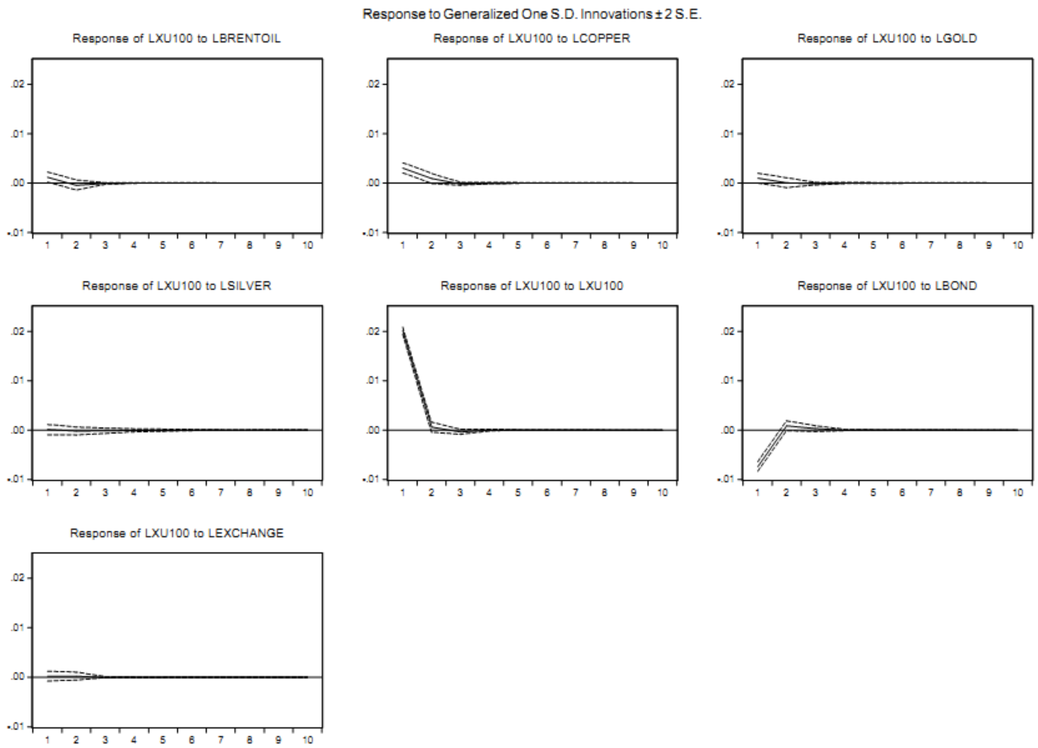

Figure 5. Response of LXU100 to generalized one S.D. innovations +/- 2 S.E. (period 1)

XU100 index showed a positive initial response to shocks in Brent oil and copper prices. However they die out after 2 periods. This finding shows that XU100 index shows sensitivity to changes in world commodity markets after all. Also, there is a strong negative initial response of XU100 index to a shock in benchmark bond rate.

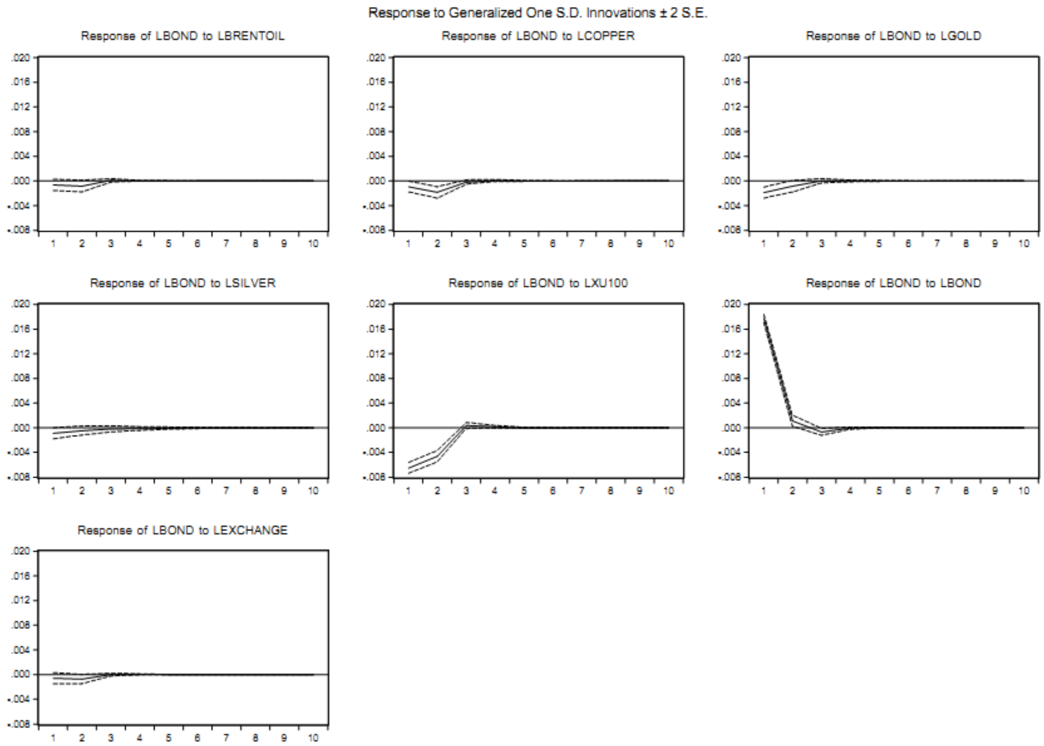

Figure 6. Response of LBond to generalized one S.D. innovations +/- 2 S.E. (period 1)

We see that response of benchmark bond rate to one standard deviation shocks to Brent oil prices and copper prices are initially negative. Furthermore, this is the case for response of benchmark bond rate to shocks in domestic gold and silver prices. A worthwhile thing to note in this figure is the response of benchmark bond rate to one standard deviation shock in XU100 index. The response is initially negative and strong. When XU100 index increases with positive shock this means more wealth and more fund seeking borrowers and eventually interest rate declines.

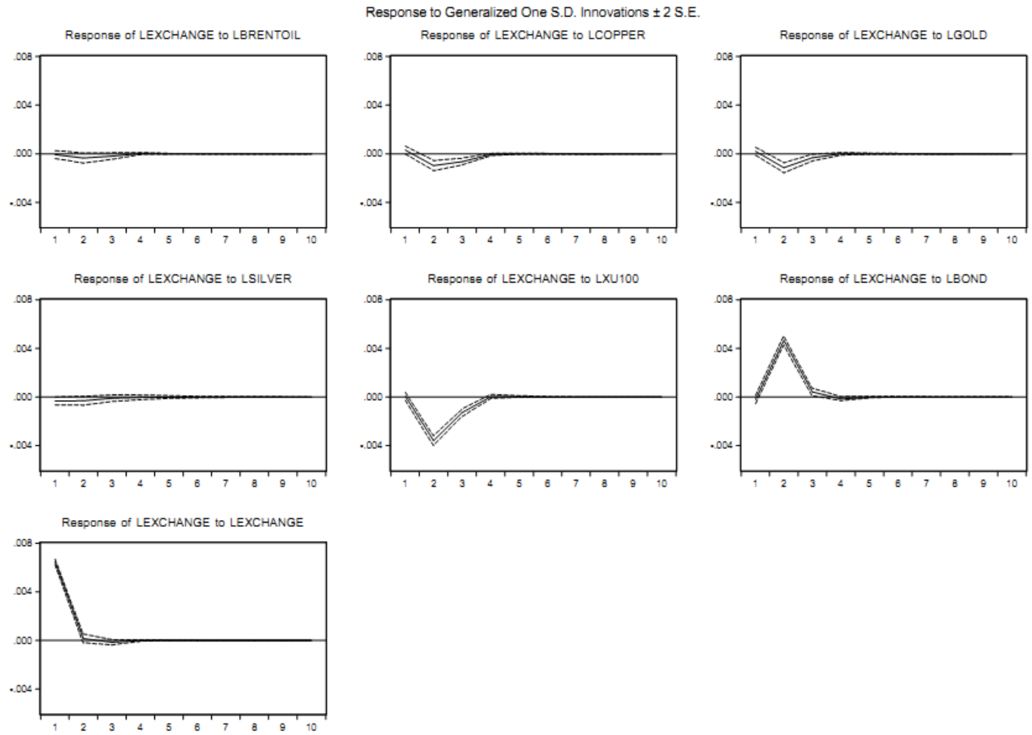

Figure 7. Response of LExchange to generalized one S.D. innovations +/- 2 S.E. (period 1)

For the case of exchange rate the initial response of exchange rate to shocks in Brent oil prices, LME copper prices and IGE gold prices are initially negative. Responses die out after the fourth period. The response of exchange rate to shocks in XU100 index is initially negative and strong. Also unlike bond, exchange rate responses positively and strongly to shocks in benchmark bond rate.

PERIOD 2

This period contains 2008 oil crisis. Like we do in period 1 we start with examining descriptive statistics of variables.

Table 5. Descriptive Statistics of Log Returns (Period 2)

	LBRENTOIL	LCOPPER	LGOLD	LSILVER	LXU100	LBOND	LEXCHANGE
Mean	-0.003208	-0.003216	-0.000755	-0.002289	-0.003418	-0.000318	0.000842
Median	-0.000908	-0.002669	0.000478	0.008454	-0.003761	-0.000522	-0.000423
Maximum	0.101438	0.114570	0.061353	0.196332	0.121272	0.049225	0.070429
Minimum	-0.168320	-0.097052	-0.059340	-0.168696	-0.090137	-0.060159	-0.119348
Std. Dev.	0.030724	0.026958	0.018629	0.058417	0.026182	0.015459	0.015211
Skewness	-0.426099	-0.103518	-0.193375	0.174585	0.231701	-0.233553	-0.904593
Kurtosis	7,269609	5,210801	3,689747	5,084764	5,630921	5,268644	19,668020
Jarque-Bera	206,9341*	53,82465*	6,826476*	48,77741*	77,90663*	58,56719*	3068,632*
Observations	262	262	262	262	262	262	262

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively.

As it can be seen from the table log returns of Brent oil prices, LME copper prices, Domestic spot gold price, benchmark bond rate and exchange rate are skewed to the left whereas XU100 index and domestic silver price data sets are skewed to the right. The standard deviation is highest for domestic silver prices. High kurtosis in exchange rate is observed. Also, for all data sets the Jarque-Bera statistic is significant and we reject the null hypothesis that data sets follow normal distribution.

After examining descriptive statistics we move on to the unit test results. The null hypothesis is that the series contains a unit root. Since test statistics are significant we reject the null hypothesis and conclude that all data sets are stationary.

Table 6. Unit root test results (period 2).

		DF-GLS	Ng-PERRON
TREND	LBRENTOIL	-16,14243* (0)	-130,500* (0)
	LCOPPER	-16,14342* (0)	-130,500* (0)
	LGOLD	-13,26521* (0)	-125,685* (0)
	LSILVER	-8,356633* (0)	-87,1729* (0)
	LXU100	-16,14243* (0)	-130,500* (0)
	LBOND	-13,98195* (0)	-127,893* (0)
	LEXCHANGE	-9,079573* (1)	-94,4629* (1)
TREND & INTERCEPT	LBRENTOIL	-16,16599* (0)	-130,499* (0)
	LCOPPER	-16,19585* (0)	-130,497* (0)
	LGOLD	-13,77471* (0)	-127,318* (0)
	LSILVER	-8,550165* (0)	-89,4206* (0)
	LXU100	-16,16789* (0)	-130,499* (0)
	LBOND	-14,16751* (0)	-128,340* (0)
	LEXCHANGE	-15,25040* (0)	-130,094* (0)

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively. To determine lag lengths Schwarz Information Criterion is used.

Next, we estimate a VAR model. In order to do that first we have to decide the lag length. AIC, SC and HQ indicate that the optimum lag length is 1. Also, we have to determine whether or not the VAR system is stable therefore we look at the AR roots graph and see that all roots lie inside the unit circle that is VAR satisfies the stability condition.

Before examining the Wald test results we look at the diagnostic tests for VAR(1).

Table 7. Diagnostic tests for VAR(1) (period 2)

	BG	BPG	White	RESET	QA
LBRENTOIL	1,13271	29,56409*	27,67574*	13,14506*	4,236195
LCOPPER	3,303048	23,50132*	59,55918*	0,263922	4,271176
LGOLD	0,17415	24,16083*	11,62193	5,889389*	2,138589
LSILVER	0,15805	11,46847	51,07511*	0,076737	3,130116
LXU100	0,171365	7,322141	27,00185*	0,283671	3,61761
LBOND	1,092535	17,55422**	49,79449*	5,22165	8,224711
LEXCHANGE	0,009274	24,29135*	63,35870*	5,763142*	3,849076

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively.

Breusch-Godfrey test results indicates that no serial correlation problem. However, both Breusch-Pagan-Godfrey test and White test indicates that there is a heteroscedasticity problem in all regressions. Heteroscedasticity causes error terms to be biased; hence we will use Newey-West corrected standard errors from now on in our analysis. The other problem is the RESET test results. It seems that regressions for Brent oil domestic gold prices and exchange rate is not stable. However, this will not be a problem for generalized impulse responses.

Next we move on to long run Granger causality results. The Wald test statistics are reported. They follow Chi square distribution with 1 degrees of freedom.

Table 8. Long run Granger causality test results (period 2).

	Variables						
Equations	**LBRENTOIL**	**LCOPPER**	**LGOLD**	**LSILVER**	**LXU100**	**LBOND**	**LEXCHANGE**
LBRENTOIL	-	4,460651**	0,155346	0,7013	0,105173	0,619019	0,124448
LCOPPER	4,605216**	-	0,289673	0,251781	0,671192	0,575333	0,261157
LGOLD	1,336812	15,63946*	-	0,102366	0,00000907	0,357929	0,825558
LSILVER	4,021626**	2,131688	7,314777*	-	2,966446	0,417117	2,848145
LXU100	1,608652	1,734755	0,512851	0,548425	-	0,682296	0,088907
LBOND	3,773205***	6,010798*	0,265899	0,058167	0,713525	-	11,80943*
LEXCHANGE	0,906615	3,392597***	9,210166*	0,149859	17,69138*	117,1274*	-

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively. Significance implies that the column variable Granger causes the row variable.

It seems that Brent oil prices Granger causes LME copper prices, IGE silver prices and Turkish benchmark bond rate in long run. The interesting point is that LME copper prices Granger causes Brent oil prices therefore world copper prices leads Brent oil prices. Investors and policy makers should keep a close eye on copper prices. LME copper prices also Granger causes IGE gold prices, Turkish benchmark bond rate and lira/dollar exchange rate. This means that Turkish policy makers and investors should also monitor world copper prices and act accordingly. Domestic gold prices Granger causes domestic silver price and exchange rate in the long run. For the case of silver, none of the variables Granger causes domestic spot silver prices.

We see that the long run Granger causality relationship between XU100 index and lira/dollar exchange rate sustains in 2008 period. In the last two columns we observe that Turkish benchmark bond rate and lira/dollar exchange rate Granger causes each other in the long run. It seems that these two variables are fundamentals of each other.

Satisfied with the long run Granger causality results we turn our attention to generalized impulse responses.

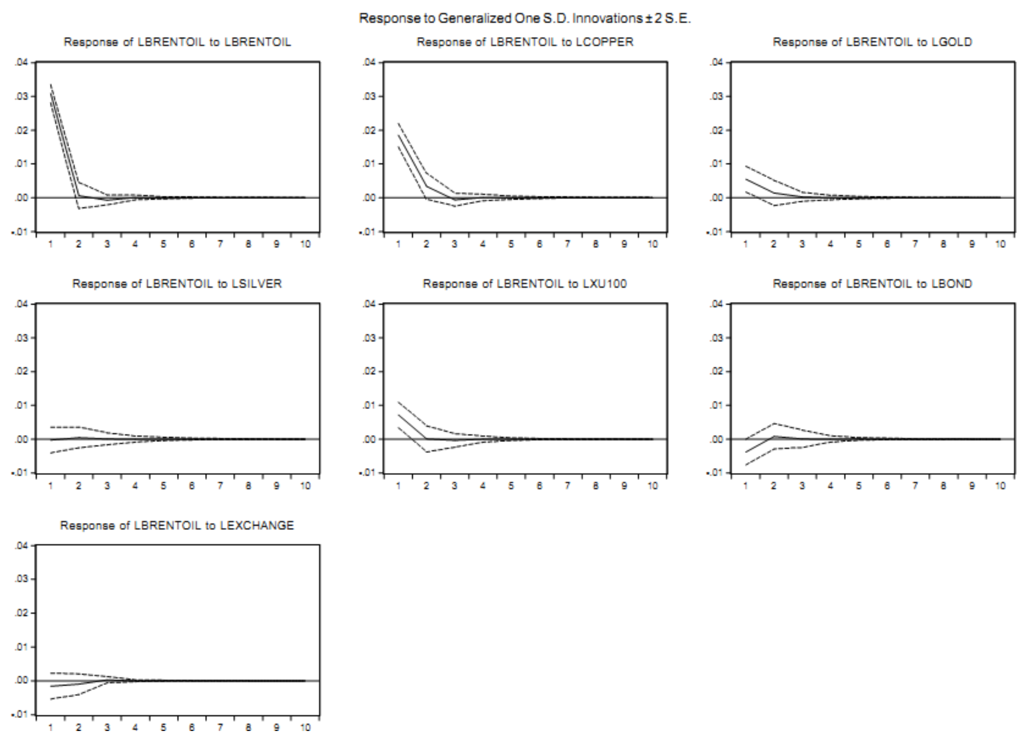

Figure 8. Response of LBrent to generalized one S.D. innovations +/- 2 S.E. (period 2)

We see that Brent oil prices initially responses positive and strong to a shock in LME copper prices. The response lasted three periods. Therefore we conclude that copper prices should be watched very closely in the short run as well as the long run in the times of crisis. Brent oil prices response positively to shocks in domestic gold prices and XU100 index. Moreover, we see a negative initial response to shocks in benchmark bond rate but the response is short lived, dies after two periods.

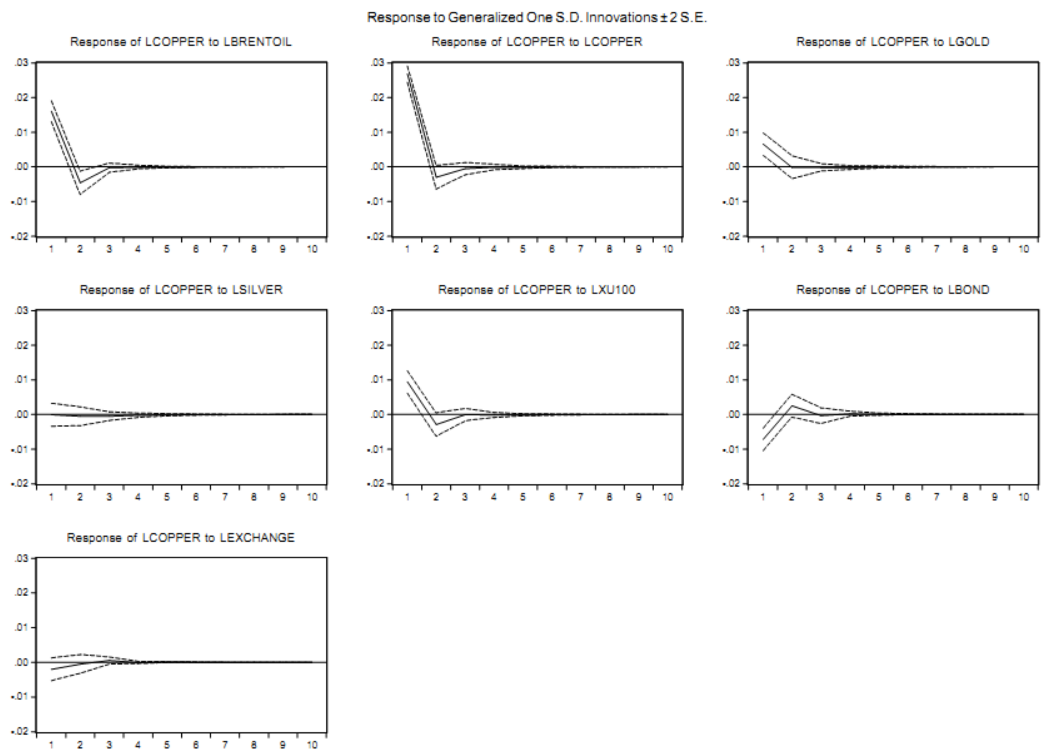

Figure 9. Response of LCopper to generalized one S.D. innovations +/- 2 S.E. (period 2)

For the case of copper, we see a positive initial response from LME copper prices to one standard error shocks in Brent oil prices. So unlike the long run, there is a short run relationship from Brent oil prices to world copper prices in 2008 period. Also, we see positive initial response to shocks in domestic gold prices and XU100 index from copper prices. Finally we see a negative initial response from copper prices to shocks in benchmark bond rate and lira/dollar exchange rate.

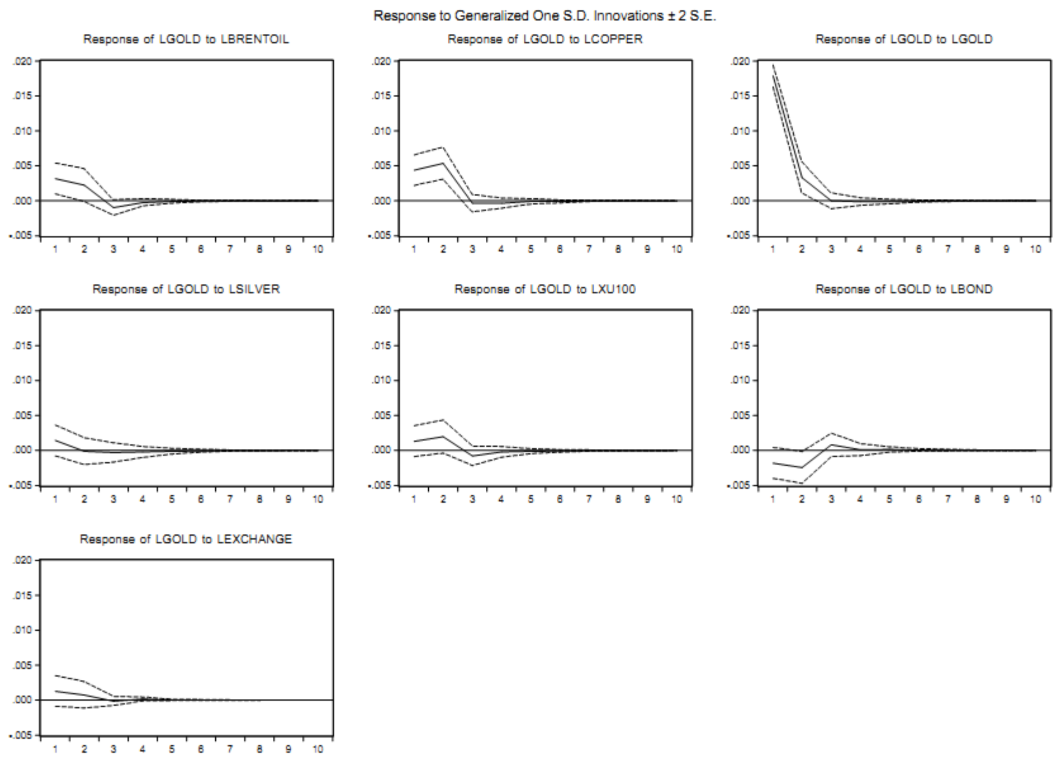

Figure 10. Response of LGold to generalized one S.D. innovations +/- 2 S.E. (period 2)

For the case of gold, we see that domestic gold prices are very responsive to shocks in other variables. We see a positive initial response from domestic gold prices to shocks in Brent oil prices, LME copper prices, XU100 index, domestic silver prices and lira/dollar exchange rate. The responses are strong to the shocks in Brent oil prices, world copper prices and XU100 index. Also, we see a negative initial response from domestic gold prices to one standard deviation shocks in benchmark bond rate. This shows the tendency of running towards to gold when interest rate declines in a negative shock or vice versa.

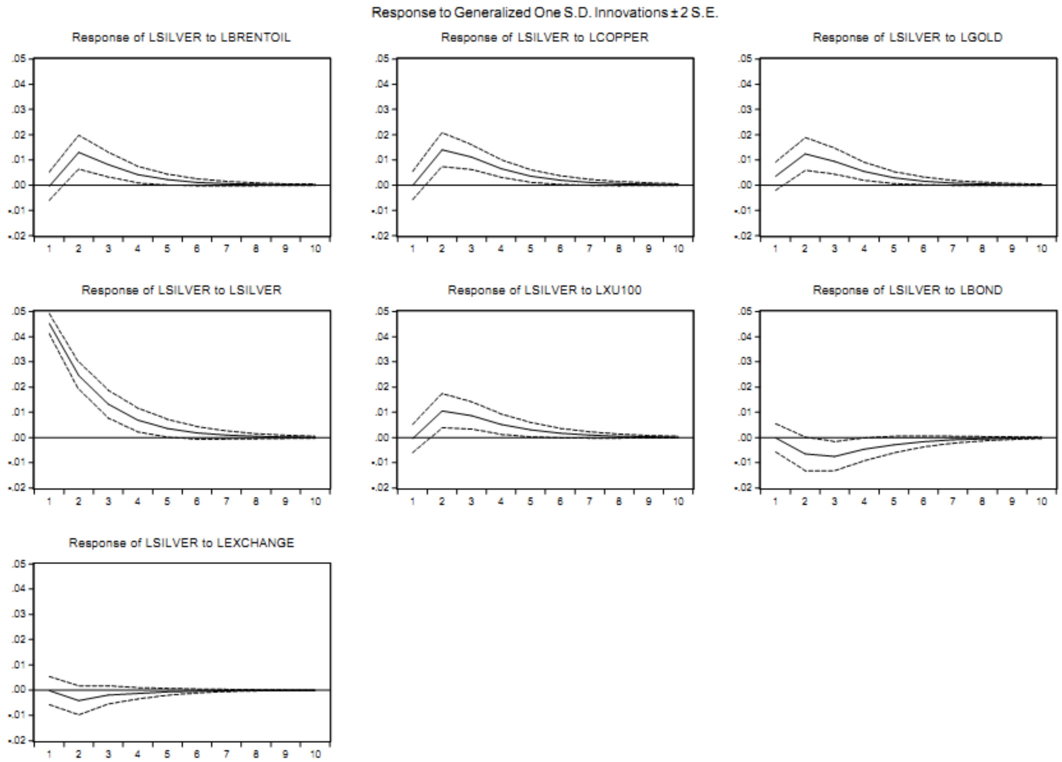

Figure 11. Response of LSilver to generalized one S.D. innovations +/- 2 S.E. (period 2)

We see that the responses of domestic silver prices are rather long lived compared to the other variables. IGE silver prices response initially positive and strong to shocks in Brent oil prices, LME copper prices, domestic spot gold prices and XU100 index. On the other hand, it responses negatively to shocks in interest rate and exchange rate. Responses die off around sixth period.

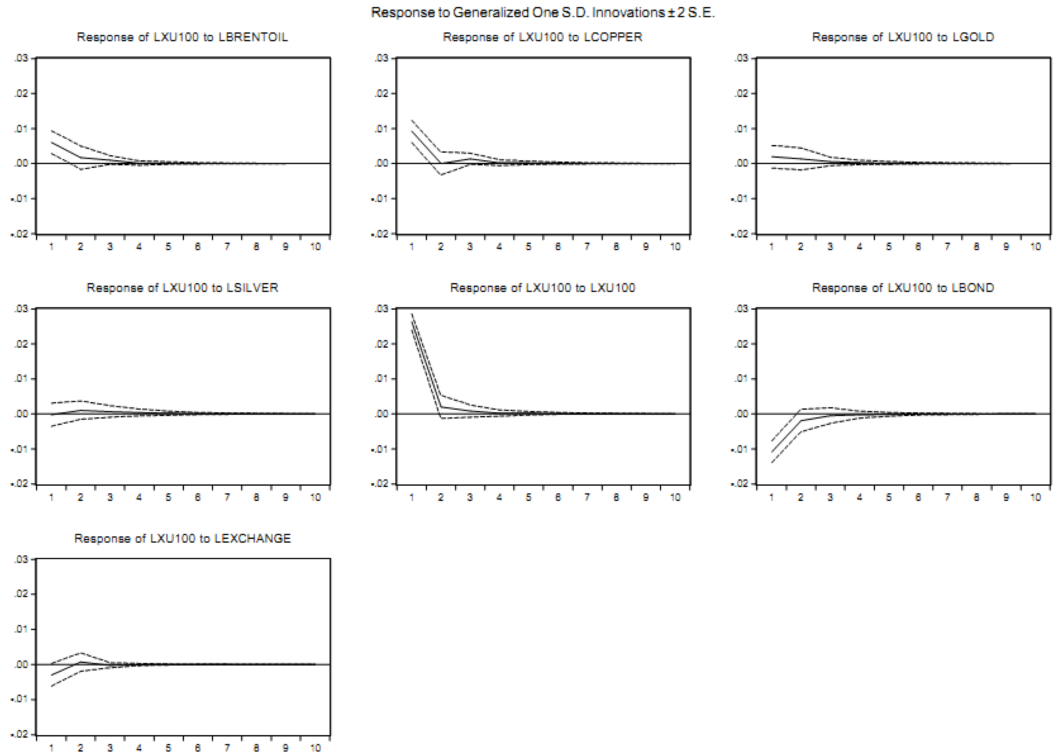

Figure 12. Response of LXU100 to generalized one S.D. innovations +/- 2 S.E. (period 2)

We see positive initial responses of XU100 index to shocks in Brent oil prices, world copper prices, domestic gold prices, IGE silver prices and lira/dollar exchange rate. This may be due to the fact that in the time of oil crisis, investors move towards more profitable opportunities like diversifying their portfolios with stocks. We also observe a negative and strong response from XU100 index to shocks in benchmark bond rate.

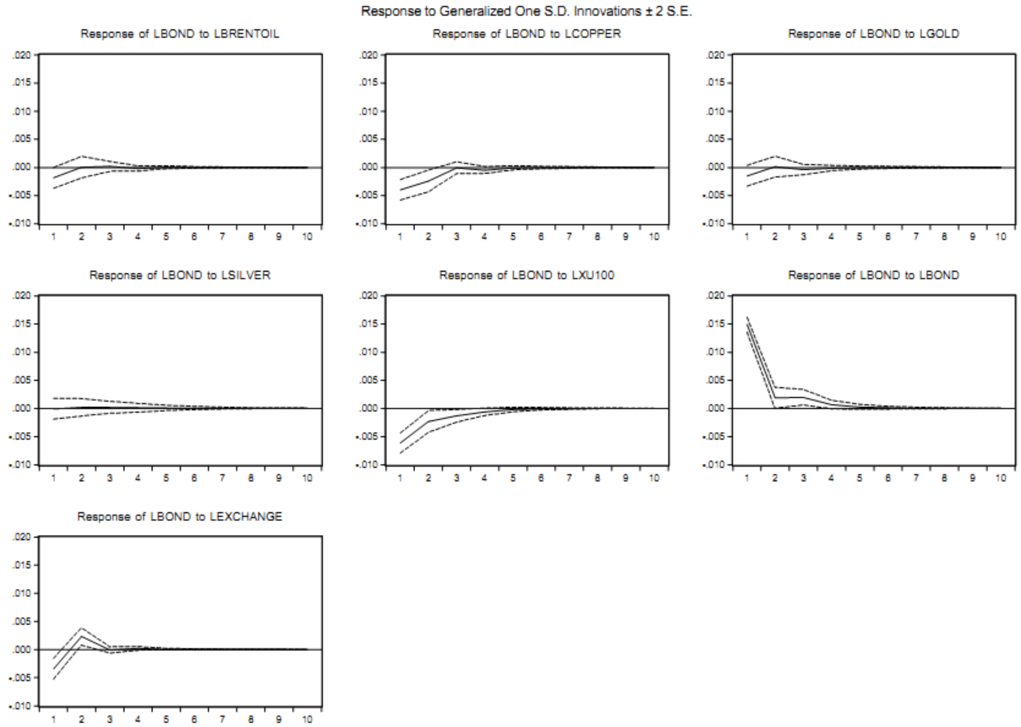

Figure 13. Response of LBond to generalized one S.D. innovations +/- 2 S.E. (period 2)

For the case of Turkish benchmark bond rate we see negative responses to shocks in Brent oil prices, LME copper prices, IGE gold prices, XU100 index and lira/dollar exchange rate. Response of benchmark bond rate to shocks in domestic silver prices does not seem strong. Also in this case we observe that responses lasted almost six periods then fizzle off.

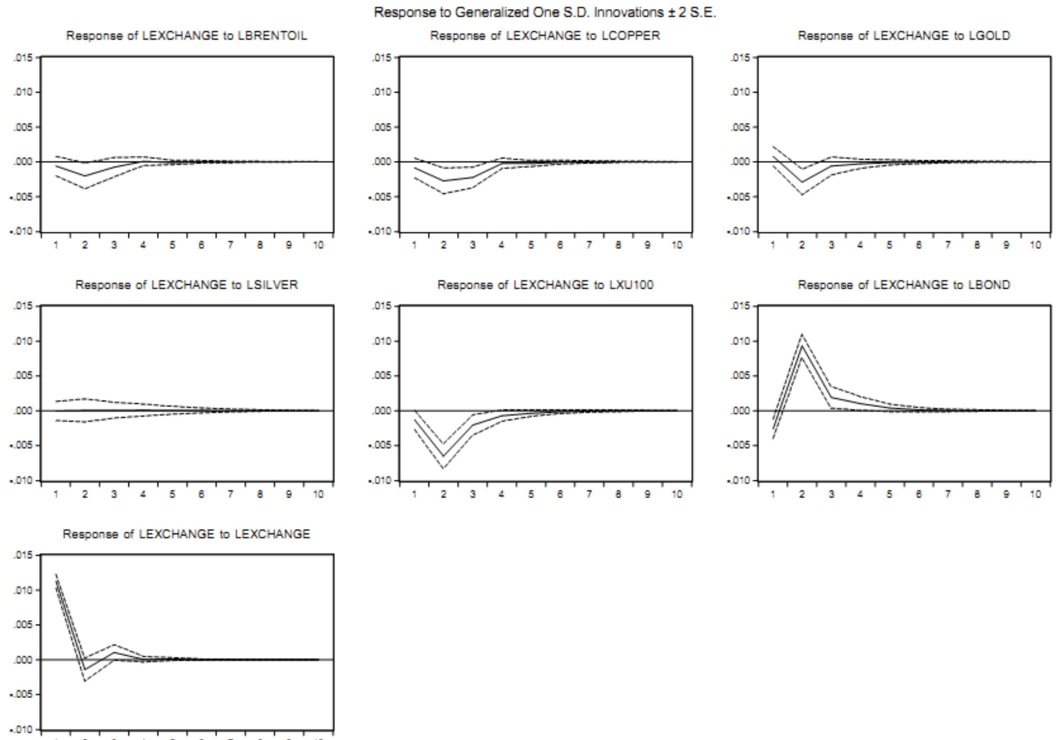

Figure 14. Response of LExchange to generalized one S.D. innovations +/- 2 S.E. (period 2)

Finally in case of exchange rate we see negative responses to shocks in Brent oil prices, world copper prices, IGE gold prices and XU100 index. Response or lira/dollar exchange rate to shocks in XU100 index is strong and lasted six periods. Unlike response to other variables, lira/dollar exchange rate responses positively and strong to shocks in benchmark bond rate. The response lasted six periods then dies off. Soytaş et al (2009) explained this relationship by stating the theory that in the short run interest rate acts as an important determinant of exchange rate.

PERIOD 3

This period covers the era between 2009 and 24/2/2011. We again begin our analysis by looking at descriptive statistics of log returns of variables.

Table 9. Descriptive Statistics of Log Returns (Period 3)

	LBRENTOIL	LCOPPER	LGOLD	LSILVER	LXU100	LBOND	LEXCHANGE
Mean	0.001559	0.002519	0.000499	0.026513	0.001401	-0.001243	0.000243
Median	0.001912	0.003064	0.000365	0.014926	0.001854	-0.002103	-0.000323
Maximum	0.106982	0.084678	0.068918	0.226124	0.068952	0.057023	0.028108
Minimum	-0.113262	-0.069242	-0.040401	-0.089948	-0.062208	-0.063851	-0.031621
Std. Dev.	0.024605	0.020862	0.011501	0.065531	0.015975	0.014006	0.008114
Skewness	-0.236185	-0.046436	0.306080	1.367.587	-0.061520	-0.730970	-0.040169
Kurtosis	6,105830	3,920213	5,869833	5,317266	4,389111	6,463624	4,029214
Jarque-Bera	230,6952*	19,99539*	201,2747*	300,3896*	45,45896*	330,3814*	24,91156*
Observations	561	561	561	561	561	561	561

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively.

We see that Brent oil prices, LME copper prices, XU100 index, Turkish benchmark bond rate and lira/dollar exchange rate are skewed to the left whereas domestic gold and silver prices are skewed to the right. Means are close to zero except for silver since data sets contains negative returns. Also Jarque-Bera statistics are significant for all data sets which mean that we reject the null hypothesis and conclude that none of the variables follows normal distribution.

After analyzing descriptive statistics we turn our attention to unit root test results. The critical values for Dickey-Fuller GLS unit root test are derived from MacKinnon (1991). The critical values for Ng-Perron unit root test are derived from Ng-Perron (2001). The null hypothesis is that the data set contains a unit root. We see that none of the data sets except LME copper prices contains a unit root. However, log returns of copper prices seem to be non-stationary. To fix this problem we take the first difference of log returns of copper prices and see that now the data set is stationary. After on we use first difference of log returns of LME copper prices to obtain reliable results.

Table 10. Unit root test results (period 3).

		DF-GLS	**Ng-PERRON**
TREND	**LBRENTOIL**	-1,984726* (13)	-2,73902 (13)
	LCOPPER	-0,426916 (14)	-1,49705 (14)
	LGOLD	-4,545105* (4)	-26,2179* (4)
	LSILVER	-4,219585* (0)	-33,7181* (0)
	LXU100	-2,983635* (7)	-8,68926** (7)
	LBOND	-19,20513* (0)	-268,647* (0)
	LEXCHANGE	-10,05193* (2)	-143,452* (2)
TREND & INTERCEPT	**LBRENTOIL**	-19,99943* (0)	-272,442* (0)
	LCOPPER	-0,132517 (14)	-1,74101 (14)
	LGOLD	-7,023559* (4)	-54,5482* (4)
	LSILVER	-5,396452* (0)	-52,7872* (0)
	LXU100	-12,54193* (1)	-195,761* (1)
	LBOND	-19,83165* (0)	-271,661* (0)
	LEXCHANGE	-20,18826* (0)	-273,137* (0)

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively.

After analyzing unit root test results, we move on to constructing VAR systems. However, this time we will use Toda-Yamamoto (TY) procedure (Toda and Yamamoto, 1995) since copper prices data set contains a unit root. This means that maximum order of integration is 1. Next, we decide the optimal lag length, say k, for VAR system and construct a VAR (k+1). By looking at AIC, HQ and SC we see that HQ and SC suggest that optimal lag length is 1 whereas AIC suggests that optimal lag length is 3. Therefore we conclude that the optimal lag length is 1 and we construct a VAR (2) system.

After deciding the order of integration and optimal lag length we look at the descriptive statistics of VAR (2).

Table 11. Diagnostic tests for VAR(2) (period 3)

	BG	BPG	White	RESET	QA
LBRENTOIL	4,65155	5,712121	135,7229*	0,013288	1,131847
LCOPPER	101,3238*	4,896014	64,53550*	0,363017	1,532082
LGOLD	0,350245	9,037419	7,028935	0,189727	2,716218
LSILVER	1,051992	3,501859	2,459127	22,90370*	5,035666
LXU100	1,827318	14,54952	31,08484	0,482092	1,55814
LBOND	5,345426	15,83417**	50,33829*	2,148632	4,168316
LEXCHANGE	0,390394	17,02923	72,31420*	3,530106	6,092328

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively.

Breusch-Godfrey test suggests that there is a serial correlation problem in regression for copper. Also, there is a heteroscedasticity problem seen on White test results and for benchmark bond rate in Breusch-Pagan-Godfrey test results. To correct this problem we use Newey-West corrected standard errors from now on. Reset test indicates a stability problem for silver but this may be due to thin trading of silver.

After diagnostic tests for VAR (2) we move on to long run Granger causality test results.

Table 12. Long run Granger causality test results (period 3).

	Variables						
Equations	**LBRENTOIL**	**LCOPPER**	**LGOLD**	**LSILVER**	**LXU100**	**LBOND**	**LEXCHANGE**
LBRENTOIL	-	0,558646	0,714163	0,426499	2,173409	0,716007	4,147793
LCOPPER	15,36216*	-	2,882971	0,89591	4,241179	5,107394*	9,193714*
LGOLD	0,350092	1,845672	-	0,366763	9,175241*	2,303415	1,489809
LSILVER	0,561107	7,932184*	5,302413*	-	1,029461	2,811864	1,173842
LXU100	3,006394	0,730031	4,741461*	2,452027	-	4,290052	1,019337
LBOND	1,987718	1,754522	3,765452	3,549804	8,870449*	-	0,995289
LEXCHANGE	14,43099*	13,89347*	2,693341	4,228279	56,45323*	67,08132*	-

Notes to table: *, **, *** indicates significance at 1%, 5%, and 10% levels, respectively. Significance implies that the column variable Granger causes the row variable.

It seems that none of the variables Granger causes Brent oil log returns in the long run. LME copper prices Granger causes domestic silver price and lira/dollar exchange rate in the long run. This is an important point for investors. We see that domestic gold prices Granger causes IGE silver prices and XU100 index.

On the other hand, silver price Granger causes none of the variables in the long run. This may be due to thin trading of silver. XU100 index Granger causes domestic gold prices, benchmark bond rate and lira dollar exchange rate. It seems that benchmark bond rate and lira dollar/exchange rate Granger causes world copper prices in the long run. That is an interesting point since we expect that none of the domestic variables Granger causes world oil and copper prices. Benchmark bond rate also Granger causes lira/dollar exchange rate.

After long run Granger causality results we move on to examine short run relationships between variables. In order to do this we look at generalized impulse responses.

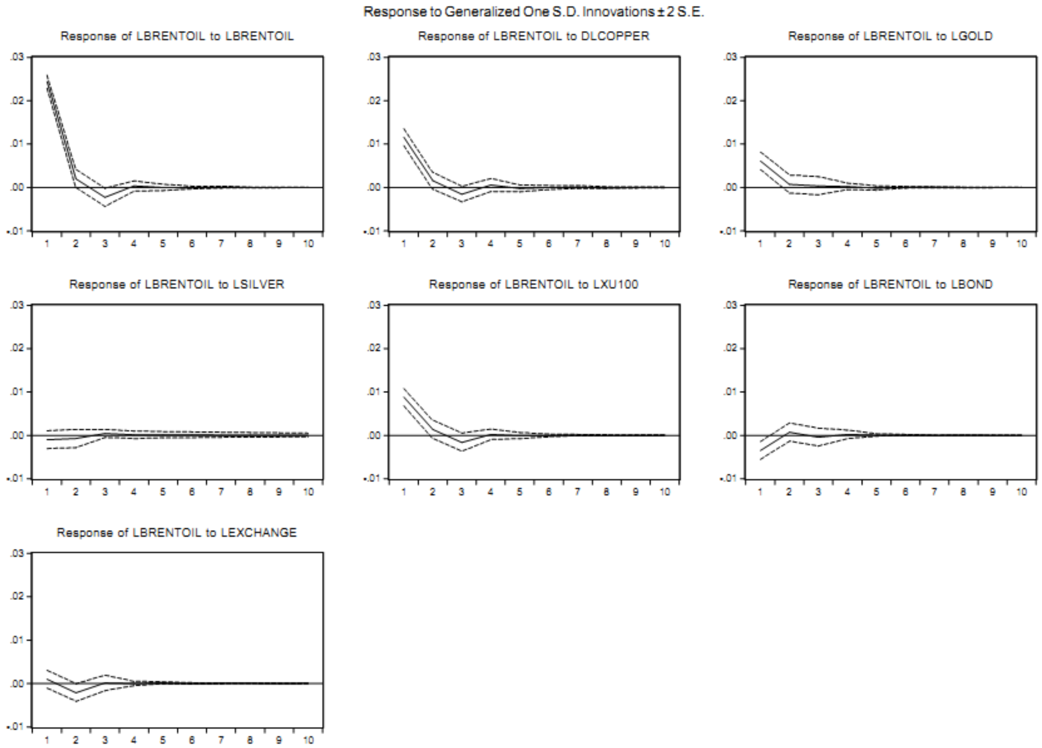

Figure 15. Response of LBrent to generalized one S.D. innovations +/- 2 S.E. (period 3**)**

World copper prices, domestic gold prices, XU100 index and lira/dollar exchange rate have positive initial impact on Brent oil prices in the short run. Brent oil prices' response to a shock in benchmark bond rate is negative. This is an interesting short run relationship since it seems that all domestic variables affect Brent oil price, except for silver price.

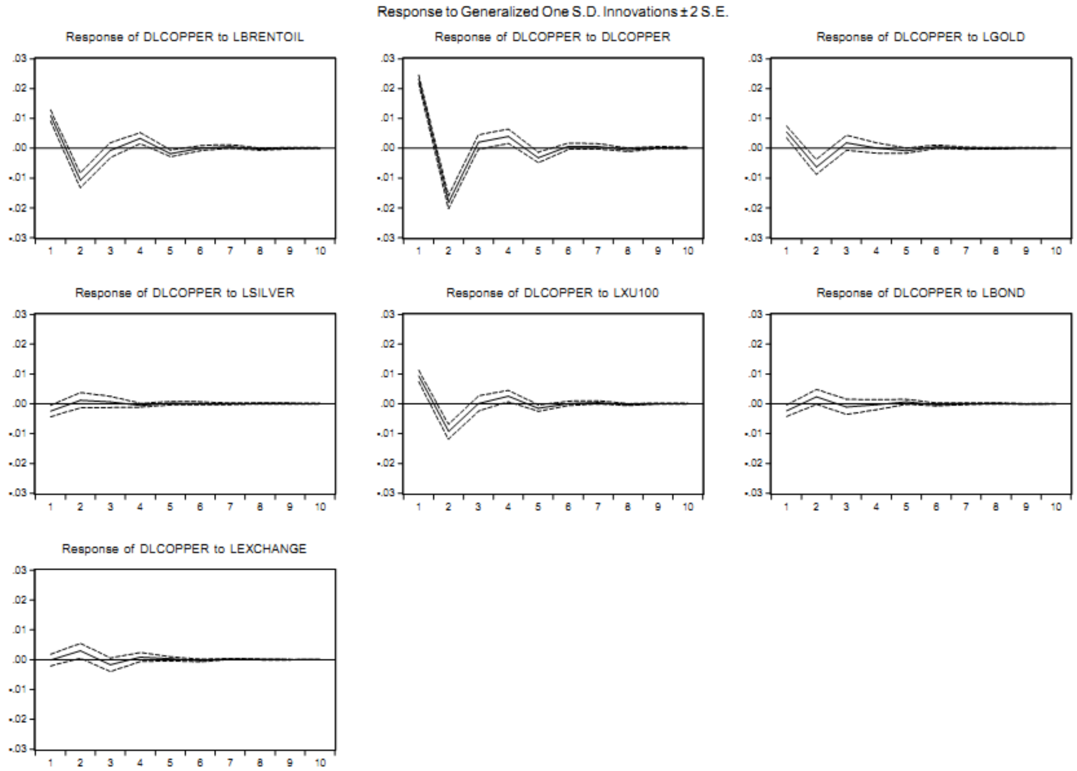

Figure 16. Response of LCopper to generalized one S.D. innovations +/- 2 S.E. (period 3)

We see a positive response from world copper prices to shocks in Brent oil price, domestic gold prices and XU100 index. on the other hand we see that benchmark bond rate has a negative initial impact on LME copper prices. Responses are rather long lived, lasted about seven periods.

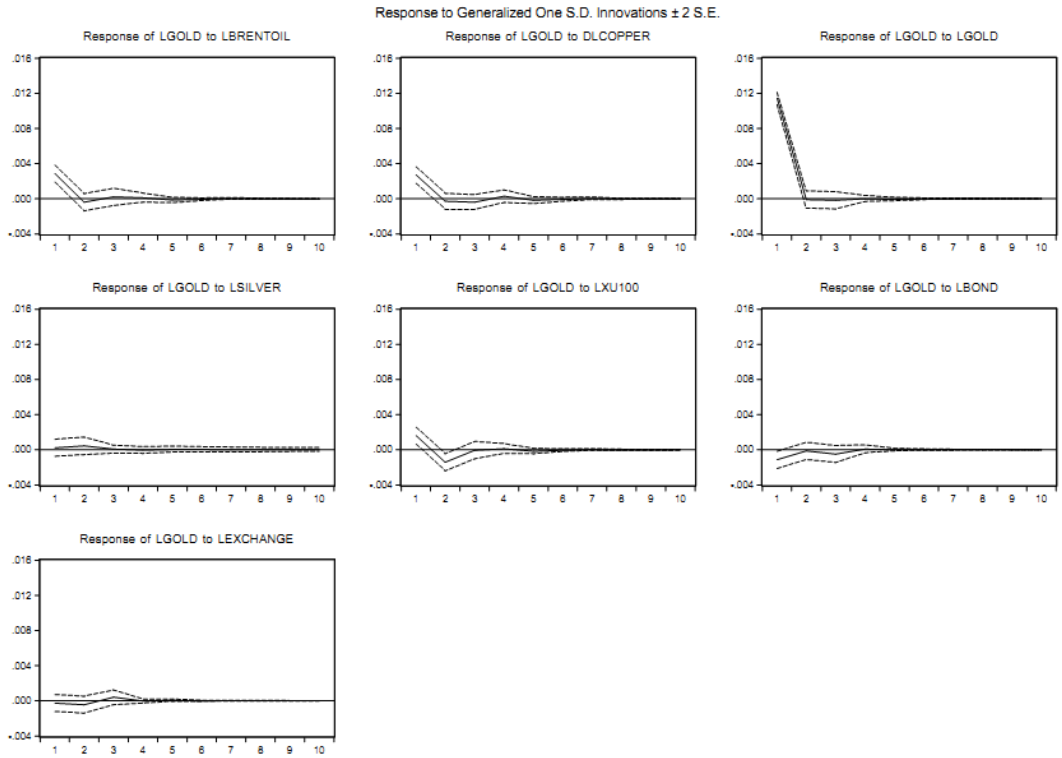

Figure 17. Response of LGold to generalized one S.D. innovations +/- 2 S.E. (period 3)

As we come to the responses of domestic gold prices, we see positive responses to shocks in Brent oil prices, copper prices, XU100 index and domestic silver prices. On the other hand, we see a negative initial response to shocks in benchmark bond rate and lira/dollar exchange rate. Responses are not strong compared to Brent oil prices and LME copper prices.

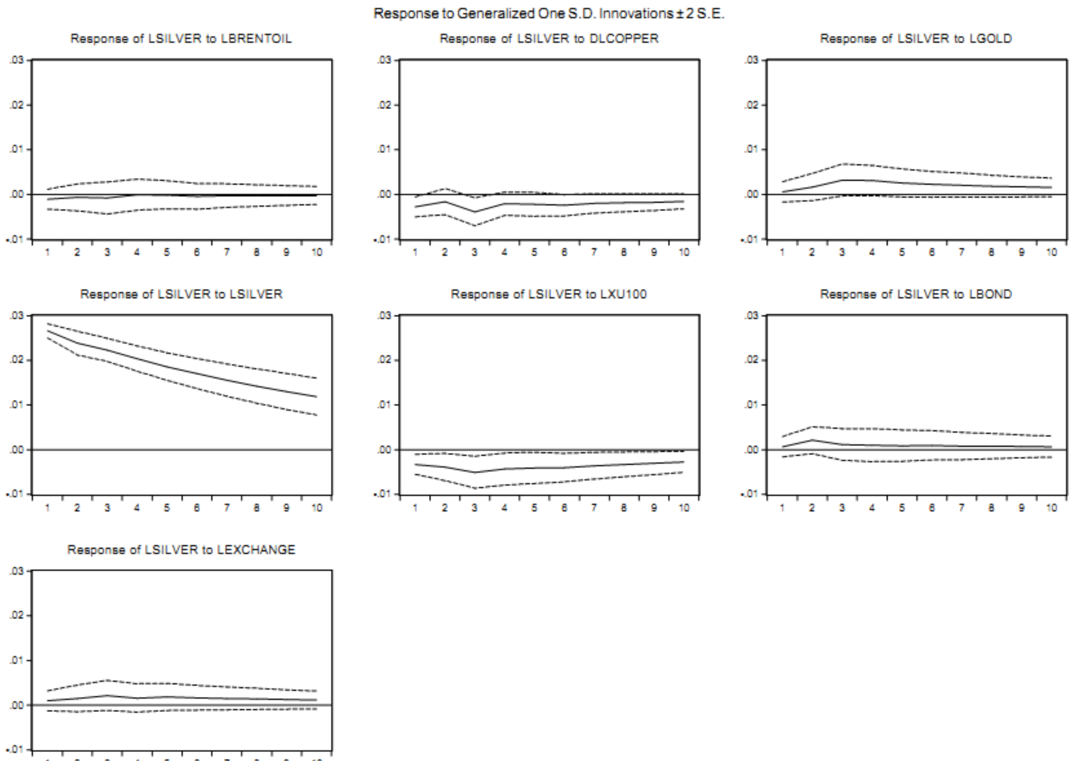

Figure 18. Response of LSilver to generalized one S.D. innovations +/- 2 S.E. (period 3)

In this case we see an interesting short run relationship. Responses of IGE silver prices are long lived and in some cases do not die off. In case of shocks to Brent oil response of domestic silver prices are not significant.

Domestic silver prices response positively to shocks in domestic gold prices, benchmark bond rate and lira/dollar exchange rate. On the other hand we see negative responses to shocks in XU100 index and world copper prices. We mentioned that responses do not die off; this may be because of infrequent trading of silver in Istanbul Gold exchange.

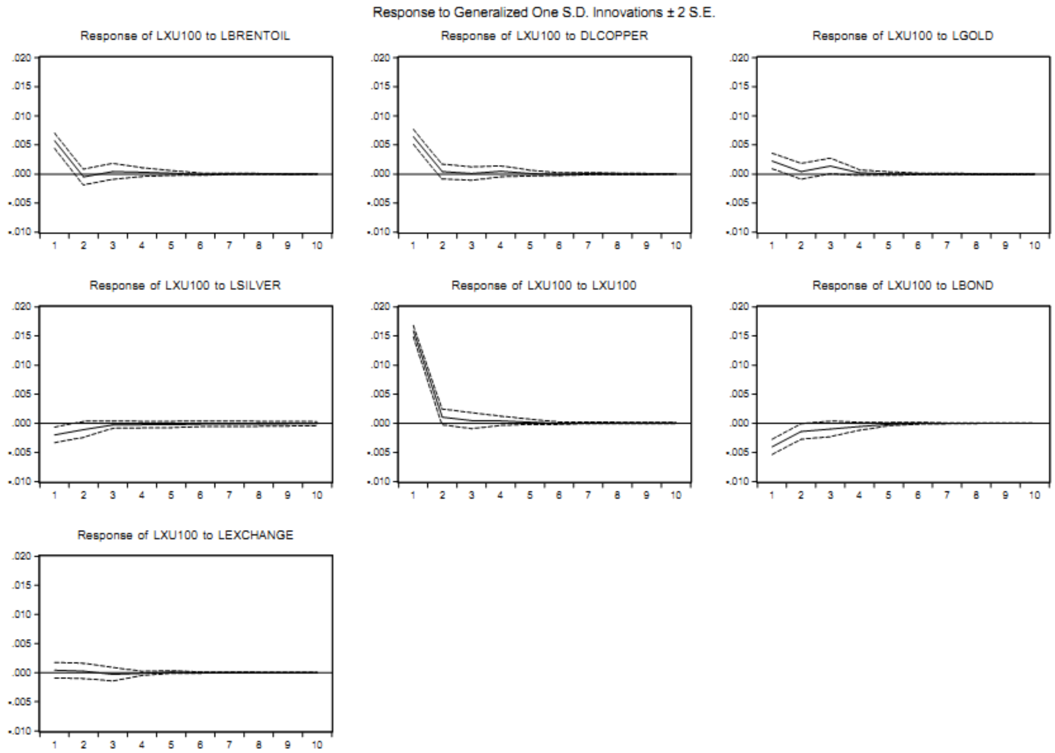

Figure 19. Response of LXU100 to generalized one S.D. innovations +/- 2 S.E. (period 3)

In case off XU100 index we see a positive response from XU100 index to one standard deviation shocks in Brent oil prices, LME copper prices, IGE gold prices and lira/dollar exchange rate. In case of shocks to domestic silver prices and Turkish benchmark bond rate we see that XU100 index responses negatively. Responses die off after six periods.

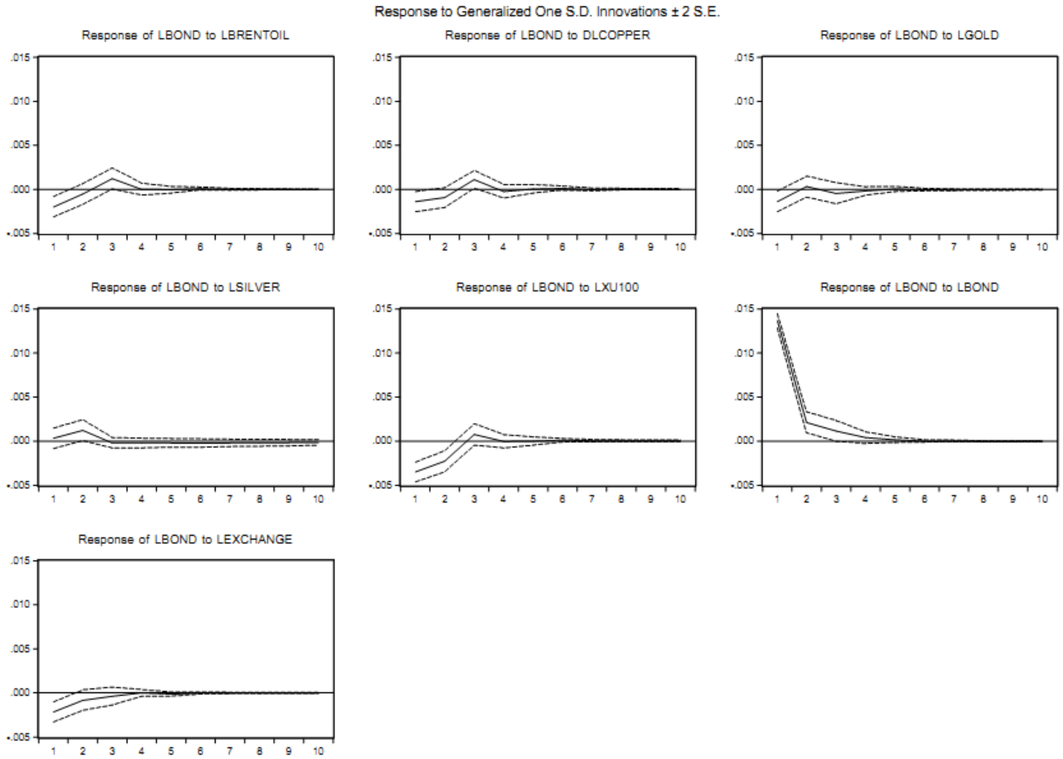

Figure 20. Response of LBond to generalized one S.D. innovations +/- 2 S.E. (period 3)

We see that benchmark bond rate responses positively to shocks in domestic silver prices whereas it responses negatively to shocks in other variables. Responses die off after six periods.

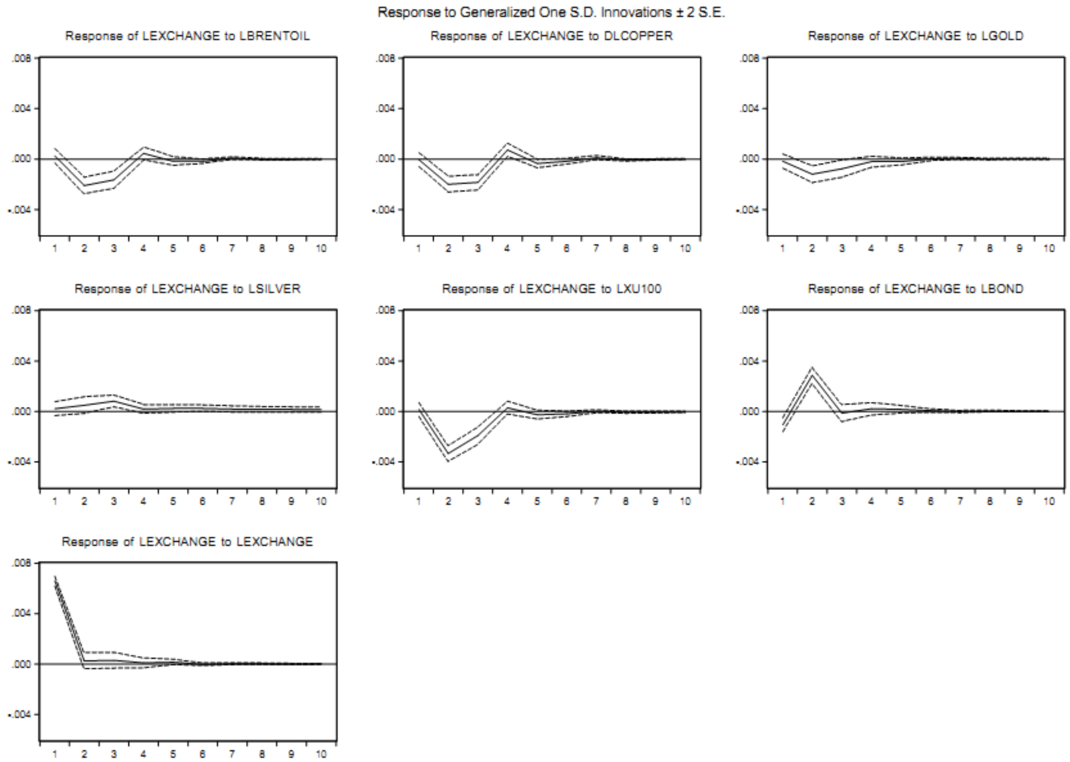

Figure 21. Response of LExchange to generalized one S.D. innovations +/- 2 S.E. (period 3)

Finally, we see rather long lived responses from lira/dollar exchange rate. It seems that responses die off after seven periods. Lira/dollar exchange rate responses initially negative to shocks in Brent oil prices, LME copper prices, XU100 index and domestic gold prices. On the other hand it responses positively to shocks in domestic silver prices and benchmark bond rate. Responses to shocks in silver prices are rather insignificant but other responses are rather strong.

CHAPTER 5

SUMMARY AND CONCLUSION

In this thesis we used world oil spot prices, world copper prices, Turkish gold and silver spot prices, Turkish interest rate, Turkish exchange rate and XU100 index and try to investigate their short run and long run causality relationships. We used daily data between the periods January 2, 2002 and February 24, 2011. Because of 2008 oil crisis we divide our data sets into three periods: from January 2, 2002 to December 31 as first period, 2007, from January 1, 2008 to December 31 as second period, 2008 and January 1, 2009 and February 24, 2011 as third period. Total observations for each data set are 2387.

We expect to see unidirectional relationships from Brent oil prices and copper prices to Turkish variables. Also we expect to see strong relationships between Turkish gold and spot prices and also a bidirectional relationship between XU100 index and interest rate. Zhang and Wei (2010) found oil prices Granger causes gold prices but not the other way around. Also they found oil shocks on gold are stronger but gold shocks on oil are more persistent. Narayan, Narayan and Zheng (2010) investigated efficiencies of these two markets and found that gold can be used to hedge portfolios. In terms of oil and commodity prices Hammoudeh and Bradley (2007) did some research and found a relationship between oil and gold and silver futures prices. They also found that copper is protected from these changes. Sarı, Hammoudeh and Soytaş (2009) found a strong relationship between oil and silver prices and a relatively weak relationship between oil and gold prices. They also found that gold has a serious impact on silver.

In terms of investigating the relationship between world oil, gold, silver and copper prices Cortazar and Eterovic (2010) found that oil prices could be used to forecast silver and copper prices. Lescaroux (2009) found the evidence that world oil and copper prices move together. Roberts (2009) argued that there is regularity in price movements of LME copper and silver prices. Hammoudeh and Yuan (2007) included more variables in their research and found that silver and gold are more volatile than copper and oil volatility has negative effects on gold and silver volatilities.

Then we extend our research into Turkish markets. An important research is made by Soytaş, Sarı, Hammoudeh and Hacihasanoğlu (2009) by using Turkish gold and silver spot prices Turkish interest and exchange rate and world oil prices. Their analysis revealed that Turkish variables do not have explanatory power on world oil prices. They found a bi directional relationship from Turkish gold prices to silver prices. In terms of impulse responses they found that the response of interest rate to shocks in gold and silver prices are initially negative. They also found a significant response from gold to shocks in silver prices.

Doğrul and Soytaş (2010) found interest rate has a positive and significant response to shocks in oil price but this response is short lived. Soytaş and Oran (2010) do not found any relationship between world oil prices and XU100 index, nor response from XU100 index to shocks in world oil price.

Our analysis starts with looking at descriptive statistics of data sets. Then, we check whether or not our data sets are stationary. Next, we tried to estimate a VAR model. However, before that we need to decide the optimal lag length. We used 3 information criteria: Schwarz information Criteria, Akaike information criteria and Hannan-Quinn information criteria.

After deciding the lag length we developed a VAR model. We check whether or not the VAR model is stationary by looking at AR roots table. Then, we conduct diagnostic tests for our VAR systems by using Breusch-Godfrey test for serial correlation, Breusch-Pagan-Godfrey test and White test with no cross terms to test heteroscedasticity, Ramsey RESET test to check specification errors and Quandt-Andrews test to investigate breakpoints.

After diagnostic test we conduct Wald test to investigate long run Granger causality relationships between variables. Then we apply generalized impulse responses to investigate short run relationships. We applied one standard deviation shock in 2 standard error bands to each variable.

In all periods variables seem not to follow a normal distribution and do not have a unit root except LME copper prices. Our analysis indicates that LME copper prices data set is not stationary in third period which is from January 1, 2009 to February 24, 2011.

The main problem for VAR systems in all periods is the heteroscedasticity problem. We overcome this problem by using Newey-West standard errors. Also, Ramsey RESET test showed instabilities in some parts of VAR systems.

In first period Brent oil prices do not Granger cause any other data sets in the long run. However, in second period we see that there is a long run Granger causality relationship from Brent oil prices to LME copper prices, IGE silver prices and Turkish interest rate. This relationship between Brent oil prices and LME copper prices sustains in the third period and also a long run bi directional Granger causality relationship from Brent oil prices to exchange rate is observed. Interestingly, in 2008 oil crisis era, a long run Granger causality relationship from LME copper prices to Brent oil prices is observed. This means that in 2008 oil crisis copper prices leads Brent oil prices. LME copper prices also Granger causes Brent oil prices in the first and second period but it seems that the link is broken in the third period. This situation is the same for the case of world copper prices and lira/dollar exchange rate. IGE gold prices long run Granger causes IGE silver prices and lira/dollar exchange rate in first two periods but in the third period XU100 index takes the place of exchange rate. Due to thin trading of silver in Istanbul Gold Exchange we do not find a long run Granger causality relationship from silver to any other variables. For the case of XU100 index, interest rate and IGE gold prices Granger causes this variable in the first period and the third period respectively. For lira/dollar exchange rate, our analysis shows that in the first two period exchange rate Granger causes interest rate in the long run. Interestingly, it seems that lira/dollar exchange rate Granger causes LME copper prices in long run. This may be because of the fact that Turkey becomes a major buyer for

LME copper. All in all, we see a long-run Granger causality relationship from LME copper prices to Turkish precious metals and lira/dollar exchange rate in long run. Also, a Granger causality relationship from XU100 index to Turkish interest rate and lira/dollar exchange rate is observed. This may be due to the fact that investors want to run away to stocks when interest rate is declining. Also, in long-run the pressing variable between Brent oil and LME copper seems to be Brent oil. It leads the LME copper prices in last two periods. We do see a Granger causality relationship to other way around, but the link is broken after 2008 oil crisis era.

In the GIRF analysis we see that during 2008 oil crisis an after that Brent oil shows stronger responses to shocks in other variables. It seems that in short run, Brent oil responses positively to shocks in LME copper prices. Also, LME copper prices shows stronger responses to shocks in other variables during 2008 and the period after 2008. There is a strong, positive initial response from copper to shocks in Brent oil prices in all periods and duration of these responses increases in last two periods. Also, response of LME copper prices to shocks in IGE gold prices and XU100 index is interesting. Response of IGE gold prices to shocks in Brent oil, LME copper prices, XU100 index is initially positive and strong. We may argue that IGE gold prices are influenced by world dynamics as well as local stock markets in short run. Investors should pay attention to that point since it seems that local gold market may not be a safety net in the times of oil or copper crisis. World oil and copper prices causes IGE silver prices to respond positively in the first two periods. Moreover in the times of 2008 oil crisis, it seems that responses of IGE silver prices get amplified. For the case of XU100 index the negative initial response to shocks in interest rate in all three periods is worth noting. Also, it seems that post 2008 oil crisis era, XU100 index responded positively to shocks in Brent oil prices and LME copper prices. This post oil crisis behavior in the variables may be because of the fact that after the oil crisis the speculations are decreased and the relationships between variables are observed more thoroughly. The negative response of XU100 index to shocks in interest rate is sustained in all periods. The negative initial response of interest rate and lira/dollar exchange rate to shocks in Brent oil prices and LME copper prices is sustained in all three periods. This finding suggests that policy makers should pay attention to world markets as well as the local markets. Lira/dollar exchange rate responded positively to shocks in interest rate whereas interest rate initially negative to shocks in exchange rate but the response becomes positives after a while. Moreover, exchange rate and interest rate respond negatively to shocks in XU100 index. Interest rate and exchange rate respond initially negative to shocks in IGE gold prices in all three periods. It seems that in all three periods responses of variables to shocks in other variables are in the same trend. The only difference is that during 2008 oil crisis and after that the responses grow stronger. To sum up, it seems that Turkish gold prices show a positive response to shocks in Brent oil prices, LME copper prices, and XU100 index in all three periods and a negative response to shocks in Turkish interest rate. This finding implies that Turkish gold market is more sensitive to global oil and copper markets than as Soytaş et. al. (2009) stated. For XU100 index, unlike the long run Brent oil prices, LME copper prices and Turkish spot gold prices causes XU100 index to respond positively, indicating that in the short run Turkish stocks market are sensitive to shocks in global markets. Turkish interest rate and lira/dollar exchange rate respond negatively to shocks in Brent oil and LME copper prices as well as Turkish gold prices and XU100 index. It seems that there is a feedback relationship between Turkish financial markets and precious metals in the short run. We may deduce that in the long run copper has more predictive power on Turkish markets that Brent oil prices whereas in the short run they have almost the same power. Nevertheless, Turkish policy makers should keep a close watch on global commodity prices since they may have serious impacts on Turkish interest rate and lira/dollar exchange rate. Another interesting remark is that it seems that copper prices are living up to its name “Dr. Copper” since it has a predictive power on global oil market as well as local markets.

This study is beneficial for investors in terms of diversifying their portfolios, investors in terms of speculation times and nature of responses, policy makers in terms of showing how world main commodity prices affects Turkish commodity prices and economic indicators so that they can better regulate policies to avoid any negative impacts. Finally, we believe that this study is beneficial for academicians in terms of showing causality relationships and impulse responses of these variables. If Turkish copper prices could be obtained, it may be used to show that how world oil price changes bring an overall impact on Turkish economy. Moreover, volatility spillover from world markets to local markets and financial variables could be an interesting future research.

REFERENCES

Amano, R. A., Van Norden S., 1998. Oil prices and the rise and fall of the US Real exchange rate. Jouurnal of International Money and Finance 17, 299-316.

Baffes, J., 2007. Oil spills on other commodities. Resources Policy 32, 126-134.

Baffes, J., Gardner, B., 2003. The transmission of world commodity prices to domestic markets under policy reforms in developing countries. Journal of Economic Policy Reform 6, 159-180.

Breusch, T. S., Pagan, A. R.,1979. Simple test for heteroscedasticity and random coefficient variation, Econometrica 47, 1287-1294.

Buyuksahin, B., Haigh M.S., Robe M.A., 2008. Commodities and Equities: A "Market of one?". Journal of Alternative Investments 12, 76-95.

Caner, M.,Killian, L., 2001. Size distortions of tests of the null hypothesis of stationarity: evidence and implications for the PPP debate, Journal of International Money and Finance 20, 639-657.

Capital Markets Board of Turkey, (February 2011). Monthly Bulletin.

Cortazar, G., Eterovic, F., 2010. Can oil prices help estimate commodity futures prices? The cases of copper and silver. Resources Policy 35, 283-291.

Dickey, D.A., Fuller, W. A., 1979. Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Society 75, 427-431.

Dogrul, H.G., Soytas, U., 2010. Relationship between oil prices, interest rate, and unemployment: Evidence from an emerging market. Energy Economics 32, 1523-1528.

Elliott, G., Rothenberg, T., J., Stock, J., H., 1996. Efficient tests for an autoregressive unit root. Econometrica 64, 813-836.

Granger, C. W. J., 1969. Investigating causal relations by econometric models and cross-spectral methods. Econometrica 37, 424—438.

Godfrey, L. G.,1978. Testing for multiplicative heteroscedasticiy. Journal of Econometrics 8, 227-236.

Hammoudeh, S., Yuan, Y., 2008. Metal volatility in presence of oil and interest rate shocks. Energy Economics 30, 606-620.

Ho, W.R.J., Wang Y.C., Liou G.J., 2010. The interactive relationship among international gold indices, gold futures and the overall economy. African Journal of Business Management 4, 1903-1915.

Jarque, C. M., Bera, A. K., 1980. Efficient tests for normality, homoscedasticity and serial independence of regression residuals. Economics Letters 6, 255-259.

Koop, G., Pesaran, M. H., Potter, S. M., 1996. Impulse response analysis in nonlinear multivariate models. Journal of Econometrics 74, 119-147.

Kwiatkowski, D., Philips, P.C.B., Schmidt, P., Shin, Y., 1992. Testing the null hypothesis of stationary against the alternative unit root test. Journal of Econometrics 54, 159-178.

Lescaroux, F., 2009. On the excess co-movement of commodity prices—A note about the role of fundamental factors in short-run dynamics. Energy Policy 37, 3906-3913.

Narayan, P.K., Narayan, S., Zheng, X., 2010. Gold and oil futures markets: Are markets efficient?. Applied Energy 87, 3299-3303.

Ng, S., Perron, P., 2001. Lag length selection and the construction of unit root tests with good size and power. Econometrica 69, 1519-1554.

Pesaran, M.H., Shin, Y., 1998. Generalized impulse response analysis in linear multivariate models. Economics Letters 58, 17-29.

Philips, P.C.B., Perron, P., 1988. Testing for a unit root in time series regressions. Biometrica 75, 335-346.

Pindyck, R., Rotemberg, J., 1990. The excess co-movement of commodity prices. Economic Journal 100, 1173-1189.

Ramsey, J. B., 1969. Tests for Specification Errors in Classical Linear Least Squares Regression Analysis. Journal of the Royal Statistical Society 31, 350-371.

Roberts, M.C., 2009. Duration and characteristics of metal price cycles. Resources Policy 34, 87-102

Sari, R., Hammoudeh S., Ewing, B.T., 2007. Dynamic relationships between oil and metal commodity futures prices. Geopolitics of Energy 29, 2-13.

Schwert, W. C., 1989. Business cycles, financial crises and stock volatility, Carnegie-Rochester Conference Series on Public Policy 31, 83-125.

Sims, C., 1972. Money, income and causality. American Economic Review 62, 540-552.

Soytas, U., Oran, A., 2011. Volatility spillover from world oil spot markets to aggregate and electricity stock index returns in Turkey. Applied Energy 88, 354-360.

Toda, H. Y., Phillips P. C. B., 1993. Vector Autoregression and Causality. Econometrica 61, 1376-1393.

Toda, H.Y., Yamamoto, T., 1995. Statistical inference in vector autoregression with possibly integrated processes. Journal of Econometrics 66, 225-250.

White, H., 1980. A heteroscedasticity consistent covariance matrix estimator and a direct test for heteroscedasticiy. Econometrica 48, 817-838.

Zhang, Y.J., Wei, Y.M., 2010. The crude oil market and the gold market: Evidence for cointegration, causality and price discovery. Resources Policy 35, 168-177.