The Impact of Oil Price Shocks on the Stock Markets of the G8 Countries

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ABSTRACT

This study investigates the short term relationship between oil price shocks and real stock returns of the G8 countries over the period of 1993:1-2011:3. Empirical analysis shows that the stock markets of the net oil exporter members of the G8, have significantly and positively affected by different oil price shock specifications instantaneously or within one month. On the contrary, the net oil importer countries have shown negative responses to different oil price shocks. Another analysis revealed that oil price shocks contribute to the variation in real stock returns of the member countries but the magnitude of the contribution varies among them. Additionally, the impacts of positive and negative oil price shocks on real stock returns of these countries are not identical which verifies the asymmetric effect of oil price shocks. Also, the stock markets of the G8 countries are more affected by a U.S. real stock return shock than by an oil price shock. Thus, the existence of spillover effect from the U.S. stock market to the other stock markets has been validated.

Keywords: Oil Price Shocks; Real Stock Returns; G8; VAR

ÖZ

Bu çalışma 1993:1 ile 2011:3 tarihleri arasında, G8 ülkeleri için, petrol fiyatlarındaki dalgalanmalar ile hisse senedi getirileri arasındaki kısa dönem ilişkiyi incelemektedir. Ampirik bulgulara gore, özellikle, net petrol ihracatcısı G8 ülkelerinde, hisse senedi piyasaları petrol fiyatlarındaki dalgalanmalardan, örneğin, 1 ay içerisinde olumlu yönde etkilenmektedir. Diğer taraftan, net petrol ithalatçısı ülkelerde ise, ilişkinin yönü negatif yöndedir. Diğer bulgular incelendiği zaman, petrol fiyatlarının, hisse senedi dalgalanmalarındaki varyasona da belirleyici olarak etki ettiği görülmektedir. G8 ülkeleri örneğinde, pozitif ve negatif etkilerin ayni seviyelerde olmadığı görülmektedir. Bu da bize petrol fiyatlarının asimetrik bir etkiye sahip olduğunu göstermektedir. Çalışmanın sonuçları ayni zamanda, G8 ülkelerindeki hisse senedi piyasalarının ABD'deki piyasalardan da etkilendiğini ortaya koymuştur.

Anahtar Kelimeler: Petrol Fiyatı Şokları; Reel Hisse Senedi Getirileri; G8; VAR

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TO MY FAMILY

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INTRODUCTION

The oil industry is one of the largest, complex, and important industries in the world. Our lives somehow depend on this industry through using its products like transportation, electricity fuels, heating, lubricants, and hundreds of petrochemical products from carpets to clothing. The industry also affects national security, geopolitics, and regional conflicts. As a result, the price of crude oil is one of the most closely watched commodities in the world economy.

Oil is one the factors which had the greatest impact on many economies since 1970. For instance, many economies across the world have witnessed recession due to OPEC's oil embargo during 1973-74 and similar consequences may occur in the future. Oil-price shocks are one of the primary reasons of macroeconomic fluctuations by Benhmad (2012). For example, Hamilton (2008) mentions that nine out of the ten recessions in the United States between 1945 to 2005 were caused by large increase in oil prices. Therefore, due to the vital role of oil in the economy, their relationship merits more scrutiny. In this regard, first it must be defined that which economic sectors have the potential to be affected by oil prices and then it should be clarified what type of events may influence oil prices.

According to Arouri and Fouguau (2009), almost all economic sectors can be affected by oil price shocks but the point is some of these influences are instantaneous and some need more time to affect the economy. For example, an oil price shock may affect stock market and transportation instantaneously but other sectors like tourism may be influenced with a delay of couple of months. In general, as the price of oil increases, the cost of non-oil related companies will rise and consequently leads to the decline in total profit. In this case, a public company may decide to reduce dividend payouts which itself sends signal to stock markets about the current situation of this company.

Thus, oil-price variations have major impact on stock price volatility in many countries specially developing economies (Basher and Sadorsky, 2006). Over the past quarter century, the role of the stock market has significantly risen in many industrialized countries. Jansen and Nahuis (2003) stated that, stock market capitalizations, expressed as a percentage of GDP, have doubled or tripled since 1985. Due to the substantial role of stock market and oil in the economy, this thesis will investigate the relationship of oil-price shocks and stock markets of the G8 countries.

1.1 Aim and Importance of the Study

This study empirically investigates the impact of oil price shocks on stock markets of the G8 countries including Canada, France, Germany, Italy, Japan, U.K., U.S., and Russia. Although some researchers have done studies about the effect of oil price shocks on stock markets, but this study differs in terms of number and type of countries and also the methodologies used. For instance, two countries of the G8, Canada and Russia, are net oil exporters and the rest are net oil importers.

This will create an opportunity to monitor the behavior of stock markets of oil-exporting and oil-importing countries simultaneously. In order to carry out this investigation, some technics and methodologies will be used such as vector autoregressives (VAR), impulse response functions (IRF), Forecast error variance decompositions and volatility spillovers.

1.2 Structure of the Study

The present study is structured as follows: in Chapter Two, the current theoretical and empirical literature will be reviewed. Later, current situation of oil industry and historical oil shocks will be discussed in Chapter Three. Chapter Four gives some information about history and formation of the stock markets of the G8 countries. In Chapter Five, data and methodologies which have been used in this thesis will be introduced. Empirical analysis will be carried out in Chapter Six. Finally, Chapter Seven will conclude this study and gives some policy implications.

Chapter 2

LITERATURE REVIEW

The study of the role of oil price shocks in United States by Hamilton (1983) had a great impact on the literature of macroeconomics of oil shocks. In that research he found that oil price changes has a strong casual and negative correlation with the U.S. real GNP growth. Further, he mentions that oil shocks caused at least some of U.S. recessions prior to 1972. Sadorsky in 1999 by using a vector autoregression method shows that oil prices and oil price volatility both affect real stock returns significantly. He says that oil price dynamics have changed and for instance, after 1986, oil price changes explain a larger proportion of the forecast error variance in real stock returns than do interest rates. He also gives some evidence that oil price volatility has asymmetric effects on the economy.

Papapetrou (2001) examines the effect of oil and stock prices, interest rates, real economic activity and employment in order to understand the connection between these factors for the case of Greece and gives a summary that the changes in oil prices affect real economic activity and employment. Gounder and Bartleet (2007) examine the impact of changes in the world oil price on New Zealand's economic growth over the period 1989-2006. They conclude that New Zealand's economy is vulnerable to the world oil price fluctuations. By using causality analysis, the generalized impulse responses and variance decompositions, they confirm that there is a direct negative relationship between the net oil price shock and economic growth. Park and Ratti have done a research in 2008 to find out the linkage between oil price shocks and real stock returns. This study covers the U.S. and 13 European countries over 1986:1–2005:12. They found out that oil price shocks have a statistically significant impact on real stock returns contemporaneously and/or within one month. They demonstrate that Norway as an oil exporter shows significant positive response of real stock returns due to an oil price shock. Other results illustrate that only oil importing European Countries show asymmetric effects on real stock returns because of positive and negative oil price shocks.

Jbir and Zouari-Ghorbel (2009) used a vector autoregression (VAR) method to study the relationship between oil prices and macroeconomic indicators of Tunisia overt the period of 1993 Q1 to 2007 Q3. The results indicate that the model using both linear and non-linear specifications of oil price shock has no direct impact on the economic activity. He concludes that oil price shocks affect economic activity indirectly via the channel of government's spending.

Al-Fayoumi (2009) examines the relationship between oil price changes and stock market returns in three oil importing countries including Tunisia, Turkey, and Jordan. He used monthly data of oil prices, interest rate, industrial production, and stock market indices and analyzed them using a Vector Error Correction Model (VECM). Based on the data from December 1997 to March 2008, he said that the hypothesis that oil prices affect stock market returns in these countries cannot be accepted. However, the results indicate that the effect of the local macroeconomic variables on the variation in stock market returns is more significant than that of oil prices. Arouri and Nguyen (2010) investigate the responses of stock markets returns in GCC countries to oil price shocks by using linear and nonlinear models. He found out that stock market returns significantly respond to oil price movements in Oman, Qatar, Saudi Arabia and UAE. However, there is no evidence that oil price variations can affect stock market returns of Bahrain and Kuwait.

Ono (2011) examines the effect of oil price changes on real stock returns using VAR models for Brazil, China, India and Russia over the period of 1999:1-2009:9. The results indicate that although real stock returns positively and significantly respond to the oil price shocks for China, India and Russia, but for Brazil it shows no significant response. Moreover, asymmetric effects of oil price increases and decreases are just significant for India. The forecast error variance decomposition suggests that the effect of oil price shocks to variability in real stock returns is large and significant for China and Russia.

Hamilton (2011) explains that although oil was less important economically in the last century than it is today, but there are interesting interactions between events in that time and more recent developments. He concludes that after each of major post-war oil shocks, the world has seen economic recessions. Berk and Aydogan (2012) investigate the effect of oil price changes on the stock market returns of Turkey. They employed a vector autoregression (VAR) model using daily data of Brent crude oil prices and the ISE-100 of Istanbul Stock Exchange over the period of 1990:1 to 2011:11. They also analyzed the relationship among oil prices and stock market returns under global liquidity conditions by using S&P 500 market volatility index (VIX) as a liquidity proxy variable. Variance decomposition results show that global liquidity conditions account for the greater amount of variation in Istanbul's stock market returns rather than oil price shocks. Moshiri (2011) finds that lower oil prices would lead to major revenue slashes and stagnation in the economies of oil-exporting developing countries. Nevertheless, higher oil prices with higher revenues do not lead to a sustainable economic growth. He employed a vector autoregressive (VAR) model with a GARCH-based oil price shocks to evaluate the asymmetric effect of oil shocks on six OPEC members.

Lee and Chiou (2011) develop a two-step methodology to examine the asymmetric effect of oil price shocks on stock returns. They also monitored oil price volatility using a regime-switching model. The findings show that unforeseen asymmetric price changes lead to negative impacts on S&P 500 returns. Conversely, the same result does not hold in a regime of lower oil price variations. Finally, they suggest that a well-diversified portfolio with a proper consideration of oil price shocks, will lead to the betterment of oil price risk hedging strategies.

Chapter 3

OIL PRICE SHOCK DEFINITION AND OIL INDUSTRY REVIEW

3.1 Oil Price Shock

Now, it's time to talk about what an oil shock is and how it may happen. Hamilton (2003) defines that oil shocks just happen when oil-price changes more than what had been experienced in the last 12 months. Although, we know that oil-price shocks will affect the macroeconomic variables but it is also important to know whether these effects are negative or positive. Despite the major role of oil-price spikes prior to recessions, however, large falls in oil prices have not caused high economic growths. As a result, it can be concluded that, oil-price shocks are directionally asymmetric and therefore, large positive oil price shocks are more important than negative ones by Benhmad (2012).

There are two major factors that may cause oil-price shocks which are oil supply and oil demand shocks. The oil supply shock can be defined as any event which can change the supply of oil and suddenly changes its price. These shocks can be negative (due to a decrease in supply) or positive (due to increase in supply). Nevertheless, they are almost always negative and seldom positive. The oil demand shock can be defined as any event which can suddenly change the demand either for oil consumption or oil procurement.

Obviously, a positive oil demand shock results in oil-price rise and a negative one leads to oil-price fall. Now, it's worthwhile to review some of the major world events which have influenced the crude oil prices. According to Hamilton (2011) and Cavallo and Wu (2006), these events caused substantial crude oil price changes:

1946: Post-World War II Reconstruction

1951: Nationalization of Iranian oil industry

1952: Supply disruptions due to the Korean War

1956: Suez Crisis

1973: Yum Kippur War

1973: OPEC oil embargo

1978: Iranian revolution

1980: Initiation of the 8-year Iran-Iraq War

1990: First Persian Gulf War (Invasion of Kuwait by Iraq)

1997: Asian financial crisis

2001: 9/11 attacks

2002: General strike and unrest in Venezuela

2003: Second Persian Gulf War (Invasion of Iraq by the U.S.)

2007: Oil price spike (strong demand and stagnant supply)

2008: Global financial crisis

2011: Arab Springs and Japanese tsunami

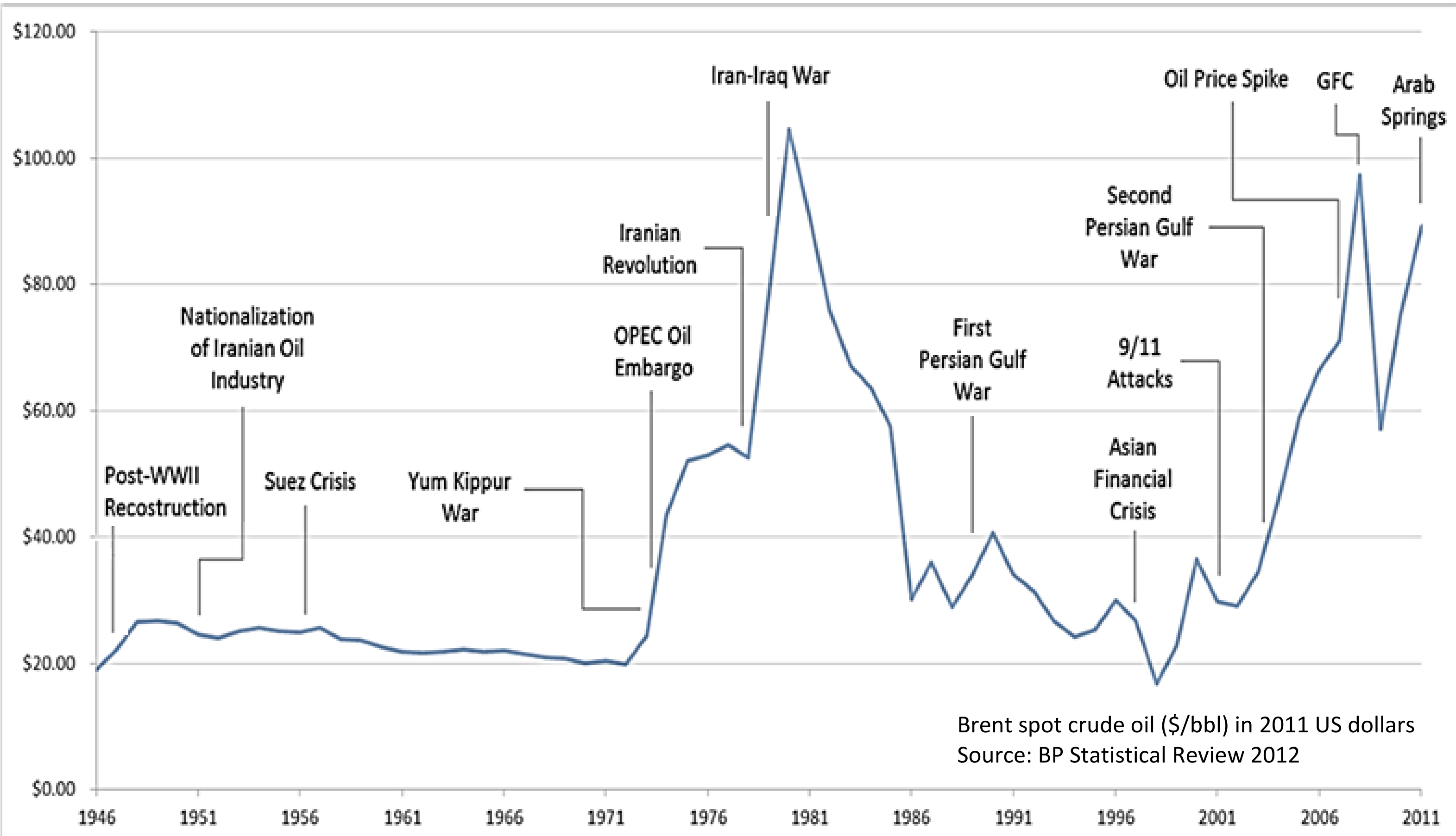

Figure 1: World Events and Crude Oil Prices Since 1946

3.2 Oil Industry Review

In this section, the oil industry will be reviewed from both producer and consumer point of views. Nowadays, the oil industry requires a chain of activities such as exploration, extraction, refining and transportation to be done in order to turn the wheels of other industries. This shows the heavy dependency of the other industries on the outputs of the oil industry ranging from petrol to lubricants and many other petrochemical materials and therefore it is a crucial concern for many nations. From the time of its exploration till now, the oil has remained as one of the most strategic goods for all countries. As Graf (2012) describes, some countries beside of the huge financial benefit from oil production, treat it as a strong weapon to achieve various goals.

The most proper example is the OPEC oil embargo in 1974 against Israel and its allies. After this phenomenon, the World familiarized with the "petropolitics" terminology which shows the significant role of oil in today's world. Although, the World has witnessed many improvements and developments in renewable and green energies, but still there is a long way to go to make them more efficient and sustainable. According to the BP Statistical Review (2012), renewable energies in total account for 2.1% of the global energy consumption whereas oil's share of global energy consumption is 33.1% which makes it the world's leading fuel. Also, its annual global production has increased by 1.3% by the end of 2011. Due to the substantial role of oil in global and national economies, the current situation of this industry will be reviewed infographically in Figures 2-5.

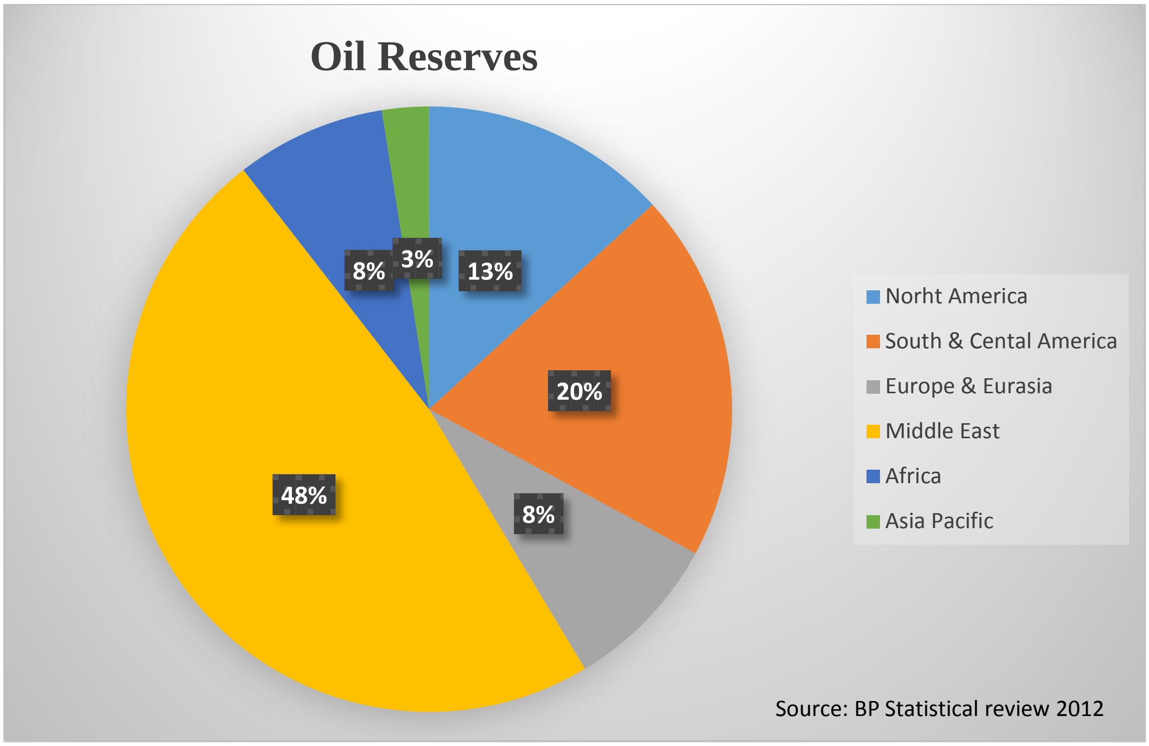

Figure 2: Distribution of Oil Reserves in 2012

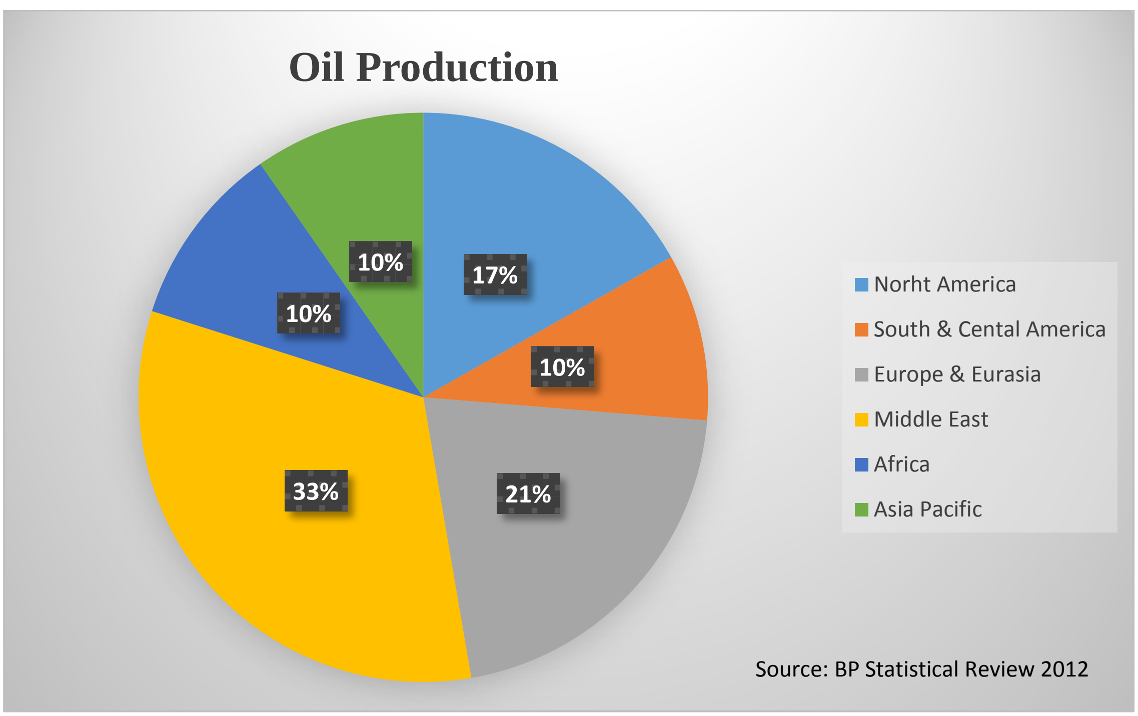

Figure 3: Oil Production in 2012

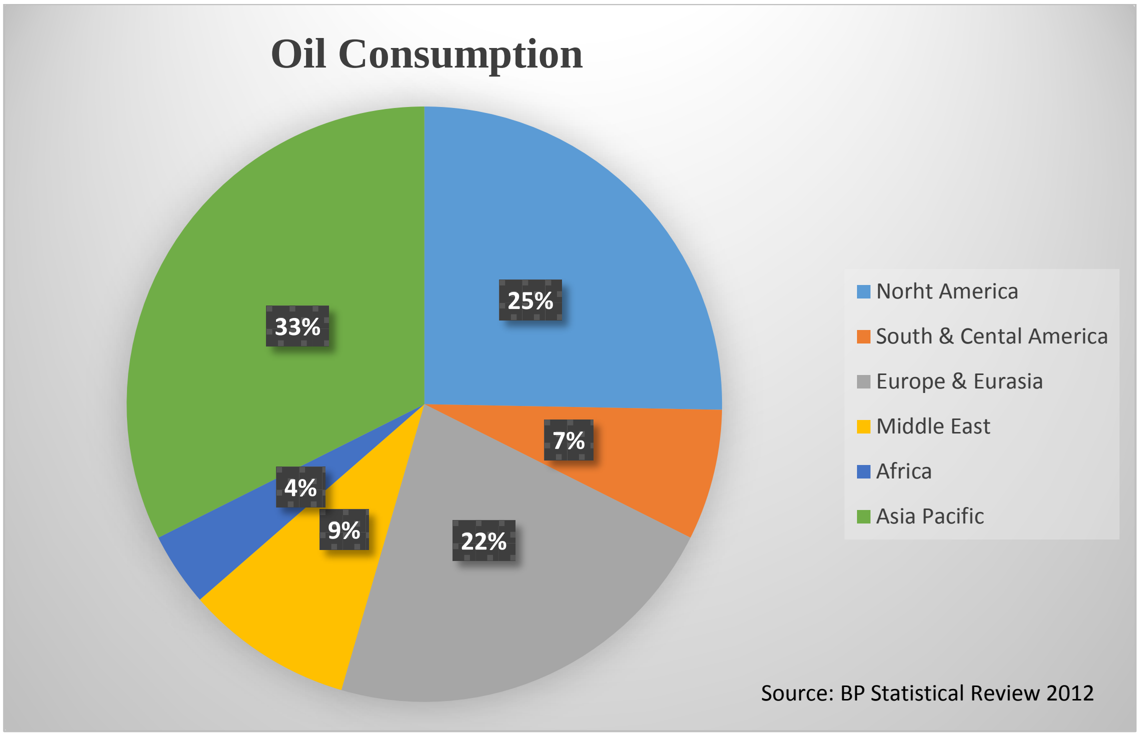

Figure 4: Oil Consumption in 2012

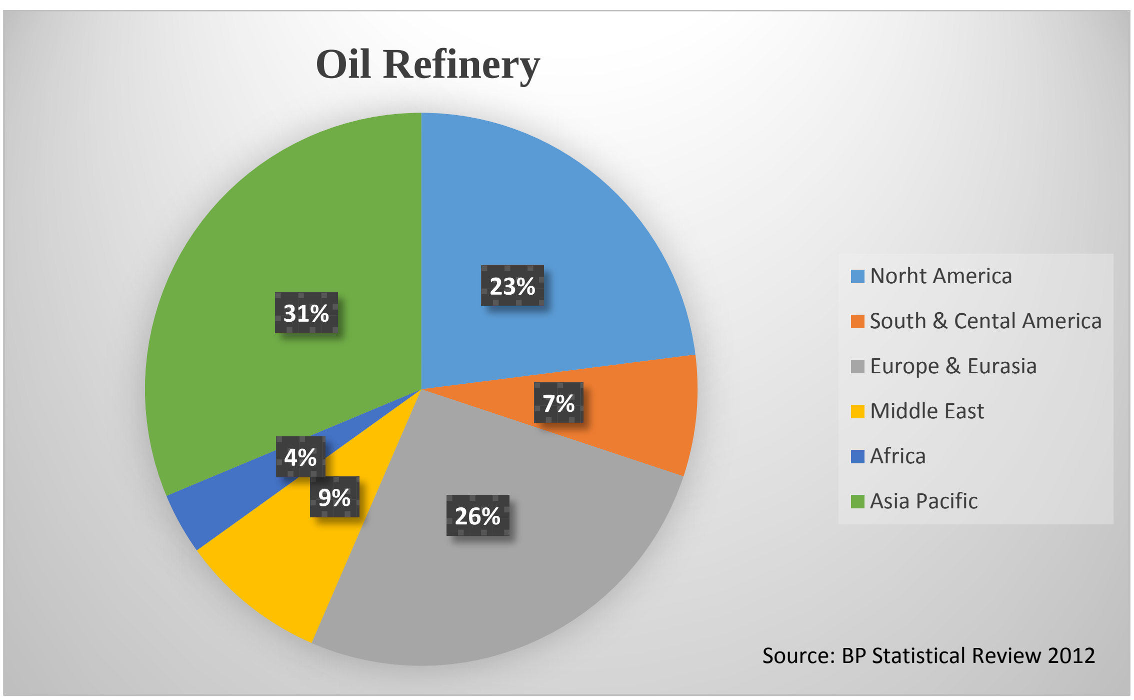

Figure 5: Oil Refinery Capacities in 2012

Figure 2 shows the distribution of oil reserves in different regions of the world in 2012. Middle East with 48% has the largest oil reserves among the other regions in the world. This shows the geopolitical importance of Middle East in the world and may be because of this reason; this part of the world is always witnessing wars and political unrests. After Middle East, South and Central America has the largest proven oil reserves with 20% of total world oil reserves.

In terms of oil production (Figure 3), Middle East is also the leading region with about 33% of total world crude oil production and then Europe and Eurasia has the second-largest share with 21%. According to the Figure 4, Asia Pacific region has the largest share in crude oil consumption with 33% of the world's total oil consumption. Second-largest oil consumer is the North America with 25% of global oil consumption. This suggests oil plays a vital role in their economies especially when we know they heavily rely on oil import.

Figure 5 represents the oil refinery capacities of different regions in the world. Although, the largest crude oil producer is Middle East, but only 9% of total crude oil can be refined in this region. The largest capacity of oil refinery is for Asia Pacific region with 31% and Europe and Eurasia is the second-largest oil refiner region with 26% of total crude oil refinery in the world.

Chapter 4

STOCK MARKETS REVIEW

4.1 Toronto Stock Exchange

Toronto Stock Exchange (TSX) is the largest stock exchange in Canada and the seventh largest in the world in terms of market capitalization. It is located in Canada's largest city, Toronto; and it is owned and operated by the TMX Group. The oil and gas sector is the flagship of the Toronto Stock Exchange as it hosts more oil and gas listed companies than any other exchange in the world. Due to this characteristic, real stock return on its main index is very sensitive to oil price shocks. Its main index is "S&P/TSX Composite" and includes the stock prices of the largest companies on the TSX as measured by market capitalization. (www.wikipedia.com, 2013).

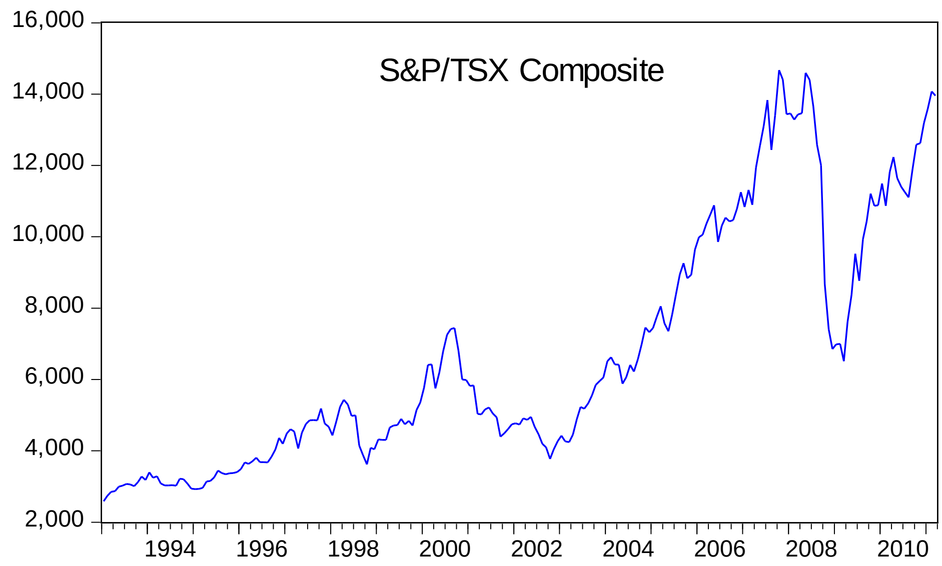

Figure 6: S&P/TSX Composite Index 1993-2011

4.2 Paris Stock Exchange

The Paris Stock Exchange or “Bourse de Paris" is known as Euronext Paris. In September 2000, the Amsterdam, Brussels and Paris stock exchanges merged to establish Euronext stock exchange. Subsequently, the Euronext expanded its coverage by taking over the Lisbon stock exchange and London's International Financial Futures and Options Exchange. Furthermore, it is the second largest stock exchange in Europe behind the London Stock Exchange. Currently, it is owned and operated by the NYSE Euronext group, which is the first global stock exchange company (nyx.com, 2013). The main index of Euronext Paris is “CAC 40” which is made up of the 40 most valuables French companies, although half of them are owned by foreigners. The CAC 40 is a market value-weighted index but in December 2003, its weighting system has changed from total market capitalization to free float market capitalization in order to be consistent with other leading indices (wikipedia.com, 2013).

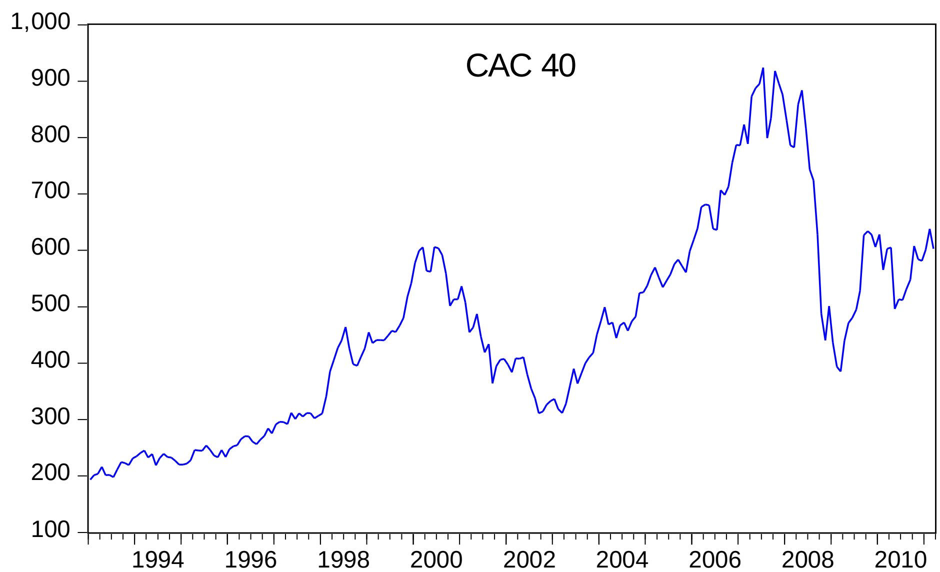

Figure 7: CAC 40 Index 1993-2011

4.3 Frankfurt Stock Exchange

In terms of market capitalization, it is the tenth largest stock exchange market in the world and it's located in Frankfurt, Germany. This city also hosts the European Central Bank and that's why it is known as "The City of the Euro" since 1998. The Frankfurt Stock Exchange is owned and operated by Deutsche Börse which also owns the European Futures Exchange (Eurex). In 2010, the Frankfurt Stock Exchange agreed to switch from conventional floor trading to full-automated trading and it is accomplished in May 2011. Today, all trading transactions take place just through the Xetra trading platform. The market's main index is known as DAX and consists of top 30 German companies. DAX is a market-value weighted index and its operator frequently measures the 30 largest companies' performance in terms of market capitalization (wikipedia.com, 2013).

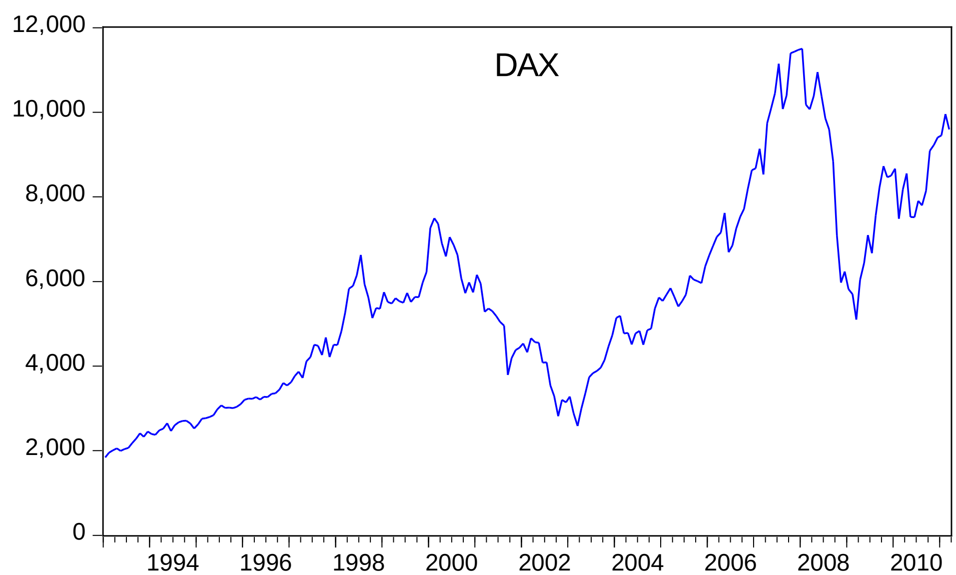

Figure 8: DAX Index 1993-2011

4.4 Milan Stock Exchange

This is the main stock exchange of Italy and due to this it's known as "Borsa Italiana" and it is located in Milan. Historically, the today's stock exchange has originated from the "Borsa di commercio di Milano" (Milan Commodity Exchange) which was established in February 1808 and it was privatized in 1997 when it was sold to a group of banks. Later in October 2007, it was merged with the London Stock Exchange Group to create one of the largest stock exchanges in Europe. The main index of the Milan Stock Exchange was S&P/MIB until June 2009 but after the merger with London Stock Exchange Group the Index responsibility was passed to FTSE Group and it has renamed to FTSE MIB. Today, this index consists of stock prices of the 40 largest companies in Borsa Italiana and it's a market-value weighted index (wikipedia.com, 2013).

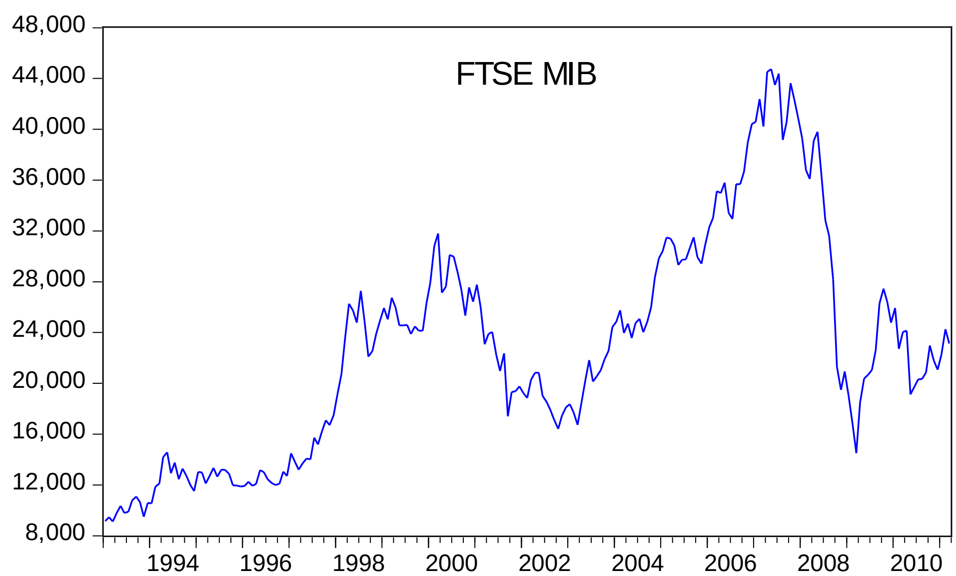

Figure 9: FTSE MIB Index 1993-2011

4.5 Tokyo Stock Exchange

The Tokyo Stock Exchange (TSE) is the third largest stock exchange in the world in terms of market capitalization. The TSE was terminated the conventional floor trading after 120 years on April 30, 1999 seeking for more market efficiency. Now, the TSE hosts 2,292 listed companies with market capitalization of nearly US$3.5 trillion by December 2012. In July 2012, the Japan Fair Trade Commission has approved a planned merger with the Osaka Securities Exchange. The new entity, the Japan Exchange Group (JPX) will start operation on January 2013. The main stock index of TSE is Nikkei 225 and it has been calculated once a day by the Nihon Keizai Shimbun newspaper since 1950. This index is a Yen-denominated price-weighted index and the components are reviewed every year (wikipedia.com, 2013).

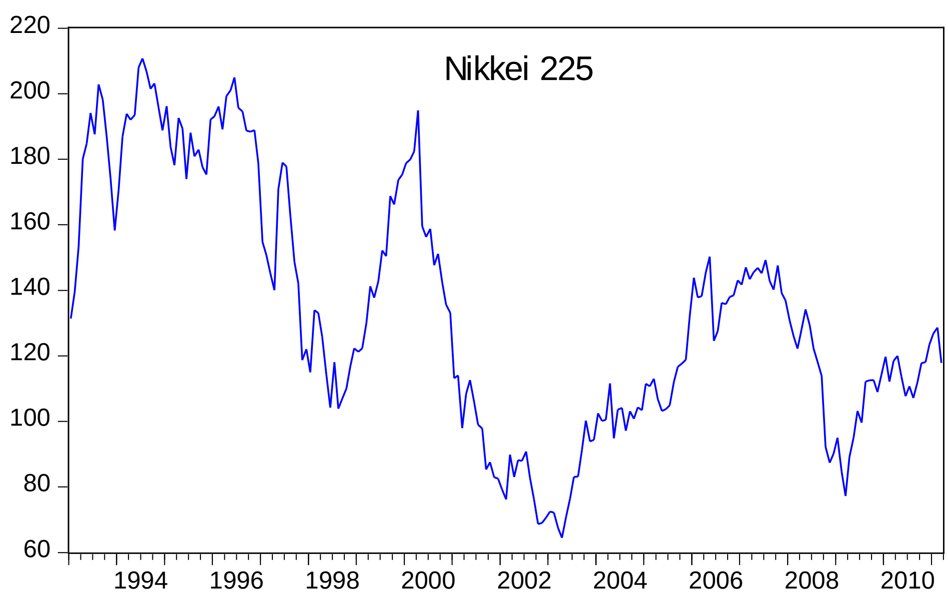

Figure 10: Nikkei 225 Index 1993-2011

4.6 Moscow Stock Exchange

It is the largest stock exchange in Russian Federation, located in Moscow, trading currencies, equities, derivatives and bonds. It was officially established in December 2011 by the merger of the two largest Moscow stock exchanges, the Russian Trading System and the Moscow Interbank Currency Exchange. Both organizations were shaped in the 1990s and for almost twenty years they were the most important exchanges in Russia, with the MICEX and RTS indices being among the world's top stock indices. This unification formed a single legal entity that is likely to turn into a leading stock exchange. The total market capitalization exceeds US$ 0.825 trillion by the end of December 2012. Also, this merger will result in unification of MICEX and RTS indices in the coming future. In this study, Russia’s real stock return has calculated based on RTS Index. It is a free-float capitalization-weighted index of stocks of the 50 largest Russian companies traded on the Moscow Exchange (wikipedia.com, 2013).

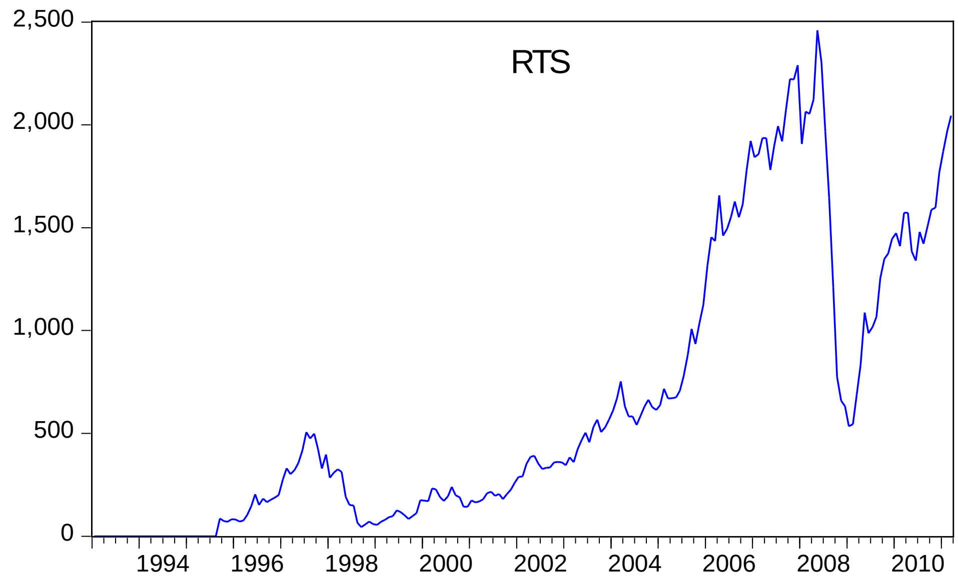

Figure 11: RTS Index 1993-2011

4.7 London Stock Exchange

This stock exchange located in London in the United Kingdom. The Exchange was founded in 1801 and by the end of 2012 its market capitalization is US$3.2 trillion which makes it the world's third largest stock exchange and the largest in Europe. LSE is the most international stock exchange in the world by hosting various companies from more than 70 countries. There are 2869 listed companies in London Stock Exchange. Currently, it's owned and operated by the London Stock Exchange Group. FTSE 100 or, informally, the "footsie" is the main index of LSE, is a stock index of the 100 companies listed on the London Stock Exchange with the largest market capitalization. It is a free-float capitalization-weighted index and it's maintained by the FTSE Group, a subsidiary of the London Stock Exchange Group. It is one of the most widely used stock indices and is seen as an indicator of business prosperity (wikipedia.com, 2013).

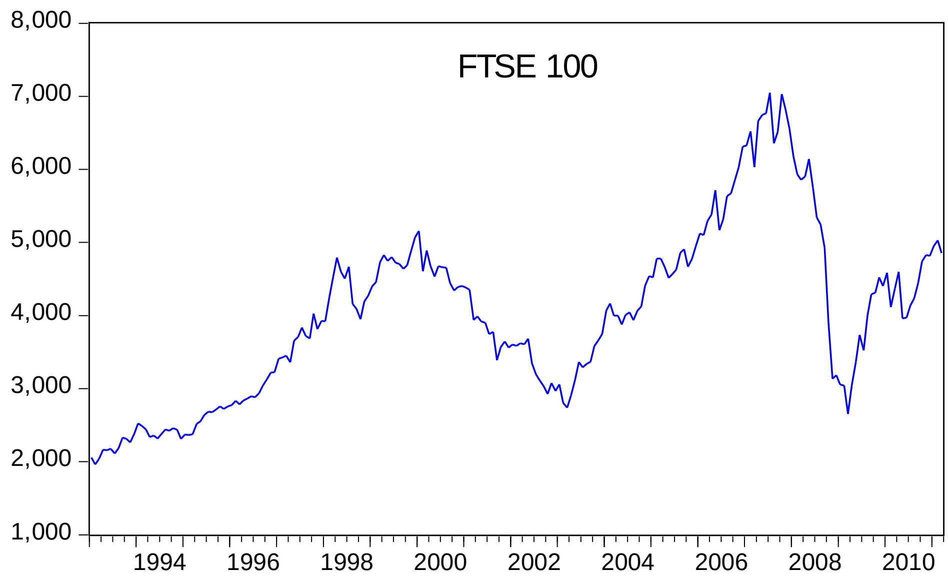

Figure 12: FTSE 100 Index 1993-2011

4.8 New York Stock Exchange

It is the world's largest stock exchange and located at 11 Wall Street, Lower Manhattan, New York City, United States. By the end of 2012, the market capitalization of its listed companies has reached US$14.085 trillion. Moreover, average daily trading value was around US$153 billion in 2008. The New York Stock Exchange is operated by NYSE Euronext, as a result of the merger with Euronext in 2007. The main index is The NYSE Composite index covering all common stock listed on the New York Stock Exchange, including American Real Estate Investment Trusts, Depositary Receipts and foreign listings. Since, the stocks of many foreign companies are in included in NYSE Composite, another leading index, S&P 500 has chosen for this study. This index is made up of stock prices of 500 largest companies listed in NYSE and it is maintained by Standard and Poor's. Like other leading indices, it's a free-float capitalization weighted index (www.wikinvest.com, 2013).

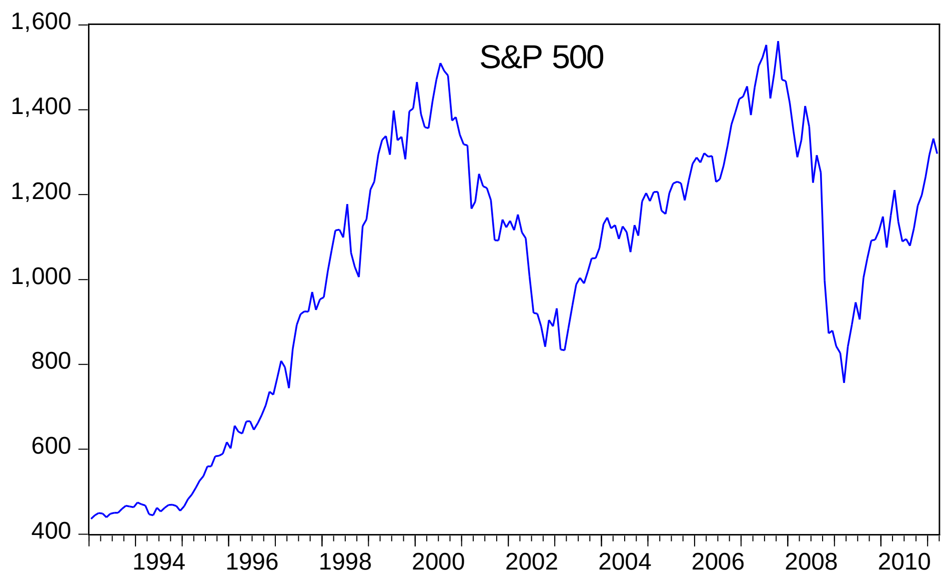

Figure 13: S&P 500 Index 1993-2011

Chapter 5

DATA AND METHODOLOGY

5.1 Type and Source of Data

Data used for this study is based on monthly time series data of the G8 countries over the period of 1993:1-2011:3. Variables of study are industrial production index (IPI), real short term interest rate (RIR), real oil price (ROP), and real stock return (RSR). Data of real short term interest rate is obtained from Federal Reserve Economic Data (FRED). For some of countries, industrial production indices are obtained from OECD database. Data of real oil price and real stock return are taken from Thomson Reuters DataStream database.

Industrial production index (IPI) is an economic indicator which measures the real production output of manufacturing, mining, and utilities. IPI is selected for this study because the total energy consumption in an economy depends on amount of goods and services produced within a country. Thus, it can act as proxy variable in this study. Real short term interest rate (RIR) is chosen because according to many researchers (Chen et al., 1986; Chen, 1991; Sadorsky, 1999, 2001) it can explain stock price movements. RIR is defined as 3-month T-bill rate deflated by consumer price index of each country. Real oil price (ROP) is based on the Brent spot crude oil ($/bbl) deflated by CPI of each country.

Brent crude oil is selected as the oil price variable because of two main reasons. Firstly, approximately 60% of total daily crude oil consumption is benchmarked by Brent oil price (Al-Fayoumi, 2009). Secondly, all types of crude oil prices have been perceived to move in the same direction empirically (Chang and Wong, 2003). Since, in this study the effect of oil price shocks on stock market return is the main focus; three different oil price shocks will be defined. First, the linear specification of oil price shock (DLROP) can be defined as first log difference of national oil price (US$ Brent/ national CPI). Second, world oil price shock (DLWOP) is defined as first log difference of Brent crude oil ($/bbl) divided by the U.S. producer price index (PPI). Park and Ratti (2008) suggest that statistically significant effect of oil price shock can be better captured by US$ Brent/ U.S. producer price index (PPI).

Third, net oil price increase (NOPI) introduced by Hamilton (1996, 2003) is aimed to show how an increase in the oil price will influence the spending plans of consumers and companies. He mentions that if the current oil price is higher than it has been in the past 12 months, then a NOPI shock has occurred. Therefore, in this analysis NOPI is defined as:

$$NOPI_t = \max(0, \log ROP_t - \max(\log ROP_{t-1} \ldots \log ROP_{t-12})) \qquad (1)$$

Real stock return (RSR) is defined as continuously compounded monthly return on stock price index deflated by each country's CPI (Park and Ratti, 2008).

5.2 Methodology

In this study, five types of analyses were employed. First, Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were undertaken to check the stationarity of selected variables. Second, Johansen (1990) cointegration test was used to evaluate the possible long-run relationship between variables of interest. Third, unrestricted vector autoregressive (VAR) approach were employed to capture the linear interdependency and dynamic relationships among variables of study. Later, the effects of oil price shocks on real stock returns were tested by means of Cholesky impulse response function and accumulated impulse response. Finally, the sources of volatility in real stock returns were identified using forecast error variance decomposition analysis.

5.2.1 Unit Root Tests

In econometrics, unit root tests are used to examine whether a time-series variable is stationary using an autoregressive model. There are various tests for unit root which can be used to determine the order of integration. Two of the most-widely used tests in econometrics literature are the Augmented Dickey-Fuller (ADF) (1979) and the Phillips-Perron (PP) (1988). The following model is used to test for unit root by including constant and trend:

number of lags “p” in the dependent variable by using the Akaike Information Criteria (AIC) or some other alternative tests for optimum lag (Katırcıoğlu et al., 2007).

T-statistics and t-tests for λ, is the main focus of both ADF and PP tests. The null hypothesis of both tests is that the series has a unit root (not stationary). Rejection of the null hypothesis means that the coefficient is significantly different from zero. If series is non-stationary at level, then we take the first difference to make it stationary. If series is stationary at level, then it is said to be integrated of order zero or called I(0); but if it is non-stationary, it is integrated of order one or called I(1). Enders (1995) recommends that we should start the test for unit root from the most general model by including trend and intercept.

The Phillips-Perron (1988) test becomes robust to serial correlation and heteroskedasticity in the errors by altering the Dickey-Fuller test statistics. This is done by the Newey-West (1987) heteroskedasticity and autocorrelation consistent covariance matrix estimator:

Where X_t, X_{t-1}, …, and X_{t-k}, are vectors of level and lagged values of P variable respectively which are I(1) in the model. Π_1, …, Π_k are coefficient matrices with PXP dimensions. Also, μ is intercept vector and ε_t is a vector of random errors. The number of lagged values is determined based on the assumption that error terms are not autocorrelated. The trace statistic is calculated by the following formula:

Another characteristic of VAR is that the specification of endogenous and exogenous variables is not necessary. In other words, all variables in a VAR model will be treated as endogenous (Brooks, 2008:44). For example, a VAR of order p, where the order p represents the number of lags, that includes k variables, can be expressed as:

5.2.4 Impulse Response Function (IRF)

In econometrics, impulse response functions are used to determine how the economy reacts over time to exogenous impulses or shocks. Impulse response functions are usually modeled in the framework of a VAR. IRFs show the response of endogenous macroeconomic variables such as GDP, consumption, and investment to an exogenous shock at specific time and also over successive points in time. Testing the estimated coefficients on successive lags in a VAR system is not suitable for detecting the dynamic relationships among the variables in the model. However, it is beneficial to trace out the system's reaction to typical random shocks that represent positive residuals of one standard deviation unit in each equation in the system. Thus, Sims (1980) recommends the use of impulse response function and variance decomposition for better interpretation of the VAR system. A bi-variable VAR (1) can be expressed as:

5.2.5 Variance Decomposition

One of the characteristics of a VAR model is its ability to conditionally forecast, particularly short-run forecasts, future movement of the variables in the system through getting the shapes of movement in the system. As a result, the multiperiod forecast error variance decompositions demonstrate that how much a random shock to one innovation is liable for forecasting following variation of the other innovation that is not already accounted for its own previous movement. In other words, variance decomposition of one variable shows that how much of its unforeseen changes can be explained by a shock in another variable in the VAR model.

Chapter 6

DATA ANALYSIS AND EMPIRICAL RESULTS

6.1 Unit Root Tests for Stationarity

This study employs two types of unit root tests on time-series data which are Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. Results are reported in Tables 1 and 2. Tests were carried out in both levels and first difference and there are two levels of restrictions. C represents the model with constant (intercept) and C&T is the most general model with constant and trend. As Katircioglu (2010) explains, PP tests are superior to ADF tests. Consequently, PP tests results will be mainly taken into consideration.

Table 1 shows the PP (Phillips and Perron, 1988) unit root test outcomes of the log level and first log difference of industrial production index (IPI), real oil price (ROP) , and real interest rate (RIR), and of real stock return (RSR) of the G8 countries. In Table 1 the null hypothesis that the level of LIPI has a unit root is rejected at 10% only for Japan. Moreover, in the level form, the null hypothesis that LROP has a unit root is rejected at 10% only for Russia. Also, RSR is rejected at 10% for all countries, so that, RSR for all countries is integrated of order zero or it's called I(0). Finally, the null hypothesis that LRIR has a unit root is rejected only for Germany at level form. At first difference, the null hypothesis that each variable has a unit root is rejected at 1% for all countries.

Thus, at first difference all variables become stationary and therefore they are integrated of order one or they're called I(1).

Table 1: Phillips & Perron (PP) Unit Root Test Results

Country	Variable	Level		First Difference	
		C	C&T	C	C&T
Canada	LIPI	-2.59	-1.47	-14.62*	-14.86*
	LROP	-0.78	-3.09	-14.81*	-14.82*
	RSR	-12.30*	-12.27*	-56.64*	-56.56*
	LRIR	-1.40	-2.35	-11.11*	-11.09*
France	LIPI	-2.1	-1.79	-18.59*	-18.65*
	LROP	-0.74	-3.12	-14.76*	-14.77*
	RSR	-13.01*	-13.02*	-82.13*	-81.93*
	LRIR	-1.93	-3.00	-10.63*	-10.62*
Germany	LIPI	-1.09	-2.86	-16.17*	-16.14*
	LROP	-0.73	-3.1	-14.65*	-14.66*
	RSR	-14.16*	-14.15*	-152.08*	-152.97*
	LRIR	-1.61	-3.25***	-10.79*	-10.76*
Italy	LIPI	-2.05	-1.91	-16.23*	-16.28*
	LROP	-0.81	-3.05	-14.69*	-14.70*
	RSR	-14.26*	-14.30*	-77.73*	-77.50*
	LRIR	-1.63	-2.49	-14.39*	-14.20*
Japan	LIPI	-2.67***	-2.56	-9.65*	-9.64*
	LROP	-0.53	-3.05	-14.73*	-14.60*
	RSR	-14.81*	-14.78*	-99.55*	-98.88*
	LRIR	-2.5	-2.36	-15.38*	-15.29*
Russia	LIPI	-0.67	-2.96	-15.68*	-16.00*
	LROP	-6.84*	-5.22*	-12.96*	-13.53*
	RSR	-11.60*	-11.58*	-26.57*	-26.49*
	LRIR	-0.78	-3.12	-17.35*	-17.32*
UK	LIPI	-1.47	-1.95	-16.93*	-17.43*
	LROP	-0.82	-3.1	-14.75*	-14.76*
	RSR	-13.93*	-13.94*	-55.23*	-54.96*
	LRIR	-0.05	-1.26	-8.64*	-8.51*
US	LIPI	-2.41	-1.52	-13.70*	-13.75*
	LROP	-0.81	-3.09	-14.87*	-14.88*
	RSR	-14.00*	-14.03*	-60.10*	-59.88*
	LRIR	-0.12	-1.49	-11.12*	-11.18*

***, ** and * denote rejection of the null hypothesis at 10%, 5% and 1% level of significance

Table 2: Augmented Dickey-Fuller (ADF) Unit Root Test Results:

Country	Variable	Level		First Difference	
		C	C&T	C	C&T
Canada	LIPI	-2.28	-1.59	-5.38*	-5.66*
	LROP	-0.78	-2.9	-14.81*	-14.82*
	RSR	-12.20*	-12.17*	-14.80*	-14.76*
	LRIR	-1.12	-2.78	-10.59*	-10.57*
France	LIPI	-2.34	-2.03	-6.47*	-6.57*
	LROP	-0.73	-2.93	-14.76*	-14.77*
	RSR	-12.99*	-13.01*	-12.73*	-12.70*
	LRIR	-1.59	-3.14***	-10.83*	-10.82*
Germany	LIPI	-1.43	-3.30***	-5.96*	-5.94*
	LROP	-0.7	-2.9	-14.65*	-14.65*
	RSR	-14.11*	-14.10*	-12.96*	-12.93*
	LRIR	-1.3	-3.48**	-11.00*	-10.97*
Italy	LIPI	-2.47	-2.43	-5.69*	-5.81*
	LROP	-0.78	-2.87	-14.69*	-14.70*
	RSR	-14.23*	-14.28*	-13.27*	-13.24*
	LRIR	-1.62	-2.75	-7.99*	-8.00*
Japan	LIPI	-3.23**	-3.033	-5.89*	-5.91*
	LROP	-0.51	-2.86	-14.73*	-14.74*
	RSR	-14.80*	-14.77*	-9.61*	-9.59*
	LRIR	-2.37	-2.27	-15.56*	-15.56*
Russia	LIPI	-0.54	-2.94	-15.69*	-16.07*
	LROP	-7.46*	-5.59*	-12.42*	-13.28*
	RSR	-11.46*	-11.44*	-15.21*	-15.18*
	LRIR	-0.58	-2.34	-12.90*	-12.87*
UK	LIPI	-1.45	-1.71	-17.14*	-17.63*
	LROP	-0.79	-2.91	-14.75*	-14.76*
	RSR	-13.68*	-13.70*	-12.60*	-12.59*
	LRIR	-0.1	-1.31	-8.64*	-8.83*
US	LIPI	-2.48	-2.43	-3.48*	-3.70*
	LROP	-0.82	-2.91	-14.87*	-14.88*
	RSR	-13.88*	-13.95*	-16.18*	-16.14*
	LRIR	-0.09	-1.44	-12.42*	-12.54*

***, ** and * denote rejection of the null hypothesis at 10%, 5% and 1% level of significance

Table 2 shows the ADF (Augmented Dickey-Fuller, 1979) unit root test outcomes of the log level and first log difference of industrial production index (IPI), real oil price (ROP), and real interest rate (RIR), and of real stock return (RSR) of the G8 countries. The ADF test results are almost the same with the PP test except for France and Germany. For these two countries, LIPI and LRIR are both stationary at level form. The rest of results are exactly the same as the PP test results. Altogether, at log level, industrial production index, real oil price and real interest rate are I(1) processes (first log difference stationary) for most of countries but real stock return is I(0) process (level stationary) for all of the countries.

6.2 Cointegration Analysis

Unit root tests results indicate that the variables of study are integrated of mix order. At first glance, one could say that since these variables integrated of mix order, classical cointegration approaches like Engel and Granger (1979) and Johansen (1990) as well as Johansen and Juselius (1990) cannot be adopted and as a result the bounds testing approach by Pesaran et al. (2001) must be conducted. But it is important to mention that in order to apply the bounds testing approach, the dependent variable must be I(1) which is not the case here because RSR is I(0) process.

On the other hand, Johansen (1990) Cointegration test can be only undertaken for those non-stationary variables which are integrated of the same order. Consequently, as the variables in this study like industrial production index (IPI), real oil price (ROP), and real interest rate (RIR) in log level each have a unit root, the Johansen (1990) cointegration test is conducted for common stochastic trend. The outcomes presented in

Table 3 shows that the null hypothesis of no cointegration is rejected only for Russia at 1% level of significance. According to this result and the findings by Engle and Yoo (1987), Clements and Hendry (1995), and Hoffman and Rasche (1996) unrestricted vector autoregressive (VAR) is superior to a restricted vector error correction model (VECM) in terms of forecast variance for short-term analysis.

Moreover, when the restriction is the case, the performance of an unrestricted VAR and a VECM for impulse response function for short-run analysis is almost equal (Naka and Tufte, 1997).

Table 3: Johansen Cointegration Test (Variables: Real Interest Rate, Real Oil Price, Industrial Production in Log Levels)

Country	Hypothesis	r = 0	r =< 1	r =< 2
Canada	Trace Test	28.555	9.110	1.907
	λ Max Test	19.445	7.203	1.907
France	Trace Test	27.711	7.921	0.253
	λ Max Test	19.790	7.668	0.253
Germany	Trace Test	26.976	9.353	0.036
	λ Max Test	17.623	9.318	0.036
Italy	Trace Test	28.740	9.531	0.839
	λ Max Test	19.209	8.692	0.839
Japan	Trace Test	19.524	5.606	0.031
	λ Max Test	13.918	5.575	0.031
Russia	Trace Test	52.164 *	16.124 **	2.017
	λ Max Test	36.039 *	14.108 **	2.017
U.K.	Trace Test	22.951	4.893	0.162
	λ Max Test	18.058	4.732	0.162
U.S.	Trace Test	22.676	8.535	0.182
	λ Max Test	14.141	8.353	0.182

(**)* denotes rejection of the null hypothesis at (5%) 1% level of significance

6.3 Vector Autoregressive (VAR)

In this study, the dynamic relationship between oil price shocks and real stock returns is investigated by means of an unrestricted vector autoregression (VAR) model. In the literature, a VAR model has been often used to examine the influence of oil price shocks on macroeconomic variables since study by Darby (1982) and Hamilton (1983). The main privilege of this model is the ability to detect the dynamic interactions between the economic variables of interest.

The basic VAR model in this study has four stationary variables and as it is known all of the variables in a VAR model must have same order of integration, thus first log difference of industrial production index (IPI), real oil price (ROP), real interest rate (RIR), and level form of real stock returns (RSR) will be taken into account (all of them are I(0) processes). In this VAR system, real oil price variable will be either first log difference of national real oil price (DLROP) or first log difference of world real oil price (DLWOP) or net oil price increase (NOPI). Lag length of the VAR models in Eq. (8), p, will be taken to be 3 for all VARs based on Akaike information criterion (AIC). Later, this basic VAR model will be extended to permit for the possibility of spillover effects from the U.S. stock market to the other G8 countries' stock markets.

6.4 Impact of Oil Price Shock on Real Stock Return:

6.4.1 Impulse Response Functions

In this section the impact of oil price shocks on real stock market returns is investigated via Cholesky impulse response functions and accumulated impulse responses using different oil price shock specifications (DLROP, DLWOP and NOPI). Table 4 and

Figures 14-21 show the response of real stock returns to a one standard deviation shock (innovation) of real oil price. The statistical significance of the impulse response functions can be measured by using the given 95% confidence intervals. These figures show that in most of the countries, an oil price shock has a significant negative effect on real stock returns at the 10% level immediately or within one month.

Table 4: Impulse Response Function of Real Stock Returns to Oil Price Shocks: VAR (DLRIR, OIL, DLIPI, RSR)

Oil Price Shock	Canada	France	Germany	Italy	Japan	Russia	U.K.	U.S.
DLROP	+	-	-	-	-	+	-	-
DLWOP	+	-	-	-	-	+	#	-
NOPI	+	-	#	-	#	+	#	-

+ (-) denote positively (negatively) significant at 10% level, #: insignificant at 10% level

The results are different based on which types of oil price specification (DLROP, DLWOP, and NOPI) are used. For instance, by using national oil price shock (DLROP), only responses of Canada and Russia are positive and significant at 10% but responses of the other countries are negative. In the case of world oil price shock (DLWOP), the outcomes are almost the same with the previous oil shock except for U.K. which is not significant at 10%. By using net oil price increase (NOPI) as an oil shock in the VAR model, results are a little different comparing with both prior oil price shocks. In this case, Canada and Russia show a significant positive response and France, Italy and the U.S. show a significant negative response. The responses of Germany, Japan and U.K. are not significant at 10%.

The above findings are consistent with the literature which studies the effect of oil price shocks on stock market. This indicates that oil price shocks influence the earnings of firms which use oil in production and as a result their productions decrease. Furthermore, by assuming an efficient stock market, these negative effects will cause stock prices to decline and consequently the real stock returns will fall too. It is interesting that the responses of Canada and Russia as the net oil exporters are positive and significant. The remaining countries which are almost net oil importers show a negative and significant (in most of the cases) responses.

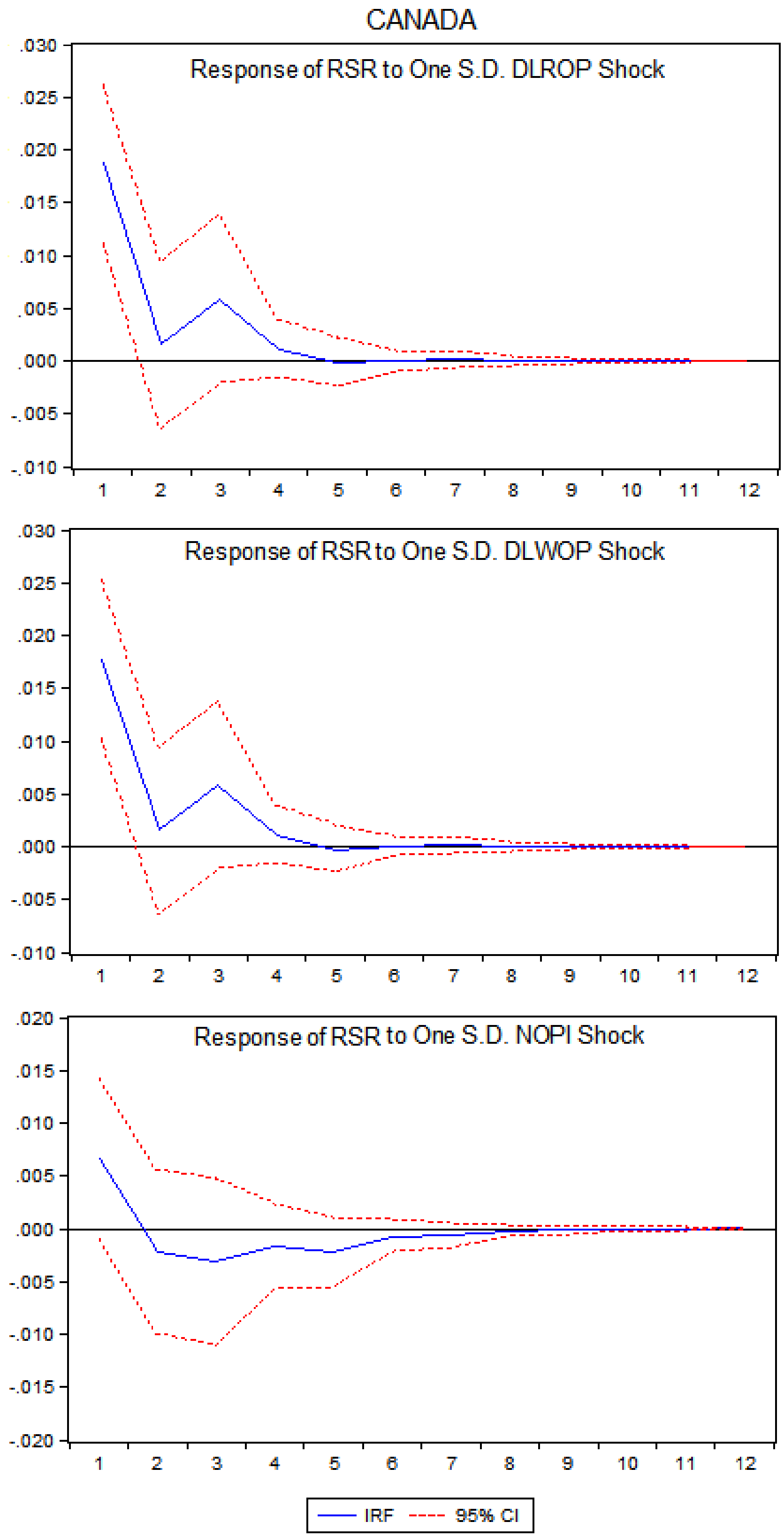

Figure 14: Impulse Response Function of Real Stock Returns of Canada to Different Oil Price Shocks

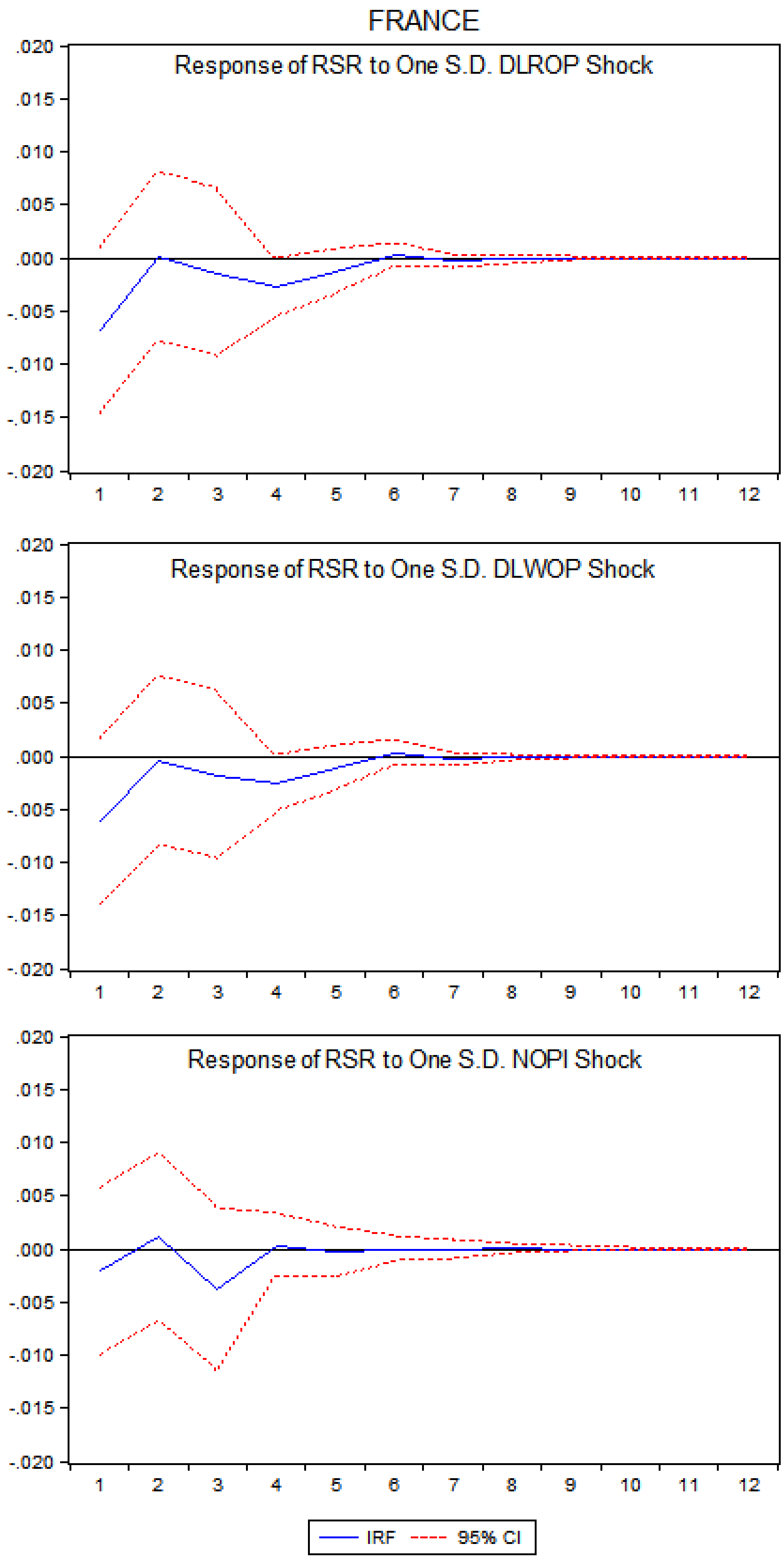

Figure 15: Impulse Response Function of Real Stock Returns of France to Different Oil Price Shocks

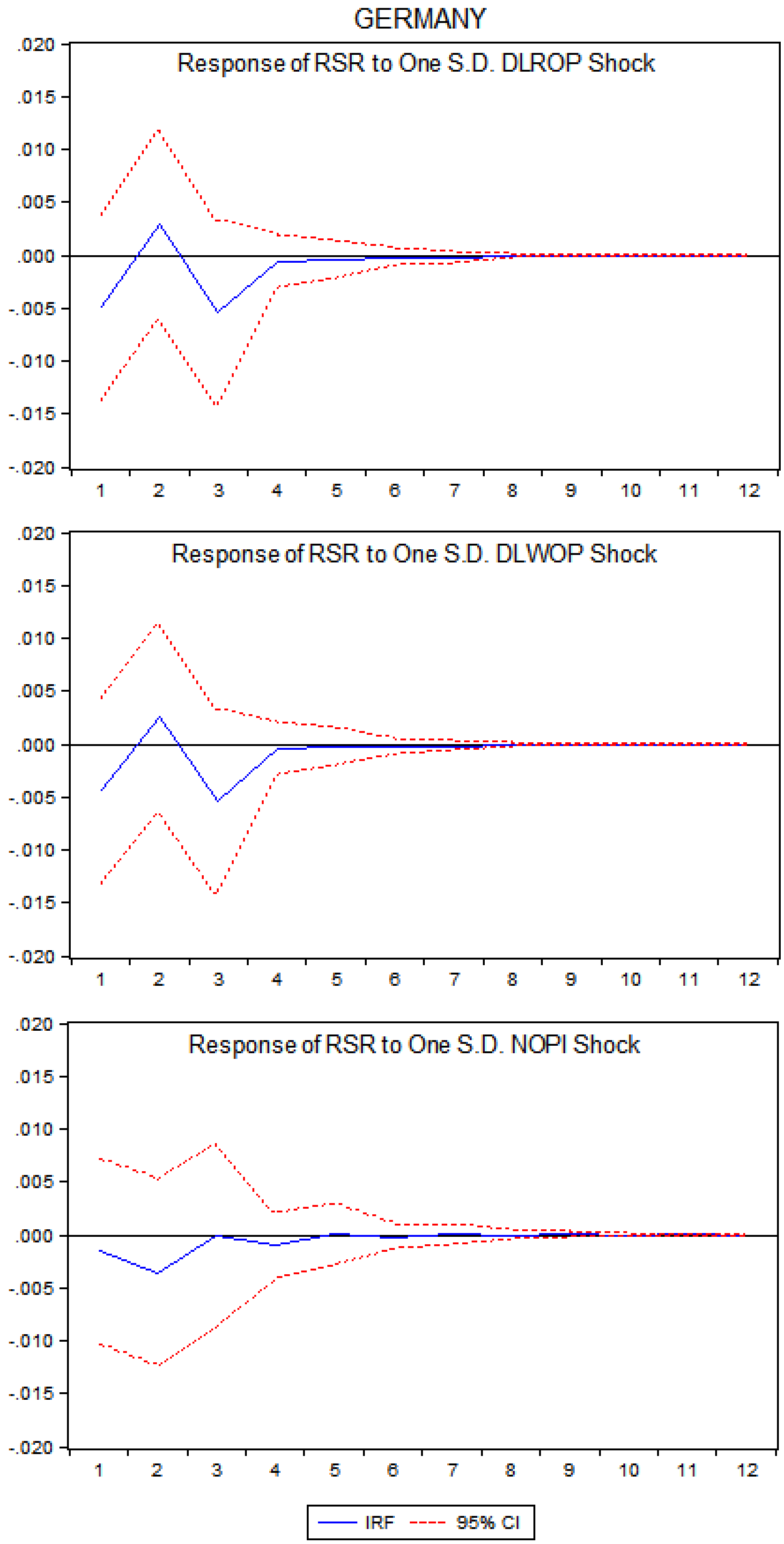

Figure 16: Impulse Response Function of Real Stock Returns of Germany to Different Oil Price Shocks

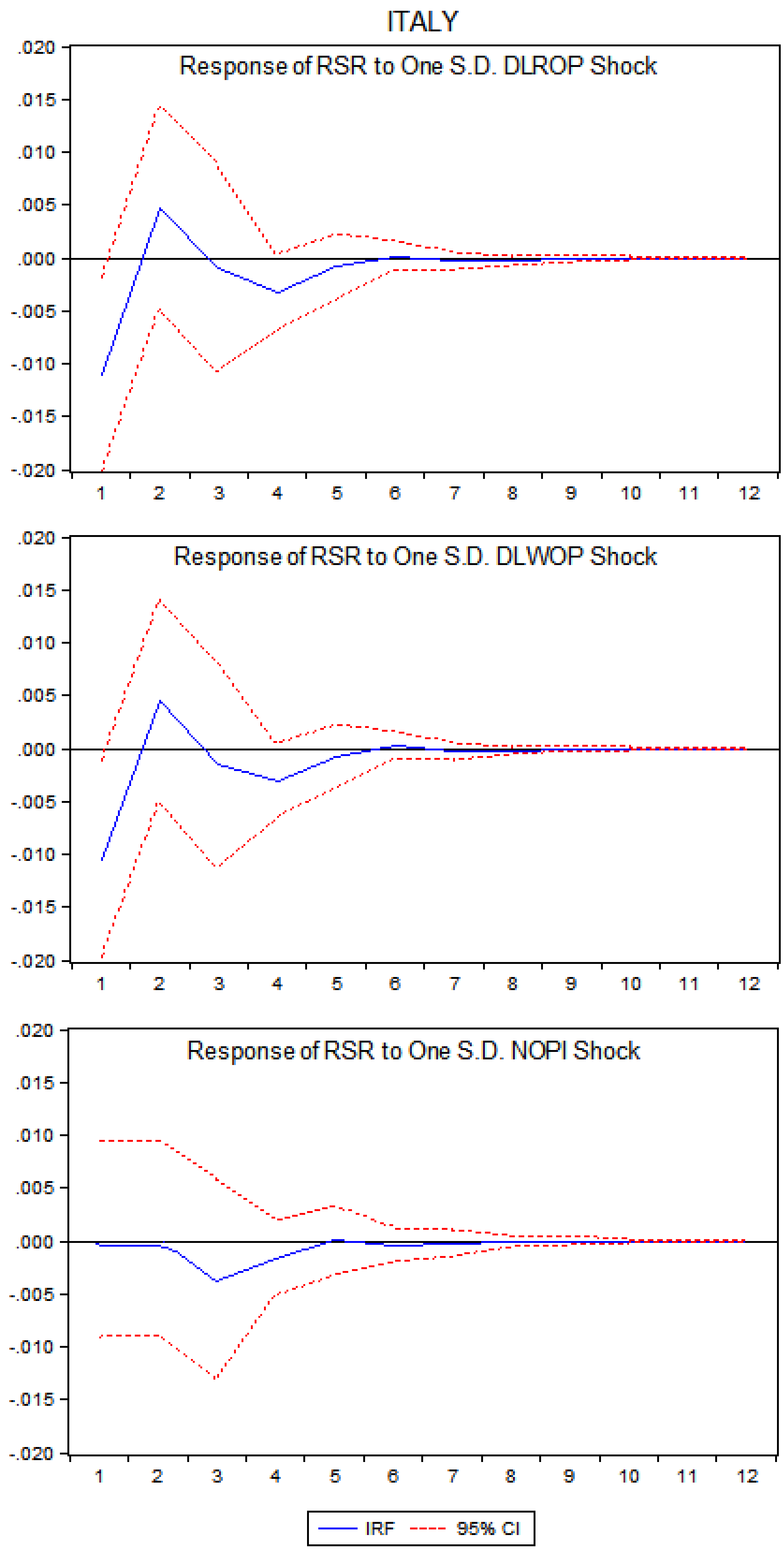

Figure 17: Impulse Response Function of Real Stock Returns of Italy to Different Oil Price Shocks

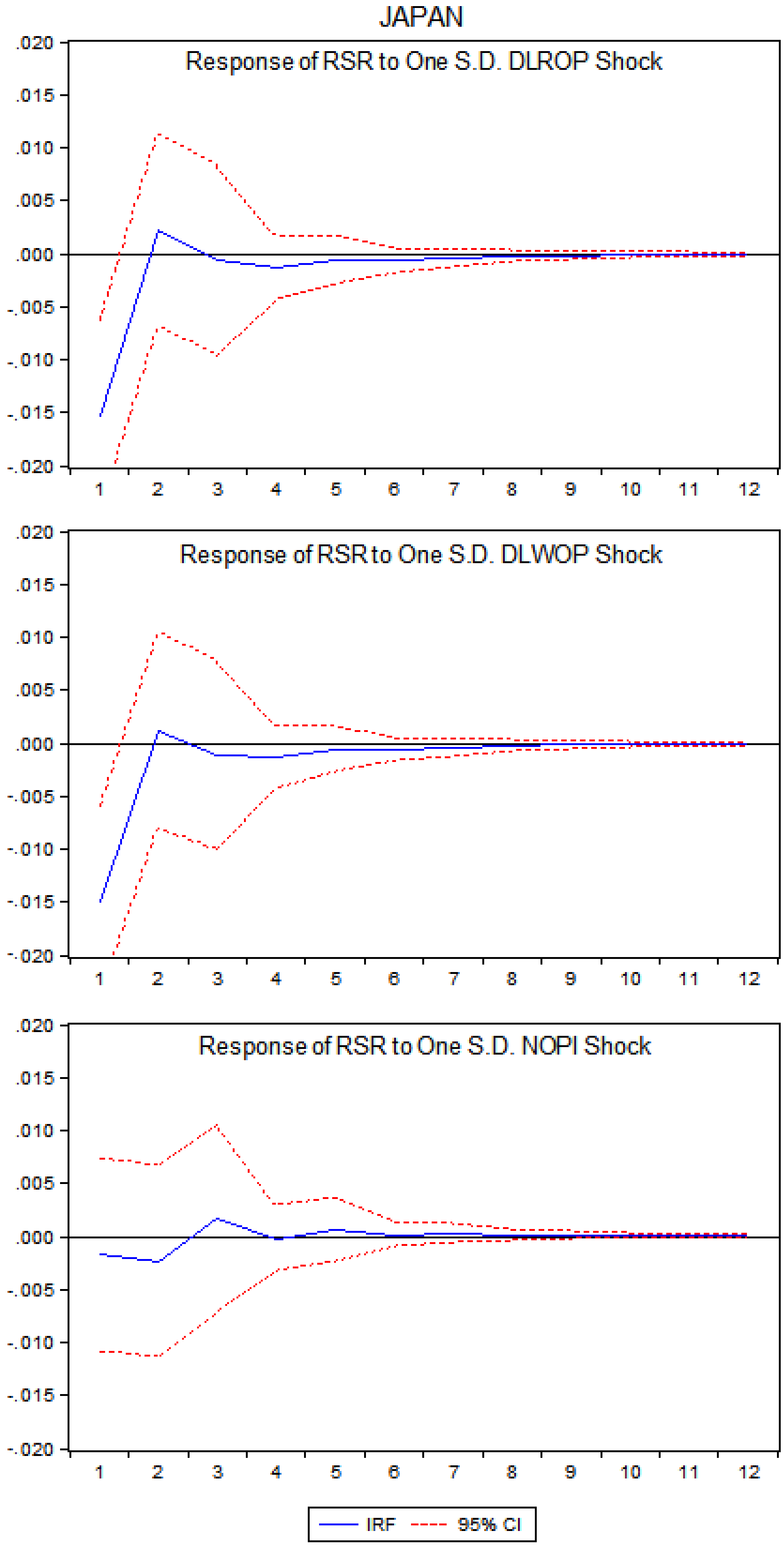

Figure 18: Impulse Response Function of Real Stock Returns of Japan to Different Oil Price Shocks

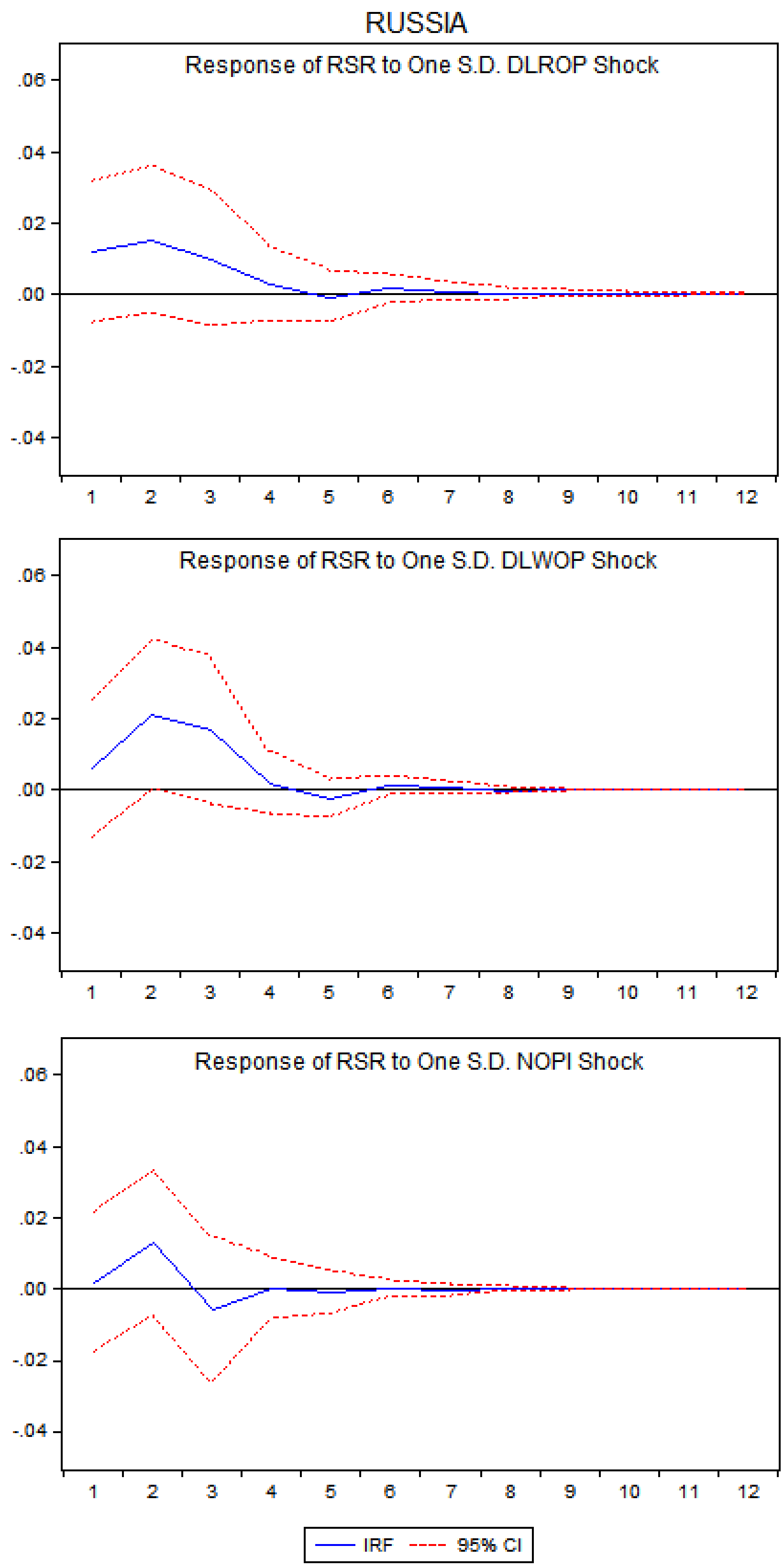

Figure 19: Impulse Response Function of Real Stock Returns of Russia to Different Oil Price Shocks

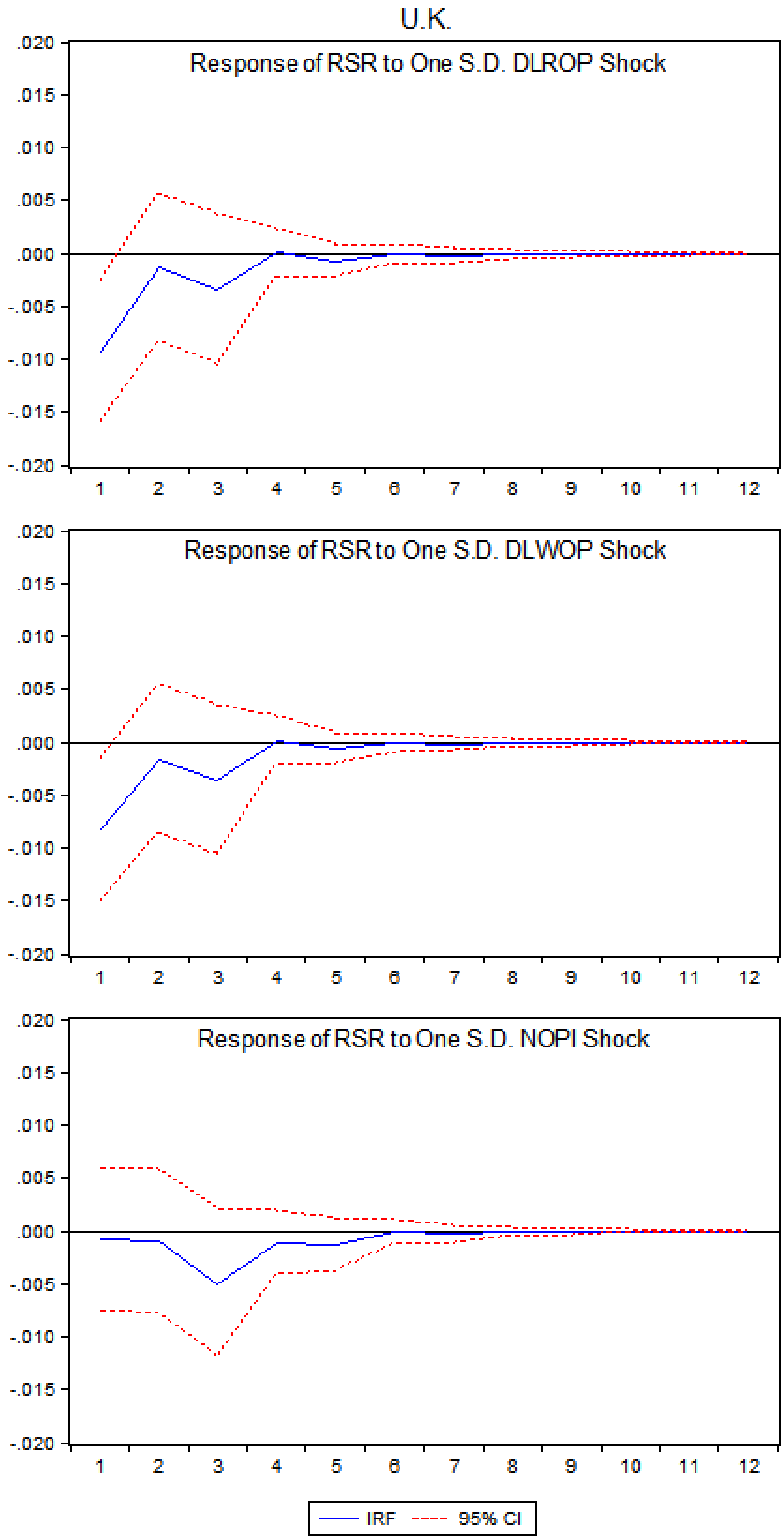

Figure 20: Impulse Response Function of Real Stock Returns of U.K. to Different Oil Price Shocks

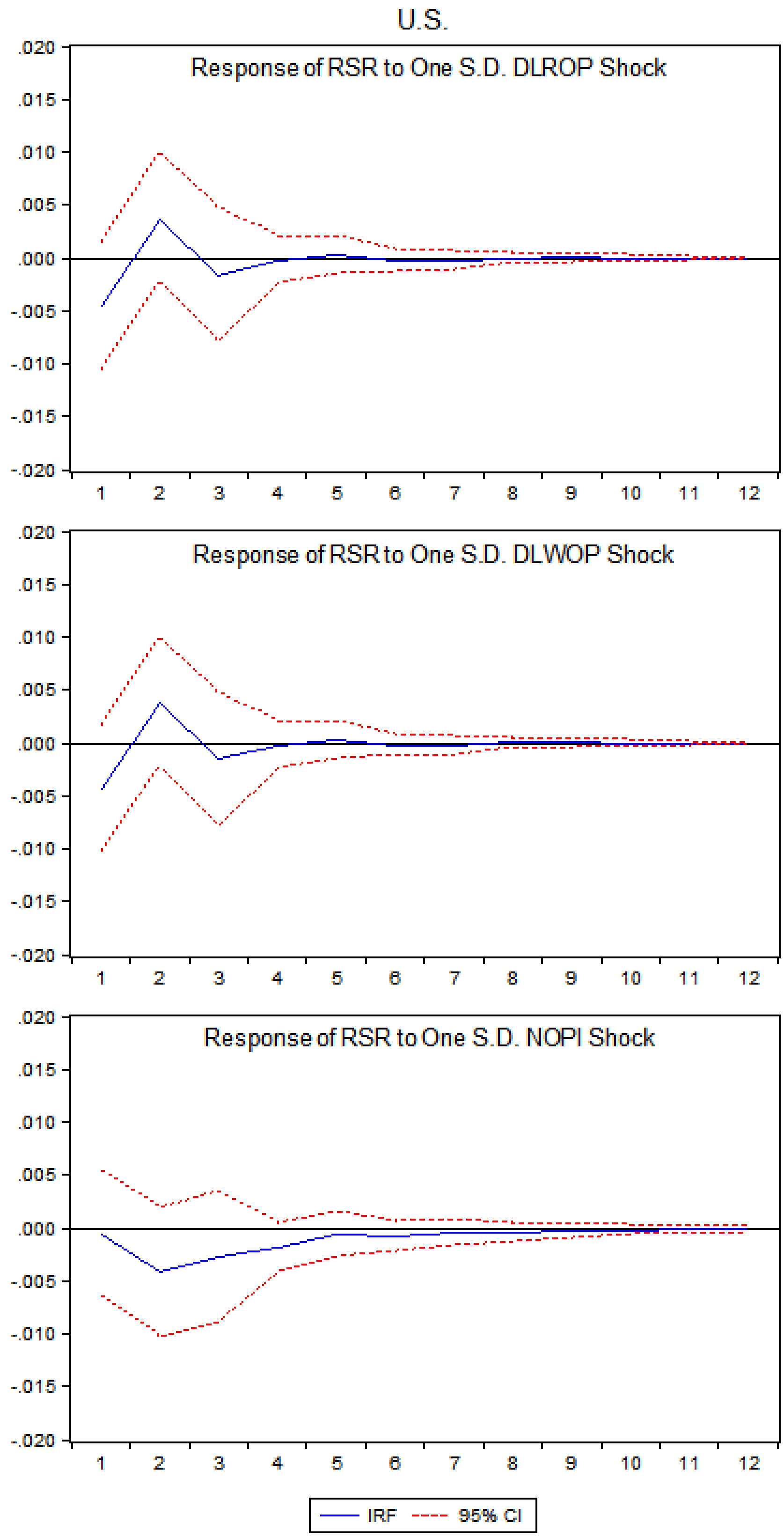

Figure 21: Impulse Response Function of Real Stock Returns of the U.S. to Different Oil Price Shocks

The accumulated impacts of oil price shocks on real stock returns after 1, 4, 8, and 12 months are presented in Table 5. By using DLROP in the VAR model, the highest positive accumulated effect is 4.19% in Russia after 12 months. This means that, a 100% oil price shock will increase Russia's real stock return by 4.19% after 12 months. Also, the highest negative accumulated effect is -1.76% in Japan after 12 months. In the case of DLWOP, the highest positive accumulated effect is 4.54% in Russia after 4 months. Moreover, the real stock return in Japan is affected by -1.85% after 12 months which is the highest negative accumulated effect. In the case of NOPI, Russia shows the highest positive accumulated effect by 0.93% after 4 months. On the other hand, the U.S. shows the highest negative accumulated effect by -1.24% after 12 months.

Table 5: Accumulated Responses of Stock Returns to Oil Price Shocks:
VAR (DLRIR, OIL, DLIPI, RSR)

DLROP / Month	Canada	France	Germany	Italy	Japan	Russia	U.K.	U.S.
1	1.87*	-0.67**	-0.50*	-1.11*	-1.52**	1.19*	-0.92**	-0.45*
4	2.72*	-1.09**	-0.81*	-1.07**	-1.53*	3.99*	-1.39*	-0.26**
8	2.71*	-1.25**	-0.91*	-1.20*	-1.72*	4.14*	-1.51*	-0.30*
12	2.71*	-1.27**	-0.92*	-1.22*	-1.76**	4.19*	-1.54*	-0.31*

DLWOP / Month	Canada	France	Germany	Italy	Japan	Russia	U.K.	U.S.
1	1.77*	-0.61**	-0.43**	-1.04*	-1.49*	0.59**	-0.78	-0.42*
4	2.62*	-1.09*	-0.77**	-1.06**	-1.62*	4.54*	-0.80	-0.23**
8	2.60*	-1.23*	-0.85**	-1.17*	-1.81*	4.46*	-0.94	-0.25**
12	2.59*	-1.24*	-0.86*	-1.18*	-1.85*	4.46*	-1.09	-0.26**

NOPI / Month	Canada	France	Germany	Italy	Japan	Russia	U.K.	U.S.
1	0.66*	-0.21**	-0.32	-0.24*	-0.54	0.18*	-0.11	-0.05**
4	0.33*	-0.45**	-0.51	-0.48*	-0.86	0.93*	-0.39	-0.93**
8	0.42*	-0.50**	-0.64	-0.53*	-0.65	0.81*	-0.27	-1.16**
12	0.44*	-0.51**	-0.59	-0.57**	-0.46	0.80*	-0.28	-1.24**

***, **, and * denote statistical significance at 10%, 5% and 1% levels

6.4.2 Variance Decomposition

The results of the forecast error variance decomposition of real stock returns due to oil price shock after 12 months are presented in Table 6. The outcomes show how much of the unexpected variations in real stock returns are explained by oil price shocks. By using this basic VAR (DLRIR, OIL, DLIPI, RSR) model, variance decomposition demonstrates that oil price shocks are a substantial source of instability for real stock returns.

Table 6: Variance Decomposition of Real Stock Returns Due to Oil Price Shocks after 12 Months VAR (DLRIR, OIL, DLIPI, RSR)

Oil Price Shock	Canada	France	Germany	Italy	Japan	Russia	U.K.	U.S.
DLROP	10.94*	1.64*	1.46*	3.07*	5.20*	2.04*	3.68**	1.73**
DLWOP	9.90*	1.39*	1.27**	2.74**	4.91*	3.21*	1.78	1.66**
NOPI	1.93*	0.58**	0.86	0.33**	0.75	0.88**	0.58	1.44**

***, **, and * denote statistical significance at 10%, 5% and 1% levels

The impact of an oil price shock to the real stock returns varies from 1.46% to 10.94% in the case of DLROP. This suggests that the national real oil price shock is an important source of volatility for real stock returns in Canada. This result indicates that the stock market in Canada is the most sensitive market to an oil price shock among the G8 countries. This can be justified by the fact that Toronto Stock Exchange has more oil and gas listed companies than any other exchange in the world. Conversely, the less sensitivity of U.S. stock market to an oil price shock in this case is a little bit misleading as its market capitalization is around $14 trillion and respectively the proportion of the U.S. oil sector is smaller than the oil sector in Canada.

Thus, based on the U.S. variance decomposition, it should not be concluded that the oil price shocks don’t play an important role in explaining volatility of real stock returns in NYSE. This outcomes are consistent with Sadorsky (1999) and Park and Ratti (2007).

6.5 Asymmetric Effect of Oil Price Shocks

According to the literature, positive oil price shocks have been found to have a larger impact (in absolute value) on macroeconomic variables than have negative oil price shocks. This is called asymmetric effect of oil price shocks and it has been confirmed by Mork (1989), Hooker (1996), Davis and Haltiwanger (2001), Lee et al. (2001), and Huang et al. (2005). As a result, the existence of asymmetric effect of oil shocks on real stock returns will be examined in this section.

In order to measure this asymmetric pattern, a VAR model is established with five variables and each of the previous oil shocks is replaced by two variables through splitting oil price shocks into positive and negative ones. This can be done only by using DLROP and DLWOP in the VAR system because the NOPI cannot be divided into two parts since it is defined as net oil price increase so it’s just a positive oil price shock. Also the optimal lag length is taken to be 3 for all VARs based on Akaike information criterion (AIC). Figures 22-23 show the impulse response of real stock return to a one standard deviation positive and negative oil price shocks. Since, the resulting figures of impulse response functions of DLROP and DLWOP are very similar, therefore the figures of DLWOP are not presented to economize on space.

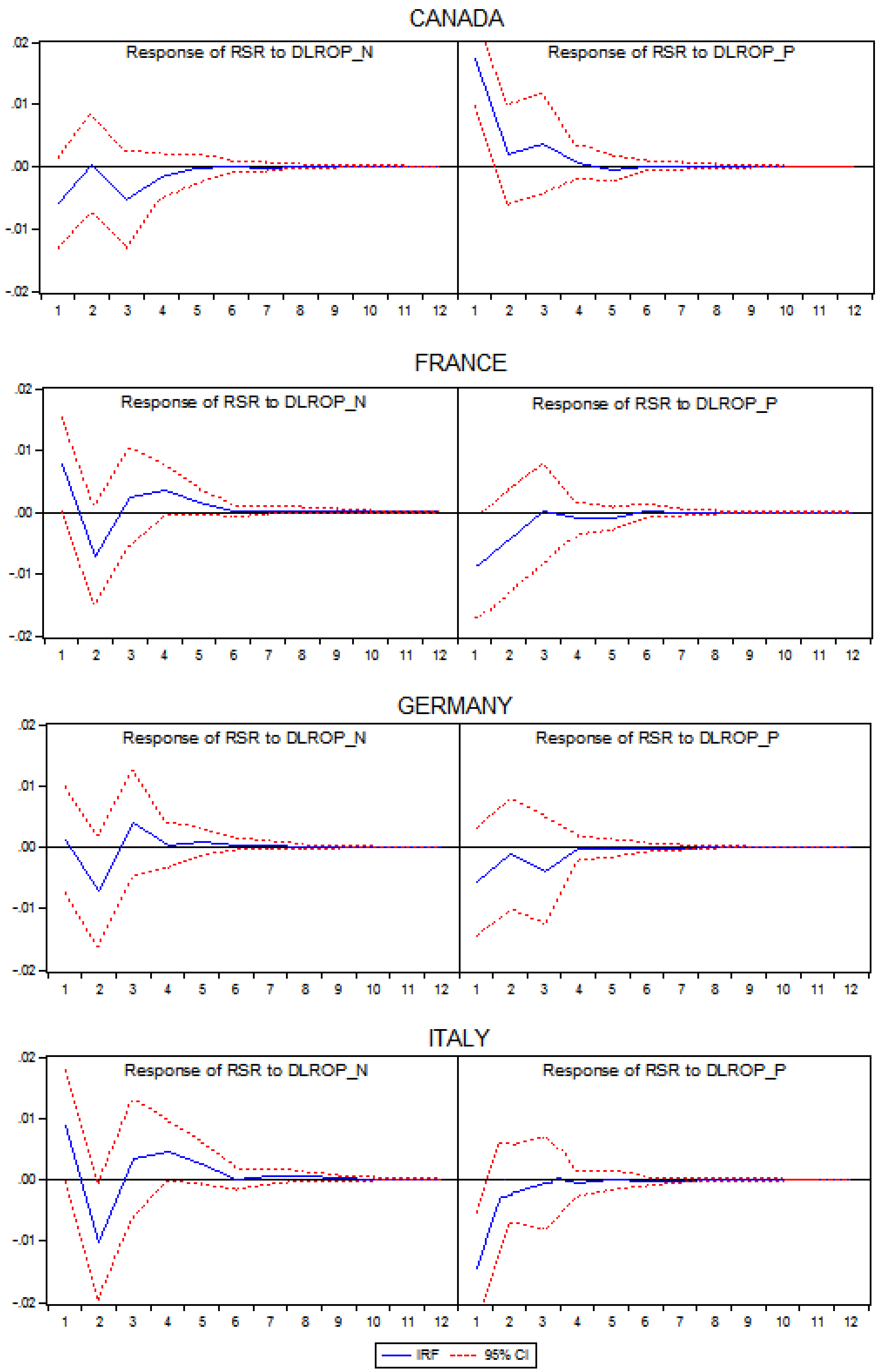

Figure 22: Impulse Response Function of Real Stock Returns to Negative and Positive Oil Price Shocks in Canada, France Germany and Italy

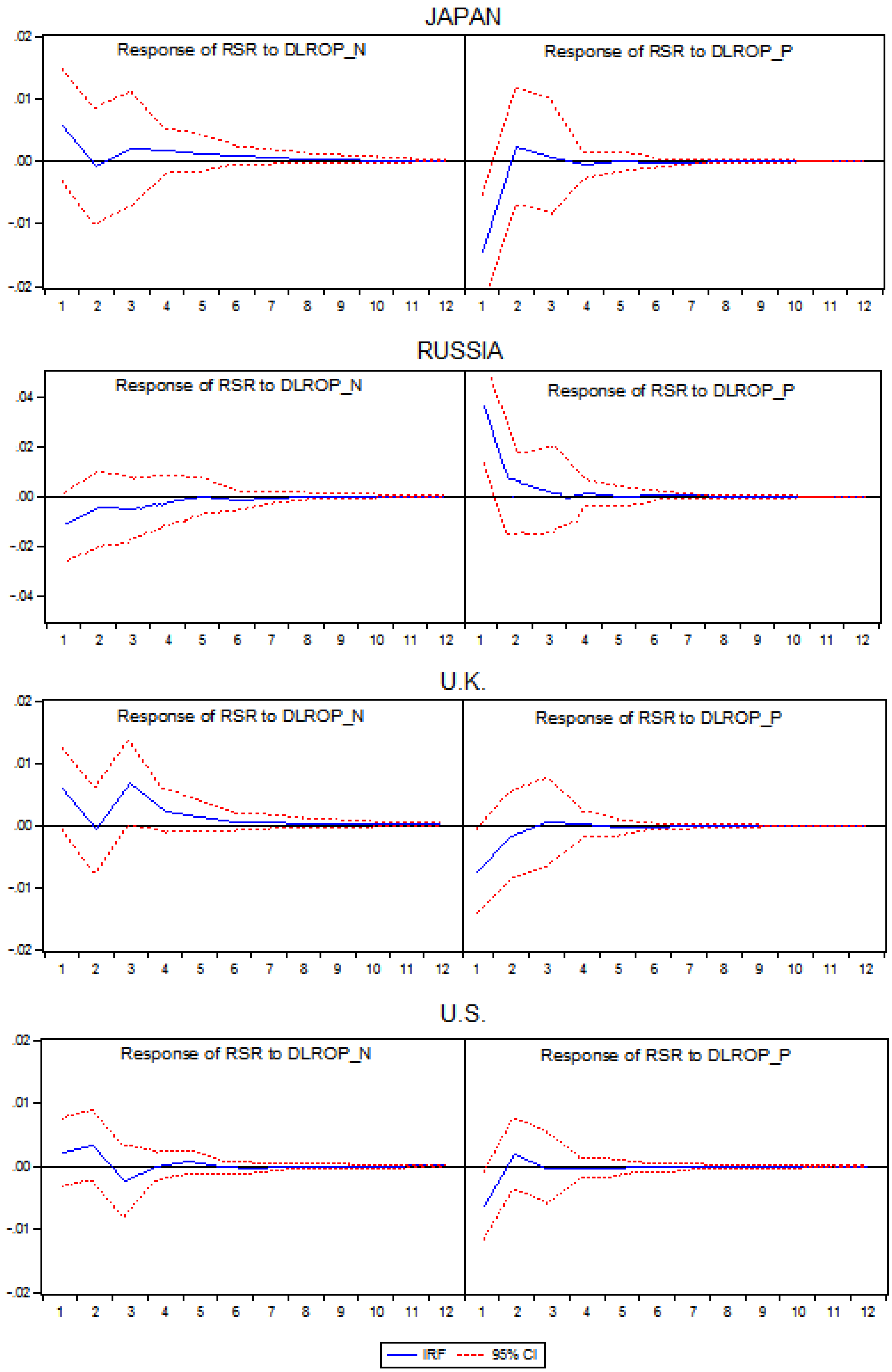

Figure 23: Impulse Response Function of Real Stock Returns to Negative and Positive Oil Price Shocks in Japan, Russia, U.K. and the U.S.

The response of real stock return to a one standard deviation shock of DLROP_N is negative only in the case of Canada and Russia and for the other countries is positive. This result indicates that real stock returns in net oil exporting countries like Canada and Russia will be negatively affected if a negative oil price shock occurs. On the other hand, real stock returns of the net oil importing countries are negatively affected by a positive oil price shock (DLROP_P). Moreover, as it is obvious in the figures the magnitude of the effects of negative and positive oil price shocks are not the same which confirms the asymmetric effect of oil price shocks on real stock returns. That Results of the variance decomposition of real stock returns due to asymmetric oil price shocks are presented in Table 7.

Table 7: Asymmetric Effect of Oil Shocks: Variance Decomposition of Real Stock Returns Due to Oil Price Shocks After 12 Months
VAR (DLRIR, OILP, OILN, DLIPI, RSR)

Oil Price Shock		Canada	France	Germany	Italy	Japan	Russia	U.K.	U.S.
DLROP	P	9.51*	1.07**	1.11**	1.30**	4.67*	2.61*	2.03*	2.60*
	N	2.11*	3.65**	1.56**	4.17*	0.91	0.39**	3.17**	1.13
DLWOP	P	8.90*	1.14**	1.10**	1.17**	4.50*	3.09*	1.87	2.41*
	N	1.80*	3.30**	1.83**	3.91**	0.75	1.14*	2.93	1.29

***, **, and * denote statistical significance at 10%, 5% and 1% levels

By using the both oil price shock specifications in the VAR model, the positive oil price shock has a greater and significant impact on real stock return than negative oil price shock for Canada, Japan, Russia and the U.S. Surprisingly, for the rest of countries negative oil price shock has a greater and in most of the cases significant effect on stock market returns. It is interesting that for net oil exporting countries, Canada and Russia, the positive oil price shock affects their real stock returns more than negative shocks. On the contrary, for net oil importing countries, unanticipated real stock return volatilities can be explained by negative oil price shocks more than the positive shocks. Therefore, it can be concluded that positive oil price shocks are more surprising for stock markets of net oil exporting countries and negative oil price shocks are more surprising for stock markets of net oil importing countries (except for Japan and the U.S.).

6.6 Spillover Effects from U.S. Stock Market

Spillover effects are defined as side-effects of business or economic activities which indirectly influence some economic sectors or variables unexpectedly. As the U.S. stock markets account for a significant portion of global stock markets, thus it is necessary to investigate the possible spillover effects from U.S. stock market (NYSE) to the other stock markets of the G8 countries. In order to perform this analysis, the variable of real stock return of the U.S. should be added to the VAR model to be able to capture the possible spillover effect from NYSE to the other stock markets. Therefore, the new VAR model will be comprised of VAR (DLRIR, OIL, DLIPI, RSR_US, RSR). This VAR ordering allows the spillover effect from the U.S. stock market to the other stock markets but not vice versa (Park and Ratti, 2007). Table 8 shows the results of variance decomposition of real stock returns due to oil price shocks considering spillover from U.S. stock market after 12 months. Based on the DLROP as the oil price shock, Canada, Germany and U.K. receive the greatest significant influence from the U.S. stock market among the other countries by more than 50%. In other words, after 12 months more than 50% of volatility in real stock return of Canada, Germany and U.K. can be explained by the U.S. RSR shock.

Table 8: Variance Decomposition of Real Stock Return Due to Oil Price Shocks Given Spillover from U.S. Stock Market after 12 Months

VAR Model	VAR(DLRIR, DLROP, DLIPI, RSR_US, RSR)	
Shocks	Due to DLROP	Due to RSR_US
Canada	10.51*	50.84*
France	1.69**	39.55**
Germany	1.38*	52.57*
Italy	2.99**	28.16**
Japan	5.51*	20.21*
Russia	2.19*	4.24**
U.K.	3.39*	50.74*

VAR Model	VAR(DLRIR, DLWOP, DLIPI, RSR_US, RSR)	
Shocks	Due to DLWOP	Due to RSR_US
Canada	9.48*	51.38*
France	1.44**	39.85**
Germany	1.20**	52.81*
Italy	2.65**	28.32**
Japan	5.19*	20.54*
Russia	3.55*	4.54*
U.K.	2.82***	51.07***

VAR Model	VAR(DLRIR, NOPI, DLIPI, RSR_US, RSR)	
Shocks	Due to NOPI	Due to RSR_US
Canada	2.05*	54.34*
France	0.58**	41.19**
Germany	0.46	53.32
Italy	0.34**	30.90**
Japan	0.28	23.24
Russia	0.95**	4.75*
U.K.	1.11	52.38

***, **, and * denote statistical significance at 10%, 5% and 1% levels

Therefore, these stock markets are very sensitive to the movement of the U.S. stock market. Interestingly, Russia is received the lowest spillover effect from the U.S. stock market by 4.24%. Thus, the NYSE is not a good source for explaining the RSR variation of Moscow stock exchange. Results of variance decomposition of the RSR due to DLROP shock is almost the same as the previous VAR model without the U.S. real stock return variable. A VAR system with the world oil price shock (DLWOP) gives roughly the same result as the prior VAR model with DLROP and the significance levels for some cases are changed but still all cases are significant at least at 10% level. In the last VAR model with Hamilton's oil price shock specification (NOPI) shows that the U.S. stock market is the source of more than 50% volatilities in the real stock returns of Canada, Germany and U.K. after 12 months but the result of variance decomposition of RSR in Canada (54.34%) is only significant. As before, the U.S. stock market is the least effective source of variation in the RSR of Russia by 4.75%. Overally, the strong evidence is found to support the spillover effect from the U.S. stock market to the other stock markets of the G8 countries.

Chapter 7

CONCLUSION

7.1 Summary of Findings

This empirical study has investigated the impact of oil price shocks on the stock markets of the G8 countries in terms of real stock returns. In order to examine this relationship, some other factors like industrial production index, short-term interest rate have added to the study to act as the proxy variables along with the main variables of interest which were real oil price and real stock return. Data used for this study is based on monthly time series data of the G8 countries over the period of 1993:1-2011:3.

Various econometric approaches like unit root tests, vector autoregressives, impulse response functions and forecast error variance decompositions have applied to the selected data. One of the main aims of this study was to understand the behaviors of stock markets of the net oil importing and net oil exporting countries after an oil price shock. According to the results of impulse response functions, the stock markets of Canada and Russia as the only net oil exporter members of the G8, have significantly and positively affected by different oil price shock specifications instantly or within one month.

On the contrary, the rest of countries which are the net oil importers have shown negative responses to different oil price shocks. The largest positive accumulated response has recorded for Russia by 4.54% after 4 months using world oil price shock. Also, the largest negative response was for Japan stock market by -1.85% after 12 months using DLWOP as the oil shock. Additionally, the results of variance decompositions have revealed that oil price shocks contribute to the variation in real stock returns. For instance, the DLROP shock was the major contributor to the volatility of Canada's real stock return. The results of forecast error variance decompositions range from 10.94% for Canada using DLROP to 0.33% for Italy using NOPI.

Furthermore, by means of impulse response functions and variance decompositions, the asymmetric effect of oil price shocks has been proven. The results suggest that the impacts of positive and negative oil price shocks on real stock returns of these countries are not identical. In this regard, it should be mentioned that positive oil price shocks had a greater impact on real stock returns than negative oil price shocks in the case of net oil exporting countries. Contrariwise, for the net oil importing countries, negative oil price shocks had a greater influence on real stock returns than positive oil price shocks. Of course, the behavior of Japan's stock market was not matching with this pattern.

Due to the substantial role of the U.S. stock markets in global capital markets, the possible spillover effects from the U.S. stock market to the other stock markets have been assessed. The variance decomposition results have confirmed that the stock markets of the G8 countries are more sensitive to a U.S. real stock return shock than to an oil price shock. Results have shown that a RSR shock to the U.S. stock market was the source of more than 50% of variations in the real stock returns of Canada, Germany and U.K. after 12 months.

7.2 Policy Implications

The increasing trend of the internationalization of stock markets along with the economic globalization, require more understanding of stock market movements for better portfolio diversifications. As it is proven in this study, the stock markets of the G8 countries are exposed to oil price shocks and therefore a proper consideration of oil price risk is essential for portfolio management and hedging strategies.

According to the findings of this study, investors with the aim of global portfolio diversification should know how the different stock markets react to oil price shocks. In this regard, it is vital for investors to determine which stock markets can be affected positively or negatively by oil price shocks. This is because, for hedging purposes investors should invest in two stocks with negative correlations.

For the case of the G8 countries, the stock markets of Russia and Canada have positively affected by oil price shocks and the stock markets of the rest of member countries have affected negatively in terms of real stock return. Thus it can be suggested that, for instance, an index investment in New York stock exchange (e.g. Vanguard 500 Index) in order to reduce its oil price risk exposure can be hedged by another index investment in Toronto stock exchange (e.g. iShares S&P/TSX 60 Index Fund) with an appropriate hedging ratio. It should be mentioned that, Vanguard 500 index fund completely tracks the S&P500 index and iShares S&P/TSX 60 Index Fund is also tracks S&P/TSX index.

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