



## TESTING THE RELATIONSHIPS BETWEEN ENERGY PRICES AND THE BORSA İSTANBUL INDICES\*

### ENERJİ FİYATLARI İLE BORSA İSTANBUL ENDEKSLERİ ARASINDAKİ İLİŞKİLERİN TEST EDİLMESİ

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**Makale Türü** Article Type  
Araştırma Makalesi Research Article

**Başvuru Tarihi** Application Date  
05.11.2020 11.05.2020

**Yayına Kabul Tarihi** Admission Date  
11.02.2021 02.11.2021

**DOI**  
<https://doi.org/10.30798/makuiibf.821611>

\* This study has been produced from master thesis of first author entitled "Investigation the relationship between energy prices and Borsa İstanbul sub-indices".

#### Abstract

Oil and natural gas, which are the most used energy sources, are consumed as raw materials in many fields. The development of technology and population increase makes these energy sources important for financial markets and the overall economy. Turkey, energy importing and developing country, maybe influenced intensely by changes in energy prices. In this study, long-term and short-term relationships between energy prices and Borsa İstanbul indices using daily data between 01.01.2007-31.10.2017 were examined by Johansen cointegration, vector autoregression (VAR), Granger causality tests, and impulse-response functions. The long-term relationship between energy prices and Borsa İstanbul indices was not found. On the other hand, it was concluded that energy prices positively impacted Borsa İstanbul indices in the short-term. Furthermore, oil prices Granger cause natural gas prices, Food Beverage, and Chemical Petrol Plastic Indices.

**Keywords:** Energy Prices, Borsa İstanbul, Sector Indices.

#### Öz

Enerji kaynakları arasında en çok kullanılan petrol ve doğal gaz birçok alanda ham madde olarak tüketilmektedir. Teknolojinin gelişmesi ve artan nüfus, bu enerji kaynaklarını finansal piyasalar ve genel ekonomi için önemli kılmaktadır. Enerji ithal eden ve gelişmekte olan bir ülke olarak Türkiye enerji fiyatlarındaki değişimlerden aşırı derecede etkilenebilir. Bu çalışmada, 01.01.2007-31.10.2017 tarihleri arasındaki günlük veriler kullanılarak enerji fiyatları ile Borsa İstanbul endeksleri arasındaki uzun ve kısa vadeli ilişkiler, Johansen eşbütünleşme, vektör otoregresyon (VAR), Granger nedensellik testleri ve etki-tepki fonksiyonları ile incelenmiştir. Enerji fiyatları ile Borsa İstanbul endeksleri arasında uzun vadeli ilişki bulunamamıştır. Diğer taraftan, kısa vadede enerji fiyatlarının Borsa İstanbul endekslerini pozitif yönde etkilediği sonucuna varılmıştır. Ayrıca petrol fiyatlarının doğal gaz, Gıda İçecek Endeksi ve Kimya Petrol Plastik Endeksinin Granger nedeni olduğu tespit edilmiştir.

**Anahtar Kelimeler:** Enerji Fiyatları, Borsa İstanbul, Sektör Endeksleri.

## GENİŞLETİLMİŞ ÖZET

### Çalışmanın Amacı

Bu çalışmada; petrol ve doğal gaz fiyatları ile Borsa İstanbul endeksleri arasındaki uzun ve kısa dönemli ilişkilerin test edilmesi amaçlanmıştır.

### Araştırma Soruları

Çalışma kapsamında ele alınan araştırma soruları şu şekildedir: Enerji fiyatları ile Borsa İstanbul endeksleri arasında uzun dönemli ilişki var mıdır? Enerji fiyatları ile Borsa İstanbul endeksleri arasında kısa dönemli ilişki var mıdır? İlişkinin yönü nedir? Enerji fiyatları Borsa İstanbul endekslerinin Granger nedeni midir? Enerji fiyatlarının etkisinin boyutu ve süresi nedir?

### Literatür Araştırması

Petrol ve doğal gaz fiyatları ile menkul kıymet borsaları ve ülke ekonomileri arasındaki ilişkiyi inceleyen birçok çalışma mevcuttur. Ham madde olarak kullanılan petrol ve doğal gaz ülkeler için büyük öneme sahip olduğundan araştırmacıların ilgisini çekmiştir. Yapılan araştırmalar incelendiğinde enerji fiyatlarının borsalar ve ülke ekonomileri için hem olumlu hem de olumsuz sonuçları olduğunu göstermektedir. Enerji fiyatlarının ülke ekonomilerine etkisi, ülkenin net enerji ithalatçısı ya da net enerji ihracatçısı olmasına ve enerji fiyatlarında meydana gelen değişimlerin enerji arzından veya enerji talebinden olmasına bağlı olarak değişiklik göstermektedir.

### Yöntem

Çalışmada zaman serisi kullanılmış olup zaman serilerinde incelenmesi gereken durağanlık test edilmiştir. Verilerin seviyede durağan olmadığı gözlemlenmiştir. Bu durum sahte regresyona neden olacağı için verileri durağan hale getirebilmek için verilerin birinci farkı alınmıştır. Bu aşamada tüm veriler durağan olmuş ve test edilebilir hale gelmiştir. Johansen eşbütünleşme testi uzun dönemli ilişkinin varlığını test etmek için uygulanmış ancak veriler arasında uzun dönemli ilişki bulunamamıştır. Kısa dönemli ilişkiyi test edebilmek için VAR (Vector Autoregression) yöntemi uygulanmıştır. Bu aşamadan sonra Granger nedensellik testi veriler arasında nedensellik ilişkisinin var olup olmadığını test etmek için uygulanmıştır. Son aşamada ise etki-tepki fonksiyonları, enerji fiyatlarına uygulanan şokların Borsa İstanbul endekslerine etkisinin büyüklüğünü, etkinin kaç gün boyunca devam ettiğini görebilmek için uygulanmıştır.

### Sonuç ve Değerlendirme

Enerji fiyatları ile Borsa İstanbul sektör endekslerinin incelendiği bu çalışmada, değişkenler arasında uzun dönemli ilişki bulunamamıştır. Kısa dönemli ilişki incelendiğinde ise petrol fiyatları ile Gıda İçecek, Kimya Petrol Plastik, Sınai ve Menkul Kıymet Yatırım Ortaklığı Endeksleri arasında; doğal gaz fiyatları ile Banka, Mali, Bist Tüm, Ulaştırma endeksleri arasında ilişki olduğu sonucuna ulaşılmıştır. Diğer taraftan Granger nedensellik analizi sonuçları, iki yönlü nedenselliğin olmadığı, yalnızca tek yönlü nedenselliğin olduğu; petrolün doğal gaz Kimya Petrol Plastik ve Gıda İçecek Endekslerinin Granger nedeni olduğu sonucunu ortaya koymuştur. Doğal gazdan endekslere doğru bir

Granger nedenselliğın olmadığı sonucuna ulaşılmıştır. Etki-tepki fonksiyonları ise petrol ve doğal gazın Borsa İstanbul endekslerini çoğunlukla pozitif etkilediğini ileri sürmektedir. Doğal gazın negatif etkisi, petrolün negatif etkisine kıyasla daha fazladır. Enerji fiyatlarının Borsa İstanbul endekslerine etkisi genellikle kısa sürmüş, etki üç ya da dört günde sönümlenmiştir. Sonuç olarak, Türkiye'de yatırım yapmak isteyen yatırımcıların enerji fiyatlarında meydana gelen artışlarda (azalışlarda) hisse senetlerinde ya da endekslerde uzun (kısa) pozisyonlarını korumasının ya da yeni pozisyon almasının (pozisyonlarını kapatması) pozitif getiri ile sonuçlanabileceği düşünülmektedir.

## **1. INTRODUCTION**

The development of technology and increment in needs associated with increasing population raises the energy demand. A limited quantity of energy sources in nature makes it very important for countries using these resources as a raw material. Oil, one of the most used energy sources, is exhaustible and constitutes a large part of the world's energy consumption. Furthermore, oil which is used as a raw material on the production of different materials like asphalt, deodorant, carpet, shoe, aspirin, sunglasses, unbreakable glass, fertilizer, plastic, and shampoo is made use of fuel for transportation and heating. Also, oil is a vital investment tool in financial markets because it is bought and sold through derivatives. Changes in the supply and demand for oil-based financial instruments may have an indirect effect on oil prices. Changes in the price of oil and its derivatives directly or indirectly impact almost all areas. However, this effect is expected because firms using oil as raw material or trading oil may be influenced significantly. Thus, changes in oil prices might directly influence firms' input costs; in this case, these changes could impact the firm's stock prices.

Natural gas used as a raw material in various fields grows in importance as it has lower carbon emission than other fossil fuels. Furthermore, natural gas' usage areas such as heating, electricity production, transportation expands. In some countries like Turkey, as it is a necessary resource for electricity production, natural gas and electricity should not be considered independently.

The impact of energy prices on national economies and financial markets depends on whether the country is an energy importer or energy exporter. Countries importing a vast majority of energy (such as; natural gas and oil) can be much more affected by changes in energy prices. An increase in energy prices harms energy importing countries while falling energy prices can create problems for energy exporters.

We can say that fossil fuels provide about 80% of the world's energy needs. Since fossil energy resources are limited and progressively consumed and countries that possess these resources control the production (supply), energy prices are continually fluctuating. These price fluctuations are crucial for the industrial sector, which uses more than half of this energy. Thus, energy prices are likely to affect the stocks and also the profitability of the industrial markets (Yıldırım et al., 2014). The oil, one of the leading fossil energy resources, together with capital and labor are considered a vital component in producing most goods and services. Therefore, changes in such significant input costs can make considerable differences in the cash flows of firms. In the absence of full substitution effect among production factors, elevated oil prices are expected to push up the production costs. Hence, high production costs lessen cash flows, which may cause stocks to depreciate.

Rising oil prices have an impact on the discount rates used in asset pricing models. High oil prices can often be seen as an indicator of inflationary pressures that central banks can control by

increasing interest rates. High-interest rates make bonds more attractive than stocks, and this may cause the price of shares to fall. The impact of the rise in oil prices may vary depending on whether the company is producing or consuming oil (Basher and Sadorsky 2006). If oil plays a leading role in an economy, changes in oil prices may be associated with stocks changes.

Consequently, it is concluded that oil prices might affect real economic activity and the profits of a company that has direct or indirect transaction costs. So, escalated oil prices lead to a decrease in expected returns, and thus a decline in stock prices (Maghyereh, 2006). According to Basher and Sadorsky (2006), the increment in oil demand brings about a surge in oil prices. High oil prices and consumers' tending to alternative energy resources could act like inflation tax on producers and consumers with increasing production costs in non-oil producers. As long as these effects reflected on consumers, it is possible to reduce returns and dividends, which are the main determinants of stock prices.

Oil shocks have an impact on stock returns by affecting expected cash flows and discount rates. Consequently, company cash flows are affected by the fact that oil is input in production, and oil prices affect production demand. Moreover, by affecting the expected inflation and the interest rate, oil prices cause a change in discount rates for cash flows, so that this change should influence firm value. High volatility in oil prices affects firm value through increasing uncertainty about firms and the overall economy (Ratti and Hasan 2013).

Investor's trading in derivative markets may think that oil prices should raise, and thus they probably take a long position in oil prices. When oil prices rise, investors who earn money from the long position are unlikely to know whether the rise in oil prices might continue, and therefore they can invest in stocks as they do not want to take more risks. This process may lead to an increment in stock prices. However, investors may take a short position in oil prices if they think that oil prices have risen and may start to fall, resulting in lower prices.

According to Kilian and Park (2009), changes in stock returns vary depending on the cause of oil price shocks. A rise in demand for crude oil due to reasons such as an increment in precautionary demand because of concerns about cuts in oil supply in the coming years might hurt stocks as it is likely to be an oil shock. However, shocks in crude oil production have no significant effect on stock returns. High oil prices resulting from unexpected global economic growth is likely to have a lasting impact on stocks for one year.

Yıldırım (2016) stated that the reason is essential in changing oil prices. The study noted that the economy would develop, production would rise, the demand for investments and stock markets would ascend when oil price increase would be driven by demand. This demand for stock markets could boost stock prices. However, that oil price is driven by supply may cause expected cash flow to decline, resulting in a drop in stock prices.

Stocks reflect the best estimate of the company's future profitability. Therefore, the impact of oil shocks on the stock market is a significant and useful determinant of its economic effects. Since asset prices are the present value of firms' future net earnings, the impact of current and future oil shocks on stocks and returns should be eliminated without anticipating these effects (Jones et al., 2004).

Considering the literature studies, we can say that energy prices can influence the general economy and countries' stock markets. The studies on how the energy price affects the economy and the financial markets are given under the literature topic. In light of those studies, it can be said that energy prices affect countries in various ways. The degree of affection can depend on different factors which diverge on whether the countries are energy importers, whether the countries are developed, developing or under development, and capacity to use energy sources. Turkey case is studied in this study. As is known, Turkey is the emerging and the oil and natural gas importer country because of the lack of natural sources. Thus, it is assumed that energy prices (oil and natural gas) affect the financial markets more than developed countries.

Moreover, energy prices affect most of the sectors directly in some countries, especially energy importer countries. In this way, the energy prices affect the stock's prices directly or indirectly. Volatility in energy prices may affect the costs of firms. Therefore, stock prices fluctuate due to changes in profit and investor tendency. As a result, it becomes more of an issue to study energy price effects on stocks. When the literature is searched, few studies examine energy prices and Borsa Istanbul indices. Most of the literature analyzes the relationship between oil prices and macroeconomic variables or only BIST100 as a proxy of the stock market. Not only oil but also natural gas prices may have significant effect on stock markets since natural gas is used in various areas, as mentioned above. When we take the case of oil and natural gas, this effect may vary across Borsa Istanbul indices as each indice uses these energy resources for different purposes. For this reason, in this study, long-term and short-term relationships between energy (oil and natural gas) prices and 17 Borsa Istanbul indices were investigated.

## **2. THE IMPORTANCE OF ENERGY PRICES FOR ECONOMY**

Rising energy prices are indicative of energy shortages. Price increases in energy, which is the essential input to production, reduce input, leading to decreased output and labor productivity. The decline in productivity reduces the real wage growth and boosts the unemployment rate. If consumers expect this rise to be temporary or short-term effects on production to be higher than long-term effects, they presumably save less and borrow more, and thus the real interest rate should surge. Falling output and high-interest rates reduce the demand for real cash balance and raise inflation. Therefore, high oil prices lead to a decrease in real GDP, increase real interest rates, and inflation. Besides, purchasing power and consumer demand drop in oil-importing countries. Falling consumer demand increases the supply of savings, which brings down the interest rates. Low-interest rates can stimulate investments, partly offset loss consumption expenditures, and somewhat increase aggregate demand. As a

consequence, it is possible to decline aggregate demand that could cause a drop in inflation. According to economic theory, real prices go down until aggregate demand and GDP return to pre-price shocks (Brown et al., 2003).

Oil is an input used in the production of goods and services in many countries. In addition to industrial areas such as chemical and heavy industry, oil usage in areas like transportation and heating makes the oil very important. Therefore, it is predicted that a sudden and high rise in oil prices due to the supply cuts can have far-reaching impacts on national economies. Moreover, two oil shocks in 1973-1974 and 1979-1980 were faced with high inflation and unemployment rates in the United States. It was observed that the inflation rate in 1974 was 12.3%, and the unemployment rate was 5.6%, with an increment in inflation. During the second oil shock in 1980, the inflation rate rose to 13.3%, and while the unemployment rate rose to 7.1% (Doroodian and Boyd 2003).

Çelik and Çetin (2007) claim a relationship between oil prices and indicators with a significant share in macroeconomics such as growth, inflation, and employment. According to the authors, high oil prices negatively affect production, especially in the manufacturing industry resulting in employment decreases. Furthermore, high oil prices raise inflation rates, and consequently, economic growth is adversely affected.

According to Firuzan (2010), a change in oil prices has a knock-on effect on both the country and the world economy, since many sectors are directly or indirectly dependent on oil. This effect can easily be seen on inflation, unemployment, growth, and other macroeconomic variables.

Bayraç (2005) states that oil prices are of great importance in countries' economic indicators. Therefore, the longer the enhancement in oil prices, the longer the impact on macroeconomics should be. The author claims that the magnitude of the rise in oil prices on the economy generally varies according to the share of oil cost in national income, consumer saving rate, and the use of alternative energy sources. An uptrend in oil prices leads to an increase in exports, raising national income for oil-exporting countries. However, due to the recession and lack of demand in the oil-importing countries, revenue from oil sales may decline in oil-exporting countries.

On the other hand, for oil-importing countries, an increment in oil prices causes an escalation in inflation, input costs, and shrinkage in demand for non-oil products. As a result, the government cuts spending and so decreases tax revenues. Accordingly, the budget deficit expands. Thus, market interest rates boost, and the nominal wage level remains under pressure, in which case this can lead to an upsurge in unemployment (Bayraç, 2005). As a result of boosting market interest rates, interest rates of government bonds, and treasury bills rise. In this case, investors sell stocks and start to buy government bonds and treasury bills.

In addition to these effects, high oil prices are likely to impact the trade balance and exchange rates. As a result of the increment in inflation, the balance of payments of oil-importing countries deteriorates, imported goods may become more expensive. In contrast, exported goods should become more worthless, and thus national income is possible to decrease.

According to Nandha and Faff (2008), high oil prices cause wealth to be transferred from oil-importing countries to oil-exporting countries. Furthermore, the authors state that high oil prices would increase the cost of production of goods and services, which would impact inflation, consumer confidence, and financial markets.

Volatility in energy prices affects firms, consumers, and investors in various ways. Rising energy prices cause to ascend costs for firms that use oil and natural gas as raw material. Increasing costs forces companies to find resources to cover these costs (unless product prices raised). As a result of the decrease in productivity, profit margin, and cash flow, the firm could fall, and thus profit may fall. The effect of oil prices on consumers might be through buying behavior. Upsurges in oil prices possibly cause gasoline prices to soar. In this case, consumers might avoid buying luxury vehicles and prefer to use public transport. Accordingly, a decrease in fuel oil and car sales may occur. Moreover, investors who review their investments due to an increased risk of rising oil prices, possibly encounter an increase in investment costs or hesitate to invest.

Hamilton (2003) says that the purchase of a small car or a large SUV varies according to the expectation of gasoline prices. If there is uncertainty about gasoline prices, a new vehicle's purchase may be postponed until the price level informs potential buyers. The author also states that oil shocks might impact the purchase of expensive products and investment goods. This situation should affect short-run economic performance. The decline in oil supply raises concern about future oil prices, which temporarily reduces the purchase of cars, households, appliances, and investment goods.

Lee and Ni (2002) claim that an upsurge of oil prices in 1973, 1978, and 1980-1981 gave rise to a downfall in many industries' outputs except electronic machines, office machines, and computers. In the 1973-1975 and 1978-1980 periods, the production of oil intensive industries decreased by 10% in oil refining and by 19% in industrial chemicals. During these periods, the automobile industry, among all industries, had the most significant decline in its production by more than 30%.

### **3. RELATIONSHIPS BETWEEN ENERGY PRICES AND STOCK PRICES**

Many studies have been conducted to find a relationship between energy prices, especially oil and natural gas with stocks, and macroeconomic indicators in the literature. Due to the large share of these natural resources used as raw materials in production and consumption, the changes in these natural resources' prices and the impact of these changes on national economies have been of



considerable interest to researchers. As a consequence of this research, different findings have been obtained. It has been found that energy prices made both positive and negative contributions to the real economy and financial markets. The reason for these different effects may vary depending on whether the countries are net oil exporters or importers or changes in energy prices stem from supply or demand. Table 1 shows a summary of the literature.

**Table 1.** Studies on the Effect of Energy Prices on Stock Prices

Author(s)	Variables	Methods	Countries	Time Period	Results of the Study
Studies Examining Developed Countries					
Huang, Masulis, and Stoll (1996)	Energy prices, Stock returns, Interest rates	VAR	USA	1979-1990	A causality relationship between oil prices and oil companies was detected, but no association between oil prices and stock exchange indices.
Faff and Brailsford (1999)	Energy prices, Stock returns	Two-factor arbitrage pricing theory	Australia	1983-1996	They find a positive impact of oil on oil and natural gas and diversified resources industries while negatively impacting paper and packaging, transportation and banking industries.
Huang, Hwang and Peng (2005)	Oil prices, Industrial production, Interest rates, Real stock returns	Multivariate threshold model	USA, Canada, Japan	1970-2002	They show that oil price volatility has more power on explaining stock returns than industrial output.
Henriques and Sadorsky (2008)	Oil prices, Alternative energy and technology stock prices, Inflation rates	VAR, Granger causality, Impulse-response functions	USA	2001-2007	The authors find that oil prices and technology companies explain alternative energy stock prices.
Apergis and Miller (2009)	Oil price shocks, Real stock returns	VAR, Variance decomposition, Johansen and Juselius cointegration	Australia, Canada, France, Germany, Italy, Japan, UK, USA	1981-2007	Oil supply shocks, total global demand shocks, and oil market-specific demand shocks have been found to have a significant impact on explaining stock returns for most countries.
Malik and Ewing (2009)	Oil prices, Sector indexes	GARCH	USA	1992-2008	They find significant volatility transmissions between oil and some indexes and a negative relationship in oil and technology, health care and consumer services.
Narayan and Sharma (2011)	Oil prices, Sector indexes Company returns	GARCH	USA	2000-2008	They observe that oil price increases raise energy and transportation sector firms, while decrease 12 sector firms.
Chortareas and Noikokyris (2014)	Oil shocks, Stock prices, Dividend yield	VAR	USA	1981-2006	A positive relationship was found between the change in oil prices and dividend yield. It was stated that the continuity of this relationship was due to the increase in oil prices.
Bastianin, Conti and Manera (2016)	Oil prices, Stocks	Structural VAR, Impulse-response functions, Variance decomposition	G-7 countries	1973-2015	It was seen that stock market volatility did not react to oil supply shocks. But demand shocks had a significant effect on the volatility of stock markets.
Jammazi, Ferrer, Jareño and Shahzad (2017)	Oil prices, Stock markets	Time-varying Granger causality	France, Germany, Italy, Spain, UK, USA	1993-2014	They have found a bidirectional causal relationship between oil prices and stock market returns of six oil-importing countries.
Bagirov and Mateus (2019)	Oil prices, the Dow Jones Stoxx Europe 600 index, sector indices and firms	VAR, Impulse-response functions, VAR-GARCH, GMM model	18 European countries	2006-2015	Results demonstrate that reactions of stocks to oil price changes differ in sectors. Oil prices have positive and significant impacts on listed oil and gas firms in Western Europe.
Sakaki (2019)	Oil prices, SandP 500 sector indices	VAR, Impulse-response functions,	USA	1990-2015	It was found that volatility in oil prices negatively affected all indices while oil production rise in the US had a positive impact on stock market.

		Variance decomposition			
Thorbecke (2019)	Oil prices, Stock market, Industry stocks, Effective exchange rate, VIX index	Regression, VAR	USA	1990-2018	Oil supply shocks are found to have a negative impact on stock returns between 1990-2007 while the effect is positive between 2010-2018.
Studies Examining Emerging Countries					
Maghyreh (2006)	Oil prices, Stock returns	VAR, Variance decomposition, Impulse response functions	22 emerging countries	1998-2004	It was found that oil shocks did not significantly affect stock market indices in emerging countries. Furthermore, stock returns did not react rationally to shocks in the oil market.
Çelik and Çetin (2007)	Oil prices, Macroeconomic variables, Stock market	VAR, Impulse-responses, Variance decomposition	Turkey	1997-2006	It was concluded that ISE-100 was positively affected by oil price shocks.
Cong, Wei, Jiao and Fan (2008)	Oil prices, Chinese stock markets	Multivariate VAR	China	1996-2007	According to the analysis result, oil price shocks do not have a significant effect on stock returns but production and oil companies.
Eryiğit (2009)	Oil prices, Stock market indices	Regression	Turkey	2000-2008	Significant positive effects of oil on Electricity, Wholesale and Retail Trade, Insurance, Holding, Investment, Wood, paper and printing, Basic Metal, Metal Products and Machinery, and Non-Metal and Mineral Products have been found.
Güler, Tuğ and Orçun (2010)	Oil prices, Energy stock prices, ISE electricity index	Johansen cointegration, Granger causality	Turkey	2000-2009	They find the comovement of oil, energy stock prices, electricity index and causality between oil prices and electricity index.
Narayan and Narayan (2010)	Oil prices, Exchange rates, Stocks	Johansen cointegration, VECM	Vietnam	2000-2008	A relationship was found between oil prices, nominal exchange rates, and stock prices. Moreover, oil prices significantly and positively affected stock prices.
Ono (2011)	Oil prices, Real stock returns, Industrial production	VAR, Impulse-response functions, Variance decomposition	BRIC countries	1999-2009	According to the results, oil prices have significantly positive effect on real stock returns of China, India and Russia.
Toraman, Başarır and Bayramoğlu (2011)	Oil prices, ISE indexes	VECM, Granger causality, Impulse-response functions	Turkey	2009-2011	Results show that oil prices explain 16.40% of ISE 100. The most influenced index by oil prices is industrial, while the least influenced index is technology.
Berk and Aydoğan (2012)	Oil prices, ISE-100 CBOE volatility index	Structural VAR, VECM, ARCH, GARCH	Turkey	1990-2011	They find that changes in oil prices significantly affect ISE-100 between only 2008-2011.
Ünlü and Topçu (2012)	Oil prices, ISE-100	Johansen cointegration, Granger causality, VECM	Turkey	1990-2011	They found causality from oil to the stock market and positive effect of oil on the stock market.
Acaravcı and Reyhanoğlu (2013)	Oil and natural gas prices, ISE-100, Macroeconomic variables	Johansen cointegration, VECM, Impulse-response functions	Turkey	2001-2010	Results demonstrate that oil price shocks negatively impact ISE-100 while natural gas price shocks positively affect ISE-100.
Öztürk, Gümüş, Taşkın and Çağlı (2013)	Oil and natural gas prices, ISE manufacturing index, ISE chemical petrol plastic index	Engle-Granger and Gregory-Hansen cointegration tests	Turkey	1997-2009	Results show a cointegrated positive relation between oil prices, manufacturing and chemical petrol plastic indexes.
Şener, Yılancı and Tıraşoğlu (2013)	Oil prices, Stock returns	Hatemi-J and Irandoust cointegration test	Turkey	2002-2012	They find that rise in oil prices lowers stock prices, and there is a long-run relationship between oil prices and stock returns.
Yıldırım, Bayar and Kaya (2014)	Oil and natural gas prices,	Johansen-Juselius cointegration, Granger causality,	Turkey	1991-2013	They find long-run relation in three variables; oil prices to industrial index and the positive

	BIST industrial index	Regression			effect of oil and natural gas prices on the industrial index.
Abdioğlu and Değirmenci (2016)	Oil prices, Interest rate, Economic activity, Real stock returns	VAR, GARCH, Impulse-resonse functions, Variance decomposition, Granger causality	Turkey	1994-2013	They have found bi-directional causality between real oil prices and real stock returns and positive response of real stock returns to real oil prices.
Eyüboğlu and Eyüboğlu (2016)	Oil and natural gas prices, BIST industrial sub-indexes	Johansen cointegration, Granger causality, VECM	Turkey	2005-2015	Long-run relationship between oil, natural gas prices and sub-indexes and causality from oil to some sub-indexes is found.
Hu, Liu, Pan, Chen and Xia (2018)	Oil prices, Stock market	Structural VAR, Impulse-response functions, NARDL model	China	2004-2016	They reveal that oil demand shocks significantly negatively affect stock markets of China in short and long-run.
Tiwari, Jena, Mitra and Yoon (2018)	Oil prices, 13 non-oil and gas sector indices, Bombay Stock Exchange 30 shares sensitive index	Quantile regression, Granger causality	India	1999-2016	They find that oil price drops increase energy, material and IT sectors and that oil price change negatively affects the health sector in a bull market.
Vardar, Kurt-Gumus and Delice (2018)	Oil prices, BIST sub-sector indices	Johansen-Juselius cointegration, Granger causality, Impulse-response functions, Variance decomposition	Turkey	1997-2016	Cointegration between oil prices and indices of chemical petrol plastic, information technology, metal products machinery, SME industrial and insurance, and Granger causality from oil to some indices was revealed.
Waheed, Wei, Sarwar and Lv (2018)	Oil prices, Stock returns, Industry returns	GMM	Pakistan	1998-2014	Results show that oil price increases have a positive effect on stock returns.
Yıldırım, Erdoğan and Çevik (2018)	Oil prices, Stock market	Markov Switching-VAR model, Granger causality, Impulse-response functions	BRICS countries	1995-2016	Oil price shocks have a positive and significant effect on stock markets of all countries, excluding China.
Hamdi, Aloui, Alqahtani and Tiwari (2019)	Oil prices, Sectoral indexes	Quantile regression, Granger causality	GCC countries	2006-2017	Results show that all indexes are dependent on oil price volatility which positively affects energy, industrial, financial, basic materials, insurance, bank, oil/gas and transportation indexes in a high market.
Ordu-Akkaya and Sarı (2019)	Oil prices, BIST100 BIST banking index	Toda-Yamamoto causality test, Impulse-response functions	Turkey	2004-2016	They found Granger causality from oil to BIST100 and banking index which were both positively affected by oil price shocks.
Cevik, Cevik and Dibooglu (2020)	Oil prices, BIST100	EGARCH	Turkey	1990-2017	They find that oil prices have significantly affect BIST100 returns.
Polat (2020)	Oil prices and oil production, Stock market, The Kilian index	TVP-VAR, Impulse-response functions	Turkey	1988-2018	It is concluded that a positive oil price shock initially has a negative impact on BIST, while the impact turns into positive and then disappear in the long-run.

#### 4. DATA

Brent crude oil, natural gas, and Borsa Istanbul sector indices were analyzed between 01.01.2007-31.10.2017 using daily data in this study. Data for Borsa Istanbul indices data were obtained from <https://finance.google.com> website, and crude oil and natural gas data were obtained from <https://www.eia.gov> website. Descriptive statistics of raw data of oil, natural gas and 17 Borsa Istanbul indices are presented in the table below.

**Table 2.** Descriptive Statistics

Codes	Variables	Mean	Standard deviation	Minimum	Maximum	Skewness	Kurtosis
<b>Oil</b>	Brent Crude Oil	81.112	27.553	26.010	143.950	-0.005	1.648
<b>NGas</b>	Natural Gas	4.299	2.070	1.490	13.310	1.733	6.255
<b>XBANK</b>	BIST BANKS	124088.704	30883.378	42089.760	199253.530	-0.502	2.998
<b>XBLSM</b>	BIST INF. TECHNOLOGY	12153.526	6405.489	2343.620	29447.400	0.717	2.772
<b>XELKT</b>	BIST ELECTRICITY	2968.113	778.880	1195.200	5129.280	0.625	2.979
<b>XGIDA</b>	BIST FOOD BEVERAGE	90873.294	33314.933	30903.400	144236.120	-0.330	1.630
<b>XHOLD</b>	BIST HOLDING AND INVESTMENT	50510.069	15829.119	14309.420	87480.400	-0.097	2.528
<b>XKAGT</b>	BIST WOOD PAPER PRINTING	34953.935	8915.730	13445.990	60957.060	-0.036	3.357
<b>XKMYA</b>	BIST CHEMICAL PETROL PLASTIC	44864.519	20657.356	11448.270	118153.690	1.066	4.120
<b>XMANA</b>	BIST BASIC METAL	79440.283	39036.609	23482.400	224230.800	1.265	4.440
<b>XMESY</b>	BIST METAL PRODUCTS MACH.	68344.322	38608.752	10060.330	160362.210	0.594	2.290
<b>XU100</b>	BIST 100	64751.266	18829.939	21228.270	110423.110	-0.125	2.601
<b>XUHIZ</b>	BIST SERVICES	43560.934	12939.325	17935.930	74381.170	-0.035	1.926
<b>XULAS</b>	BIST TRANSPORTATION	46979.848	28472.402	5560.090	108834.640	0.223	1.710
<b>XUMAL</b>	BIST FINANCIALS	90444.692	23517.562	29355.580	140622.300	-0.502	2.904
<b>XUSIN</b>	BIST INDUSTRIALS	58560.092	22797.210	16845.780	125433.370	0.434	2.838
<b>XUTEK</b>	BIST TECHNOLOGY	30559.192	25007.828	4045.840	137884.710	1.664	5.735
<b>XUTUM</b>	BIST ALL SHARES	64644.295	19236.036	21258.460	111304.380	-0.094	2.549
<b>XYORT</b>	BIST INVESTMENT TRUSTS	19726.991	4584.598	7130.460	30035.500	-0.806	3.218

Table 2 shows that the average oil price is 81.112 USD/barrel, the minimum value is 26.010 USD, the maximum value is 143.950 USD, and the standard deviation is 27.553 USD. The skewness of oil is -0.0005 – it is very close to the 0. That is, its distribution is a normal distribution. Skewness is a measure of symmetry, and the kurtosis is the measure of whether the data are heavily tailed or light-tailed relative to the normal distribution. If the data sets have high kurtosis value, it tends to have heavy tails and if the kurtosis value is low, it tends to have light tails. The skewness value for a normal distribution is near zero. The negative skewness value indicates that the data skewed to the left and the positive value indicates skewed to the right. The natural gas average price is 4.299 USD, the minimum value is 1.490 USD, the maximum value is 13.310 USD, and the standard deviation of natural gas is 2.070 USD. The skewness (1.733) and kurtosis (6.255) values show that natural gas prices are not normally distributed. For all sample, the skewness values change among -0.005 and 1.733, and the kurtosis values are changing among 1.630 and 6.255. BIST 100 index value change among 21228.270 and 110423.110 for the study time frames. Moreover, the average value and the standard deviation of BIST100 is 64751.266 and 18829.939 respectively. These values show the volatility of Borsa Istanbul for the studied time frame. Simultaneously, the skewness of BIST 100 is so close to 0 (-0.125) and the kurtosis of BIST 100 is 2.601. According to the skewness and the kurtosis values, we can say BIST100 symmetrically distributed.

## 5. ANALYSIS AND RESULTS

### 5.1. Unit Root Tests

In the case of working with time series, the stability of the data should be tested via unit root tests. In this study, ADF (Augmented Dickey-Fuller) and PP (Phillips-Perron) unit root tests were used. While the model's critical value with the trend is -3.960 for 1% significance level, the critical value without trend is -3.430. AIC (Akaike Information Criterion), HQIC (Hannan-Quinn Information Criterion), and SBIC (Schwarz Bayesian Information Criterion) were taken into consideration in selecting the lag length of the variables. The null hypothesis states that the model has a unit root, whereas the alternative hypothesis states that the model does not have a unit root; in other words, it is stationary.

Table 3 shows the t-statistic values and the lag lengths of models with and without trend at level – I(0) obtained by ADF and PP unit root tests. According to test results, the null hypothesis could not be rejected for all variables meaning that the data were not stationary at both with and without trend model; that is to say, they had a unit root.

**Table 3.** ADF and PP Results - I(0)

Variables	ADF		PP		Lag Length
	No Trend t-statistics	Trend t-statistics	No Trend t-statistics	Trend t-statistics	
<b>Oil</b>	-1.707	-2.155	-1.680	-2.131	1
<b>NGas</b>	-2.176	-3.070	-2.326	-3.451	3
<b>XBANK</b>	-2.022	-2.599	-2.002	-2.604	1
<b>XBLSM</b>	-0.162	-1.818	-0.112	-1.888	2
<b>XELKT</b>	-2.727	-2.716	-2.445	-2.437	4
<b>XGIDA</b>	-1.425	-1.907	-1.445	-1.916	1
<b>XHOLD</b>	-1.035	-2.318	-0.948	-2.308	2
<b>XKAGT</b>	-1.128	-2.077	-1.034	-2.025	4
<b>XKMYA</b>	-0.148	-1.969	-0.155	-2.025	4
<b>XMANA</b>	-0.596	-2.114	-0.554	-2.074	2
<b>XMESY</b>	-0.217	-1.975	-0.149	-1.975	2
<b>XU100</b>	-1.179	-2.357	-1.142	-2.341	1
<b>XUHIZ</b>	-1.297	-2.835	-1.291	-2.836	1
<b>XULAS</b>	-0.927	-1.654	-0.894	-1.598	2
<b>XUMAL</b>	-1.661	-2.462	-1.625	-2.453	1
<b>XUSIN</b>	-0.374	-2.038	-0.289	-1.981	2
<b>XUTEK</b>	1.126	-1.499	1.205	-1.595	2
<b>XUTUM</b>	-1.087	-2.329	-1.048	-2.313	1
<b>XYORT</b>	-1.030	-2.052	-1.017	-2.086	1

Note: The null hypothesis for the ADF (Augmented Dickey–Fuller) is “series contain a unit root”. Null hypothesis for PP (Phillips–Perron) is “time series is integrated of order 1”. The alternative is that a stationary process generated the variable. PP uses Newey-West (1987) standard errors to

account for serial correlation, whereas the ADF test implemented in Dickey-Fuller uses additional lags of the first differenced variable.

The first difference of the data with a unit root was taken to make the data stationary, and the same tests were applied again. According to the results, the null hypothesis was rejected because of the t-statistic values of both with and without trend models. As shown in Table 4, it was lower than the critical value for all data, and it was concluded that all data were stationary, which means the data has no unit root.

**Table 4.** ADF and PP Results - I(1)

Variables	ADF		PP		Lag Length
	No Trend t-statistics	Trend t-statistics	No Trend t-statistics	Trend t-statistics	
Oil	-49.409*	-49.413*	-49.409*	-49.413*	0
NGas	-33.870*	-33.864*	-48.421*	-48.411*	2
XBANK	-51.621*	-51.612*	-51.621*	-51.612*	0
XBLSM	-36.061*	-36.071*	-47.706*	-47.714*	1
XELKT	-24.496*	-24.498*	-47.685*	-47.679*	3
XGIDA	-25.334*	-25.344*	-51.512*	-51.509*	4
XHOLD	-34.747*	-34.744*	-48.550*	-48.545*	1
XKAGT	-24.463*	-24.472*	-49.768*	-49.770*	3
XKMYA	-29.233*	-29.239*	-48.561*	-48.563*	2
XMANA	-35.442*	-35.441*	-47.964*	-47.960*	1
XMESY	-34.473*	-34.477*	-48.041*	-48.043*	1
XU100	-50.532*	-50.523*	-50.532*	-50.523*	0
XUHIZ	-51.354*	-51.345*	-51.354*	-51.345*	0
XULAS	-34.410*	-34.404*	-48.490*	-48.481*	1
XUMAL	-50.797*	-50.787*	-50.797*	-50.787*	0
XUSIN	-34.478*	-34.478*	-48.251*	-48.249*	1
XUTEK	-22.396*	-22.472*	-48.607*	-48.659*	4
XUTUM	-50.471*	-50.462*	-50.471*	-50.462*	0
XYORT	-51.442*	-51.437*	-51.442*	-51.437*	0

Note: \* shows significance level at %1.

When the data is stationary, the next step is to apply cointegration tests to see whether there is a relationship between variables or not. When there is a cointegration relationship, VECM could be applied to examine the short-term relationship. On the other hand, if there is no cointegration relationship, the VAR model is applied.

## 5.2. VAR and Causality Test

To examine relationships between energy prices (oil and natural gas) and Borsa Istanbul indices, VAR based Johansen cointegration test and VAR model should be applied. The model as follows:

$$X_{l,t} = a_0 + \sum_{i=1}^p a_{1i}X_{l,t-i} + \sum_{j=1}^p a_{2j}Oil_{l,t-j} + \sum_{k=1}^p a_{3k}NGas_{l,t-k} + \varepsilon_{lt}$$

Where  $l=1, 2, \dots, 17$  (1=XBANK, 2=XBLSM, ..., 17=XYORT) for each  $l$ ,  $p$  is maximum lag length,  $a$  are coefficients of independent variables,  $i, j$  and  $k$  are lags of independent variables,  $\varepsilon$  is the error term, Oil and NGas are oil and natural gas prices.

While the Johansen Cointegration test is applied to the series, the fact that the trace statistics are higher than the significance level allows the rejection of the null hypothesis that there is no long-term relationship between series. This section investigated the long-term relationship between oil and natural gas with each Borsa Istanbul indices. According to the results of the analysis, the null hypothesis failed to be rejected for all models. Therefore, no cointegrated relationship between oil and natural gas with Borsa Istanbul indices was found at a 1% significance level.

After no cointegrated relationship was found, the VAR test was applied at 5% significance level to test whether there was a short-term relationship in models that were not cointegrated. The null hypothesis shows that there is no short-term relationship between the variables. The results are shown in Table 5.

**Table 5. VAR Results**

	Lag length	Coefficients (z-value)			
		Dependent Variable	Oil	NGas	Constant
<b>XBANK (-1)</b>	2	-0.0108387 (-0.54)	0.0062176 (0.31)	0.0235322** (2.12)	0.0003135 (0.72)
<b>XBANK (-2)</b>		0.0034499 (0.17)	0.0007576 (0.04)	-0.014593 (-1.31)	
<b>XBLSM (-1)</b>	2	0.0737807*** (3.74)	-0.0071737 (-0.43)	-0.0006409 (-0.07)	0.0005618 (1.54)
<b>XBLSM (-2)</b>		-0.0352974* (-1.79)	0.0234919 (1.42)	-0.0161794* (-1.75)	
<b>XELKT (-1)</b>	3	0.0694777*** (3.52)	0.0179191 (0.97)	0.0077728 (0.74)	0.0002933 (0.72)
<b>XELKT (-2)</b>		-0.059692*** (-3.02)	0.0202349 (1.09)	-0.0135526 (-1.31)	
<b>XELKT (-3)</b>		0.0583903*** (2.96)	0.0250375 (1.35)	0.0146611 (1.39)	
<b>XGIDA (-1)</b>	4	-0.0116528 (-0.59)	0.0129127 (0.87)	0.0134074 (1.59)	0.0005056 (1.56)
<b>XGIDA (-2)</b>		-0.0339635* (-1.72)	0.0362875** (2.45)	0.0010177 (0.12)	
<b>XGIDA (-3)</b>		-0.0261458 (-1.33)	0.0253436* (1.71)	0.0053707 (0.64)	
<b>XGIDA (-4)</b>		-0.0745743*** (-3.79)	-0.0275543* (-1.86)	0.0135143 (1.61)	
<b>XHOLD (-1)</b>	2	0.0447854** (2.23)	0.0194552 (1.21)	0.0123815 (1.4)	0.0003281 (0.94)
<b>XHOLD (-2)</b>		0.0127333 (0.63)	0.0053442 (0.33)	-0.0011214 (-0.13)	
<b>XKAGT (-1)</b>	3	0.0257885 (1.3)	0.0080382 (0.52)	0.0024746 (0.29)	0.0002713 (0.81)
<b>XKAGT (-2)</b>		-0.007333 (-0.36)	0.0141433 (0.87)	-0.0024654 (-0.24)	

		(-0.37)	(0.92)	(-0.29)	
<b>XKAGT (-3)</b>		0.0372371* (1.88)	0.0125069 (0.81)	0.01566* (1.81)	
<b>XKMYA (-1)</b>	3	0.0372091* (1.86)	0.041861*** (2.74)	0.0131631 (1.54)	0.0006483* (1.95)
<b>XKMYA (-2)</b>		0.0384177* (1.92)	0.0227605 (1.49)	-0.0112696 (-1.34)	
<b>XKMYA (-3)</b>		-0.0441242** (-2.21)	0.0170184 (1.11)	0.0084707 (0.99)	
<b>XMANA (-1)</b>	2	0.0558753*** (2.78)	0.0370248* (1.96)	0.0104043 (1)	0.0007085* (1.73)
<b>XMANA (-2)</b>		-0.0132705 (-0.66)	0.0061741 (0.33)	-0.016483 (-1.59)	
<b>XMESY (-1)</b>	2	0.0541396*** (2.71)	0.0222902 (1.45)	0.0106186 (1.25)	0.0005756* (1.72)
<b>XMESY (-2)</b>		0.0127664 (0.64)	0.0141735 (0.92)	-0.007963 (-0.94)	
<b>XU100 (-1)</b>	2	0.0072279 (0.36)	0.0131308 (0.86)	0.0164894* (1.96)	0.000407 (1.23)
<b>XU100 (-2)</b>		0.0094103 (0.47)	0.0070371 (0.46)	-0.007558 (-0.9)	
<b>XUHIZ (-1)</b>	3	-0.0083568 (-0.42)	0.0110969 (0.88)	0.0116871 (1.64)	0.0004948* (1.8)
<b>XUHIZ (-2)</b>		-0.0144846 (-0.73)	0.0126834 (1)	-0.0010834 (-0.15)	
<b>XUHIZ (-3)</b>		-0.0055779 (-0.28)	0.0040471 (0.32)	0.0057148 (0.8)	
<b>XULAS (-1)</b>	2	0.052019*** (2.65)	0.0091845 (0.47)	0.0218825** (1.99)	0.0008079* (1.86)
<b>XULAS (-2)</b>		0.0209123 (1.07)	0.0149733 (0.76)	-0.0075987 (-0.69)	
<b>XUMAL (-1)</b>	2	0.0039973 (0.2)	0.0090923 (0.5)	0.0200178** (2.01)	0.0003217 (0.82)
<b>XUMAL (-2)</b>		0.0112622 (0.56)	-0.0000514 (0)	-0.0101509 (-1.02)	
<b>XUSIN (-1)</b>	2	0.0457661** (2.27)	0.0252169** (1.98)	0.0107011 (1.54)	0.0005155* (1.88)
<b>XUSIN (-2)</b>		0.0133588 (0.66)	0.013732 (1.08)	-0.0071025 (-1.02)	
<b>XUTEK (-1)</b>	2	0.0516087*** (2.61)	0.0018058 (0.11)	-0.0027015 (-0.31)	0.0009749*** (2.82)
<b>XUTEK (-2)</b>		-0.0162451 (-0.82)	0.0144766 (0.92)	-0.0062945 (-0.72)	
<b>XUTUM (-1)</b>	2	0.0077601 (0.39)	0.0139437 (0.94)	0.0159363** (1.97)	0.00042 (1.32)
<b>XUTUM (-2)</b>		0.0096183 (0.48)	0.006625 (0.45)	-0.0072185 (-0.89)	
<b>XYORT (-1)</b>	3	-0.0096271 (-0.48)	0.0116902 (0.9)	0.0085678 (1.16)	0.0002372 (0.83)
<b>XYORT (-2)</b>		0.0093884 (0.47)	-0.0114543 (-0.88)	-0.0038685 (-0.53)	
<b>XYORT (-3)</b>		0.0186047 (0.04)	0.0267635** (2.05)	0.0036038 (0.49)	

Note: \*\*\*, \*\* and \* denotes significance at the %1, %5 and %10 level, respectively.

Usage areas of natural gas are more comprehensive than that of petroleum. Especially for some countries – like Turkey- natural gas is the main electricity production source and used in industry or housing heating. Accordingly, it is assumed that natural gas affects various industries. Therefore, the causality between natural gas, oil, and sectoral indices was examined. According to the results obtained by VAR analysis, the null hypothesis, which claims there are no relationships between Banks,



Financials, All Shares and Transportation Indices, and natural gas are rejected. Consequently, the first lag of natural gas has a positive effect on Banks, Financials, All Shares, and Transportation Indices, while it has no statistically significant effect on the other indices. Furthermore, natural gas prices do not have a negative effect on the Borsa Istanbul Index. On the other hand, because of the rejection of the null hypothesis considering z values, oil price changes are concluded to positively affect Food Beverage, Chemical Petrol Plastic, Industrials and Investment Trusts Indices. Like natural gas, oil does not negatively affect any indices.

At the beginning of this study, we started by assuming that energy prices affected the stock market. The effect of energy prices on stock market indices or stock market prices has been studied for different time frames, different countries, and stock markets. As a result of these studies, the authors reached similar results with different methodologies. In this study, we used the causality test to examine the causalities between variables. The causality relationship between the variables was tested by Granger causality analysis at 5% significance level. According to this analysis, the null hypothesis states that there is no causal relationship between the variables. Granger causality test results can be seen in Table 5.

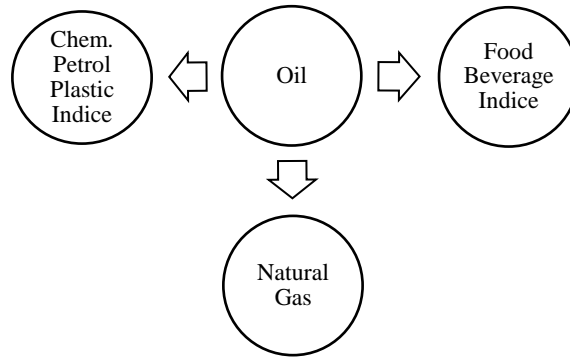
**Table 5.** Granger Causality Test Results

	Lag Length	Oil	NGas	Joint
		$\chi^2$ (p-value)	$\chi^2$ (p-value)	$\chi^2$ (p-value)
<b>XBANK</b>	2	0.09743 (0.952)	5.9267 (0.052)	6.2203 (0.183)
<b>XBLSM</b>	2	2.1517 (0.341)	3.0792 (0.214)	4.757 (0.313)
<b>XELKT</b>	3	4.0327 (0.258)	3.6232 (0.305)	7.9908 (0.239)
<b>XGIDA</b>	4	13.509 (0.009)	5.1241 (0.275)	18.819 (0.016)
<b>XHOLD</b>	2	1.5843 (0.453)	1.9633 (0.375)	3.9959 (0.407)
<b>XKAGT</b>	3	1.8544 (0.603)	3.3 (0.348)	5.6013 (0.469)
<b>XKMYA</b>	3	11.031 (0.012)	4.338 (0.227)	16.325 (0.012)
<b>XMANA</b>	2	3.9744 (0.137)	3.3638 (0.186)	7.689 (0.104)
<b>XMESY</b>	2	3.0123 (0.222)	2.3328 (0.311)	5.6672 (0.225)
<b>XU100</b>	2	0.96209 (0.618)	4.4844 (0.106)	5.8473 (0.211)
<b>XUHIZ</b>	3	1.9393 (0.585)	2.9705 (0.396)	5.453 (0.487)
<b>XULAS</b>	2	0.82776 (0.661)	4.2949 (0.117)	5.3574 (0.253)
<b>XUMAL</b>	2	0.25291 (0.881)	4.8866 (0.087)	5.414 (0.247)
<b>XUSIN</b>	2	5.1379 (0.077)	3.2436 (0.198)	8.9957 (0.061)
<b>XUTEK</b>	2	0.87114 (0.647)	0.63848 (0.727)	1.3519 (0.853)
<b>XUTUM</b>	2	1.1129	4.5035	6.0597

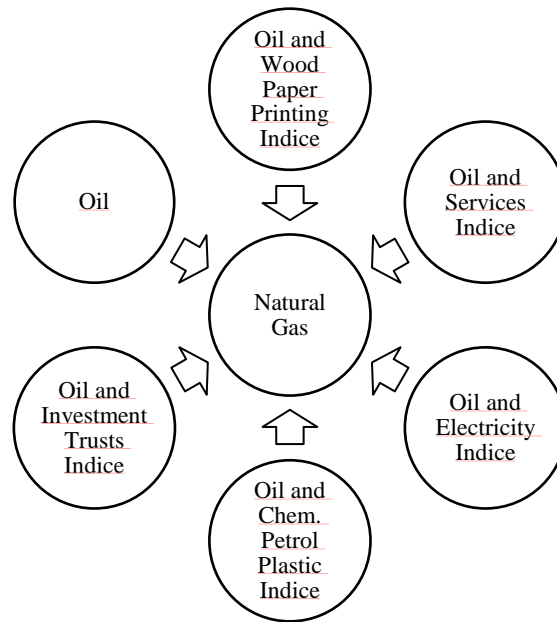
		(0.573)	(0.105)	(0.195)
<b>XYORT</b>	3	5.6241 (0.131)	1.636 (0.651)	7.7613 (0.256)

Considering the Granger causality analysis results, which was applied together with the VAR model, as can be seen in Figure 1, oil Granger causes natural gas, Chemical Petrol Plastic Indice, and Food Beverage Indice while natural gas does not granger cause any indices. On the other hand, Figure 2 shows variables that Granger cause natural gas, while Figure 3 indicates that oil and natural gas jointly Granger cause Food Beverage and Chemical Petrol Plastic Indices.

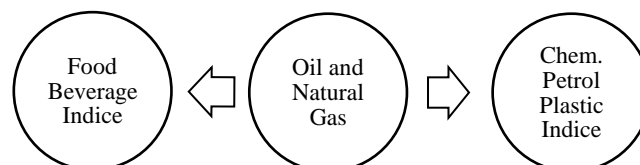
**Figure 1.** Variables that Oil and Natural Gas Granger Cause



**Figure 2.** Variables that Granger Cause Natural Gas



**Figure 3.** Variables that Oil and Natural Gas Jointly Granger Cause



### **5.3. Impulse-Response Functions**

Impulse-response functions that measure the effect of shock applied to each variable in the VAR model on the dependent variable can be seen in Appendix 1. Accordingly, a vast majority of the impact of oil on indices is positive, while the impact of natural gas on indices is both negative and positive. The negative impact of oil is less and shorter term than that of natural gas. The effects of both oil and natural gas on the indices are observed in the second or third day and peaked during these days. After these days, the effects are gradually diminished and finally absorbed. The response of Banks, Technology, Holding, Basic Metal, Metal Products, BIST 100, Transportation, Financials, Industrials, and all indices to oil prices changes is not continuing after four periods. Other indices' response to oil prices continues after the fourth period. Nevertheless, the response of all indices to natural gas price after fourth periods continue.

## **6. CONCLUSIONS**

The purpose of this study is to investigate whether there is a relationship between energy prices (oil and natural gas) and Borsa Istanbul indices as energy prices are significant for the economy and stock market of Turkey being an energy importer. Since energy is used in a bulk of different areas such as raw materials in industry, lightening, heating, fuel, all people in the country and investors around the world may be affected differently by the volatility in energy prices. 17 Borsa Istanbul indices were analyzed measuring the changes in oil and natural gas prices on the stock market. Short-term and long-term relationships were examined for the dates between 01.01.2007-31.10.2017.

First of all, ADF and PP tests were applied to the data of which logarithms were taken. It was concluded that the data were not stationary at the level. After the first differences of the data were taken, the data became stationary. After this step, the Johansen Cointegration test was applied. It was concluded that there was no long term relationship between oil, natural gas, and Borsa Istanbul indices; in other words, variables did not have cointegrated relations. Therefore, the VECM (Vector Error Correction Model) could not be applied in case of a cointegrated relationship.

VAR model used to test the existence of short-term relationships between the time series in case there is no long term relationship, was applied together with the Granger causality test. VAR results suggest that oil affects Food Beverage, Chemical Petrol Plastic, Industrials and Investment Trusts Indices while natural gas affects Banks, Financials, All Shares and Transportation Indices. Surprisingly, these effects are all positive, meaning that these indices tend to rise when energy prices rise. Considering Granger causality test results, oil Granger causes natural gas, Chem. Petrol Plastic Indice and Food Beverage Indice, while natural gas does not Granger cause any indices.

On the other hand, oil and natural gas jointly Granger cause Petrol Plastic Indice and Food Beverage Indice. The fact that oil Granger causes Petrol Plastic Indice seems reasonable as oil is used

widely in the petrol and plastic industry. That oil Granger causes Food Beverage Indice is surprising because there is no direct connection between oil and this indice. However, an unexpected situation that oil or natural gas does not Granger causes Transportation Indice even if both energy resources are commonly used in the transportation industry. Impulse-response functions show that oil affects indices positively, while the effect of natural gas is both positive and negative. However, the effect of oil and natural gas on indices is briefly.

That the effect of energy price increases is mostly positive may be due to the fact that firms exceedingly reflect the increase in energy costs to products, thus attracting investors by making more profits. Another implication could be that investors who make profit from oil price increases sell their positions and buy stocks, hence causing stock prices to go up.

Considering Borsa Istanbul, the results of this study are similar to those of Çelik and Çetin (2007), Eryiğit (2009), Ünlü and Topçu (2012), Toraman et al., (2011), Berk and Aydoğan (2012), Öztürk et al., (2013), Yıldırım et al., (2014), Abdioğlu and Değirmenci (2016), Eyüboğlu and Eyüboğlu (2016), Vardar et al., (2018), Ordu-Akkaya and Sarı (2019), Cevik et al., (2020). But the results contradict those of Güler et al., (2010), Şener et al., (2013), Polat (2020). This study also corresponds to the results of Acaravcı and Reyhanoğlu (2013) in terms of natural gas, but not in terms of oil.

When studies that examine stock markets apart from Borsa Istanbul are searched, the present study is consistent with the findings of Huang et al., (1996), Faff and Brailsford (1999), Huang et al., (2005), Apergis and Miller (2009), Narayan and Narayan (2010), Ono (2011), Chortareas and Noikokyris (2014), Jammazi et al., (2017), Waheed et al., (2018), Bagirov and Mateus (2019), Hamdi et al., (2019), Thorbecke (2019) while contradicts with the results of Maghyreh (2006), Cong et al., (2008), Malik and Ewing (2009), Narayan and Sharma (2011), Hu et al., (2018), Tiwari et al., (2018), Sakaki (2019).

Oil and natural gas, being scarce resources, are vital because of their areas of usage. As Turkey, which is a developing country, imports most of its raw material and energy needs, the fluctuations in energy prices may influence everybody in the country and investors inclined to invest in Turkey. Therefore, it is crucial to study the effect of these energy resources on Borsa Istanbul and Turkey.

This study helps conclude that energy prices affect some of Borsa Istanbul indices. That this effect is positive for both oil and natural gas, will be helpful for investors and shareholders. Accordingly, investors can take long positions in the stock market, even if energy prices rise. In this period of time, investors raise their returns. However, this investment is not well-diversified as stock prices should fall when energy prices decrease. In this case, investors may take short positions in stocks to return from energy price decreases.

For further studies, macroeconomic variables and exchange rates could be investigated to see whether energy prices affect the overall economy. This study includes only Borsa Istanbul indices. If each company that is directly related to energy resources is investigated, better results can be presented. Moreover, other energy resources and commodities can be included in studies.

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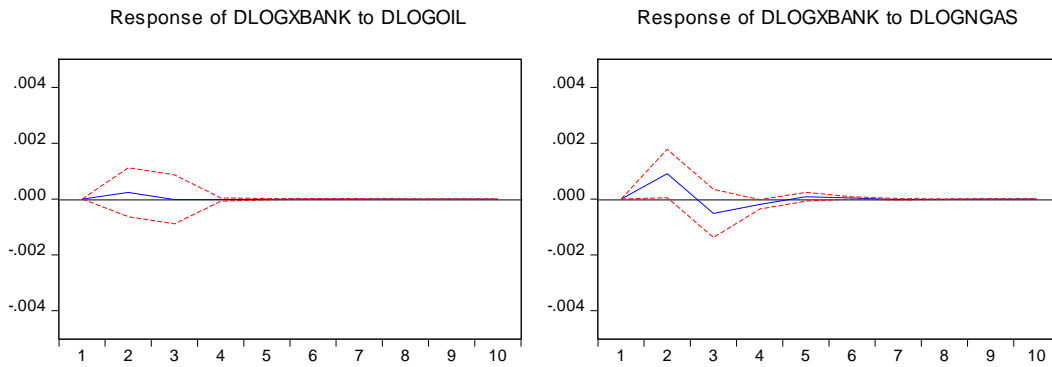
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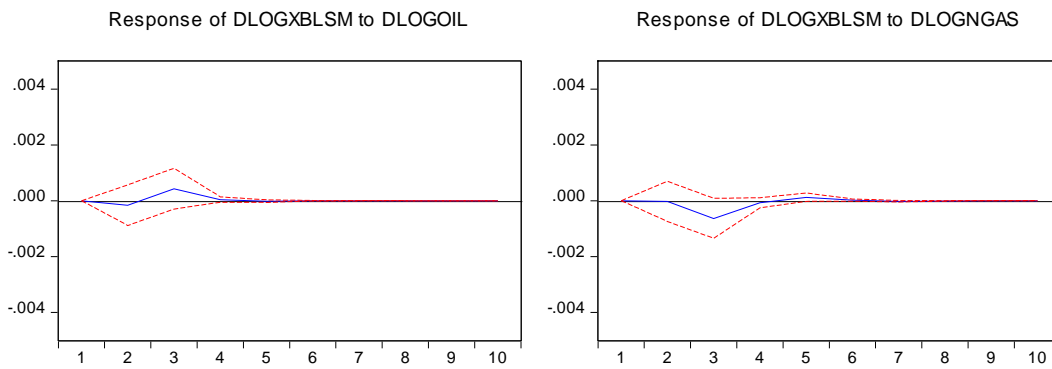


## APPENDIX (IMPULSE-RESPONSE FUNCTIONS)

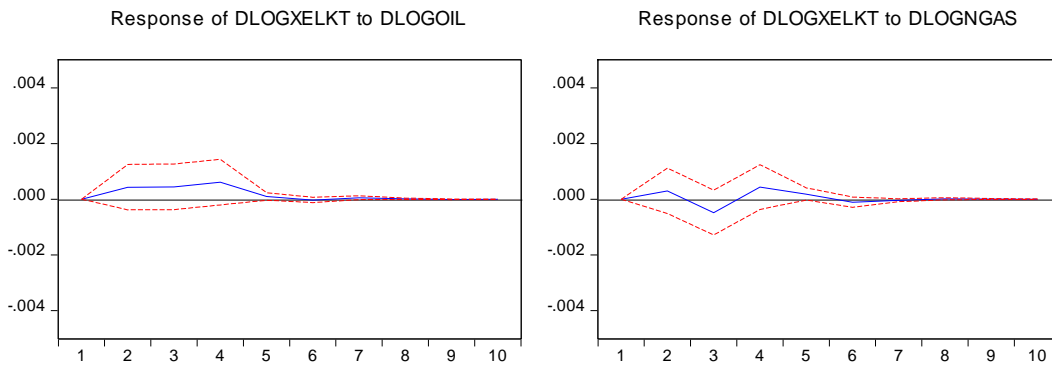
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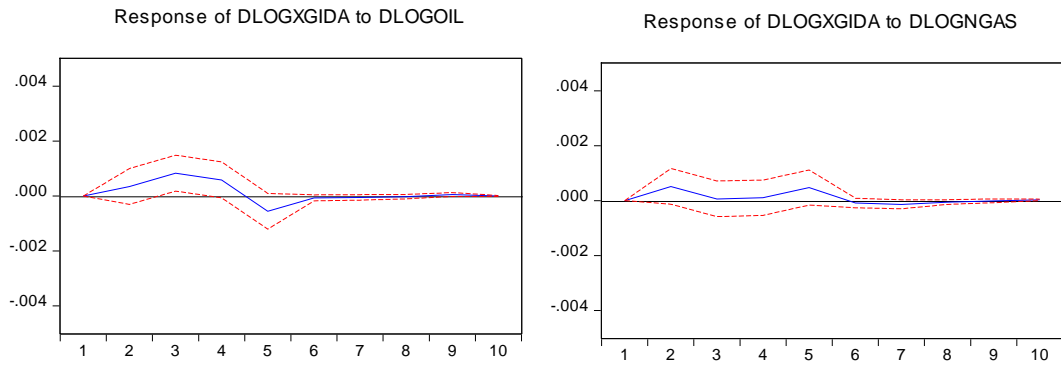
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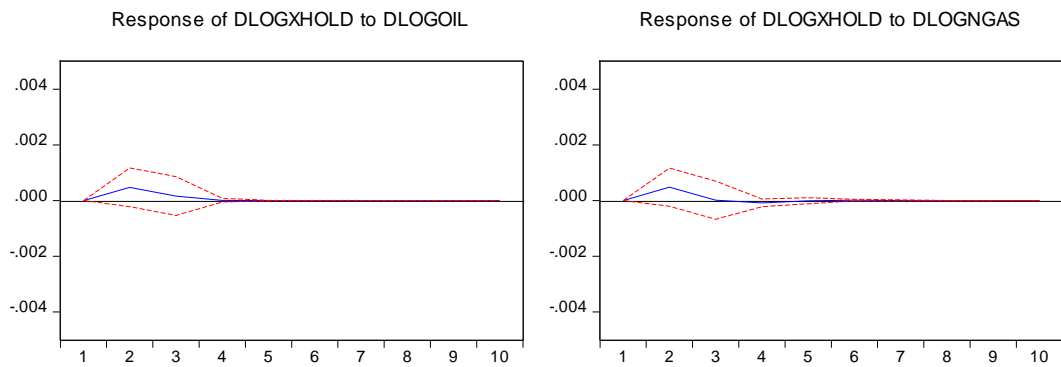
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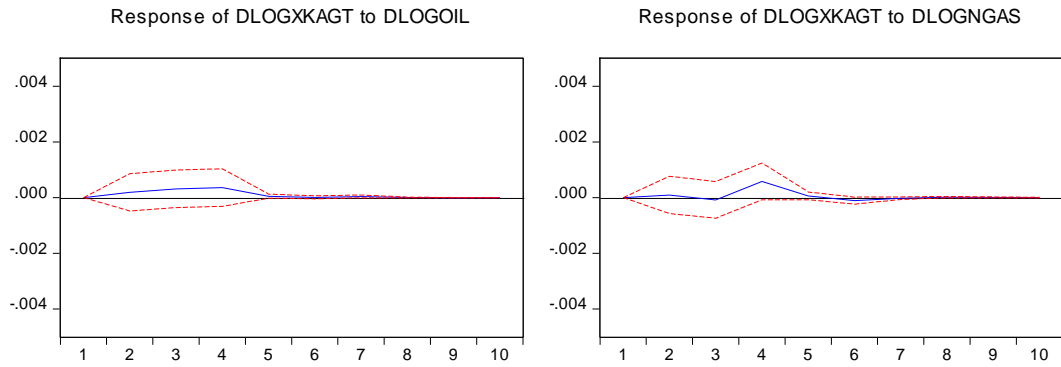
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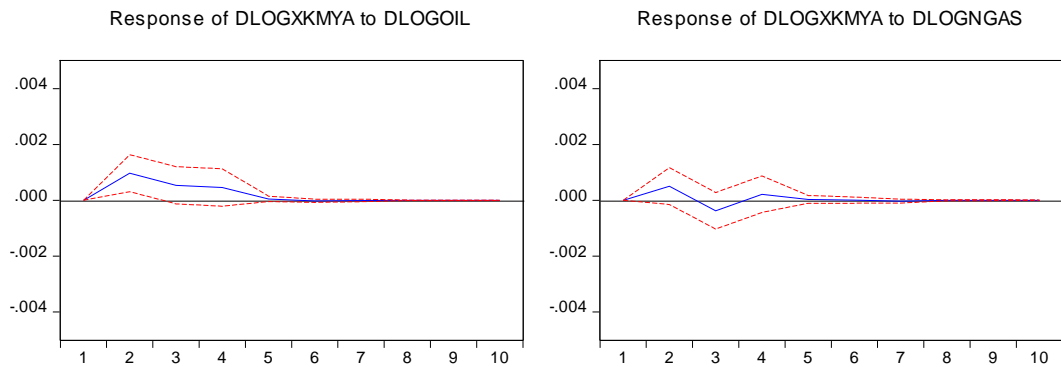
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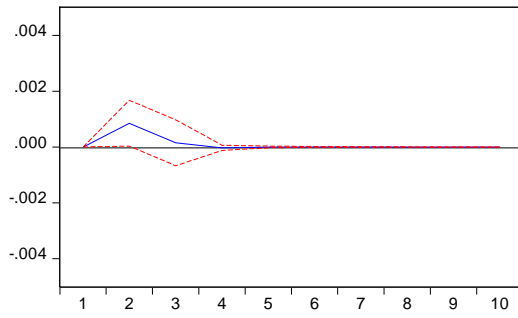


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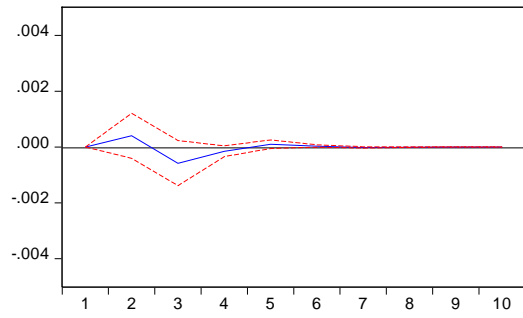


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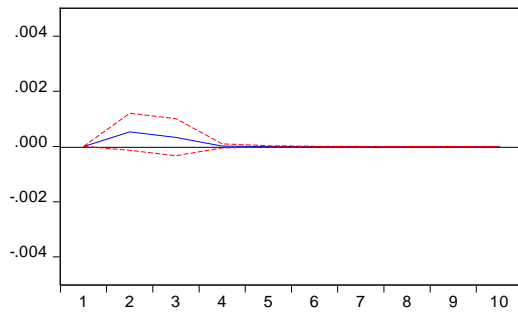


Response of DLOGXMANA to DLOGNGAS

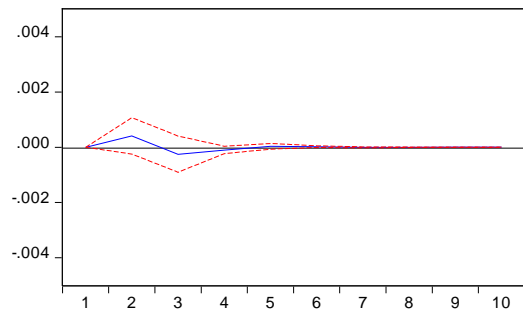


## XMESY

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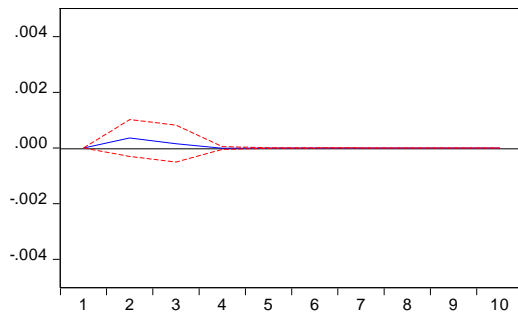


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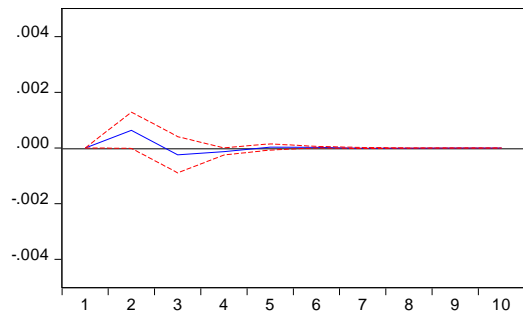


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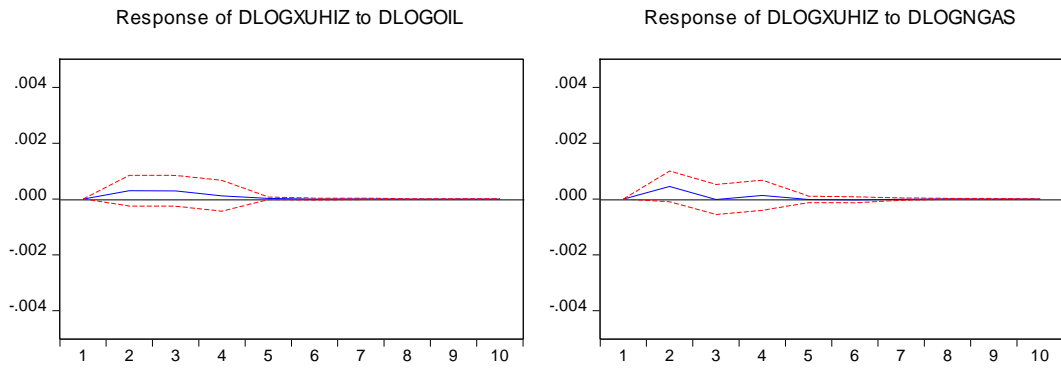
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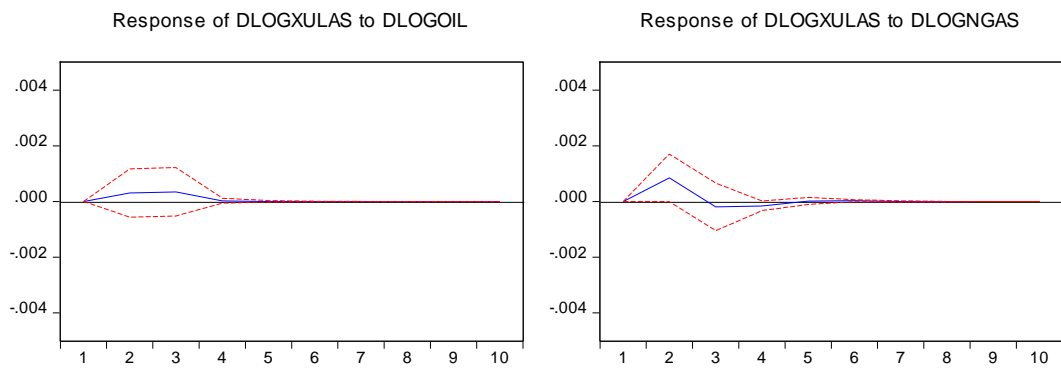
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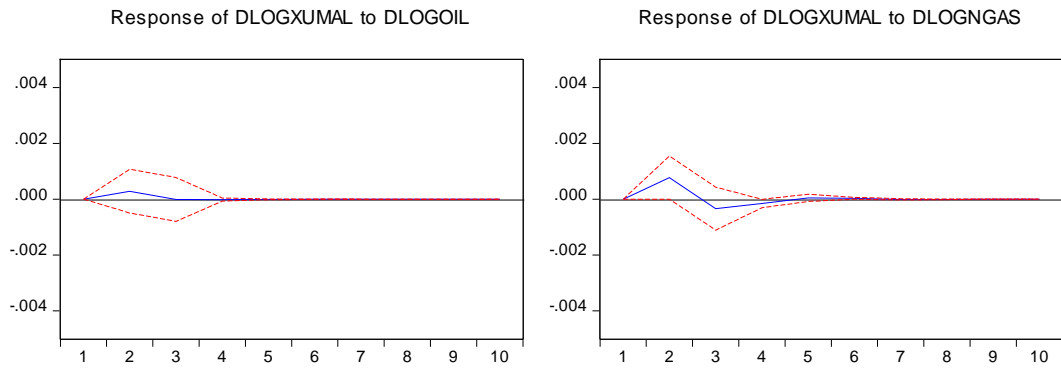
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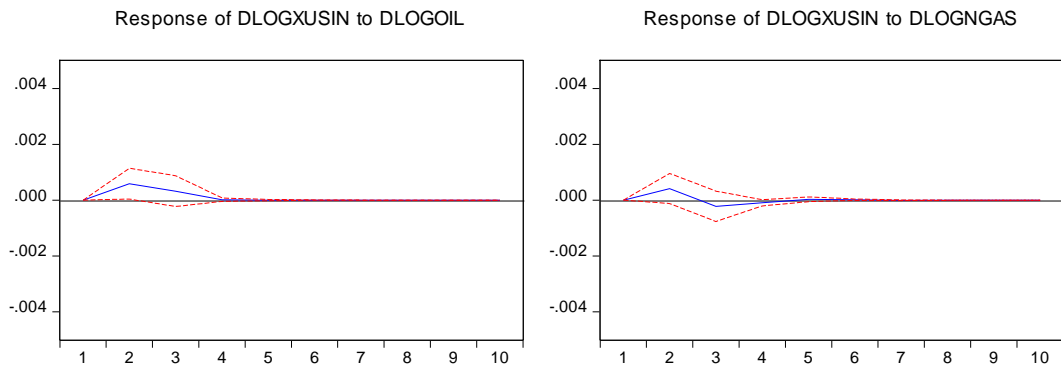
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## XUMAL

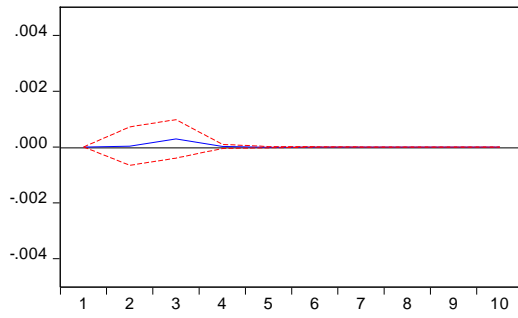


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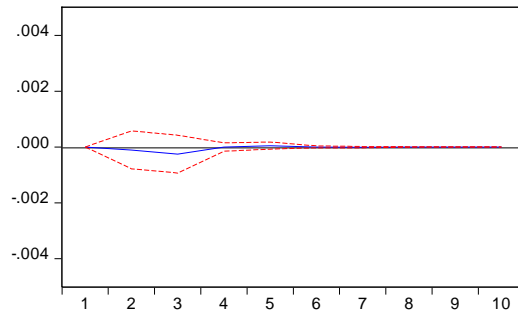


## XUTEK

Response of DLOGXUTEK to DLOGOIL

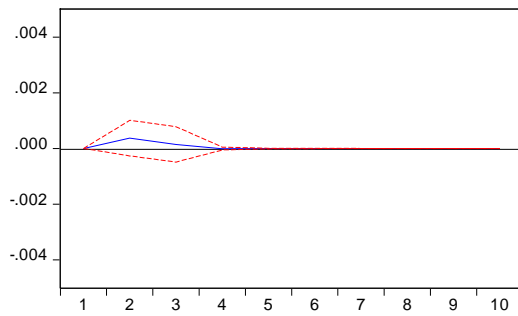


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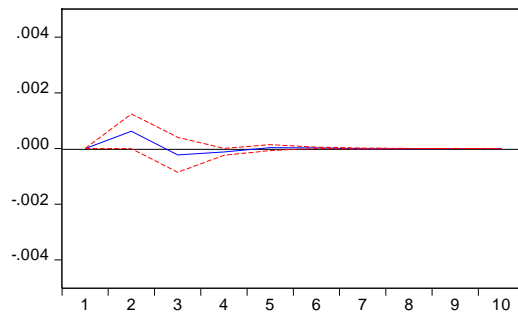


## XUTUM

Response of DLOGXUTUM to DLOGOIL

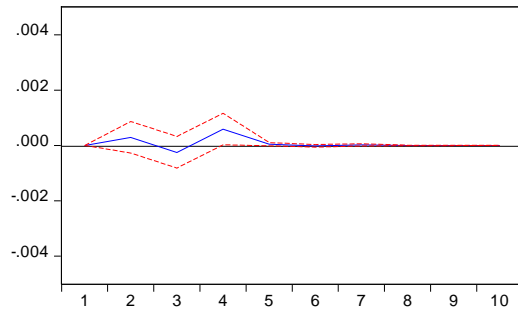


Response of DLOGXUTUM to DLOGNGAS



## XYORT

Response of DLOGXYORT to DLOGOIL



Response of DLOGXYORT to DLOGNGAS

