

# **Dynamics of oil prices, exchange rates and asset prices in the GCC countries**

**Mehmet Candemir<sup>1</sup>, Mehmet Balcilar<sup>2</sup>**

## **Abstract**

We analyse the relationship between the oil prices, asset prices, and foreign exchange rates in the selected GCC economies, namely United Arab Emirates (UAE), Qatar, Kuwait and Saudi Arabia. Using a time-varying parameter VAR we study the coherence, conditional volatility and impulse responses of the exchange rates and stock markets to oil price shocks over specific periods and policy regimes. The model is identified using sign-restrictions imposed on the impulse responses over contemporaneous and long horizons. Our results suggest that the impact of oil prices on the exchange rate and asset prices are time dependent. Hence there is a loss in information when using standard linear models that average out effects over time. The response of the exchange rates and asset prices to oil prices weakens and strengthens depending on the regime of the markets. The period following financial crisis uniformly strengthens the relationships between the variables. The responses also vary across the GCC economies, emphasizing the fact that differences exist across these economies although their economic structures increasingly become similar.

**Keywords:** Oil prices, exchange and asset prices, GCC

**JEL Classification:** C32, G12, N15

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## **1. Introduction**

Energy related topics are very common in the literature of economics since the oil crisis in 1973. So, energy economics became one of the hottest topics in the world's agenda. On the other hand, energy markets are also known as commodity markets and these are complex, dynamic and increasingly global markets all around the world. As we know from the literature, fluctuation of oil prices affects the economy as a whole and has a huge impact on the economy. Their impacts are changed from national to international levels. Therefore, because of this reason, this makes oil market very important and everybody tries to follow and understand the impacts of both current and future changes on the economy.

In this study, we focus on the oil market and try to see the relationship between oil prices, stock exchange market and real effective exchange rate. It is obvious that, oil price fluctuations play a key role on the economy especially those who produce and export the oil like selected GCC countries, namely United Arab Emirates (UAE), Qatar, Kuwait and Saudi Arabia. These countries are the top oil exporter countries in the world ranking. For instance, Saudi Arabia is the first and top oil exporter country in the world with US\$ 133.3 billion/year which is equal to 17% of the total crude oil export of the world. Then, UAE exports US\$ 51.2 billion which is equal to 6.5%, Kuwait exports US\$ 34.1 billion which is equal to 4.3% and Qatar exports US\$ 10.6 billion which is equal to 1.3% of the total crude oil export of the world. So, we expect to see the impact of the oil price fluctuations on the economy of these countries. On the other hand, using a time-varying parameter VAR we study the coherence, conditional volatility and impulse responses of the exchange rates and stock markets to oil price shocks over specific periods and policy regimes.

The model is identified using sign-restrictions as Mumtaz and Sunder Plassmann (2013) used and imposed on the impulse responses over contemporaneous and long horizons. Therefore, our approach is parallel with the Mumtaz and Sunder Plassmann (2013) so, we use the same methodology of them in this study.

Our results suggest that the impact of oil prices on the exchange rate and asset prices are time dependent. Hence, there is a loss in information when using standard linear models that average out effects over time which is also mentioned in Mumtaz and Sunder Plassmann's (2013) study. The response of the exchange rates and asset prices to oil prices weakens and strengthens depending on the regime of the markets. The period following financial crisis

uniformly strengthens the relationships between the variables. The responses also vary across the GCC economies, emphasizing the fact that differences exist across these economies although their economic structures increasingly become similar.

The contribution of the study to the literature is by studying how the selected GCC countries reacted to the fundamental shocks especially to see the sign of the co-movements with the shocks over time. Another contribution is that, we use TVP VAR model rather than using VAR model in order to capture the important changes to the economy.

This study is organized as follows; Section 2 provides an overview of the existing literature on the concepts of oil prices, stock exchange market and real effective exchange rate.

Section 3 presents the data and empirical techniques that are used in this paper, respectively.

Section 4 reports the empirical findings from TVP-VAR model. Lastly, Section 5 provides the final remarks and policy recommendations.

## **2. Literature Review**

Amano and Norden (1998) investigate the linkage between oil prices and real exchange rates for United States, Germany, and Japan by using monthly data between 1973 – 1993 years.

Augmented Dickey Fuller (1979) and Phillips and Perron (1988) unit root tests are done for stationarity, then they move to Johansen and Juselius (1990) cointegration test in order to see the long run relationship between oil prices and real exchange rates. Also, they apply to other methods like Phillips and Hansen's (1990) fully modified least squares (FMLS) and Hansen's (1992) in order to see the stability of the parameter. According to estimation results, Granger causality test shows that, although oil prices Granger cause real exchange rate in the long run, real exchange rate does not Granger cause oil prices. Moreover, oil prices play a significant role on other macroeconomic variables of the long term exchange rates.

Amano and Norden (1998) estimate the relationship between oil prices and United States real exchange rate by using monthly data over the periods 1972.2 – 1993.1 for United States.

Augmented Dickey Fuller (ADF) and Phillips and Perron (PP) unit root tests and Kwiatkowski Phillips Schmidt Shin (KPSS) stationarity test are done in order to estimate the stationarity and they run for Johansen Juselius cointegration test to check whether or not there is long term relationship between two variables. Johansen and Granger causality tests are used separately and Error Correction Model (ECM) is used as a method. As a result, they find causality which runs from oil prices to the real exchange rate, but not runs from real

exchange rate to oil in the long run. Also, ECM has significant ability to predict out of sample for the sign and the size of the changes in real exchange.

Hammoudeh and Choi (2006) investigate the effect of oil price and financial markets of US on GCC stock markets. They use daily data for the period 15 February, 1994 – 28 December, 2004. Also, two different oil price series are used which are US Western Texas Intermediate (WTI) and UK Brent spot, then US Treasury bill rate, S&P 500 index as a US stock market return and five GCC stock markets are used to estimate the results. They find that, although WTI or Brent oil price and S&P 500 index do not have direct impact on GCC stock markets, profitability and liquidity have direct impact on them. Also, direct impact of US T-bill is found on some of the GCC stock markets. In contrast, impulse response results show that, there is positive dynamic impact of S&P 500 index shocks on all of the GCC markets in twenty weeks forecast horizon. On the other hand, the findings show that, while US market becomes more valuable, then the value of GCC stock markets increase as well.

Zarour (2006) estimates the effect of increase in oil prices on stock market returns for five GCC countries (Bahrain, Kuwait, Oman, Saudi Arabia, and Abu Dhabi) by using vector autoregression model (VAR). Daily data is used and it begins in 25 May, 2001 and ends in 24 May, 2005. Estimation results show that, when the price of oil is doubled in these periods, this causes to big cash surplus in GCC stock market returns and influence them positively. On the other hand, impulse response functions prove that, when the price of oil increased, the response of stock markets to the oil price shocks raised fastly. Moreover, responses of Saudi Arabian stock market returns to the shocks are more and vice versa.

Using a daily data, Malik and Hammoudeh (2007) focus on the impact of oil prices on United States and some of GCC (Saudi Arabia, Kuwait, and Bahrain) equity markets. They use standard Box Jenkins techniques as a method in order to estimate the impact of oil prices. They find a significant transmission into the second moments. On the other hand, there is volatility which runs from oil market only to Saudi Arabian equity market in all cases and there is significant volatility spillover from Saudi market to oil market. Also, estimation results make a guidance for building asset pricing model, forecasting of future equity and oil price return volatility and also the analyzing the link between GCC stock market, United States equity market and oil market.

Maghyreh and Al-Kandari (2007) focus on the relationship between oil prices and stock market returns in GCC countries. They use Breitung's method which is rank tests of nonlinear cointegration estimations over the period 1 January, 1996 – 31 December, 2003.

They find nonlinear relationship between oil prices and stock market returns in GCC countries.

Zhang et.al. (2008) investigate the spillover impact of US dollar exchange rate on oil prices by using cointegration tests, VAR model, ARCH models and Granger causality test in risk. They find three types of spillover effect which are mean, volatility and risk spillover. Also, rigorous appraisal analysis is done in order to see the impact of US dollar exchange rate on oil price over the periods 4 January, 2000 – 31 May, 2005. They find that, there is a linkage between exchange rate and oil prices in the long run. On the other hand, Granger causality test shows changes in US dollar exchange rate Granger cause the volatility of oil price but not vice versa. However, volatility spillover effect is not significant. In other words, both the price volatility of US dollar exchange rate and oil are not dependent to each other which means they follow different ways and also this shows if US dollar exchange rate fluctuations may not cause any significant changes in oil price market. Moreover, risk spillover effect seems to be limited and price risk effect of US dollar exchange rate on price of oil is partial.

Arouri and Rault (2009) analyze the impact of oil prices on the stock markets of Gulf Corporation Countries (GCC) in the long term by using bootstrap panel cointegration techniques and Seemingly Unrelated regression (SUR) methods. They also use two sets of data which are weekly and monthly. One of the data set starts from 7 June, 2005 and ends with 21 October, 2008 and second dataset starts from January 1996 and December 2007. On the other hand, the estimation results provide that there is long run relationship between oil prices and stock markets in GCC countries and also increases in oil price has positively significant effect on stock prices, but it is not same in Saudi Arabia.

Arouri and Rault (2010) investigate the same relationship as mentioned above. In other words, they try to investigate the sensitivity of GCC stock markets to oil price shocks by using the same methods but adding the Granger causality test and the same dataset for the same periods. They find bidirectional causality which means oil price shocks Granger cause GCC stock price changes for Saudi Arabia, but do not find the Granger causality for the other GCC countries. As a result, both stock market and oil market investors should be aware of the price changes of both markets in Saudi Arabia.

Mohanty et. al. (2011) estimate the relationship between oil price fluctuations and stock market prices for GCC countries over the June 2005 - December 2009 period by using weekly both country level and industry level stock return data and linear factor pricing model. They found negative effect of decreases in oil price on stock market returns in all

GCC countries, but, in contrast, positive and significant effect of increases in oil prices on stock market returns only in two GCC countries which are United Arab Emirates and Saudi Arabia at the country level. On the other hand, they found a positive effect of oil price shocks on stock market returns in 12 out of 20 industries at the industry level estimations.

Fayyad and Daly (2011) examine how the oil price shocks influence stock market returns. They use daily data for GCC countries and two more countries which are US and UK over the period 2005 – 2010. Vector Auto Regression (VAR) analysis is used to estimate the results and find that, when the price of oil increases, it has more impact on stock market return and also it is affected more from Global Financial Crises. They find that, United Kingdom in advanced countries and United Arab Emirates and Qatar in GCC countries give more response to the oil price shocks comparing with other countries.

Arouri et. al. (2011) apply to VAR-GARCH model in order to analyse the volatility transmission and the return links between oil prices and stock markets of GCC countries during 2005 – 2010 periods by using daily data set of the GCC stock market prices and world oil prices. Estimation results show that, there are significant shock and volatility spillovers between oil prices and stock markets mainly during the crisis. On the other hand, volatility of GCC stock markets increases while world oil prices increase and affecting the both demand and supply sides of the oil.

Reboredo (2012) examine the dependency of oil price and exchange rate by using both linear and nonlinear dependency measures which are Pearson correlation for linear, Spearman and Kendall rank correlation for nonlinear and copula function for estimating the tail and asymmetric dependence. Daily data span from 4 January, 2000 to 15 June, 2010. US oil prices and European Union exchange rate data sets are used for estimations. The results show that, dependency between oil price and exchange rate are weak, but it increases after global financial crisis largely and they do not find high degree of dependency between oil and exchange rate market.

Akoum et. al. (2012) investigate the dependencies between stock market returns and OPEC basket oil returns both in the short run and long run by using wavelet coherency method during 2002 – 2011 years for GCC countries, Egypt and Jordan. According to estimation results, co movements of oil prices and stock market prices are changed in the long run (over 6 months). Also, market dependencies have become more powerful after 2007 and market dependencies are weak in the short run (between 2 weeks and 6 months periods). As a result

of the study, dependencies between stock market returns and oil prices differ from country to country.

Naifar and Dohaiman (2013) focus on the effect of crude oil prices on stock market returns by using Markow regime – switching model which are crisis and non-crisis regimes. The period of the study starts in 7 July, 2004 and ends in 10 November, 2011 which means using daily basis data for GCC countries. They find that, the linkage between volatility of crude oil prices and stock market return are regime dependent.

Khalifaoui et. al. (2015) estimate the relationship between stock market and crude oil market and also focus on the volatility spillovers of oil and stock market prices by using two approaches which are multivariate GARCH models and wavelet based MGARCH approach in G-7 countries. Daily data span from 2 June, 2003 to 7 February, 2012. As a result of the study, the volatility spillovers between oil and stock markets are highly significant and the correlation is time varying between them.

Maghyereh and Awartani (2016) investigate the effect of oil price uncertainty on the stock market by using GARCH (Generalized Autoregressive Conditional Heteroskedasticity) in mean VAR (Vector Autoregression) model in MENA region. The weekly data is used during 2001 – 2014 years. The empirical findings prove that, the effects of oil price uncertainty on stock market returns are negative and significant in MENA region. Another important finding is that, the effect of oil price is more critical if the economy of the country depends on the oil revenue and also if it has effect on economic growth.

### **3. Methodology**

We use monthly data from 2004M01 to 2016M09 for United Arab Emirates (UAE), from 2002M01 to 2015M09 for Qatar, from 2004M02 to 2016M09 for Kuwait and from 2003M12 to 2016M07 for Saudi Arabia. The data is taken from Data Stream. We use three different variables which are crude oil price, stock exchange price index and real effective exchange rate of each country and we calculate the growth of each variable.

In our study, we follow the same methodology of Mumtaz and Sunder – Plassmann (2013), but the basic empirical model is determined by the Clarida and Gali (1994). The TVP – VAR builds on Pricimeri (2005). On the other hand, we use the same approach like Mumtaz and Sunder – Plassmann (2013) which is sign restrictions in order to identify the shocks. But, Pricimeri (2005) used Cholesky decomposition. In our analysis, three different shocks are

defined which are oil price, stock exchange and real effective exchange rate shock. When the shocks are given to variables in each country, the responses of the variables are same to the each shock. Also, responses of these variables are confirmed the economic theory with assigned signs. As a result, oil price shock increases stock exchange and real effective exchange rate and increases the price of oil too. When the stock exchange shock is given, it reduces the oil prices and appreciates the real effective exchange rate and it has positive impact on itself. A final shock is the real effective exchange rate shock and it increase oil prices and appreciating real effective exchange rate but depreciates the stock exchange. The sign restrictions are summarized and contemporaneous as following;

	Oil (Oil Price)	SE (Stock Exchange)	ER (Real Effective Exchange Rate)
Oil Price Shock	+	+	+
Stock Exchange Shock	-	+	+
Real Effective Exchange Shock	+	-	+

Our estimated TVP -VAR model is shown as following;

$$Z_t = c_t + \sum_{l=1}^L \varphi_{l,t} Z_{t-l} + v_t \quad (1)$$

Where  $Z_t = \Delta oil_t, \Delta se_t, \Delta er_t$  ( $oil$  = crude oil price US\$/BBL,  $se$  = stock exchange price index,  $er$  = real effective exchange rate domestic currency/US\$) and the meaning of  $L$  is the lag length.

As we mentioned above, we use the Clarida and Gali's (1994) empirical model as a basic model so the main difference of our empirical model is to allow for time variation in the parameters of VAR and the covariance of residuals.

We assume to have the following law of motion for the parameters;

$$\hat{\varphi}_{l,t} = \hat{\varphi}_{l,t-1} + \eta_t \quad (2)$$

Where  $\hat{\varphi}_{l,t} = \{vec(c_t), vec(\varphi_{l,t})\}$  denotes the time varying parameters bulked in one vector and  $\eta_t$  denotes the comfortable vector innovations. The covariance matrix of the innovations is factored as follows;

$$VAR(v_t) \equiv \Omega_t = A_t^{-1} H_t (A_t^{-1})' \quad (3)$$



The time varying matrices which are  $H_t$  and  $A_t$  are defined as follows;

$$H_t \equiv \begin{pmatrix} h_{1,t} & 0 & 0 \\ 0 & h_{2,t} & 0 \\ 0 & 0 & h_{3,t} \end{pmatrix} \quad A_t \equiv \begin{pmatrix} 1 & 0 & 0 \\ \alpha_{21,t} & 1 & 0 \\ \alpha_{31,t} & \alpha_{32,t} & 1 \end{pmatrix} \quad (4)$$

The parameter in  $H_t$  which is  $h_{i,t}$  developing as geometric random walks;

$$\ln h_{i,t} = \ln h_{i,t-1} + \hat{v}_t$$

On the other hand, as Pricimeri (2005) used in his study, we accept non one and non-zero elements of matrix  $A_t$  to develop as driftless random walks;

$$\alpha_t = \alpha_{t-1} + \tau_t \quad (5)$$

Then, the distribution of vector of innovations is shown below;

$$\begin{pmatrix} v_t \\ \eta_t \\ \tau_t \\ \tilde{v}_t \end{pmatrix} \sim N(0, V), \text{ with } V = \begin{pmatrix} \Omega_t & 0 & 0 & 0 \\ 0 & Q & 0 & 0 \\ 0 & 0 & S & 0 \\ 0 & 0 & 0 & G \end{pmatrix} \text{ and } G = \begin{pmatrix} \sigma_1^2 & 0 & 0 \\ 0 & \sigma_2^2 & 0 \\ 0 & 0 & \sigma_3^2 \end{pmatrix} \quad (6)$$

TVP – VAR model is written compactly as;

$$y_t = x_t' \tilde{B}_t + A_t^{-1} H_t \varepsilon_t \quad (7)$$

Where  $y_t = \text{vec}(Z_t)$ ,  $x_t = I \otimes [1, Z_{t-1}, Z_{t-2}, \dots]$ ,  $\tilde{B}_t = ([c_t, \varphi_{1,t}, \varphi_{2,t}, \dots])$  and  $\text{VAR}(\varepsilon_t) = I$ .

As it is mentioned before, TVP – VAR model will be used in our study and Equation (7) will be our structure of the study. However, we need to rewrite the equation (7) again for estimating the results. Also, this equation takes into consideration of the changes in the role and transmission of structural shocks.

Rewriting of equation (7) is as following;

$$y_t = x_t \tilde{B}_t + \tilde{A}_{0,t} \varepsilon_t \quad (8)$$

On the other hand,  $\tilde{A}_{0,t}$  is a TVP – VAR structural effect matrix and it is not always lower triangular.

$$\Omega_t = \tilde{A}_{0,t}' \tilde{A}_{0,t}$$

Since there is a structural VAR in equation (8), it provides flexibility at two dimensions. First of all, it allows them to have the simultaneous relationships between  $v_t$  to be different within a time period. Also, this approach is suited for the economy of the each country in the study.

Moreover,  $\tilde{A}_0$  which is known as fixed impact matrix is not able to estimate the feature of the data in our study. So, when we take the structural changes into consideration in the economy, it is shown that, the cause of structural changes are not only the because of policy rules. Then, this brings independent shifts in different structural changes (equations) of the model. On the other hand, when there is independent time variation lagged and contemporaneous coefficient, then the model seems to be a good proxy for the structural changes. In addition, TVP –VAR model allows having shifts in the shock volatility and these shifts are independent from the changing in the coefficients  $B_t$ .

## 4. Estimation Results

### 4.1. Time Varying Volatility

Time variation gives chance to model the conditional and unconditional volatility. We can estimate the time varying volatility at each point in time with standard deviations. The estimated unconditional variances are;

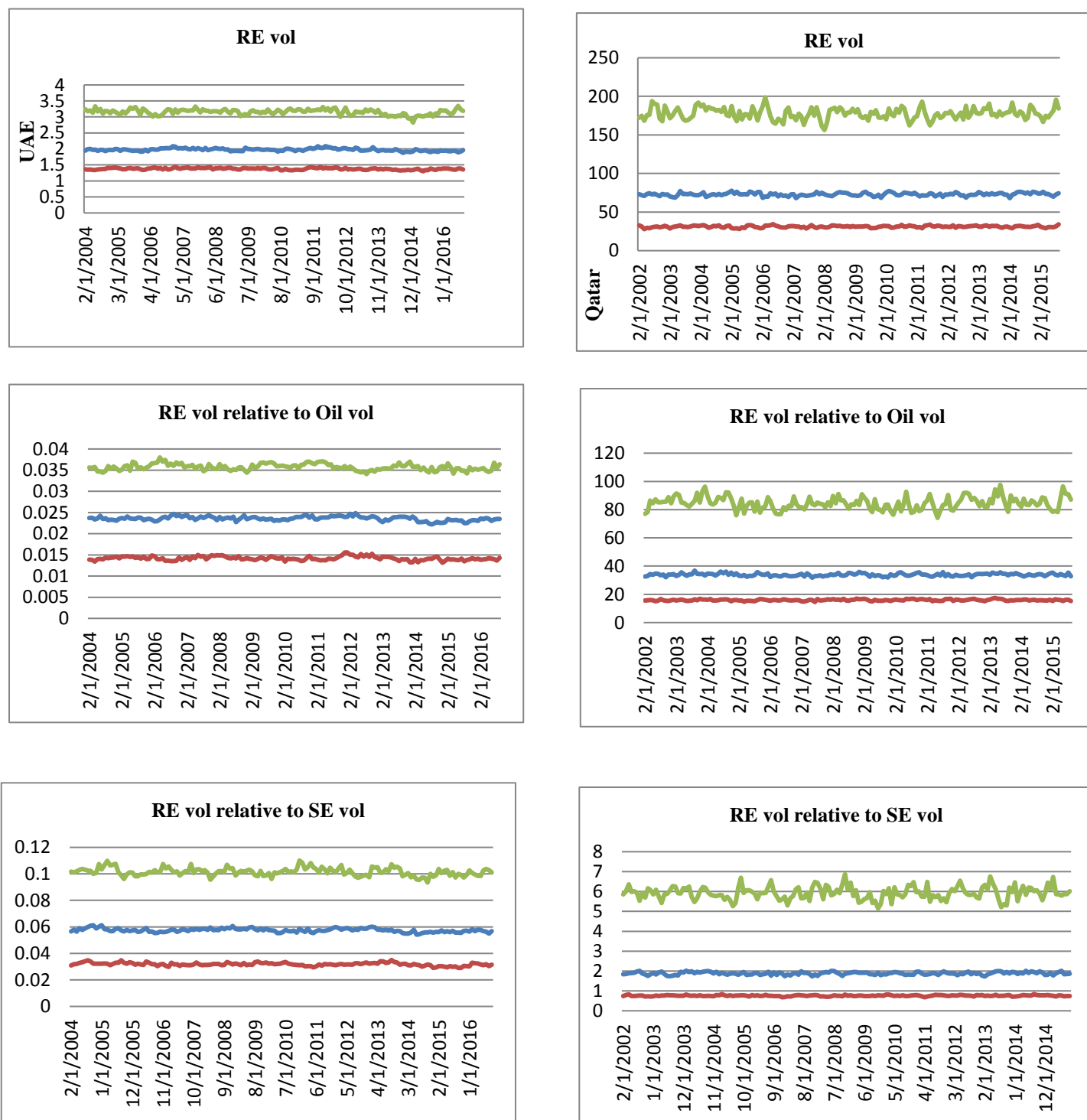
$$\int_{-\pi}^{\pi} \hat{f}_{t|T}^{ii}(\omega) d\omega \quad (9)$$

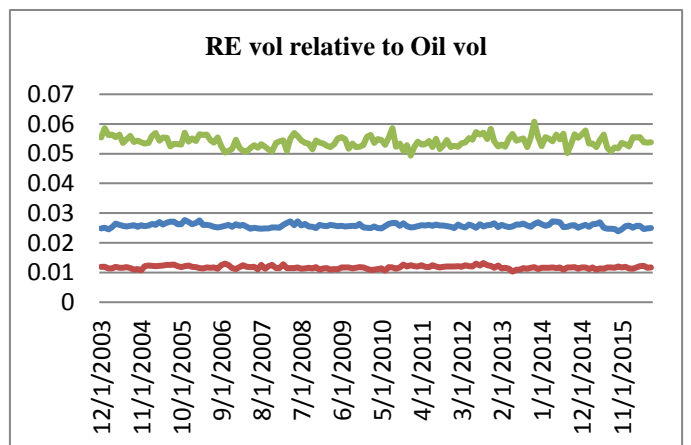
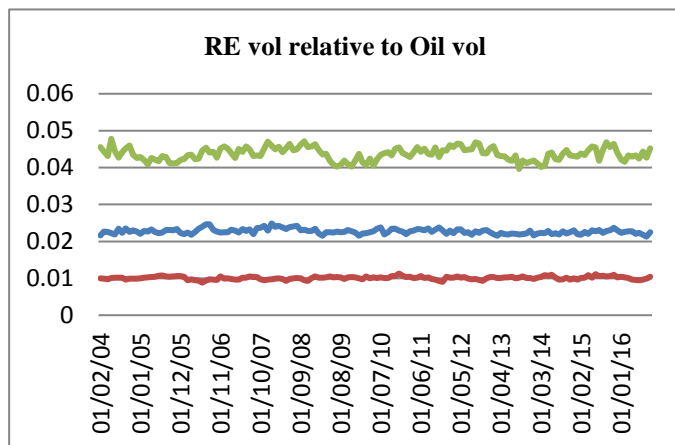
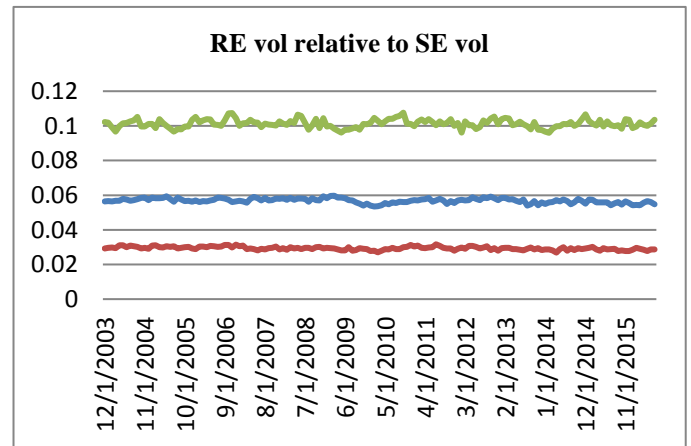
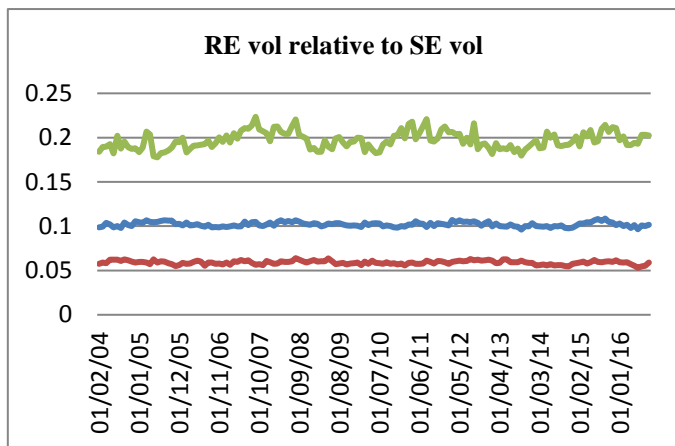
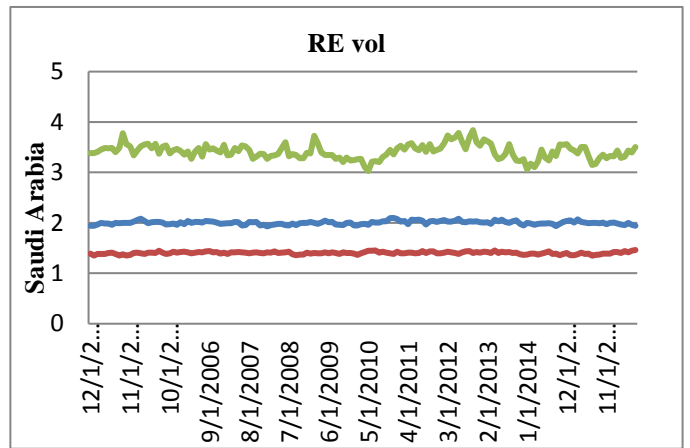
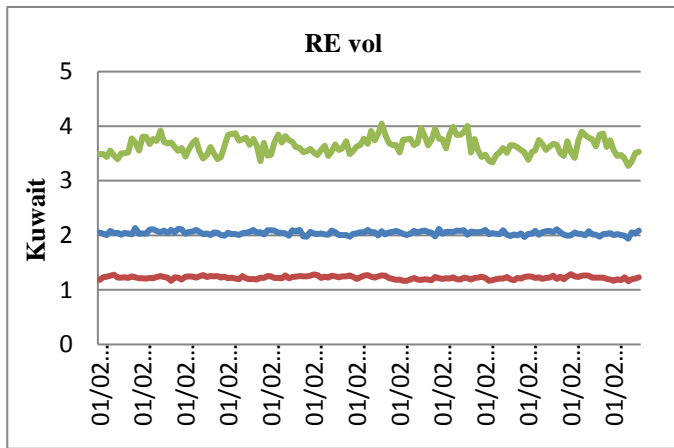
$\hat{f}_{t|T}^{ii}(\omega)$  shows the spectrum of the  $i$ th endogenous variable at frequency  $\omega$ . According to Hamilton (1994), diagonal values of  $\hat{f}_{t|T}^{ii}(\omega)$  are non-negative and real valued for all  $\omega$  but off-diagonal values are complex numbers. The calculated spectral density matrix is;

$$\hat{f}_{t|T}^{ii}(\omega) = (I_4 - \hat{\varphi}_{t|T} e^{-i\omega}) \frac{\hat{\Omega}_{t|T}}{2\pi} [(I_4 - \hat{\varphi}_{t|T} e^{-i\omega})^{-1}]' \quad (10)$$

$\hat{\Omega}_{t|T}$  and  $\hat{\varphi}_{t|T}$  are the estimation of TVP VAR error covariance and coefficients of VAR model. In addition, the existence of time variation in the model shows that, the estimation of each point in time can be done by using equation (10). So, we can get the estimated time varying volatility by using equation (9).

**Figure 1. Conditional and unconditional exchange rate volatility (with standard errors)**





We now discuss about the time varying volatility of real effective exchange rate and the relationship between the real effective exchange rate and fundamentals which are oil and stock exchange. Our estimation covered four countries which are UAE, Qatar, Kuwait and Saudi Arabia respectively. Above the Figure 1 shows the conditional and unconditional exchange rate volatility (standard deviation) of countries separately.

In general, real effective exchange rate volatility itself is stable in each country. When the analyses are done for each country, the results are almost same in each country except Qatar. For UAE, Kuwait and Saudi Arabia, the real effective exchange rate is 2.5% less volatile relative to oil. Also, for UAE and Saudi Arabia 6% less volatile relative to stock exchange and for Kuwait 10% less volatile relative to stock exchange. Moreover, stock exchange is more volatile than oil in these countries. On the other hand, for Qatar, real effective exchange rate is 34% less volatile relative to oil and 2% less volatile relative to stock exchange. Also, oil is more volatile than stock exchange.

In addition to these results, we investigate the relationship between oil and the fundamentals by using time varying VAR in order to check how series are jointly influenced by cycles at various frequencies. The off-diagonal elements of the spectral-density matrix give a summary of this relationship in equation (10). We concentrate on the measure of relationship by using coherence. The definition of coherence is known as the degree to which the two series are jointly influenced by cycles of frequency  $\omega$ .

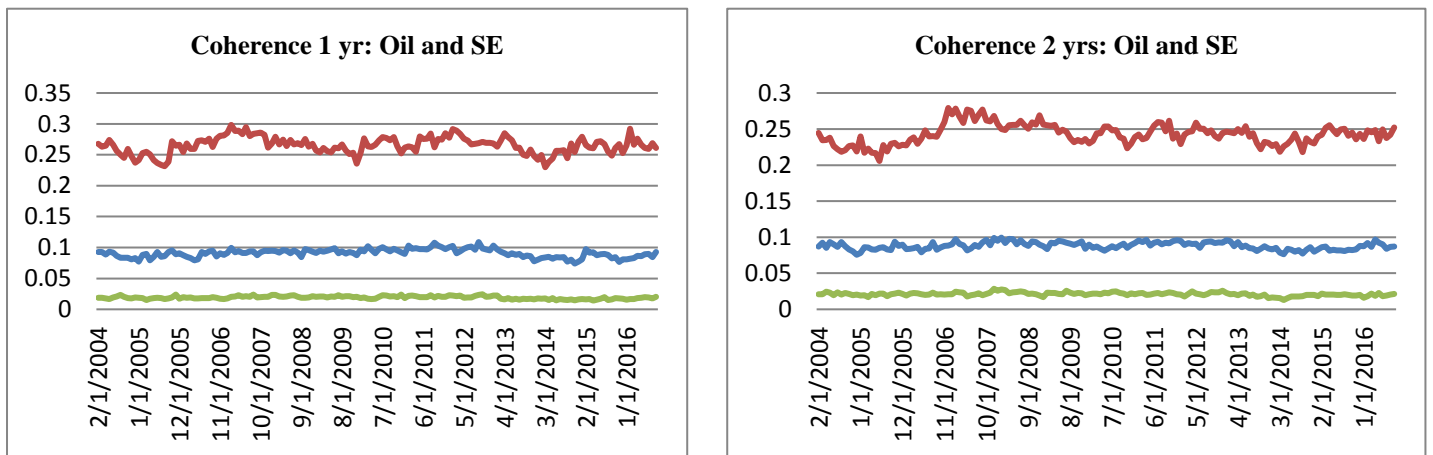
The calculation of the coherence is;

$$\hat{h}_{ij}(\bar{\omega}) = \frac{[\hat{c}_{ij}(\bar{\omega})]^2 + [\hat{q}_{ij}(\bar{\omega})]^2}{\hat{f}_{t|T^i(\omega)}^{ii} \hat{f}_{t|T^j(\omega)}^{jj}} \quad (11)$$

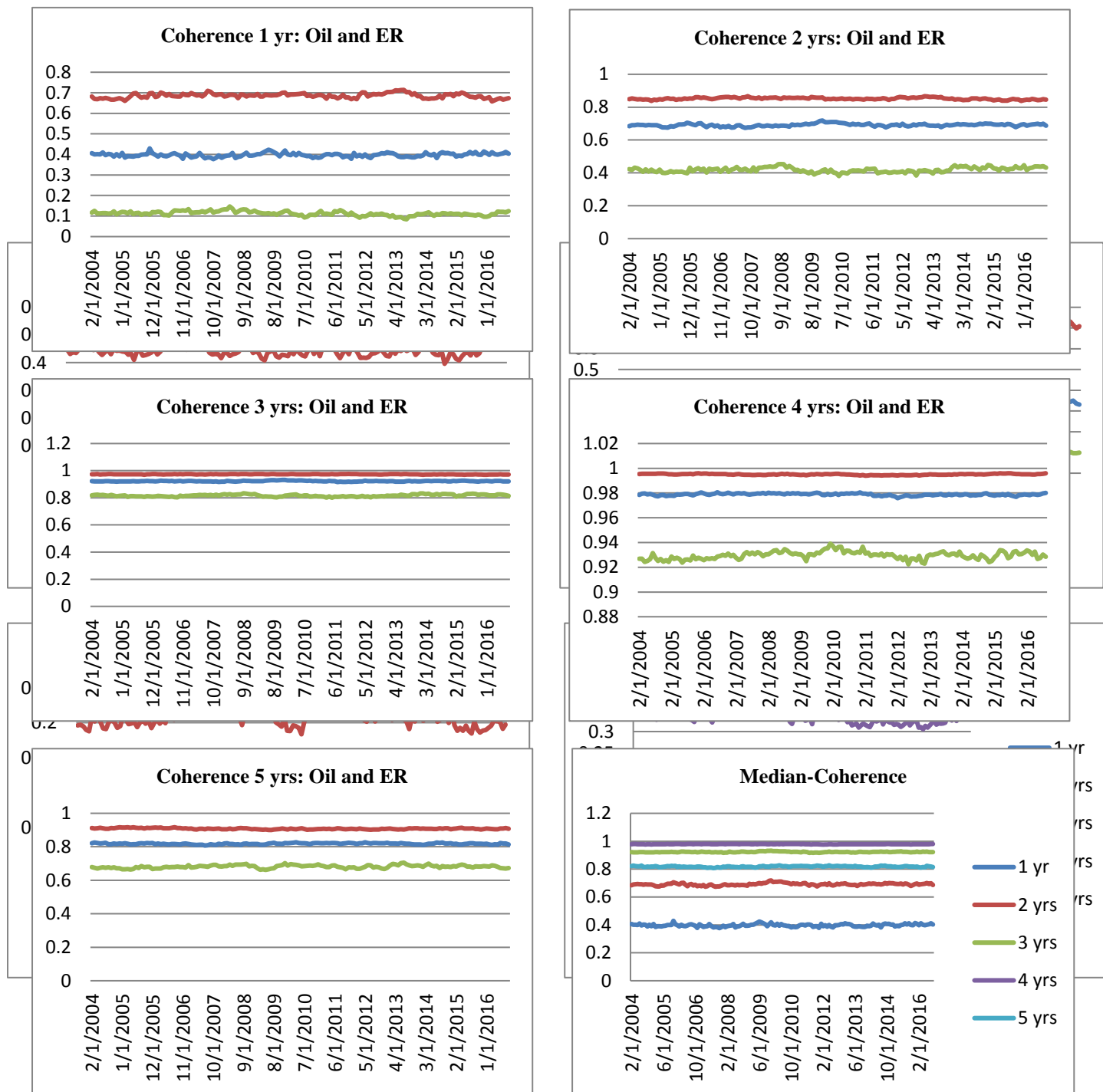
$\hat{c}_{ij}(\bar{\omega})$  represents the co-spectrum which means the real component of the off-diagonal elements of the spectral density matrix  $\hat{f}_{t|T(\omega)}$ . On the other hand,  $\hat{q}_{ij}(\bar{\omega})$  represents the quadrature spectrum which means the imaginary component of the off-diagonal elements of the spectral density matrix  $\hat{f}_{t|T(\omega)}$ . Hamilton (1994) investigate that, co-spectrum tests the covariance between the series at difference frequencies. Also, he found that, the series are at a different phase in the cycle in quadrature spectrum. High values of  $\hat{h}_{ij}(\bar{\omega})$  shows that, series  $i$

and  $j$  share a common cycle at a specific frequency. Also, it is known that  $0 < \hat{h}_{ij}(\bar{\omega}) < 1$ . Moreover, if there are high values of  $\hat{h}_{ij}(\bar{\omega})$ , we know that the relationship between oil and the fundamentals which are stock exchange and real effective exchange rate would be at various horizons. Below the Figure 2a, 2b, 3a, 3b, 4a, 4b, 5a and 5b measure the level of coherence of the oil with stock exchange and real effective exchange rate for UAE, Qatar, Kuwait and Saudi Arabia respectively.

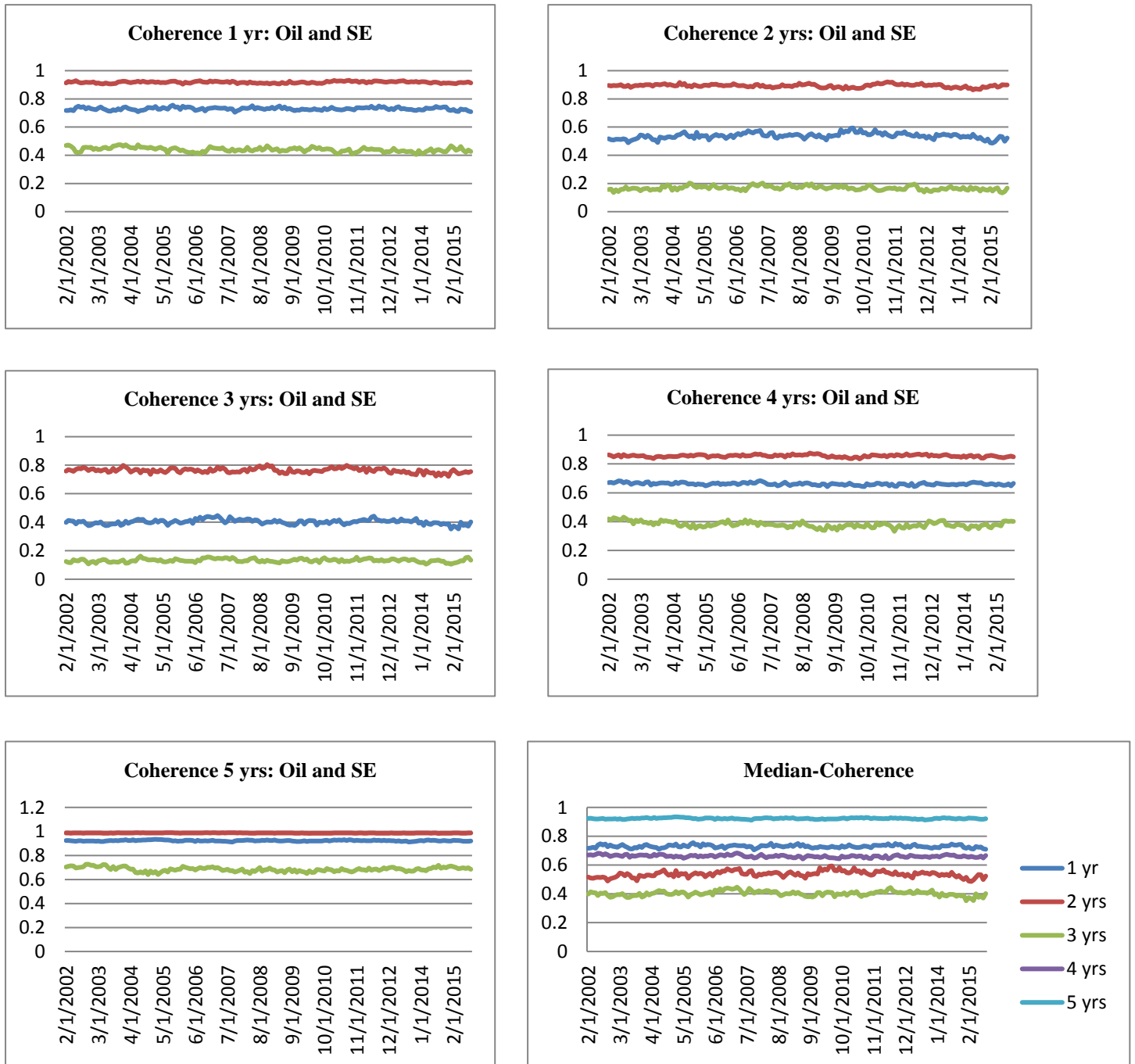
**Figure 2a: Coherence between Oil and SE for UAE**



**Figure 2b: Coherence between Oil and ER for UAE**

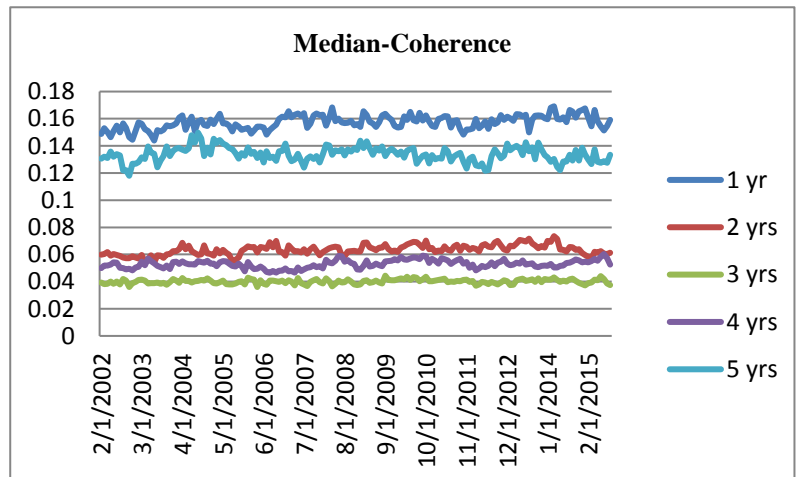
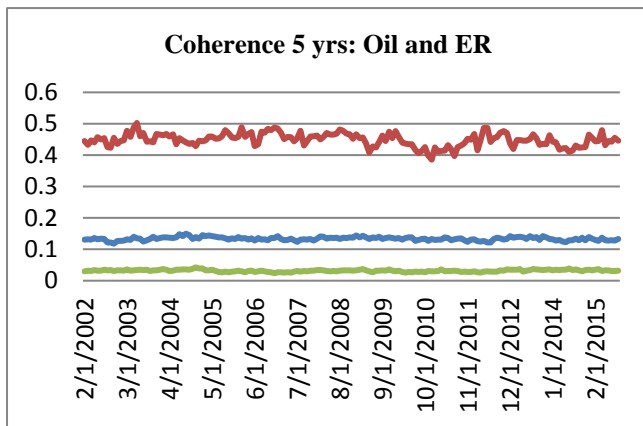
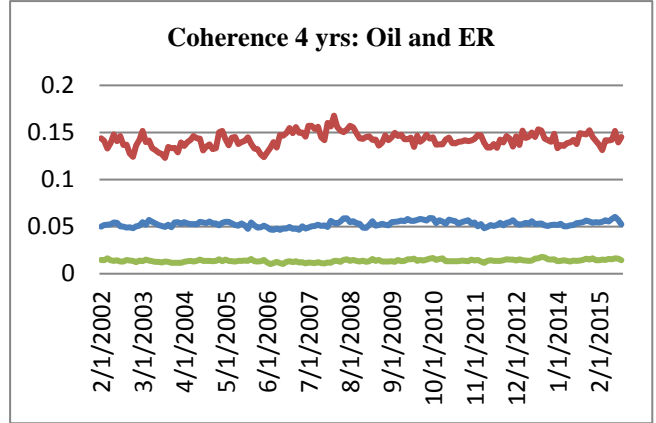
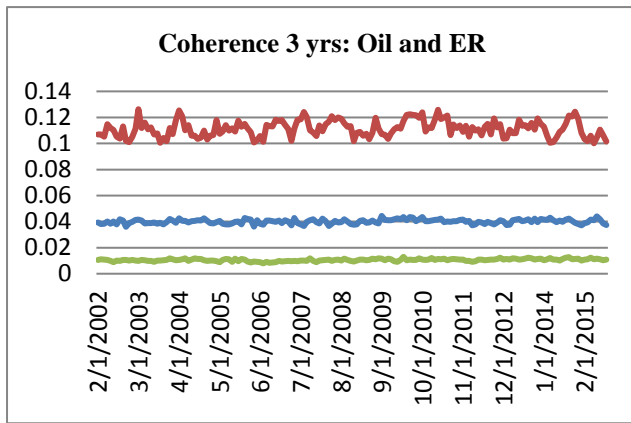
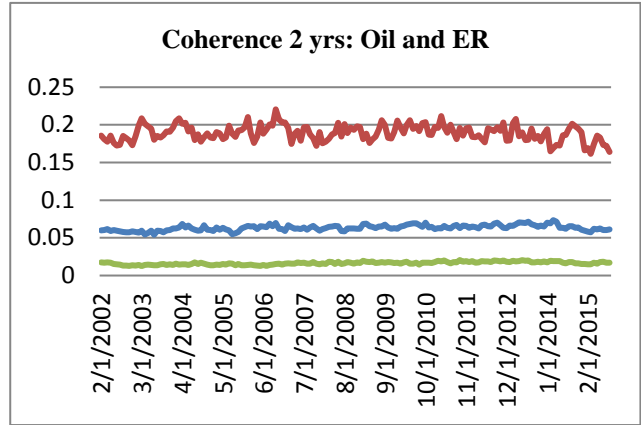
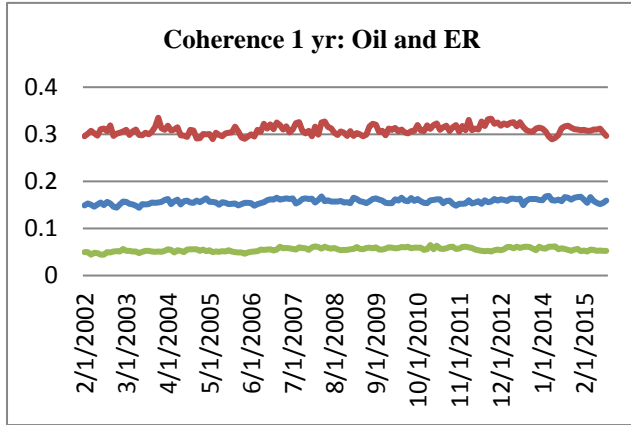


**Figure 3a: Coherence between Oil and SE for Qatar**

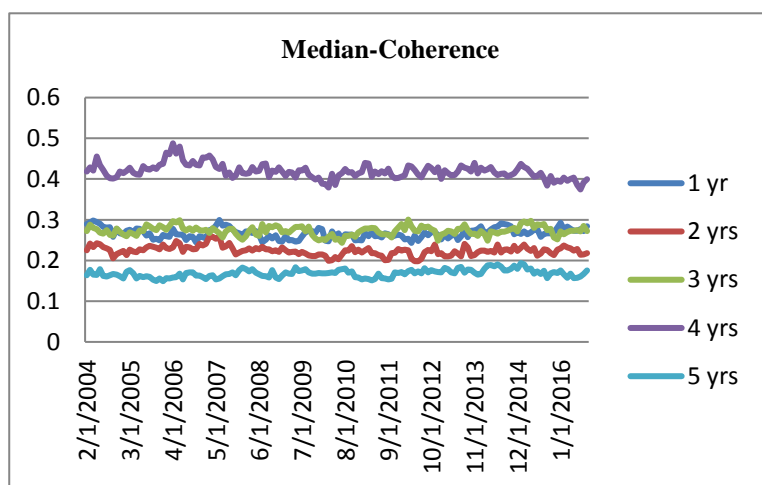
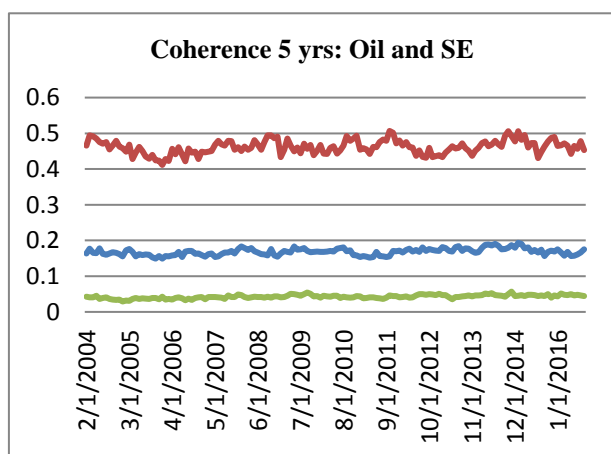
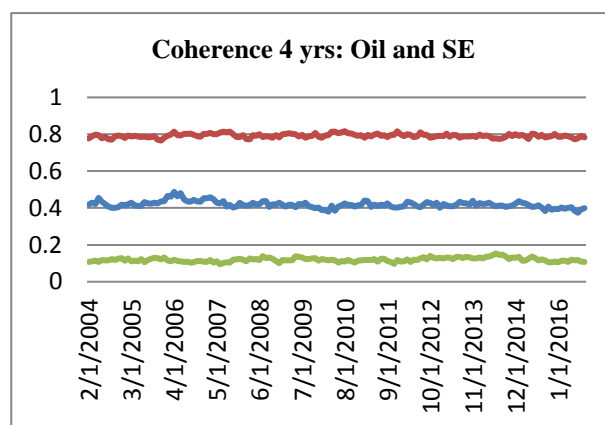
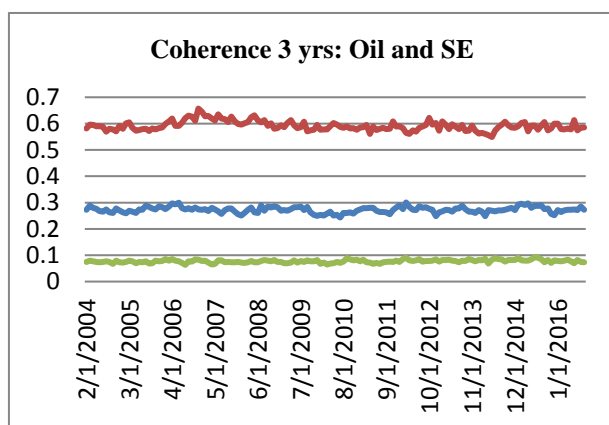
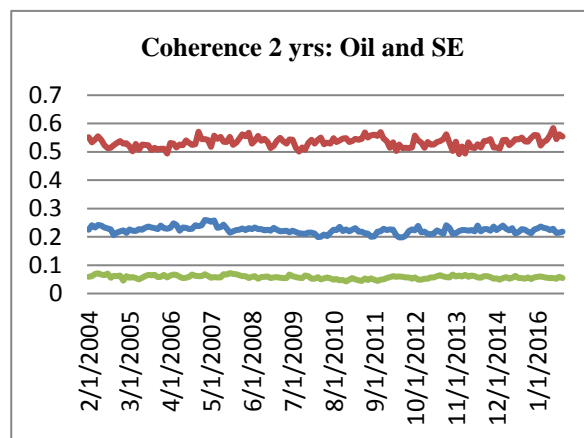
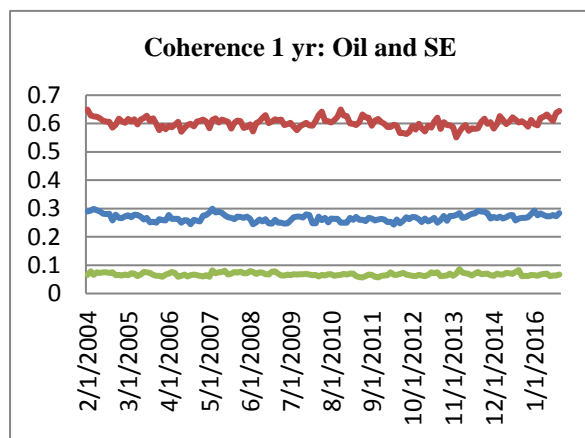




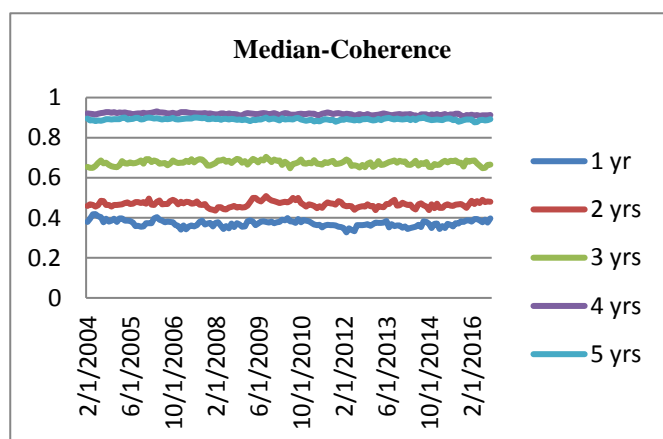
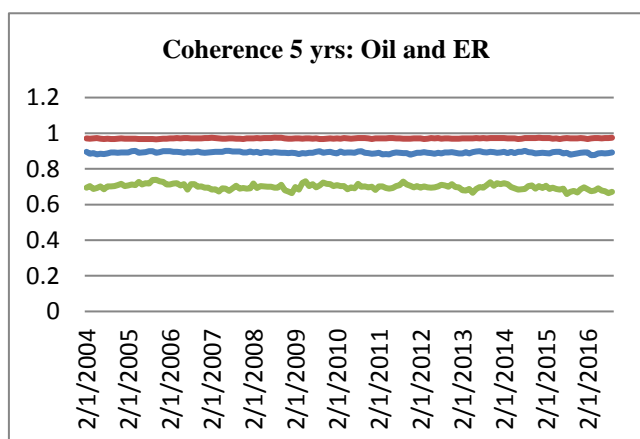
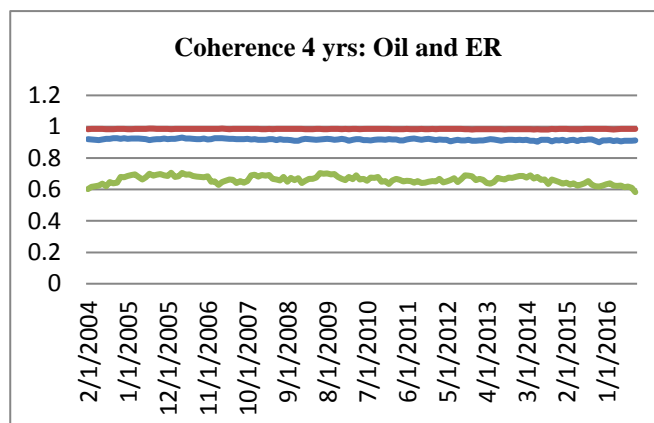
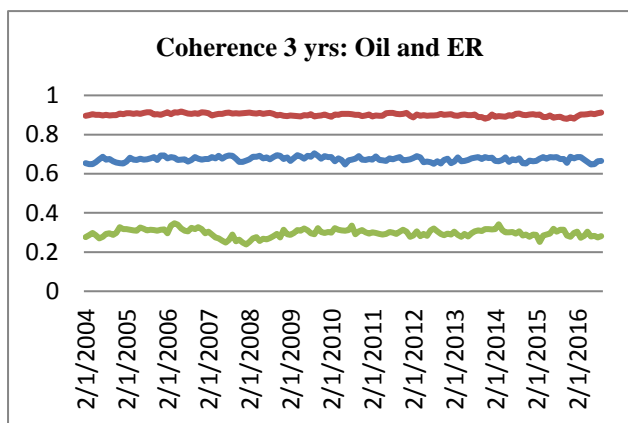
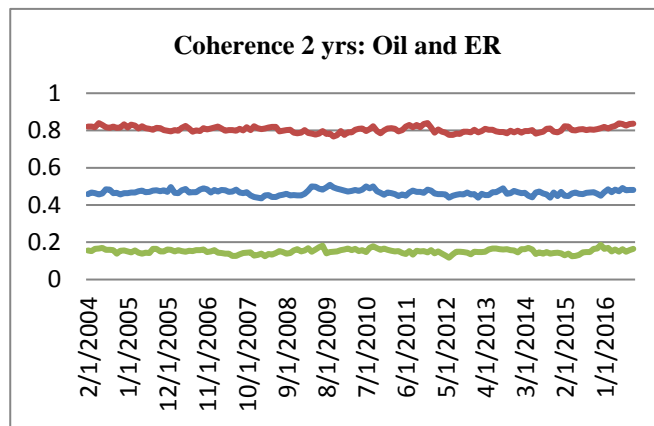
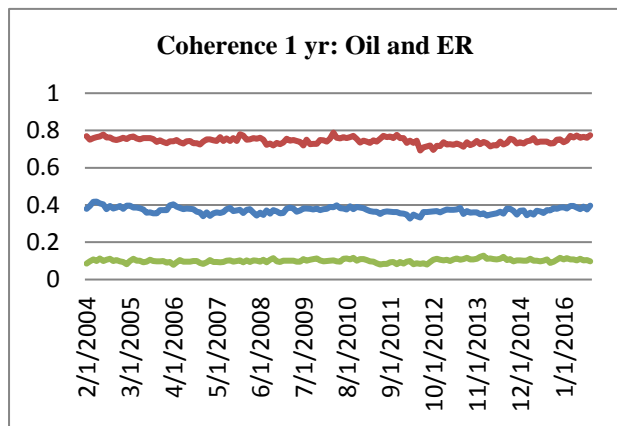
**Figure 3b: Coherence between Oil and ER for Qatar**



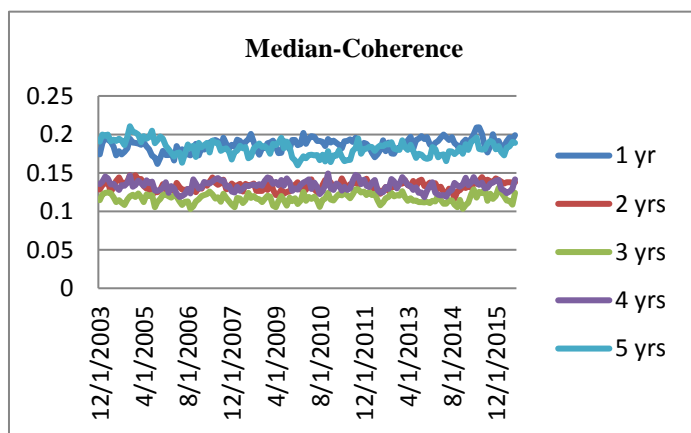
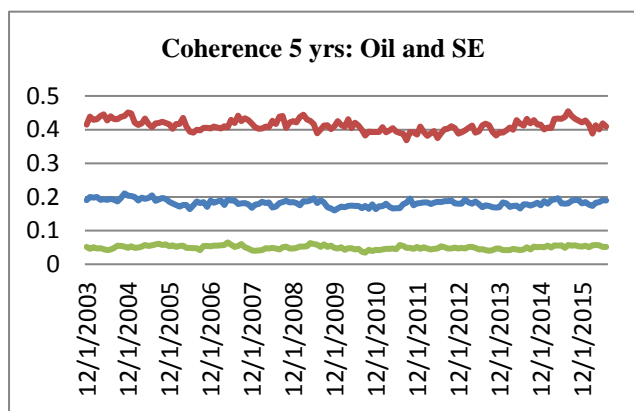
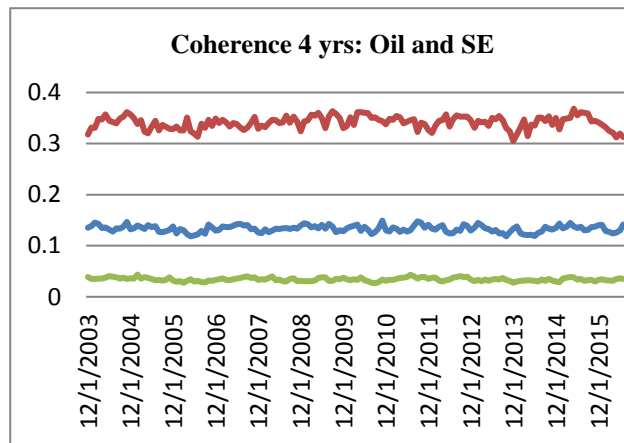
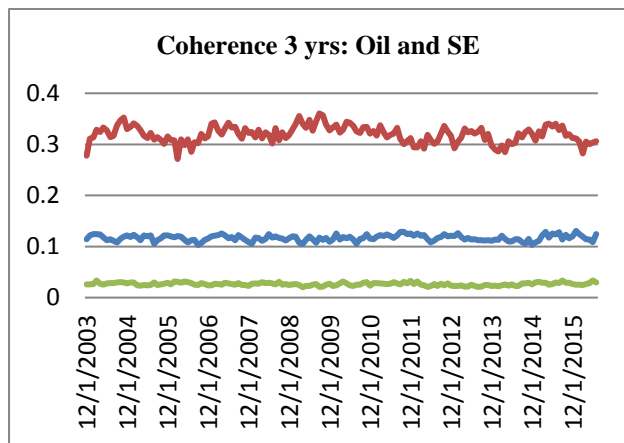
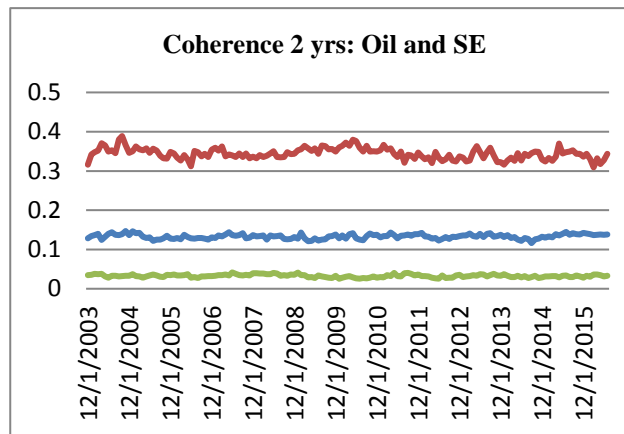
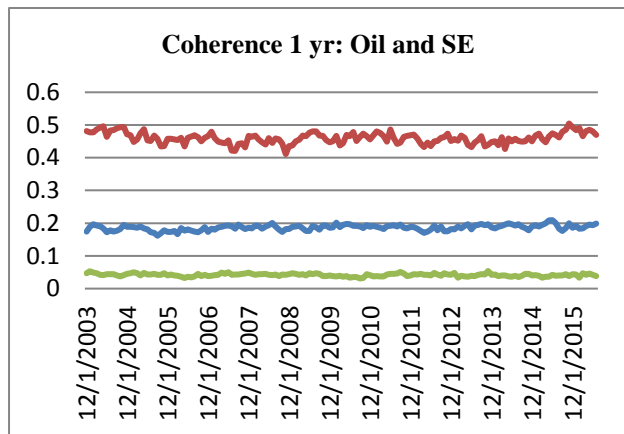
**Figure 4a: Coherence between Oil and SE for Kuwait**



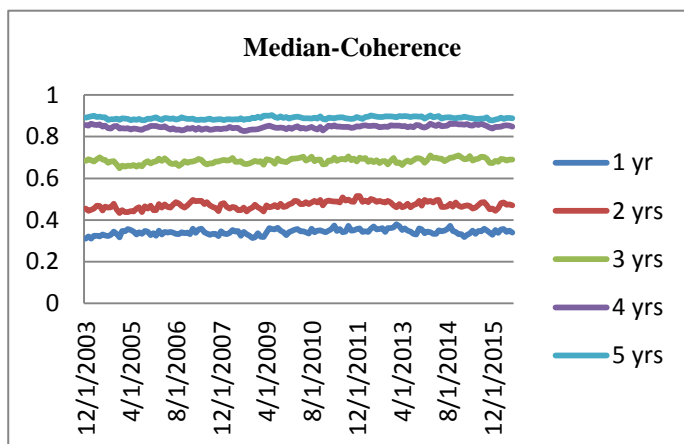
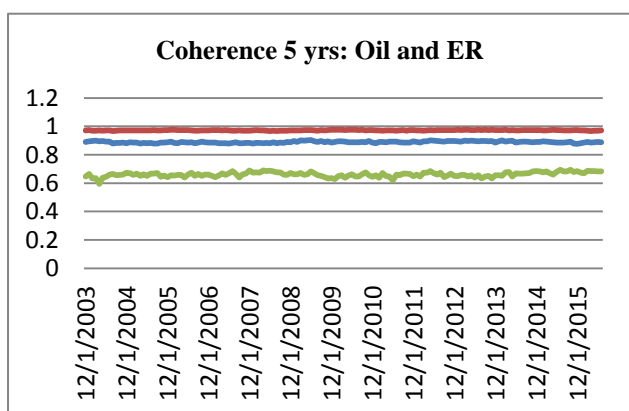
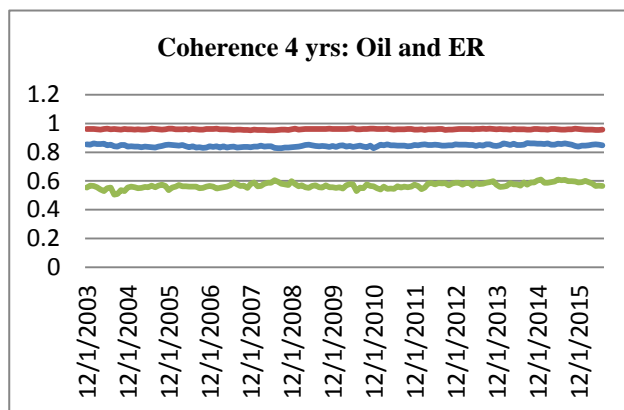
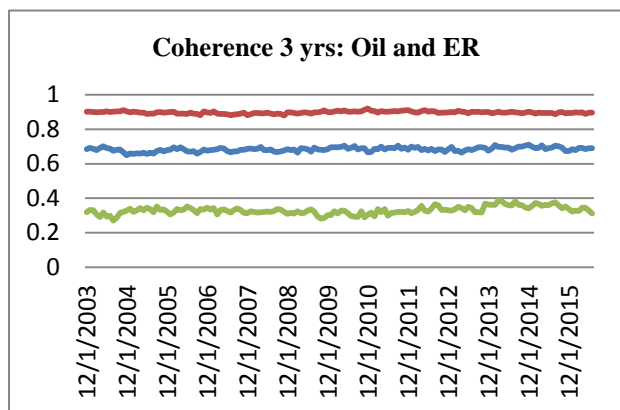
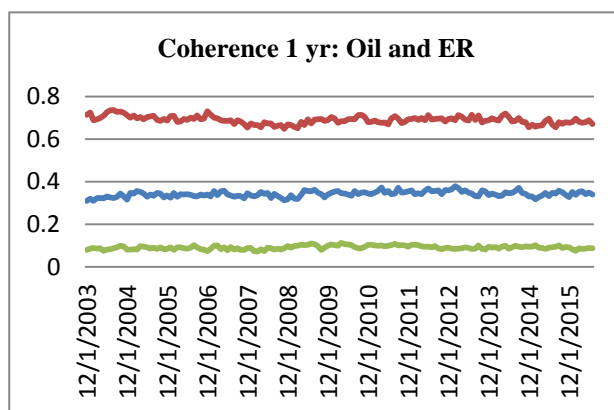
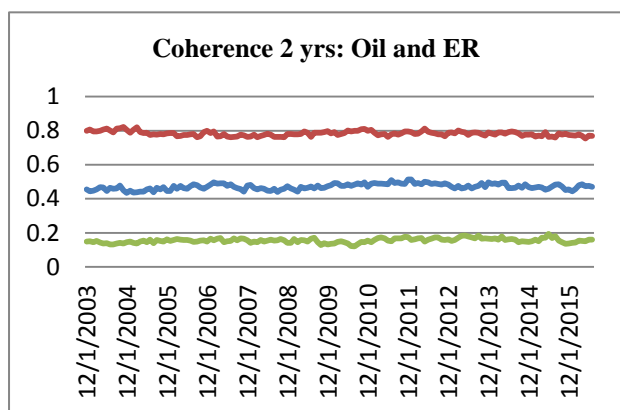
**Figure 4b: Coherence between Oil and ER for Kuwait**



**Figure 5a: Coherence between Oil and SE for Saudi Arabia**



**Figure 5b: Coherence between Oil and ER for Saudi Arabia**



The level of coherence between the oil - stock exchange and oil – real effective exchange rate differentials at various horizons and over various business cycle frequencies (1, 2, 3, 4, and 5 years) has increased over time and then started to lose the impact after some years.

For UAE, there is a little relationship between oil and stock exchange in the first year but then it starts increasing in the second year. The impact is the maximum in the fourth year and then it starts losing the impact in the fifth year. On the other hand, coherence between oil and real effective exchange rate is high and it increases year by year until the fourth year which is almost 98%. It starts losing the impact in the fifth year. For Qatar, there is different scenario. The relationship between oil and stock exchange are huge which is almost 75% but the impact starts reducing in second and third year and then increases in the fourth year and reach to the maximum level in the fifth year interestingly. Similarly, the relationship between oil and real effective exchange rate are almost 15% in the first year then it reduces and reaches to the maximum level of impact in the fifth year. Moreover, for Kuwait, the coherence between oil and stock exchange becomes more powerful after three years and reach to the maximum impact in fourth year. Later, it loses the impact in the fifth year. Also, the relationship between oil and real effective exchange rate has 40% association in first year. Then, this impacts increases year by year and reach to the 90-92% level in four years time then reducing to 89% in the fifth year. Finally, for Saudi Arabia, the coherence between oil and stock exchange are almost same for first four years but reaches to the maximum level in the fifth year. Lastly, the relationship between oil and real effective exchange rate increases year by year from 35% to 83% at the end of year four. Then, it increased to maximum level and become 90%.

#### **4.2. Impulse Response Analysis of the Variables in each country:**

In this study, we define the time varying oil price, stock exchange and real effective exchange rate dynamics by investigating the impulse response analyses to the identified structural shocks which are oil price, stock exchange and real effective exchange rate shocks. The model is identified using sign restrictions imposed on the impulse responses over contemporaneous and

long horizons. On the other hand, we use the same way of Koop et. al. (1996) and also follow the Monte Carlo integration to give an explanation for uncertainty of future coefficient.

Moreover, impulse response functions are defined at each point in time as follows;

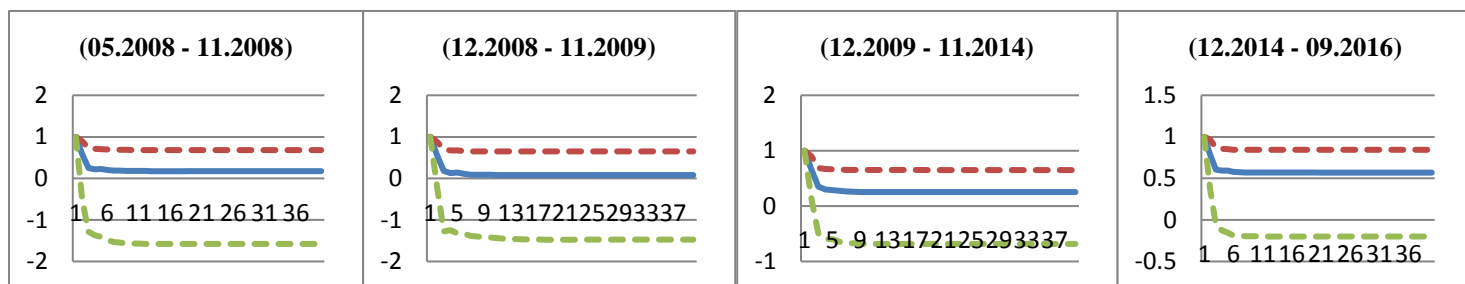
$$IRF_t = E(Z_{t+k} / \psi_t, Z_{t-1}, \mu) - E(Z_{t+k} / \psi_t, Z_{t-1}) \quad (12)$$

Where  $\psi_t$  represents the all the parameters and hyper parameters of the of the VAR model,  $k$  represents the horizon under consideration and  $\mu$  represents the shock. Equation (12) clarifies that, impulse response functions are calculated by taking the difference between two conditional expectations. The equation is in two folds, first part denotes the endogenous variable which its forecast is the condition of one of the structural shocks  $\mu$ . The second term represents the baseline forecast and the shock is equal to zero which is conditioned on the scenario. In addition to this, Koop et. al. (1996) defines the estimation of these conditional expectations by stochastic simulation of the VAR model.

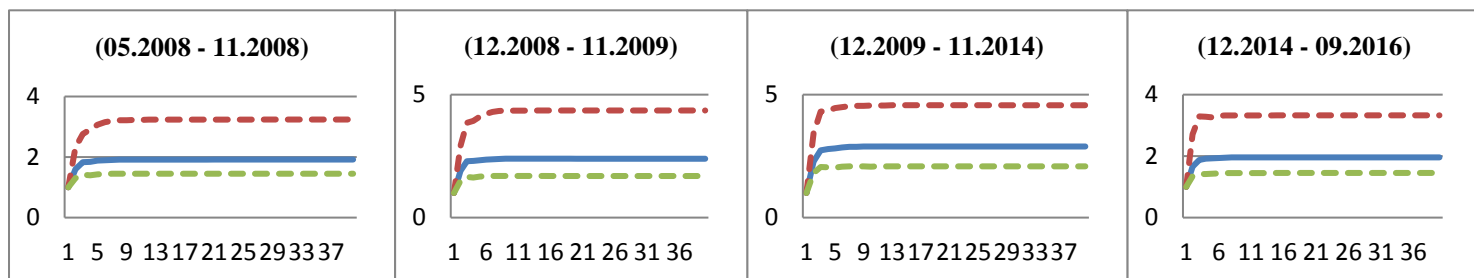
Figure 1 (from a to i), Figure 2 (from a to i), Figure 3 (from a to i) and Figure 4 (from a to i) show the TVP-VAR cumulated impulse responses to shocks which we defined them as oil price, stock exchange and real effective exchange rate shocks for UAE, Qatar, Kuwait and Saudi Arabia, respectively.

**Figure 6: Impulse Response Analysis for United Arab Emirates:**

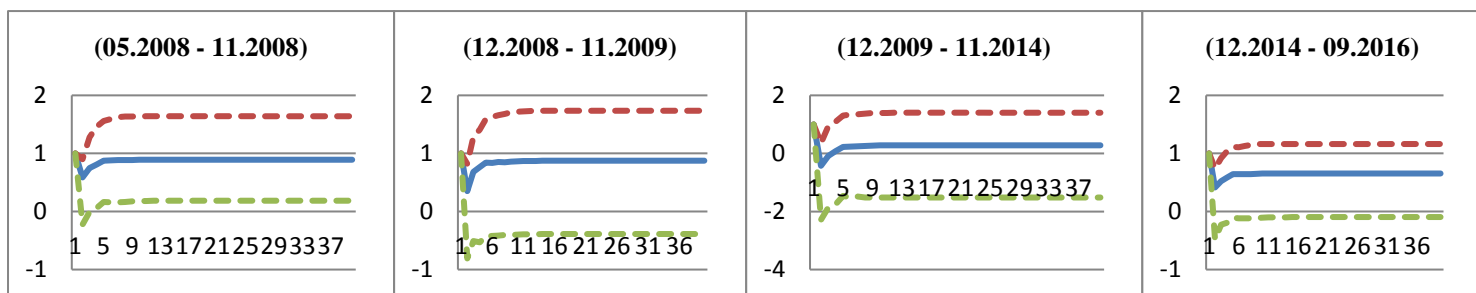
**(a) Impulse of Oil Shock on Oil between terms**



**(b) Impulse of Oil Shock on Stock Exchange between terms**

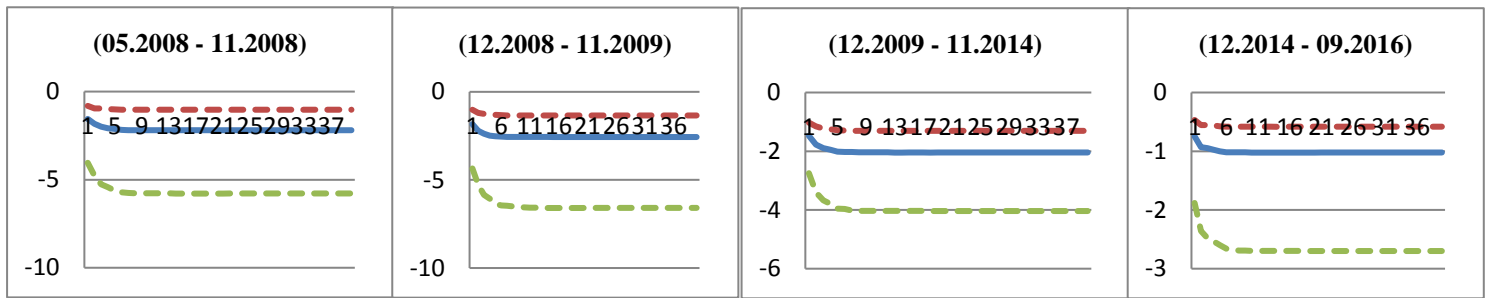


**(c) Impulse of Oil Shock on Real Effective Exchange Rate between terms**

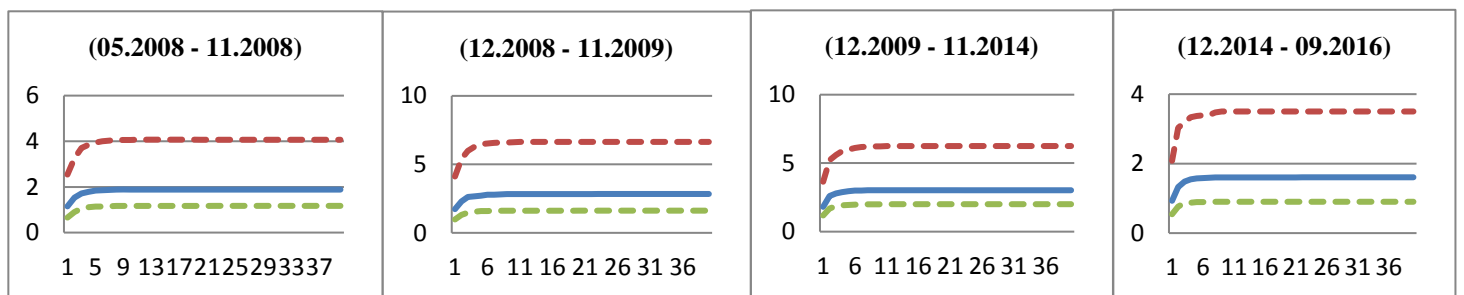




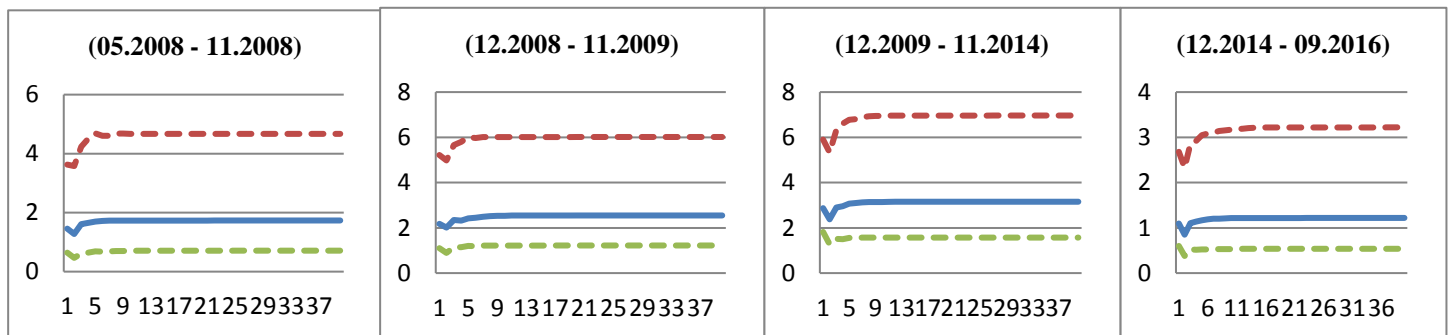
**(d) Impulse of Stock Exchange on Oil between terms**



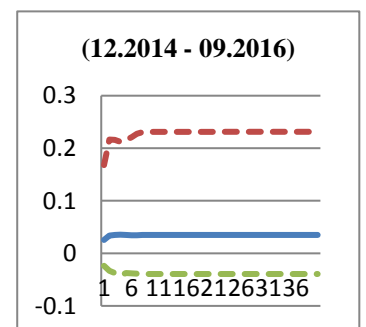
**(e) Impulse of Stock Exchange on Stock Exchange between terms**

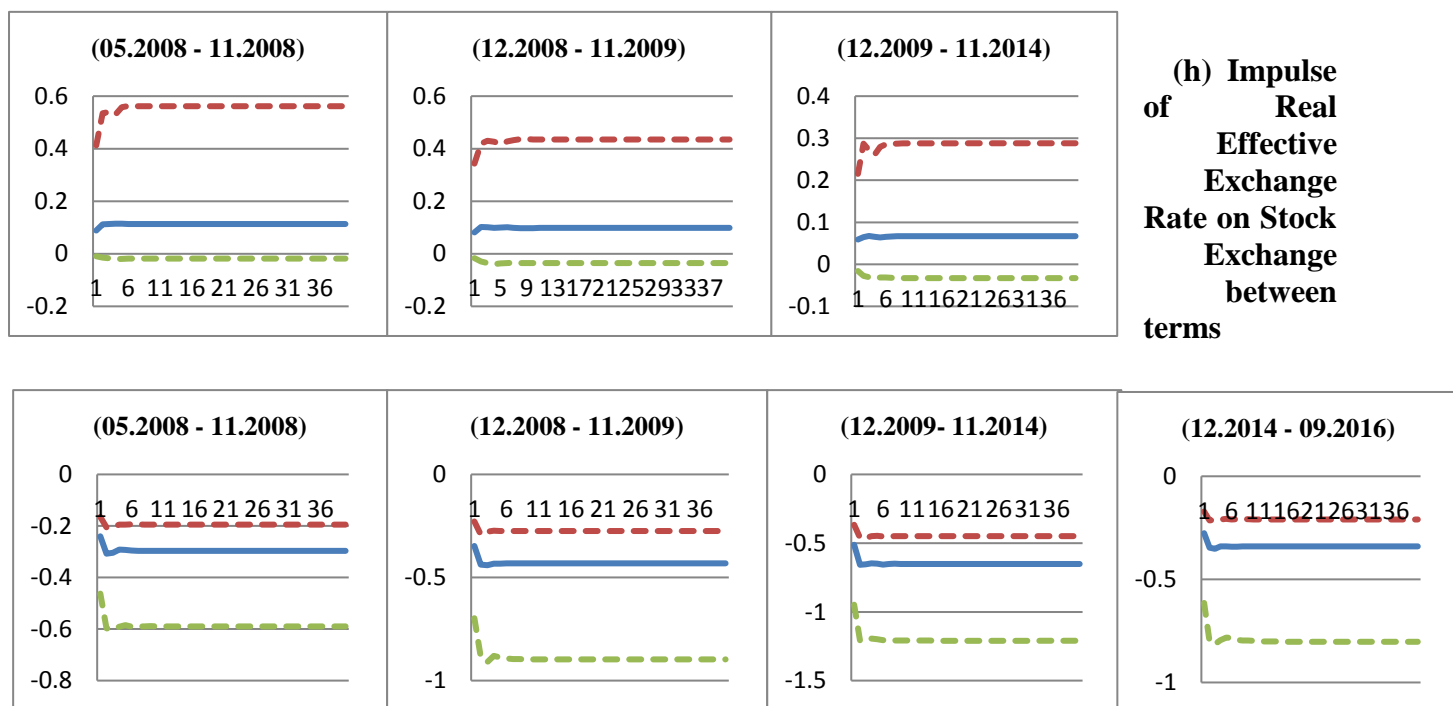


**(f) Impulse of Stock Exchange on Real Effective Exchange Rate between terms**



**(g) Impulse of Real Effective Exchange Rate on Oil between terms**





(i) Impulse of Real Effective Exchange Rate on Real Effective Exchange Rate between terms

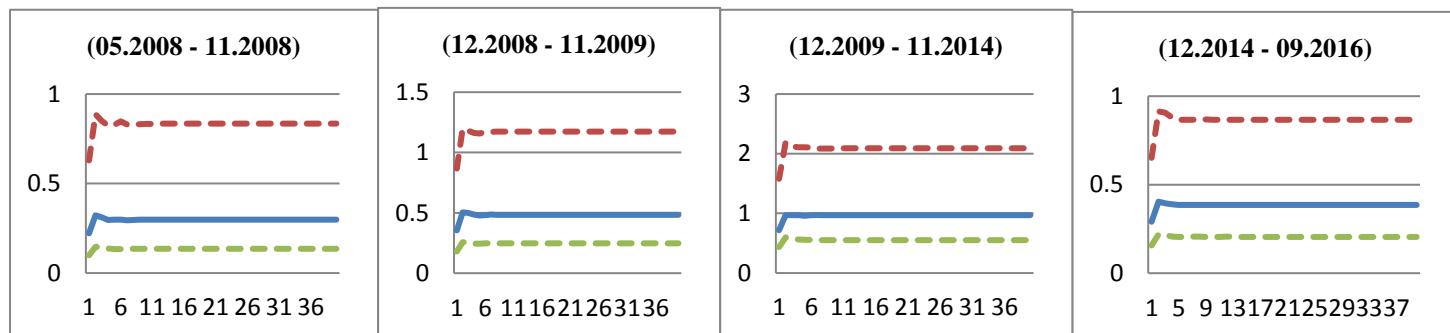
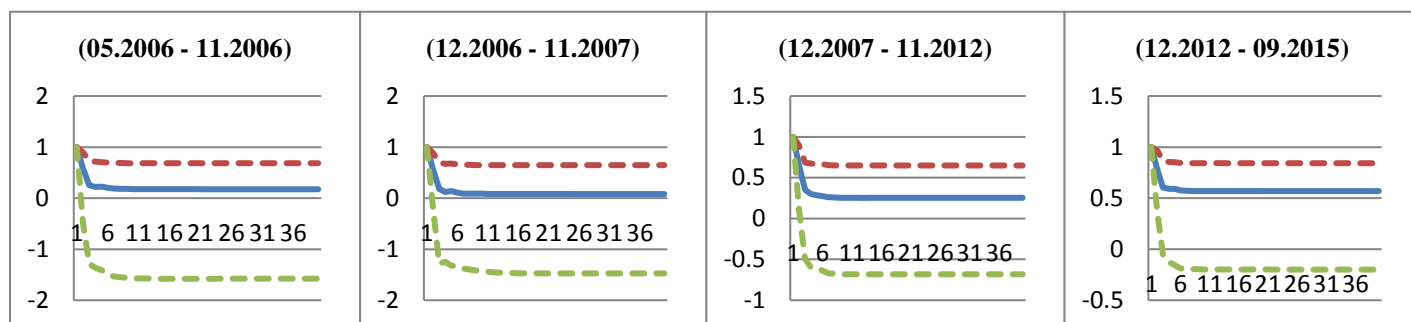
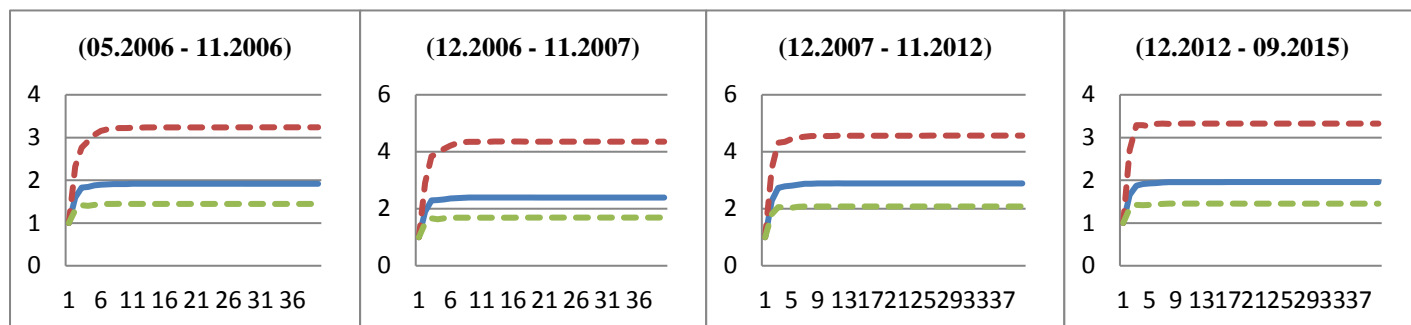


Figure 7: Impulse Response Analysis for Qatar:

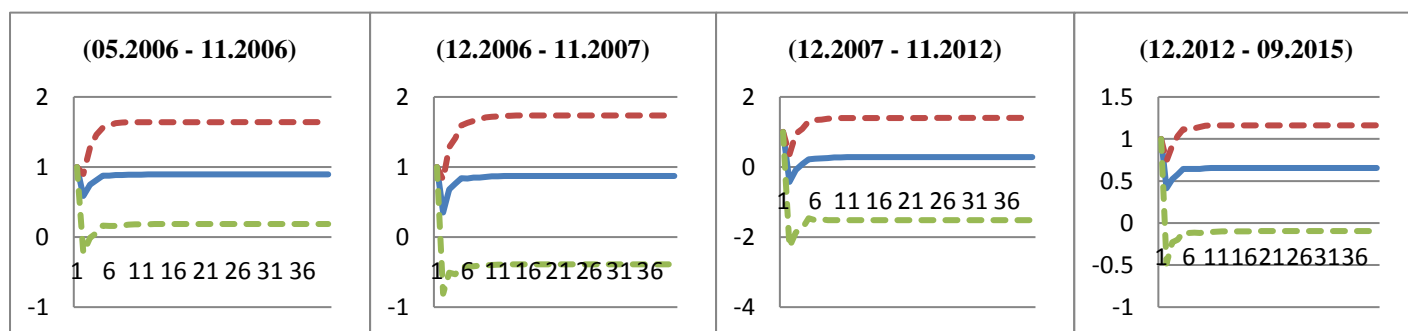
(a) Impulse of Oil Shock on Oil between terms



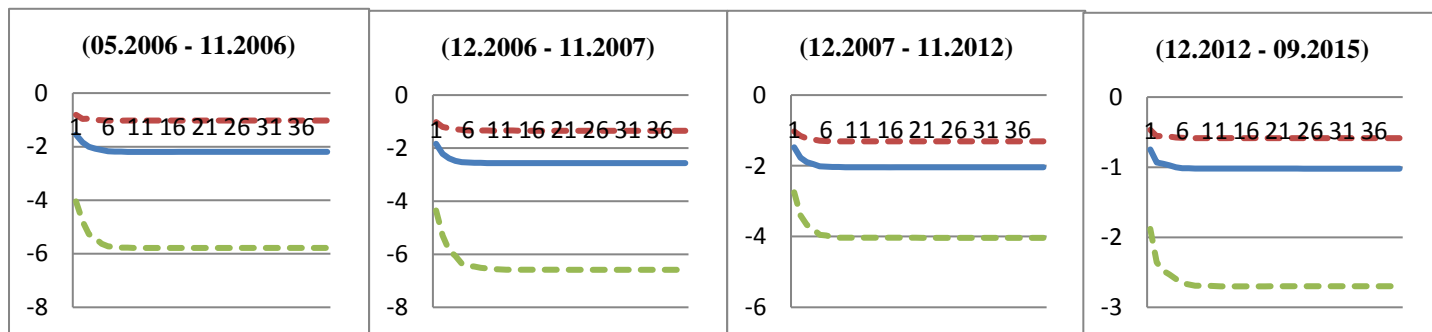
**(b) Impulse of Oil Shock on Stock Exchange between terms**



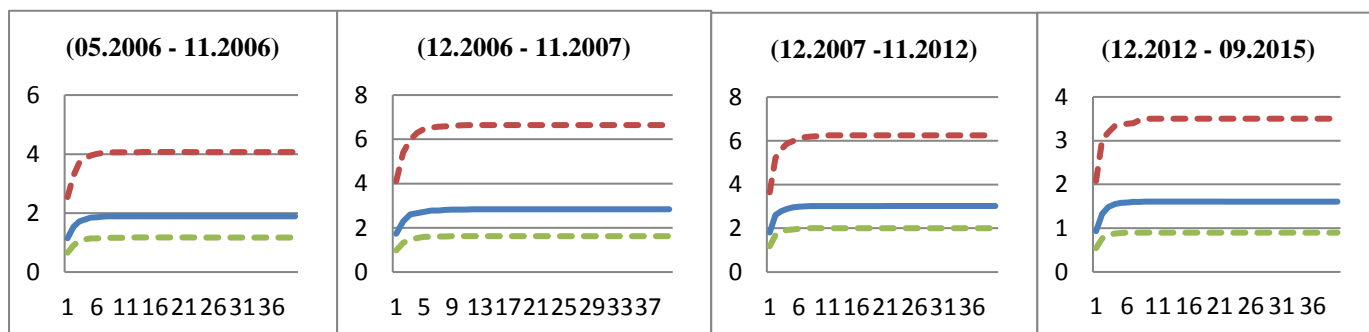
**(c) Impulse of Oil Shock on Real Effective Exchange Rate between terms**



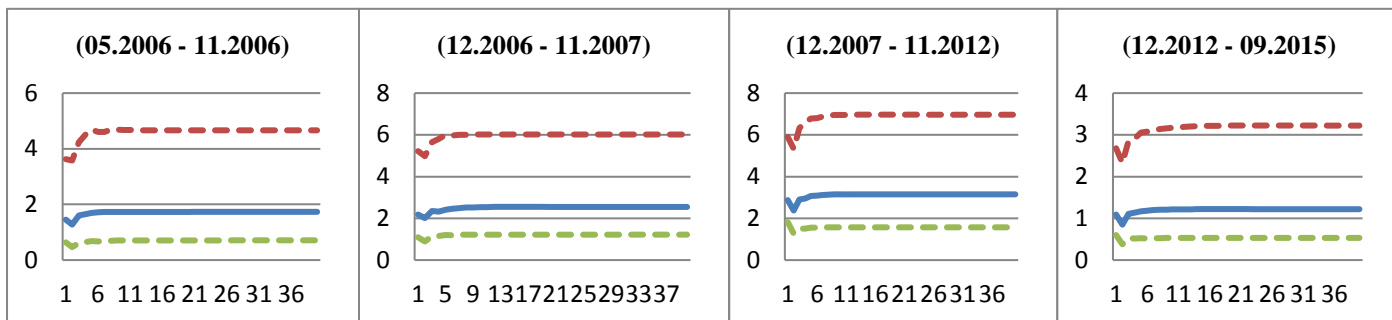
**(d) Impulse of Stock Exchange on Oil between terms**



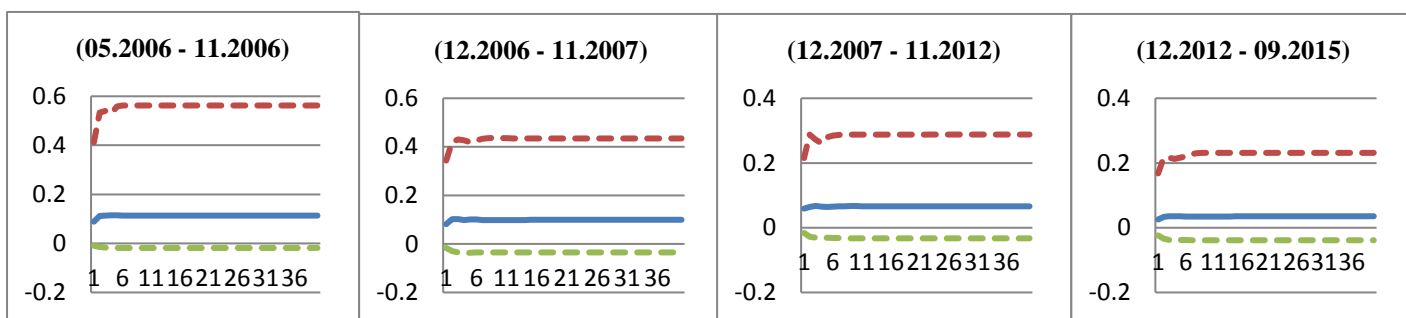
**(e) Impulse of Stock Exchange on Stock Exchange between terms**



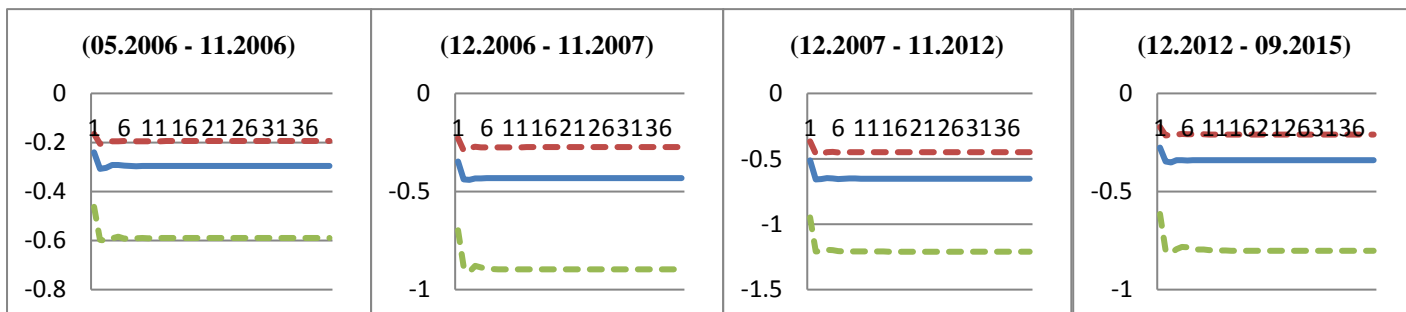
**(f) Impulse of Stock Exchange on Real Effective Exchange Rate between terms**



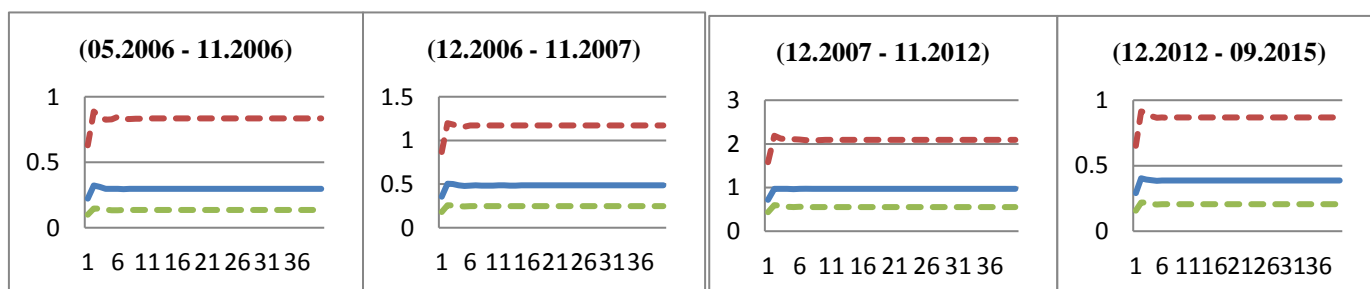
**(g) Impulse of Real Effective Exchange Rate on Oil between terms**



**(h) Impulse of Real Effective Exchange Rate on Stock Exchange between terms**

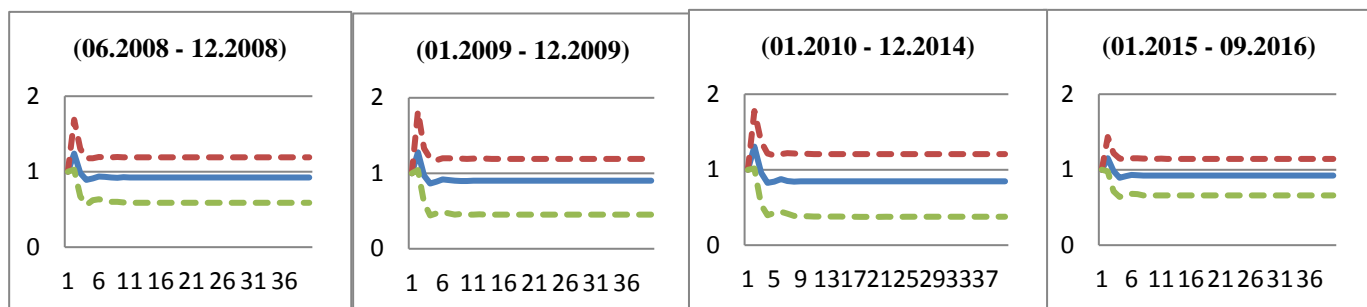


**(i) Impulse of Real Effective Exchange Rate on Real Effective Exchange Rate between terms**

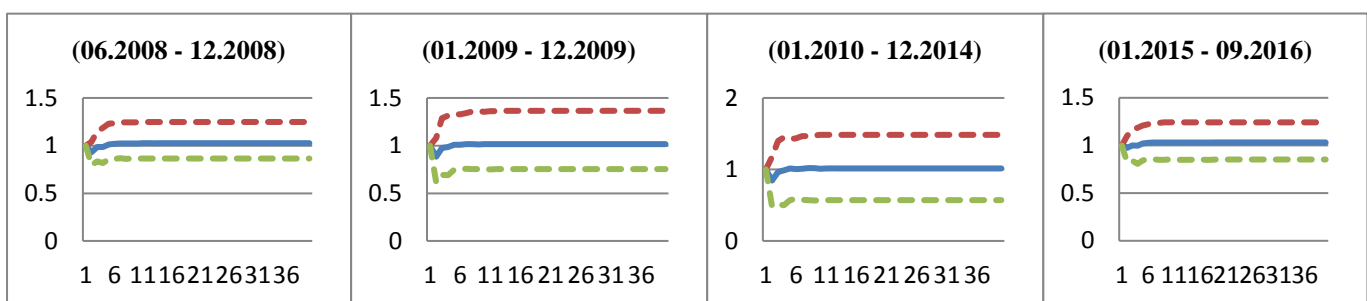


**Figure 8: Impulse Response Analysis for Kuwait:**

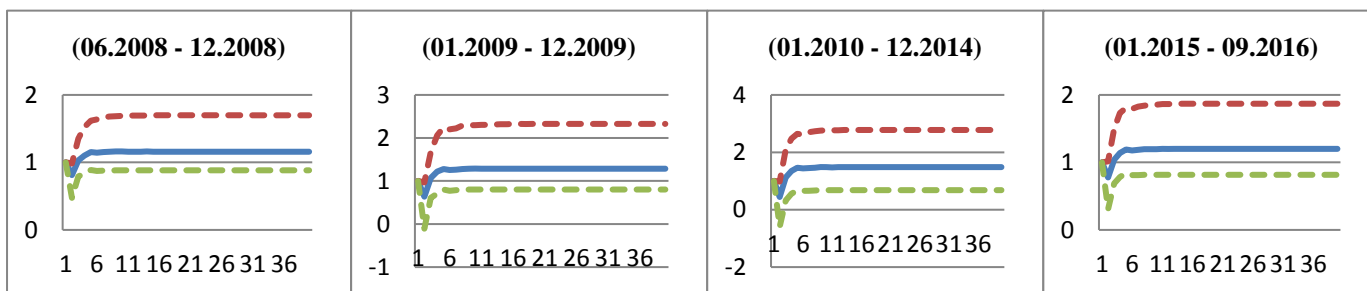
**(a) Impulse of Oil Shock on Oil between terms**



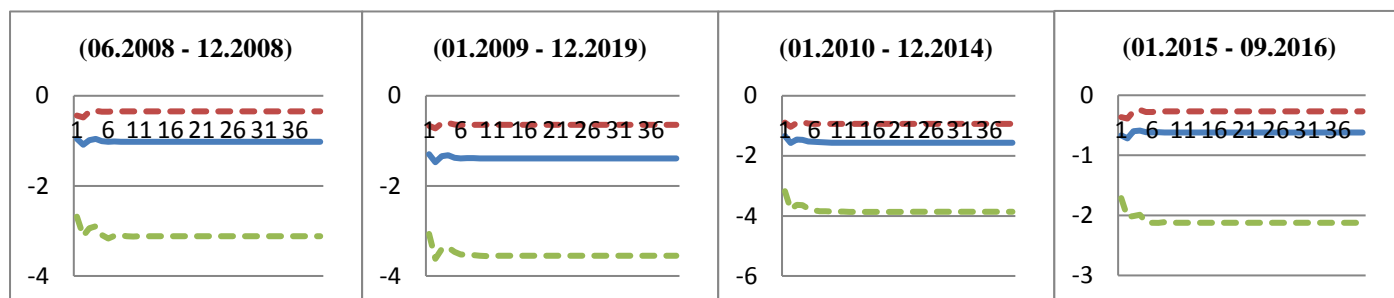
**(b) Impulse of Oil Shock on Stock Exchange between terms**



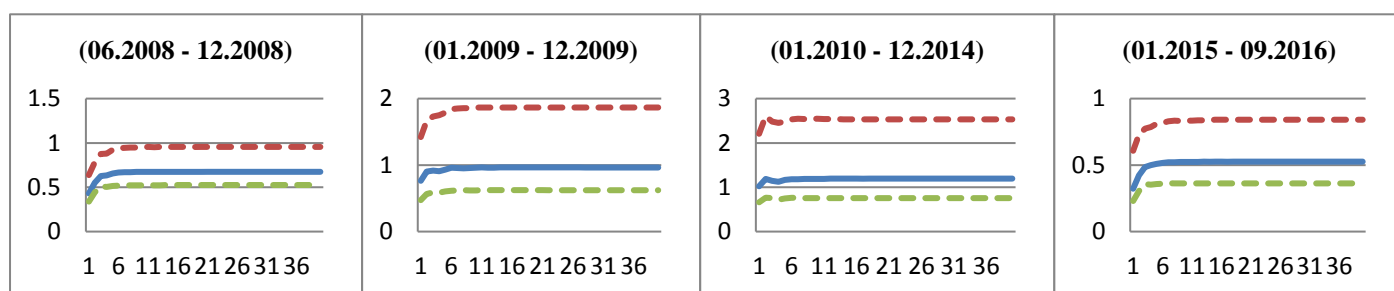
**(c) Impulse of Oil Shock on Real Effective Exchange Rate between terms**



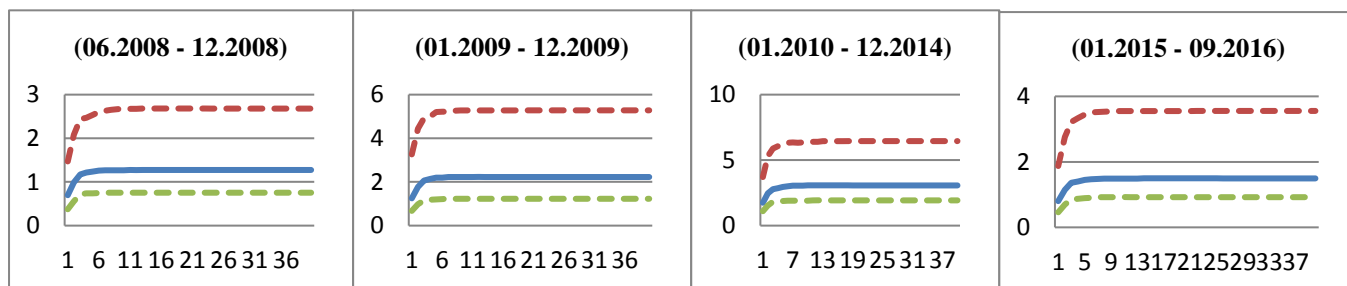
**(d) Impulse of Stock Exchange on Oil between terms**



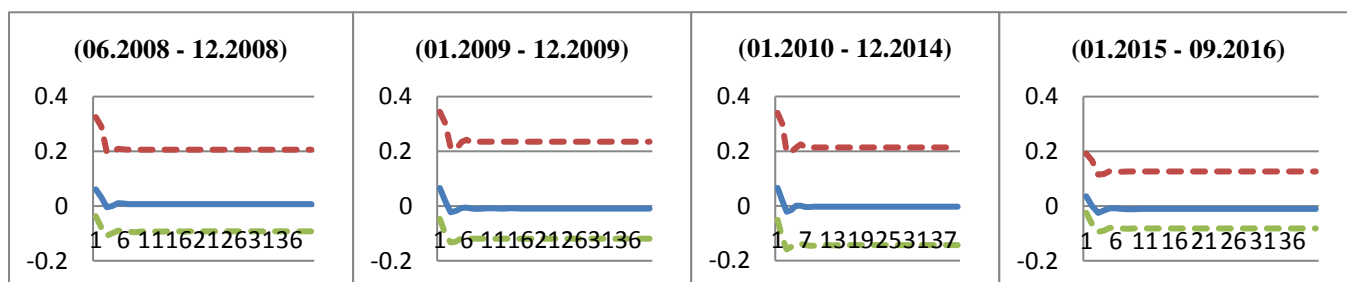
**(e) Impulse of Stock Exchange on Stock Exchange between terms**



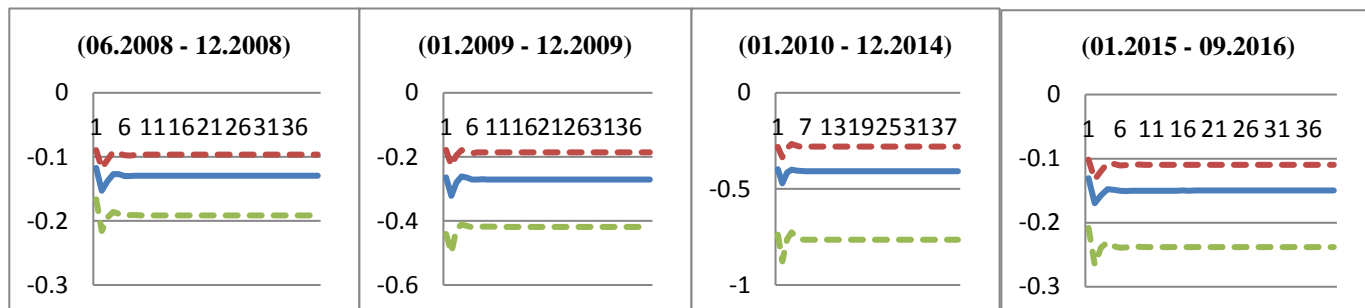
**(f) Impulse of Stock Exchange on Real Effective Exchange Rate between terms**



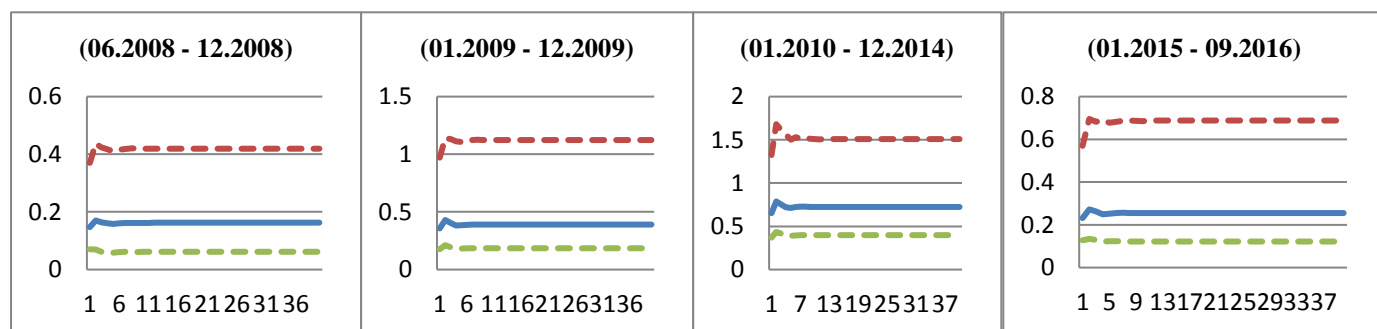
**(g) Impulse of Real Effective Exchange Rate on Oil between terms**



**(h) Impulse of Real Effective Exchange Rate on Stock Exchange between terms**

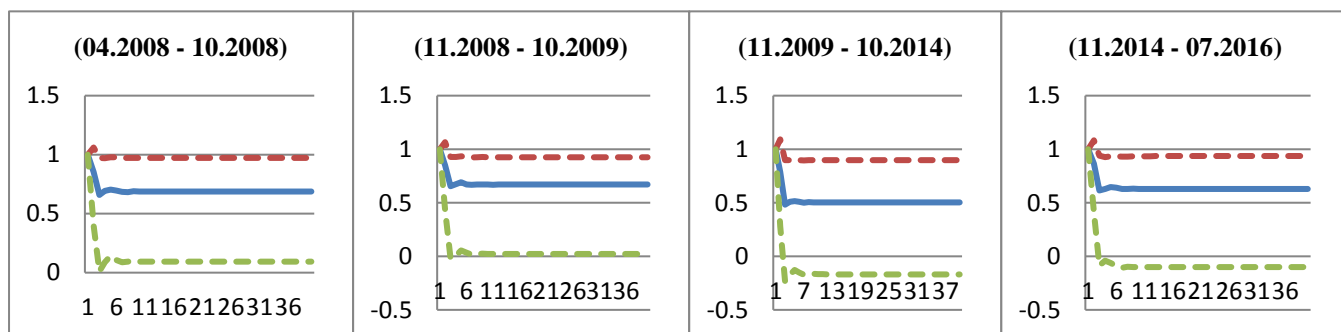


**(i) Impulse of Real Effective Exchange Rate on Real Effective Exchange Rate between terms**

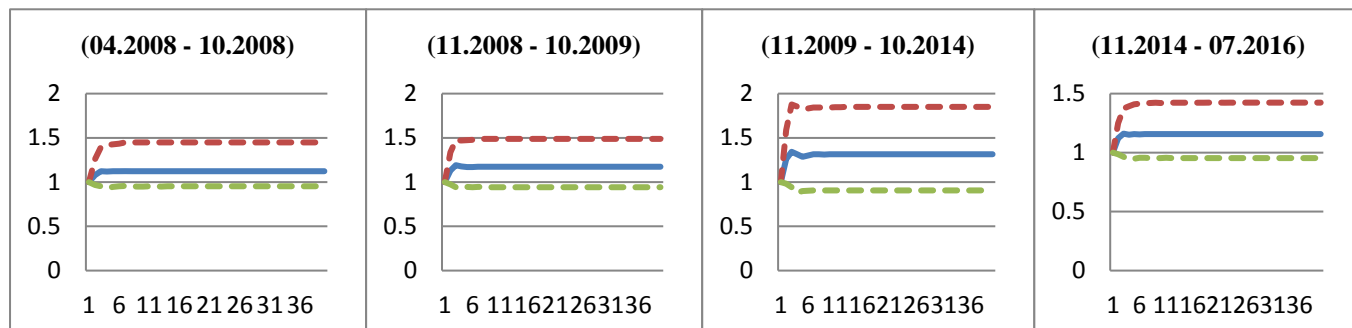


**Figure 9: Impulse Response Analysis for Saudi Arabia:**

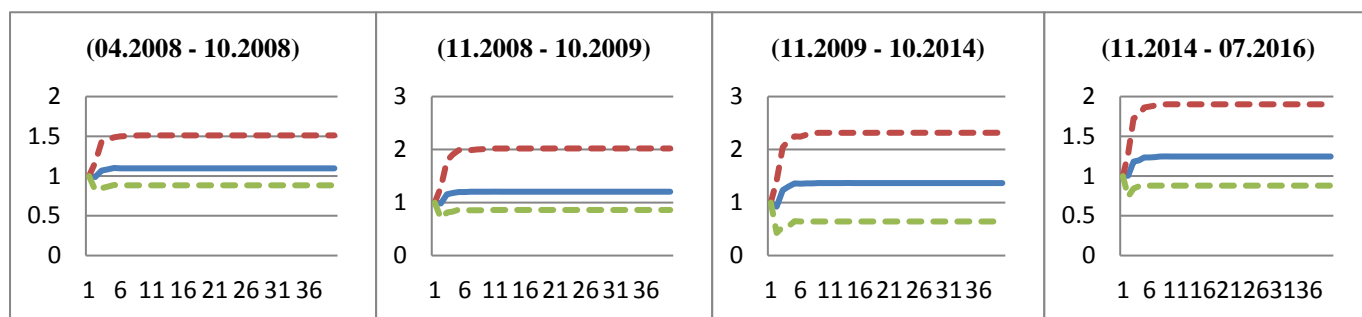
**(a) Impulse of Oil Shock on Oil between terms**



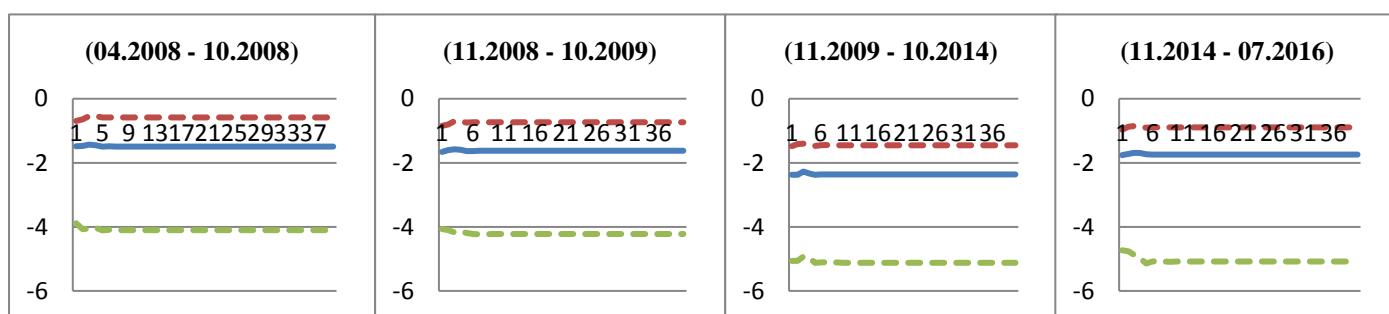
**(b) Impulse of Oil Shock on Stock Exchange between terms**



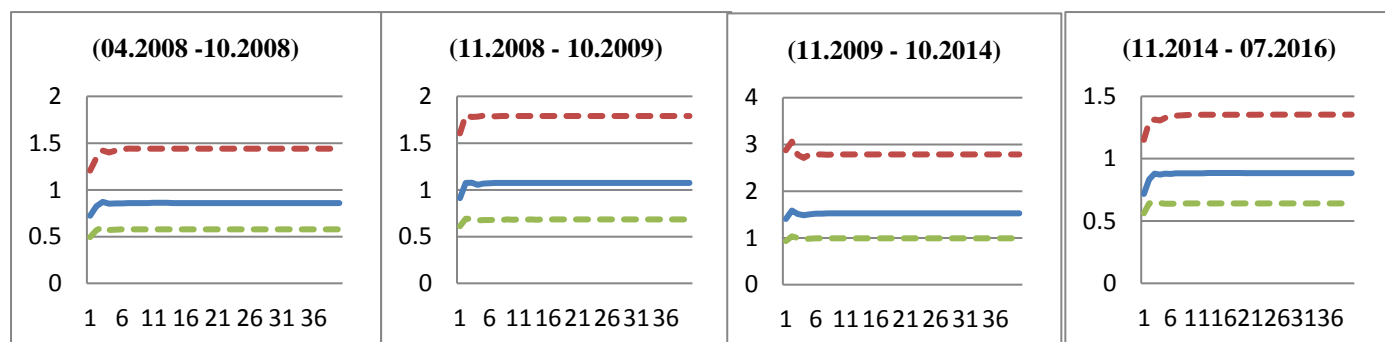
**(c) Impulse of Oil Shock on Real Effective Exchange Rate between terms**



**(d) Impulse of Stock Exchange on Oil between terms**

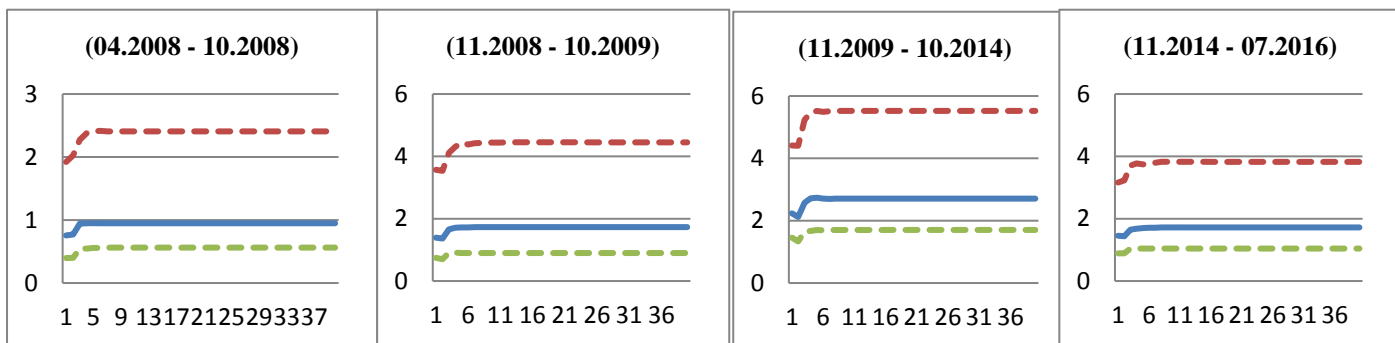


**(e) Impulse of Stock Exchange on Stock Exchange between terms**

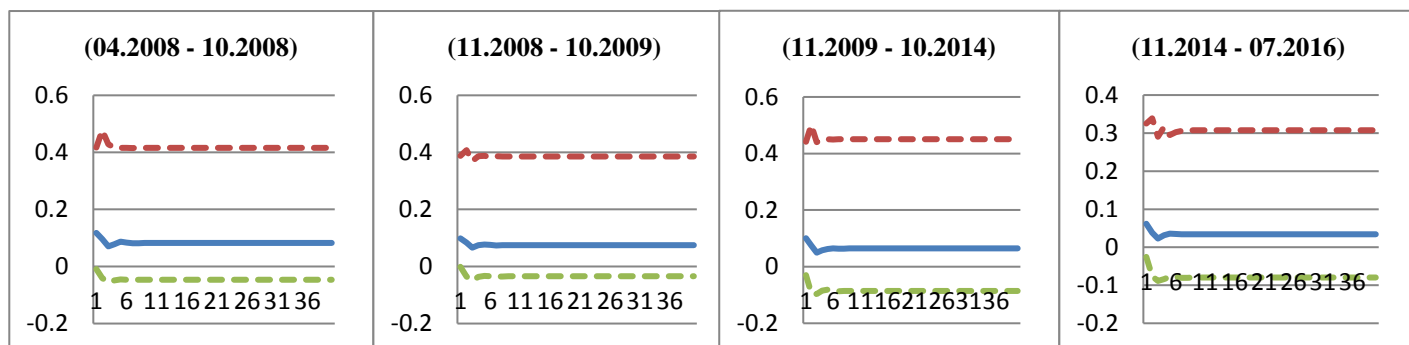




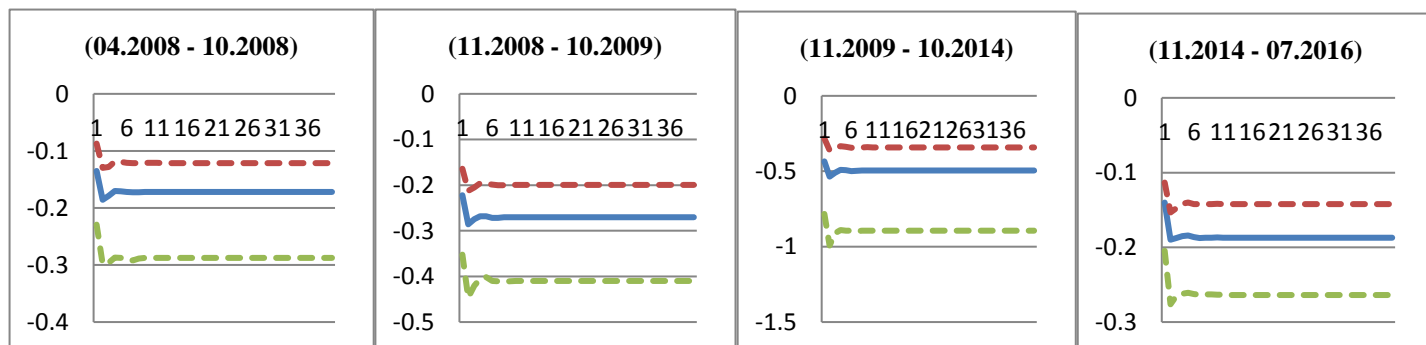
**(f) Impulse of Stock Exchange on Real Effective Exchange Rate between terms**



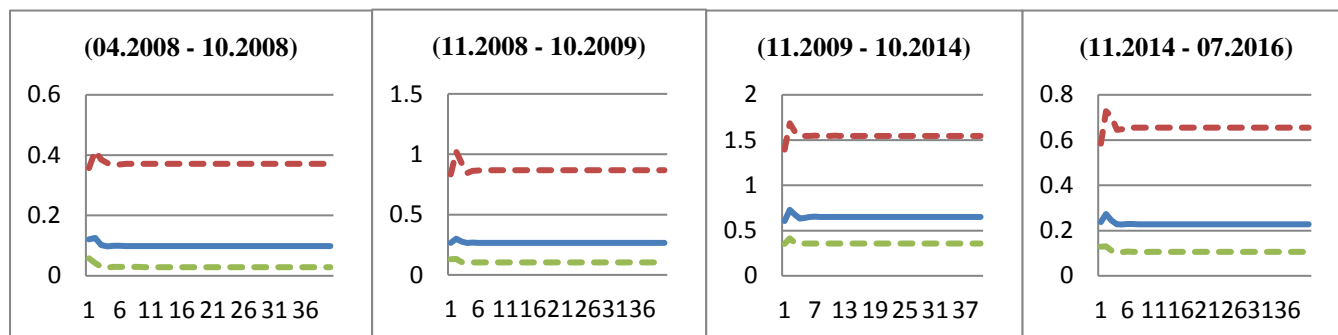
**(g) Impulse of Real Effective Exchange Rate on Oil between terms**



**(h) Impulse of Real Effective Exchange Rate on Stock Exchange between terms**



**(i) Impulse of Real Effective Exchange Rate on Real Effective Exchange Rate between terms**



Oil shock is used to see the responses of stock exchange and real effective exchange rate in UAE, Qatar, Kuwait and Saudi Arabia respectively. As it is mentioned above, there are for different time periods and the shocks are given them separately. It can be seen the impulse response of oil shock on Figures 6(a-b-c), 7(a-b-c), 8(a-b-c), and 9(a-b-c). In general, oil shock has positive long lasting and significant impact on the oil itself, stock exchange and real effective exchange rate. As a result, the response of stock exchange to oil is positive and it increases first three months in each period continuously and then continue to increase in the same level after three months in UAE, Qatar and Saudi Arabia. In contrast, although oil shock has positive and long lasting impact on stock exchange, it reduces the stock exchange first two months then starts to increase until the fifth months. After that, it continues to increase in the stable level in each period in Kuwait.

On the other hand, oil has insignificant impact on real effective exchange rate after one month during 12.2009 – 11.2014 in UAE and during 12.2007 – 11.2012 in Qatar which is period three but it has significant and positive long lasting impact on it, but decreases first three months then increases until fifth months and become stable in the rest of the periods. Moreover, real effective exchange rate decreases positively two months then increases until the fifth months and continue to increase in a stable level in each period in Kuwait and Saudi Arabia.

On the other hand, Figures 6(d-e-f), 7(d-e-f), 8(d-e-f) and 9(d-e-f), represent the stock exchange shock on the other variables. When it is given on oil, the response of oil is negative long lasting and significant. In addition, the oil is more responsive to the stock exchange in second periods in Qatar and UAE. In contrast, the impact on real effective exchange rate and also on itself is

positive long lasting and significant in each periods. In general, the response of real effective exchange rate is higher in period three in each country. Also, it increases positively first three months and then become stable in UAE, Qatar and Saudi Arabia. However, it increases first five months and become stable in Kuwait.

Lastly, Figures 6(g-h-i), 7(g-h-i), 8(g-h-i) and 9(g-h-i) show the real effective exchange rate shock on the other variables and itself. As it can be seen on the figures, it has positive and long lasting impact on oil but negative long lasting and significant on stock exchange when the shock is given. Moreover, the response of oil to real effective exchange rate is not too much. It is almost close to zero but it is significant during the all periods in each country except Kuwait. It gives response only for a short time which is only one month in each period.

As a result, all of the countries give the same response to the shocks and and because they have almost same characteristics, these results are as expected.

## **5. Conclusion and Policy Recommendations**

The association between oil and fundamental shocks which are stock exchange and real effective exchange rate have been changed over time. We estimated these changes by using TVP VAR model. In our estimations, we considered the results of volatility, coherence (joint dependence over business cycle frequencies) and lastly impulse response analysis over time.

We found that, stock exchange is more volatile than oil in UAE, Kuwait and Saudi Arabia but opposite in Qatar. On the other hand, the coherence between oil and stock exchange and oil and real effective exchange rate are at the maximum level in four years time in general. Moreover, the response of stock exchange and real effective exchange rate to the oil shock is positive and long lasting. The response of oil is negative and the response of real effective exchange rate is positive to the stock exchange shock. Moreover, when the the real effective exchange rate shock is given on oil and stock exchange, the responses are positive and negative respectively.

Finally, it is obvious that, oil shock has impact on the stock exchange and real effective exchange rate. Especially, oil shock has more impact on stock exchange. This shows that, these countries are oil dependent countries and the economies of them may be affected from possible oil shocks. So, policy makers could try to find the ways of reducing the oil dependency of the economy.

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