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The Effect of Oil Supply Shock on Global Economy: Two OPEC Oil Giants

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Abstract

This study employs the GVAR-Oil model estimated for 27 countries/regions for the 1979Q2-2019Q4 timeframe to mainly concentrate on the global macroeconomic consequences of country-specific oil supply shocks. This strategy not only considers how shocks impact countries that are directly exposed to them, but it also highlights how secondary or tertiary channels can help shocks have an indirect effect. Adopting this model makes it easier to analyze oil supply shocks in the context of individual countries, which is important given the significance of Saudi Arabia and Iran in the global oil supply. Therefore, depending on which country is affected by the shock, the results show various disruptions. In reality, our analysis demonstrates that, compared to Saudi Arabia, a negative shock to Iran's oil supply has very little consequences on the world economy since it may be offset by a rise in Saudi Arabia's oil output. However, a negative shock to Saudi Arabia's oil supply leads to higher oil prices, which have a negative impact on the economy and financial markets in general. Additionally, this strategy gives decision-makers more opportunity to deal with the effects of Covid-19, sanctions, and conflict, for example, across a larger variety of nations that serve as representations of the global economy, which enables them to make better strategic choices.

Highlights

- Writing (Times New Roman, 8) The GVAR permits to analyze both the direct and indirect effects of country-specific oil supply shocks.
- The oil supply shock is highly dependent on the country that caused the shock
- A negative shock to Iran's oil supply has very little consequences on the world economy since it may be offset by a rise in Saudi Arabia's oil output.
- A negative shock to Saudi Arabia's oil supply leads to higher oil prices, which have a negative impact on the economy and financial markets in general.

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1. Introduction

This study aims to examine how the global economy, especially aspects pertaining to oil prices, GDP, and financial markets, is affected by oil supply shocks brought on by Iran and Saudi Arabia. However, several studies focused on the effects of oil supply shocks on a small number of industrial Organization for Economic Co-operation and Development (OECD) members, the US in particular, leaving other countries with little to no research. But dealing with small-scale country-specific oil supply shocks required a different approach. To this end, the Global Vector Autoregressive (GVAR) approach, first proposed by Pesaran et al. (2000), paved the way for modelling interactions in a complex high-dimensional system, thereby facilitating the capture of transmissions in a wide range of channels. For instance, Baumeister & Peersman (2013b) investigated how oil supply shocks affected the US economy over time. Their research explains why a similar oil price increase is linked to lower oil production and a higher loss rate in US production over the past few years, whereas a similar oil production shortfall is linked to a stronger response of oil prices and more severe macroeconomic consequences over time. This study also demonstrates that oil supply shocks play a less significant role in real oil price variability, highlighting the more significant role played by oil demand shocks. The overall aggregate impact of the disruption in the oil supply on the US economy has been modest, despite the variability of this period (Baumeister & Peersman, 2013b).

Although there has been a lot of study on oil supply shocks in general, we were able to shed light on the consequences of country-specific oil supply shocks on the global economy by using the GVAR technique. Using a Global-VAR model for 38 countries/regions for the period 1979Q2-2011Q2, Cashin (2014) investigated the varying impacts of oil demand and supply shocks on the global economy. According to the findings, a supply-driven oil price shock has substantially different economic effects on economic activity than a demand-driven oil price shock does. Additionally, compared to energy exporters, the economic effects of supply- and demand-driven oil price shocks differ for nations that import their energy. Our study widens the extant literature in a number of ways:

Initially, it is thought that using GVAR to analyse interactions in the global economy as well as other networks will help leading policymakers better predict financial crises caused by sanctions, the Covid-19 pandemic, natural disasters, and war, giving them the opportunity to take appropriate action. Second, the current research intends to establish the exceptional effects of Saudi Arabia and Iran on both advanced and developing economies. These two nations account for 16.7% and 4.6% of global oil exports, respectively, on average between 2004 and 2019.Thirdly, this article primarily focuses on the effects of the oil supply shocks of the provided nations across a broader spectrum, encompassing more than 30 countries that account for 90% of the global GDP, in contrast to other research, which mostly concentrated on OECD countries. A fuller knowledge of financial links across multiple transmission channels, such as share prices and currency rates, is therefore provided by using this technique, which also helps discover trade ties in a global context. The introductory portion of this study is followed by a section on the research literature. The next stage integrates the global oil markets with a condensed quarterly model of the world economy to create a model for the global oil markets. The GVAR-Oil Model estimate is described in the third part. The study's fourth part discusses the global macroeconomic repercussions of shocks to the oil supply that are unique to Saudi Arabia and Iran. The last step is to suggest the findings.

2. background and related work

2.1 Impact of oil shocks on production

Increased export revenues from nations that export oil directly correlate with increasing national wealth. This profit is mostly offset by the loss resulting from decreasing export demand as a result of business partners' economic downturn (Akpan, 2009).A higher oil price causes revenue and resources to be diverted from oil-importing nations to oil-exporting nations, which increases the wealth impact in oil-exporting nations. As a consequence, incomes for families, consumers, and the government increase, which raises demand for goods. On the other hand, rising demand creates opportunities for more production, therefore the rate of production will rise in nations that export oil (Maravalle, 2013).Evidence from the 1970s indicates that an oil shock has a significant influence on output or production, which led economic actors to believe in the product's amazing response to rising oil prices. The economic actors increasingly changed their opinions in light of the reduced effect of oil prices on the good. Due to business principles and manufacturing factor substitutions, the effect of the oil shock on the product has been lessened. The effect of an oil price shock on expectations may increase the responses of macro factors since expectations are a key factor in influencing the oil change rate.

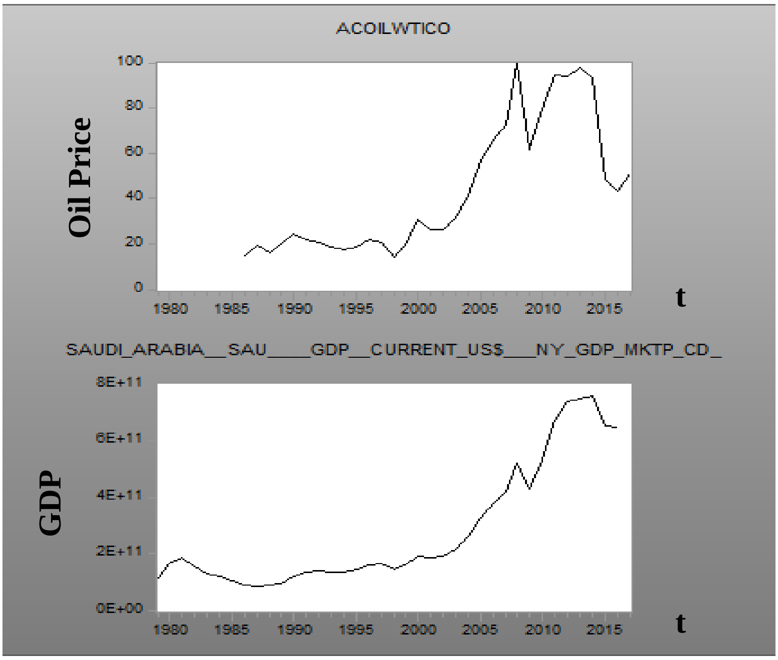


Figure 1. Saudi Arabian's GDP and Oil price
source: world bank

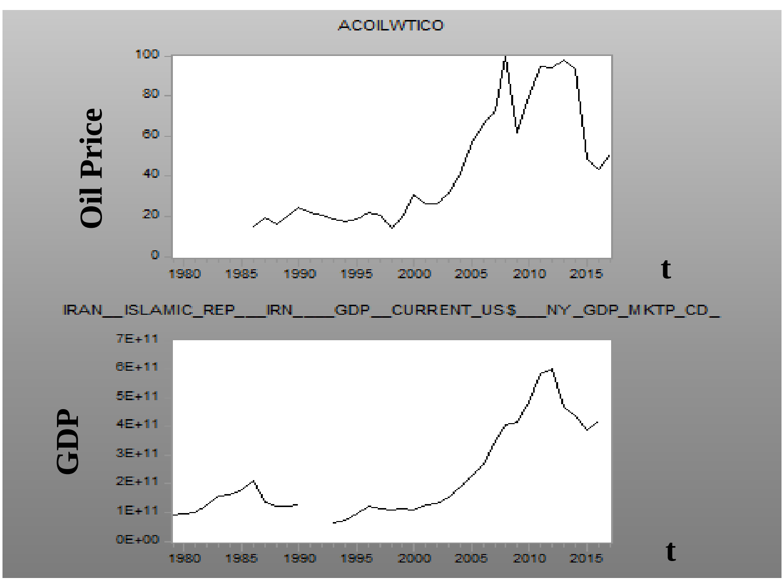


Figure 2. Iran's GDP and Oil price
source: world bank

As shown in figures(1),(2) there is a significant relationship between oil price shock and GDP fluctuations oil-exporter countries.

Due to Iran's economy's heavy reliance on oil earnings, during the years 1996 to 2002, the oil industry accounted for around 15% of nominal GDP. Additionally, the oil industry accounts for around 50% of government income and 70% to 75% of exports. The Iranian economy is characterized by a large and ineffective state-owned sector, an excessive reliance on the oil industry, and statist policies that often change direction. Instability in oil revenue and "stop-go" policies have also had an impact on economic performance, causing boom and bust cycles. Additionally, short-term rises in the price of crude oil result in higher expenditure, which is often maintained long when oil earnings start to decrease once again (Mehrara & Oskoui, 2007).

2.2 related work

Kilian (2008) evaluates how exogenous oil supply shocks affect the world's output of crude oil in 7 major industrialized nations. The author contends that a disruption in the external oil supply leads to a temporary slowing of real GDP growth in the second year after the shock. Strong statistical evidence shows that the responses to exogenous oil supply changes across the seven analyzed industrial economies varied despite the many qualitative similarities (Kilian, 2008). A research titled "an empirical growth model for major oil exporters" was conducted by Salehi Esfahani et al. 2014. Using a long-run growth model for a significant oil exporting country, this study then establishes the circumstances in which oil money is expected to have a long-term effect. The long-run hypothesis was developed using quarterly data from nine significant oil-producing economies, six OPEC members (Iran, Kuwait, Libya, Nigeria, Saudi Arabia, and Venezuela), plus former members Indonesia, Mexico, and Norway. The test findings often agree with long-term hypotheses. In six out of the nine economies indicated above, real production, foreign output, and real oil income have long-term correlations that were the subject of this research. As outliers, neither Mexico nor Norway have enough oil reserves for oil revenue to have a significant influence on their economies. The proved oil reserves of Mexico and Norway are anticipated to last 9 and 10 years, respectively, at their present production rates, as opposed to the reserve ratios of OPEC nations, which vary from 45 to 125 years. Over the last three decades, the percentage of Indonesia's GDP attributable to oil revenue has been dropping (Salehi Esfahani et al., 2014).Simulating and analyzing data in various contexts has been done using a variety of techniques (Baumeister & Peersman, 2013a, 2013b; P. Cashin, Mohaddes, Raissi, & Raissi, 2014; Chudik & Fidora, 2012; Hansen, 1992b; Kilian, 2009; Kilian & Murphy, 2012, 2014; Peersman & Van Robays, 2012; Pesaran, Shin, & Using the CS-ARDL methodology, Jarretta et al. (2019) examined oil price volatility, financial institutions, and economic development in 30 oil-producing nations from 1980 to 2016. Better financial institutions might enhance macroeconomic stability and lessen the dependency on quantitative adjustment mechanisms in oil-exporting nations, according to the findings. Additionally, stronger financial institutions might reduce oil prices. In general, the flexible and free fiscal structure contributed to a quick adjustment of the market in the event of oil price volatility in terms of improved capital allocation and sustained development (Jarrett, Mohaddes, and Mohtadi, 2019).But dealing with small-scale country-specific oil supply shocks requires a different approach. To this purpose, the Global Vector Autoregressive (GVAR) technique, first proposed by Pesaran et al. (2004), cleared the way for modeling interactions in a complex high-dimensional system, hence facilitating the capture of transmissions in a broad range of channels. For instance, Baumeister & Peersman (2013b) investigated how oil supply shocks affected the US economy over time. Their research explains why a same oil price rise is linked to lower oil output and a higher loss rate in US production over the last several years, but a similar oil production deficit is linked to a greater reaction of oil prices and more severe macroeconomic effects over time. This analysis also demonstrates that oil supply shocks have a less significant impact in actual oil price fluctuation, highlighting the more significant role played by oil demand shocks. The overall aggregate impact of the interruption in the oil supply on the US economy has been low, notwithstanding the fluctuation of this period (Baumeister & Peersman, 2013b).

With the use of an open-economy DSGE model that employs oil demand and supply while allowing for interaction between domestic and foreign monetary policy, Azomahou et al. (2021) looked at the effects of oil price shocks. It was feasible to quantify the relative impact of the oil price shock and the monetary policy reaction on large-scale variables because to the availability of Canadian and American data. They came to the conclusion that domestic monetary policy accounts for more than 40% of the discounted volatility in domestic production over a four-year horizon after an oil shock. The international channel, however, was shown to be less significant in the case of US monetary policy when price shocks on an oil-exporting country are involved (Azomahou, 2021). Delpachitra et al. investigated the effects of a COVID-19 outbreak and an oil price shock that occurred simultaneously in Africa. They came to the conclusion that deaths related to COVID-19 accounted for -2.75% points of the predicted GDP growth loss while countries relying primarily on oil experienced a loss of -7.6% points GDP growth. They claimed that two shocks could have a negative impact on the African economy of as much as 10.75% points. They proposed five crucial policies that might be useful to address this issue. These regulations cover a wide range of topics, including those that promote the environment,economic diversification, technological advancements, and plans for financial and social security.

2.3 Research methods

An effective model of interactions in a complex, high-dimensional system like the universal economy is provided by the Global Vector Autoregressive (GVAR) method, which was first proposed by Pesaran et al. in 2000. Even though

GVAR is not the first global macroeconomic model of the world economy, it employs a methodological approach that is theoretically sound and statistically reliable when dealing with dimensionality (the more the model's dimensions increase, the more parameters would be needed). (Chudik & Pesaran, 2016). The GVAR technique may be summed up as a two-step process. First, based on other global estimates, small-scale models for each nation are created. The weighted mean values of foreign variables, sometimes known as "star variables," are included in these models, which go by the term VARX*. The country-specific VARX* models are layered and concurrently solved in the second step to create a sizable global VAR model that can be used to understand and forecast the shock situation (Chudik & Pesaran, 2016).

2.3.1 GVAR-Oil model

The GVAR-Oil combination model relates the global economy and oil prices in two different ways. Changes in oil supply and demand that affect oil prices and have the potential to have an effect on all GVAR-Oil-specific variables of nations Similar to how variations in oil supply are impacted by oil prices in an oil price cycle as stated by the oil price equation, significant oil producers in the chosen country model are also affected. The following equation is provided from the combination of the above oil price equation with country-specific models:

$$\begin{pmatrix} 1 & w'_{ep} \\ -\Upsilon_0 & I_k - H\,0 \end{pmatrix}\begin{pmatrix} p_t^o \\ x_t \end{pmatrix} = \begin{pmatrix} c_p \\ \varphi_t \end{pmatrix} + \begin{pmatrix} \phi_1 & \phi_1 w'_{ep} + \alpha_1 w'_y + \beta_1 w'_q \\ \Upsilon_1 & \Phi + H_1 \end{pmatrix}\begin{pmatrix} p_{t-1}^o \\ x_{t-1} \end{pmatrix} + \begin{pmatrix} u_t^o \\ \mathbf{u}_t \end{pmatrix} \quad (1)$$

vectors and the elements are zero or equal to weights wi or wi0, assigned to epit,yit or q0it. This can be observed in (1) .

Which is written quite concisely below:

$$\mathbf{G}_0\mathbf{z}_t = \mathbf{b}_t + \mathbf{G}_1\mathbf{z}_{t-1} + \mathbf{v}_t \quad (2)$$

Based on the assumption that I_k - H_0 is invertible, the GVAR-Oil model has the solution as the following reduced form

$$\mathbf{z}_t = \mathbf{a}_t + \mathbf{F}\mathbf{z}_{t-1} + \zeta_t \quad (3)$$

$a_t = \mathbf{G}_0^{-1} b_t$, $\mathbf{F} = \mathbf{G}_0^{-1}\mathbf{G}_1$, $\xi_t = \mathbf{G}_0^{-1}\mathbf{v}_t$ (Arthur, 1998; Dees, Mauro, Pesaran, & Smith, 2007; Hashem, Til, & Scott; Mohaddes & Pesaran, 2016).

2.2. Data references

The GVAR-OIL model's primary source of data utilized for estimation is It includes the majority of variables' seasonal data from 1979Q2 to 2016Q4. We added seasonal observations for Iran's oil output to this database to enhance it. Data on the GDP, the consumer price index, and the exchange rate for Iran from 1979Q1 to 2006Q4 have all been taken from The Central Bank's (CBI) web data, numerous volumes of its economic bulletins, the World Bank's monthly consumer price index, and other sources were utilized to create these statistics. The World Bank and International Monetary Fund (IMF) have revised their figures on Iran's GDP. The International Monetary Fund provided exchange rate data (for free-market exchange rates), and the US Energy Information Administration provided seasonal oil price time-series data (on a scale of one thousand barrels per day).

2.3.Trade weights

Based on information taken from the International Monetary Fund, the wij trade weights used to calculate external variables are shown as a 27*27 matrix. According to the years 2007 to 2009, the Eurozone accounted for 25% of Iran's overall commerce, making it the country's most significant trading partner. Over the last 20 years, trade with China, India, and Korea has risen by 19%, 9%, and 12%, respectively. In actuality, Asian nations account for more than 57% of Iran's trade. After US sanctions in 2011 and EU oil and financial penalties on Iran in 2012, however, this figure is probably going to rise dramatically. Japan (14%), Turkey (7%), and other nations in our sample with which Iran does trade in excess of 5% are included in parenthesis. Comparing Iran to Saudi Arabia reveals that although trade with China (12%), the Eurozone (16%), Japan (16%), and Korea (10%) is considerable for Saudi Arabia, the region's overall commerce has been less oriented toward Asia and Europe. For instance, Saudi Arabia's top trade partner is the United States (19%).

3. Empirical application

34 economies are included in the model, accounting for more than 90% of global GDP in total (GDP). Ten of these are categorized as large oil producers, producing more than 1% of the world's oil supply on average between the years 2004 and 2013 (Table 1). This need is met by significant oil exporters including Canada, Iran, Mexico, Norway, and Saudi Arabia. The same is true for Indonesia, which was an OPEC member until January 2009, and for Britain, which was only an oil exporter until 2006. Brazil, China, and the United States are three more nations in our sample that generate much more than 2.4 million barrels per day. These nations rank as the 11th, fourth, and second-largest oil producers in the world, respectively, while being net importers of the commodity. Iraq has the fifth-largest known oil reserves in the world, yet despite this, we are unable to include it in our sample since there aren't enough long-term time series data for it. Additionally, seasonal measurements are not available during the sample period for Russia, the third-largest oil production in the world.

Table 1. Countries and Regions in the GVAR Model

Major Oil Producers	Other Countries

Net Exporters	Europe	Asia pacific
Canada	Austria	Australia
Iran	Belgium	India
Indonesia	Finland	Japan
Mexico	France	Korea
Norway	Germany	Malaysia
Saudi Arabia	Italy	New Zealand
	Netherlands	Philippines
Net Importers	Spain	Singapore
Brazil	Sweden	Thailand
China	Switzerland	
United Kingdom	Rest of the Word	Latin America
United states	South Africa	Argentina
	Turkey	Chile
		Peru

Source:

The importance of their daily oil output to the global oil market is an essential characteristic shared by the top 10 oil producers. Nonetheless, the oil output, exports, degree of stable oil reserves, and surplus oil capacity of these nations vary considerably (Table 2).Table 2 in particular demonstrates that although Iran has enormous oil reserves and is the fourth-largest oil producer in the world, its oil output represents less than 5% of global oil production. This is comparable to Chinese output, which accounts for less than 1% of all known reserves in the globe. It may surprise you to learn that while Canada exports around 1 million less barrels per day than Iran, it really has higher oil reserves. Table 2 demonstrates that Saudi Arabia is crucial to the supply of oil across the globe. Not only did they account for more than 12.9% of global oil production, but they also held 17% of the world's stable oil reserves and exported roughly 16.7% of it, which is about the same as the total of the four largest oil exporters in the sample. Furthermore, Saudi Arabia not only produces and exports the most oil in the world, but it also has the most surplus capacity and is regarded as a generator of unstable regulators. As a result, it is anticipated that raising Saudi Arabia's oil output would address any interruptions in the global oil supply. On the other hand, as the majority of producers have production capacities that are comparable to or near to those of Saudi Arabia, the interruptions to the oil supply caused by Saudi Arabia may only be partly mitigated by other producers.

Table 2. Oil Reserves, Production and Exports of Major Oil Producers, averages over 2004–2019 †

	Oil Production		Oil Exports		OIL Reserves	
Country	Million percent Barrels/day	percent of world	Million percent Barrels/day	percent of world	Billion Barrels	percent of world

Net Exporters						
Canada	3.9	4.4	2.02	4.8	174.5	10.9
Indonesia	.96	1.1	.3	.7	3.7	.23
Iran	4	4.5	1.97	4.6	148.9	9.3
Mexico	2.9	3.3	1.5	3.5	10.4	.65
Norway	2.2	2.5	1.6	3.8	7.9	.49
Saudi Arabia	11.4	12.9	7.1	16.7	271.1	17
Net Importers						
Brazil	2.7	3	.62	1.5	13.4	.84
China	4.3	4.8	.07	.2	23.2	1.45
United Kingdom	1.3	1.4	.77	1.8	3	.19
United States	10.95	12.3	.5	1.2	43.6	2.73
World	88.9	100	42.5	100	1595.3	100

† ***Source:*** Oil production data are from the U.S. Energy Information Administration *International Energy Statistics*, oil reserve data are from the British Petroleum *Statistical Review of World Energy* and oil export data are from the OPEC *Annual Statistical Bulletin*.

$$ep_t = \sum_{i=}^{N} w_i ep_{it}. \quad (4)$$
$$y_{t=} \sum_{i=1}^{N} w_i y_{it,}\, q_t^o = \sum_{i=1}^{N} w_i^o\, q_{it}^o. \quad (5)$$

We computed the ep_t and y_t provided from Equations (4) and (5) based on PPP-GDP weights.

Specifically $ep_t = \sum_{i=1}^{N} \ln\left(\frac{Eit}{CPIit}\right)$〛 and $y_t = \sum_{i=1}^{N} wiln(GDPit)$

that *Eit* is the US dollar exchange rate, *CPIit* is consumer price index and *GDPit* is real GDP of the ith country in the time t,i = 1,2,…, N and *Wi*, weight of the ith country PPP-GDP with respect to $\sum_{i=1}^{N} Wi$=1

To decrease the impact of individual changes on weights, we calculated *Wi* based on a three-year average of 2007-2009 .To supply world oil, we used the relation $q_t^o = \sum_{i=1}^{N} wi^o\ \ qit^o$.

Which qit^o = 0 for the euro area and 16 countries where producers are not major oil (Table 1 shows the list of major oil producers).

We regarded oil exports and production in deciding about Wi^o, but the findings of satisfactory oil exports and production were not provided. For example, according to weight-based on oil export values $w_{us}^o = 0$.

On the other hand, despite the fact that US output accounts for around 11% of global production, findings based on oil production do not suggest the significance of final changes in oil exports at oil prices. Regarding the vast nature of the international oil trade, we decided to adopt an equal weight scenario, which puts equal weight on the relative changes in oil production among all major oil producers. Finally $p_{t=\ln}^o (p_t^o)$ which p_t^o is the price of Brent crude oil is computed in US dollars (Salehi Esfahani et al., 2014; Smith & Galesi, 2014).

3.1 Estimation of country-specific VARX* model

34 countries are included by our study. There is a block comprising 8 of the 11 nations that first entered the Eurozone in January 1999 (Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, and Spain) in the GVAR-OIL model structure. Time series data were created as cross-sectionally weighted data using the weighted average of the variables from the eight euro area member nations and based on the PPP GDP weights for the average time period 2009–2007.The seasonal GVAR-oil model, shown in Table 1, covers the years 1979Q2 through 2019Q4; for information on creating variables, see Appendix A. In Appendix B, we analyze the structural failure of the GVAR-oil model and briefly provide evidence of the weak exogenous assumptions of external variables (M. P. Cashin et al., 2015; Dees et al., 2007; Rey, 2015).

3.1.1 Unit root tests

We need to take into account the unit root features of the variables in country-specific models to evaluate long-term connections and make sure we don't operate with a combination of variables I (2), I (1). Both the generalized Dickey-Fuller weight symmetric tests (ADF-WS) and the Augmented Dickey-Fuller (ADF) unit tests were employed (Park & Fuller, 1995). In certain cases, generalized Dickey-Fuller tests are less effective than ADF-WS testing. Results are not published here for brevity, although they are accessible upon request.

3.1.2 Testing the weak exogeneity assumption

A weak exogenous test of external and global variables was done, the findings of which are indicated in Table A.1 (Harbo et al., 1998; Johansen, 1992).

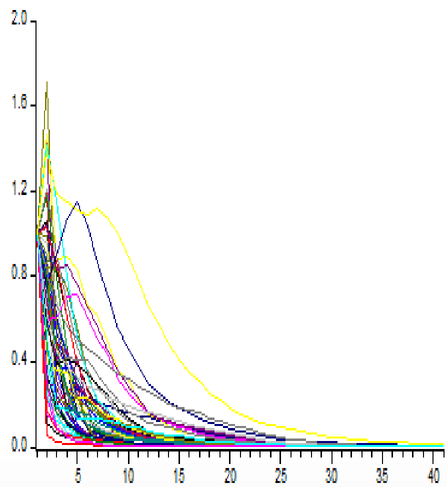
3.1.3 Tests of structural breaks

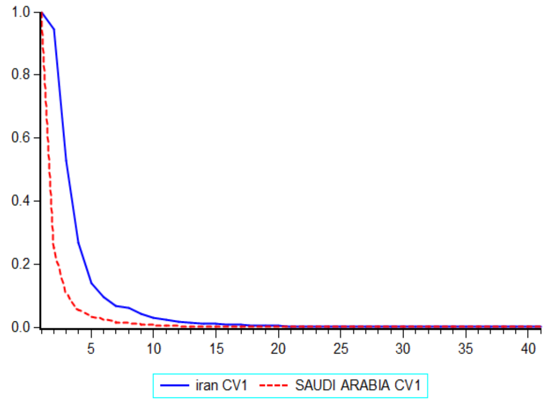
A significant issue with macroeconomic modeling is the potential for structural breaks. The number of parameter stability null hypotheses that were found to be false at a 5% significance level for each variable is shown in Table A.2. Test data and crucial Bootstrap values are not included here for sake of clarity, although they are accessible. Regression coefficients generally seem to be steady. But the outcomes differ from test to test. The null hypothesis that 10%–11% of the cases in each of the two PK tests is now rejected. On the other hand, the substantially higher rate is rejected in between 14% and 49% of instances for the NY, MW, QLR, and APW tests (Andrews & Ploberger, 1994; Dees et al., 2007; Nyblom, 1989; Quandt, 1960). 78 and 79 out of 162 are rejected under the QLR and APW assumptions of zero coefficient stability and error variance stability. The rejection rate is reduced to 12% and 20% once these tests are run in their robust form, nevertheless. As a result, we observed signs of structural instability, which seems to be the primary factor behind potential increases in error variance bigger than the parameter coefficients (Table A.3).

3.2. Lag order selection, cointegrating relations, and persistence profiles

Global stability of the GVAR model requires that long-term convergence connections may be reversed to their average. In the first PPS study for the GVAR-oil model, we discovered that the convergence rate is almost nonexistent in several nations. In particular, the adjustment pace for Norway, South Africa, and the UK is particularly slow. As seen in Table B.1, five of the 57 stacked vectors' graphs jumped before zero. We created PPS for Iran and Saudi Arabia in the form of a b1 and c1. We came to the conclusion that the convergence rate was very high for these two big oil

exporters, which was consistent with the other reported exporters (MacKinnon,1991; Pesaran et al., 2000). (a) All Countries.





(b) Iran, Saudi Arabia

Figure 3. Persistence Profiles of the Effect of a System-wide Shock to the Cointegrating Relations

4. Counterfactual analysis of oil supply shocks

4.1 Reducing oil supply shock by Iran

A recent problem that hasn't been examined in the study of global oil supply and demand is how to deal with country-specific shocks. We start by looking at how Iran's oil supply shock may affect output and oil prices. Figure 4 demonstrates unequivocally that Iran's output temporarily declines by 4.9% in the first four quarters after the supply shock. Other OPEC members (particularly Indonesia and Saudi Arabia) raised their output in reaction to the fall in Iranian oil production and to stabilize the oil markets. Saudi Arabia's production first climbed by 1.04% and ultimately increased by 2.14% over time. Oil prices therefore rose by the same amount in the near term and by 0.15% in the long term. Figure 5 compares oil output in Iran and Saudi Arabia for the years 1980 to 2019. It is easy to observe that Iran's oil production saw two distinct periods of significant reduction. The Iranian Revolution and its immediate aftermath fall inside one of the periods, which is known as the 1978 era. Midway through 2011, when sanctions on Iran were being tightened, the second term officially started. But in the first phase, from 1971 to 1978, Iran's oil production was halted by the revolution, the upheavals, and the oil workers' strike. However, the Provisional Government of Iran made the intentional choice to lower oil output to a level that is around 30% below the average level of the years 1978 to 1971. (Mohaddes & Pesaran, 2013). It turned out, however, that the 1980 Iraqi invasion of Iran drastically decreased oil output, refining capacity, and real production, which dropped from an average of 2.1 million barrels per day in 1980 to roughly 6 million barrels per day in 1978. It's important to note that between 1978 and 1981, Saudi output increased by 1.6 million barrels per day, largely offsetting the drop in Iranian supply, as illustrated in Figure 3. The second significant supply shock for Iran is linked to some of the sanctions put in place against it by the European

Union and the United States in 2012, which include:1- The punishment of companies including upstream activities of Iran and petrochemical industry.

2- The sanctions of the Central Bank of Iran

3- Ending financial services (to financial transactions) to Iranian banks

Finally, as a consequence of these severe financial and oil sanctions, Iran's oil exports and production decreased due to the complete ban on its oil imports. The US Energy Agency reports that daily oil output decreased by 875,000 barrels between January 2011 and June 2014.It's noteworthy to note that Saudi Arabia's output rose by 865,000 barrels per day during this time. when political concerns caused a significant decrease in Iran's oil output. Only Saudi Arabia, which has the ability to cause worldwide volatility, can offset this decline in output; but, outside of these two time periods (1978–1979 and 2011–present), Saudi oil production is extremely erratic whereas Iranian oil production has mostly remained consistent (Hansen, 1992a).

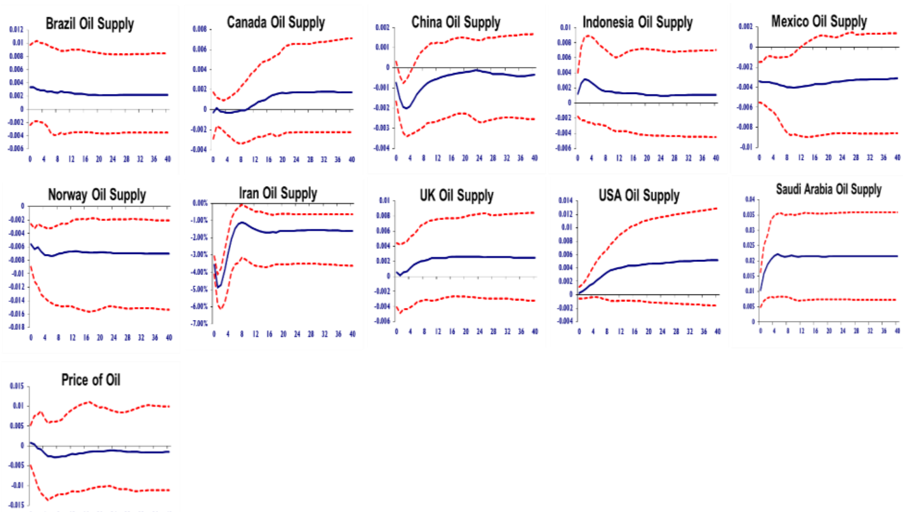


Figure 4. Structural Impulse Responses of a Negative Unit Shock to Iranian Oil Supply

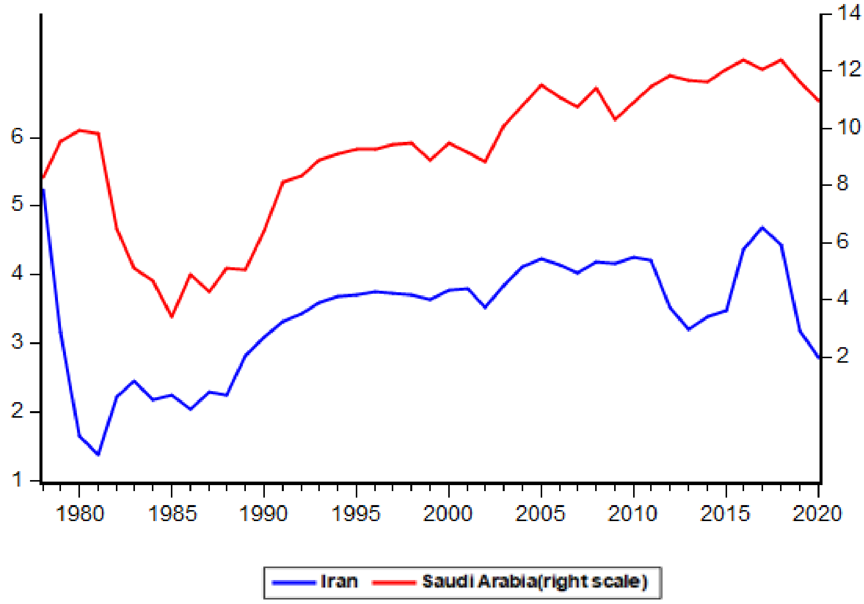


Figure 5. Iranian and Saudi Arabian Oil Production in Million Barrels per Day, 1980-2020

According to the GDP's response to the shock to Iran's oil supply, actual output decreased by.37% in the near run and 1.59% in the long run (Figure 6). But in Saudi Arabia, rising oil output countered the decline in oil prices. Real output thus grew by 0.06% in the short term and by 0.43% during the long run. In general, it may be assumed that Saudi Arabia's increased oil output has made up for the shock effects of Iran's oil supply on the global economy.

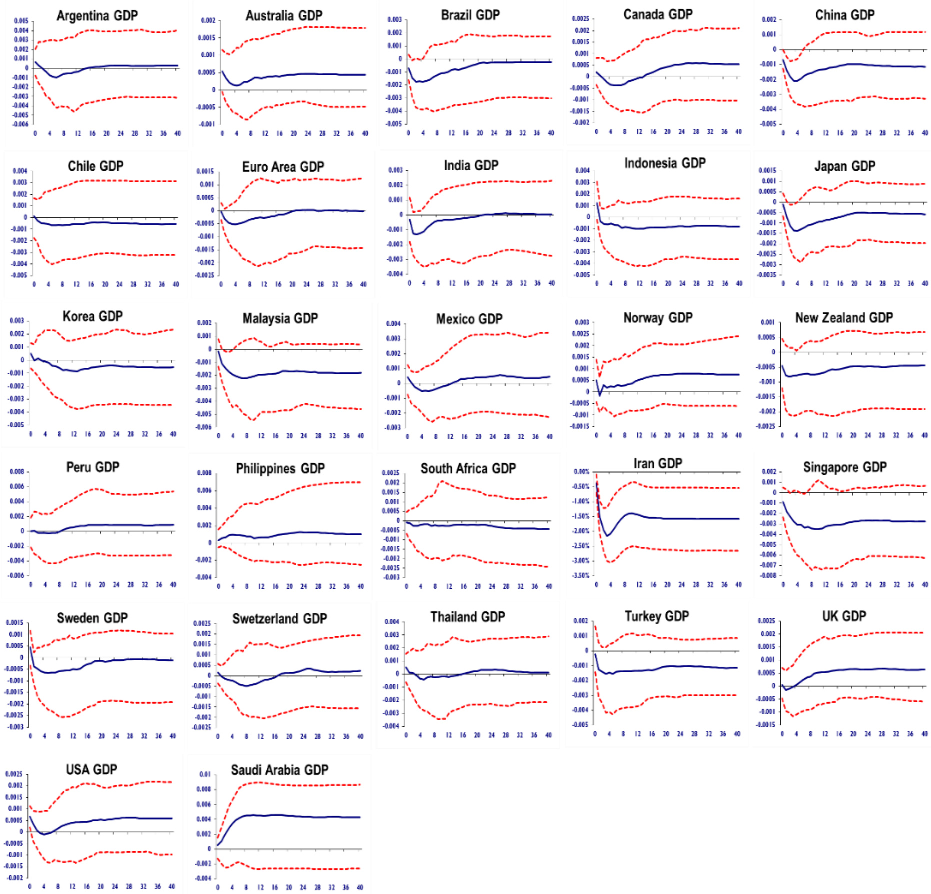


Figure 6: Structural Impulse Responses of a Negative Unit Shock to Iranian Oil Supply

4.2 Reduction of oil supply shock by Saudi Arabia

Figure 7 depicts the negative consequences of Saudi Arabia's supply shock on oil prices as well as the global oil supply. It can be shown that Saudi Arabia's output declined by 9.9% every season in the long term. But in the near run, Norwegian and Iranian oil output has climbed by 3% and 1% every quarter, respectively. However, considering that all major producers, with the exception of Saudi Arabia, are producing at or near capacity, the decline in Saudi Arabia's supply will not be compensated in the long term by other producers. Consequently, oil prices rise by 0.38 percent. Larger consequences have been recorded after Saudi Arabia's decision to make big adjustments to its production. In September 1985, for instance, Saudi Arabia's output increased from 2 million barrels per day to 4.7 million barrels per day, resulting in a decrease in price from 59.67 dollars to 30 dollars.

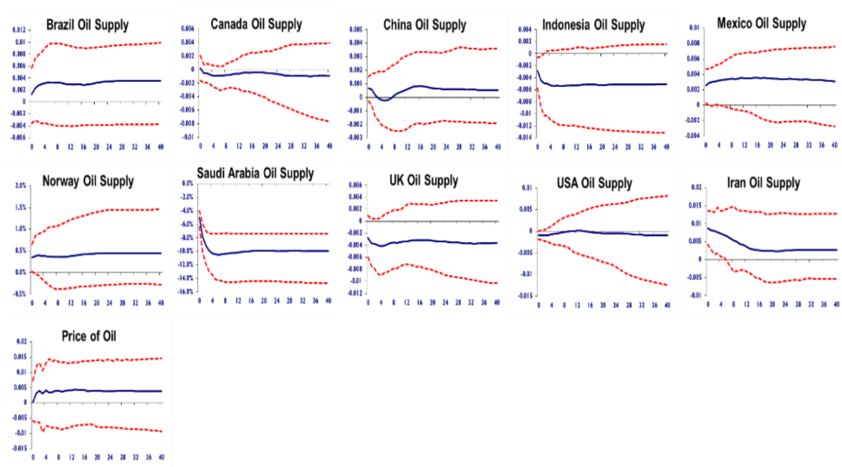


Figure 7: Structural Impulse Responses of a Negative Unit Shock to Saudi Arabian Oil Supply

Figure 8 depicts the consequences of the negative Saudi oil production shock on the real output of 26 countries and the Eurozone. Over time, Saudi Arabia's actual output will decline by 2.21%. Iran's real GDP, on the other hand, will grow by 0.2% over time and by 0.07% in the near term. Figure 6 shows the crude oil importers, and we can see that almost all of the effects are moderately negative. In the sixteenth season, moderate effects were reported for Argentina (-.4%), Australia (- 0.09%), Chile (-0.1%), Korea (-0.39%), Malaysia (0.09%), the United Kingdom (-0.01%), and the United States (-0.0005%).

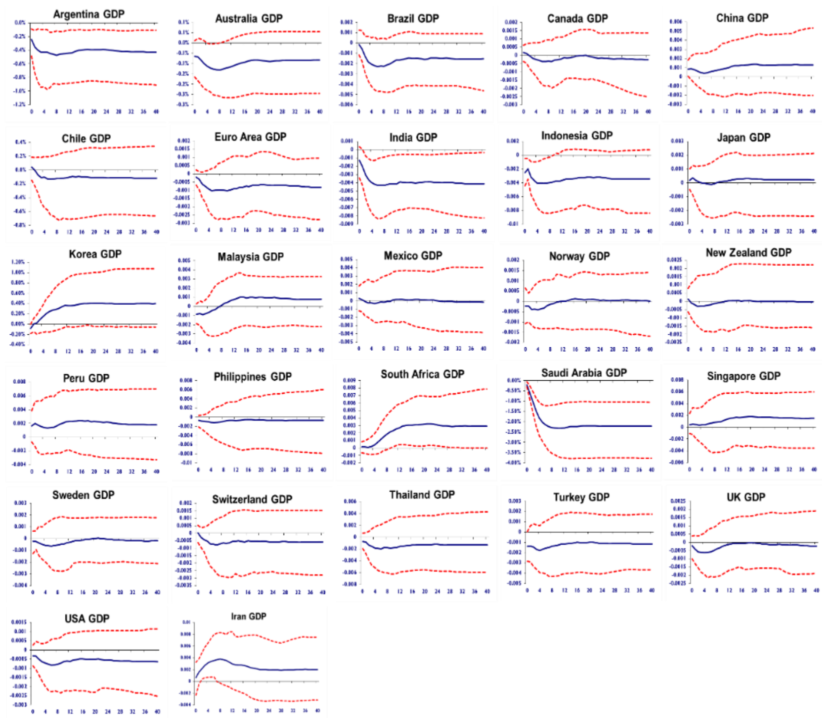


Figure 8. Structural Impulse Responses of a Negative Unit Shock to Saudi Arabian Oil Supply

4.3 Forecast Error Variance Decomposition

The results of the variance decomposition of GDP may be seen in figure (9), which demonstrates that a variety of variables can influence changes in GDP. The GDP lag is the first element, followed by the shock to the oil supply. It is important to note that the latter builds momentum gradually. (Appendix B contains statistics relating to Forecast Error Variance Decomposition.)The shock to the oil supply accounts for around 2% of Iran's GDP variations in the first year, rising to more than 20% in the following two. In Saudi Arabia, the short-term GDP variations are mostly caused by the shock to the oil supply. The oil supply shock is the primary factor behind long-term GDP changes in Saudi Arabia and Iran. Long-term GDP changes in Saudi Arabia and Iran are 23% and 25%, respectively. Due to their heavy reliance on oil earnings, Iran and Saudi Arabia are particularly vulnerable to fluctuations in the oil supply.

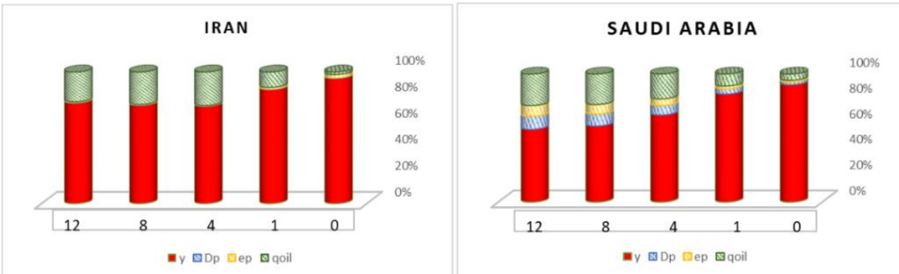


Figure 9. GDP Variance Decomposition

5. Conclusion and Policy Implications

This research put out a quarterly oil market model called GVAR-Oil that accounts for both global supply and demand factors. In order to present a novel method to country-specific oil supply shocks in the context of several nations, this study explores the relevant literature using oil price modeling. 27 nations' quarterly data from 1979Q2 to 2019Q4 were utilized to estimate this combined model. To evaluate this model, the fundamental hypotheses of parameter stability and weak exogeneity of global and country-specific foreign variables were also taken into consideration. Only 11 out of 158 tests of weak exogeneity were statistically significant at the 5% level based on the collected statistical data. Furthermore, despite instability in error variances, the majority of regression coefficients were found to be stable, which is consistent with the evidence for "great moderation" in the United States. Therefore, confidence limits for the impulse responses were computed using bootstrapping approaches to resolve the error variances instability. Comparing the suggested model to the global shock analysis literature reveals differences. As a result, based on a country-specific methodology, this research might provide important answers on the macroeconomic effects of disruptions in the oil supply (induced by sanctions, war, and natural catastrophes) for the global economy. According to the findings, depending on which country imposes the supply shock, the effects of oil supply shocks on the global economy fluctuate dramatically. Findings in particular demonstrate how a bad oil supply shock from Iran caused Saudi Arabia to expand its oil output. Such an increase maintains the oil market's balance while covering decreased OPEC exports. Results show that a bad shock to Iran's oil supply causes an interim fall of 4.7% during the first four quarters. The other OPEC oil producers, particularly Saudi Arabia and Indonesia, have raised production in response to Iran's decreased oil output in order to stabilize the oil market. In consequence, Saudi Arabia's oil output increased by 1.16%, reaching 2.28% over the long run. Short-term and long-term GDP reductions due to Iran-specific oil supply shock are estimated to be 0.14 percent and 0.9 percent, respectively. This reduction was brought on by lower long-term oil prices and shorter-term oil output, which in turn lowered Iran's oil earnings. It should be noted that the ratios of total exports to total income from oil exports, which have remained stable for more than three decades, are roughly 70% and 22%, respectively. But in Saudi Arabia, growing oil output offset the drop in oil prices. As a result, across both the long-term (0.83%) and short-term (0.08%) periods, actual output increased. It's interesting to note that several nations have had favorable medium-term impacts on output, demonstrating that falling oil prices have contributed to an increase in actual production. Although this reaction is statistically significant, it can be said that Saudi Arabia's enhanced oil output has offset the effects of Iran's oil supply shock on the world economy. As was already noted, Iran has not benefited from the oil capacity. Saudi Arabia's oil output has decreased by 9% over each quarterly period in reaction to the negative shock to the oil supply. However, the quarterly short-run oil output in Iran and Norway has decreased by 1% and 0.4%, respectively. Since all of the major producers anticipate Saudi Arabia to produce at or over capacity, a long-term drop in Saudi Arabia's production won't be compensated for by other producers. As a result, there will be a 0.7% rise in oil prices. According to Huang et al(1996) .'s equity pricing model, the equity price is equal to the estimated present discounted value of future cash flows. Lower projected inflation may lower the discount rate, which has a beneficial impact on stock market returns as oil prices fall. Additionally, a number of other scholars have backed the beneficial impact of declining oil prices on stock markets in net oil importers, including Cheung and Ng (1998), Sadorsky (1999), and Park and Ratti (2008). Although buffers and accessible financing help most oil exporters to prevent sharp cuts in government spending in the near term, the long-term effect relies on their medium-term financial plans and capital spending. (Mohaddes & Raissi, 2019).

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Appendices

Table A.1. F-Statistics for Testing the Weak Exogeneity of the Country-Specific Foreign Variables and Oil Prices †

Country	F test	Critical value	y*	Δp*	ep*	r*	eq*	poil
ARGENTINA	F(2,130)	3.065839	0.213871	0.688942	-	2.531817	0.244379	1.353219
AUSTRALIA	F(3,143)	2.667887	1.917279	1.113823	-	1.210415	0.111059	0.638892
BRAZIL	F(2,144)	3.058928	0.45672	2.332558	-	1.244449	0.706187	0.627052
CANADA	F(3,142)	2.668337	1.846391	2.98877	-	2.394662	0.187474	3.790001

CHINA	F(2,144)	3.058928	0.352704	0.841141	-	0.894689	0.293235	0.661925
CHILE	F(2,144)	3.058928	0.157877	0.503378	-	0.472222	1.54697	0.265899
EURO	F(1,145)	3.906392	1.060257	0.243093	-	0.882083	1.629459	0.00609
INDIA	F(2,144)	3.058928	0.902293	0.910906	-	1.890243	0.866134	0.368497
INDONESIA	F(3,143)	2.667887	0.37168	0.711756	-	1.05024	0.904944	1.171049
Iran	F(1,146)	3.905942	0.272318	1.104507		3.192534	0.295601	0.065417
JAPAN	F(2,144)	3.058928	3.072894	2.711405	-	0.08752	0.397012	0.944858
KOREA	F(3,143)	2.667887	0.487578	1.340857	-	0.449879	1.096813	0.697473
MALAYSIA	F(2,144)	3.058928	3.74241	3.383474	-	4.380355	2.22689	2.414988
MEXICO	F(2,144)	3.058928	0.725628	1.834667	-	0.504945	0.78991	0.729867
NORWAY	F(3,142)	2.668337	2.013964	0.345422	-	0.298049	0.074303	1.45122
NEW ZEALAND	F(3,143)	2.667887	2.811685	1.841276	-	0.774817	0.319988	1.446058
PERU	F(2,145)	3.058486	0.252258	0.862871	-	2.248788	0.508262	1.379173
PHILIPPINES	F(3,143)	2.667887	0.635624	0.602582	-	2.638146	0.602635	2.422031
SOUTH AFRICA	F(2,144)	3.058928	0.374698	0.12563	-	2.072856	0.533671	0.048897
SAUDI ARABIA	F(1,146)	3.905942	0.165706	0.271721	-	0.001756	2.78487	0.007741
SINGAPORE	F(1,145)	3.906392	1.772948	0.046706	-	0.785867	3.622172	2.194722
SWEDEN	F(2,144)	3.058928	1.477172	0.777531	-	0.194513	0.166414	0.539453
SWITZERLAND	F(3,143)	2.667887	2.013937	2.492761	-	0.374835	3.299463	0.934909
THAILAND	F(2,144)	3.058928	1.225879	1.016518	-	1.473998	1.489681	1.207151
TURKEY	F(1,146)	3.905942	0.394699	1.038636	-	0.000467	1.583427	0.114865
UNITED KINGDOM	F(2,143)	3.059376	3.006507	0.056086	-	1.698699	0.229317	0.24815
USA	F(2,146)	3.05805	0.744889	4.174839	3.6802	-	-	0.512636

† Notes: * denotes statistical significance at the 5% level.

Table A.2. Number of Rejections of the Null of Parameter Constancy per Variable across the Country-specific Models at the 5 percent Significance Level †

TESTS	Y	DP	EQ	EP	R	QOIL	TOTAL
pksup	5	4	2	2	3	2	18(11)
Pk msq	4	5	1	3	0	3	16(10)
NY	3	6	1	4	4	5	23(14)
Robust-NY	1	3	1	3	5	7	20(12)
QLR	15	14	11	11	18	9	78(48)
Robust-QLR	5	3	7	11	9	3	38(23)

MW	11	7	8	8	9	7	50(31)
Robust-MW	5	5	4	9	7	3	33(20)
APW	16	14	11	11	18	9	79(49)
Robust-APW	5	4	6	11	9	3	38(23)

† Notes: The test statistics *PKsup* and *PKmsq* are due to the cumulative sums of *OLS* residuals, *Ny*isthe Nyblom test for time-varying parameters and *QLR*, *MW* and *APW* are the sequential Wald statistics for a single break at an unknown change point.Statistics with the prefix 'robust'denote the heteroskedasticityrobust version of the tests. All tests are implemented at the 5% significance level. The number in brackets are the percentage rejection rates.

Table A.3. Break Dates Computed with Quandt's Likelihood Ratio Statistic†

Country	y	Δp	ep	r	qoil	Eq
ARGENTINA	1994Q3	1990Q3	1989Q3	1990Q2	-	1985Q4
AUSTRALIA	1991Q4	1990Q4	1986Q3	1987Q3	-	1988Q2
BRAZIL	1986Q1	1989Q3	1999Q1	1989Q3	2013Q4	
CANADA	1987Q1	1994Q3	1996Q3	1986Q2	2010Q1	2000Q4
CHINA	1994Q4	1989Q4	1994Q2	1993Q2	2012Q2	
CHILE	1986Q1	1986Q1	1988Q1	1987Q2	-	1987Q4
EURO	1987Q4	1990Q1	1998Q4	1985Q3	-	1999Q3
INDIA	1988Q1	1998Q4	1991Q4	2008Q2	-	1993Q2
INDONESIA	1985Q3	1998Q3	1998Q1	1998Q1	-	
Iran	2013Q4	2013Q1	2011Q3	-	1988Q2	-
JAPAN	1990Q1	2013Q4	2007Q1	1986Q1	-	2011Q4
KOREA	1988Q2	1985Q3	1996Q4	1998Q3	-	1996Q2
MALAYSIA	1987Q3	2008Q3	1995Q2	1998Q2	-	1998Q3
MEXICO	1986Q1	1988Q1	1995Q1	1988Q1	1986Q1	
NORWAY	2010Q1	2002Q3	2003Q3	1992Q3	1996Q3	1990Q4
NEW ZEALAND	1986Q4	1986Q4	1987Q2	1986Q2		1988Q1
PERU	1990Q4	1990Q4	1991Q2	1989Q4	-	-
PHILIPPINES	1986Q1	1991Q2	1985Q4	1986Q1	-	1986Q1
SOUTH AFRICA	1986Q1	1986Q1	1988Q2	1986Q1	-	1986Q3
SAUDI ARABIA	1990Q2	1992Q2	1986Q3	-	1986Q1	-
SINGAPORE	2000Q3	1985Q3	1992Q4	1985Q3	-	1991Q1
SWEDEN	1985Q3	1993Q2	1986Q2	1985Q3	-	1985Q3
SWITZERLAND	2007Q3	1986Q1	1986Q2	1986Q4	-	1987Q4
THAILAND	2011Q3	1985Q3	1998Q2	1994Q4	-	1999Q3
TURKEY	1994Q1	1992Q4	1985Q3	1994Q1	-	-

UNITED KINGDOM	2008Q2	1987Q2	1987Q2	1988Q4	2013Q2	1992Q4
USA	1985Q3	2002Q2	-	1985Q3	2012Q4	1999Q2

†Notes: All tests are implemented at the 5% significance level.

Complementary Documents

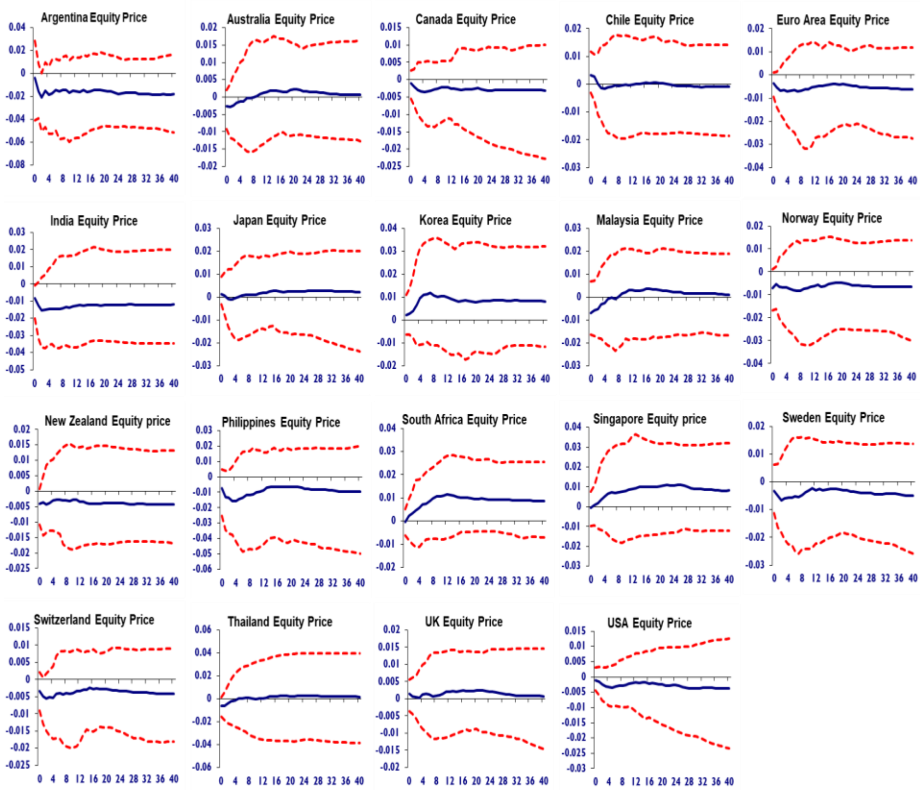

Figure B.1. Structural Impulse Responses of a Negative Unit Shock to Saudi Arabian Oil Supply

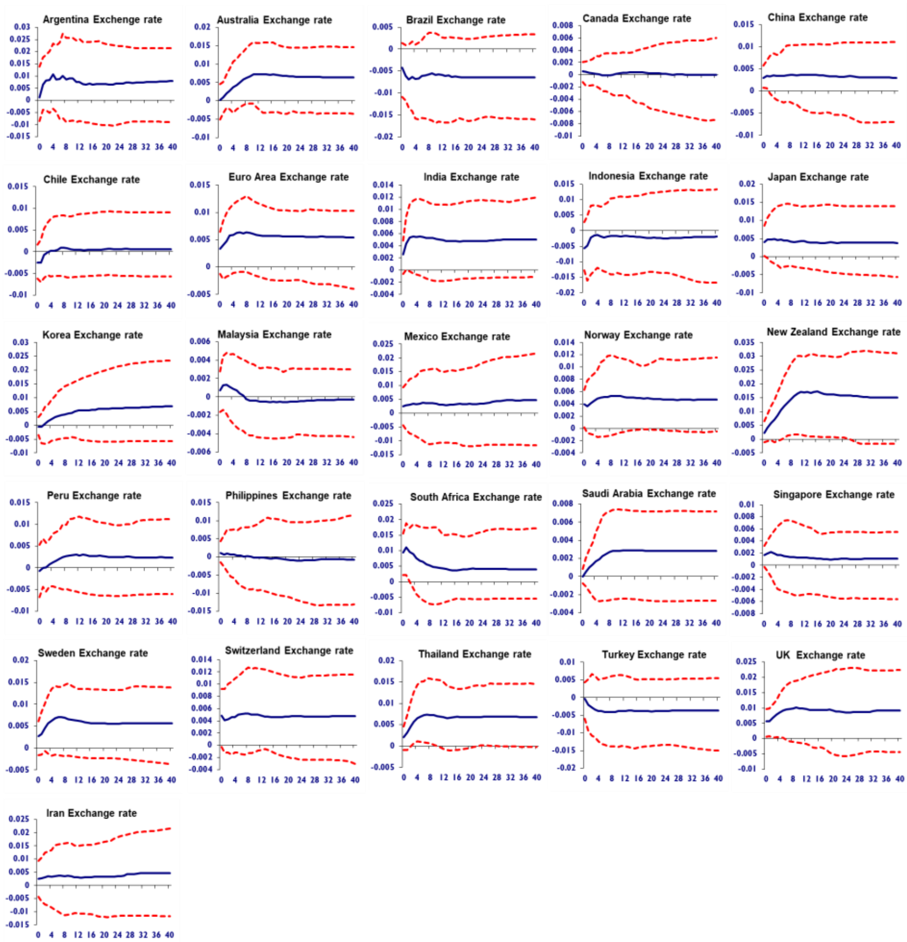

Figure B.2. Structural Impulse Responses of a Negative Unit Shock to Saudi Arabian Oil Supply

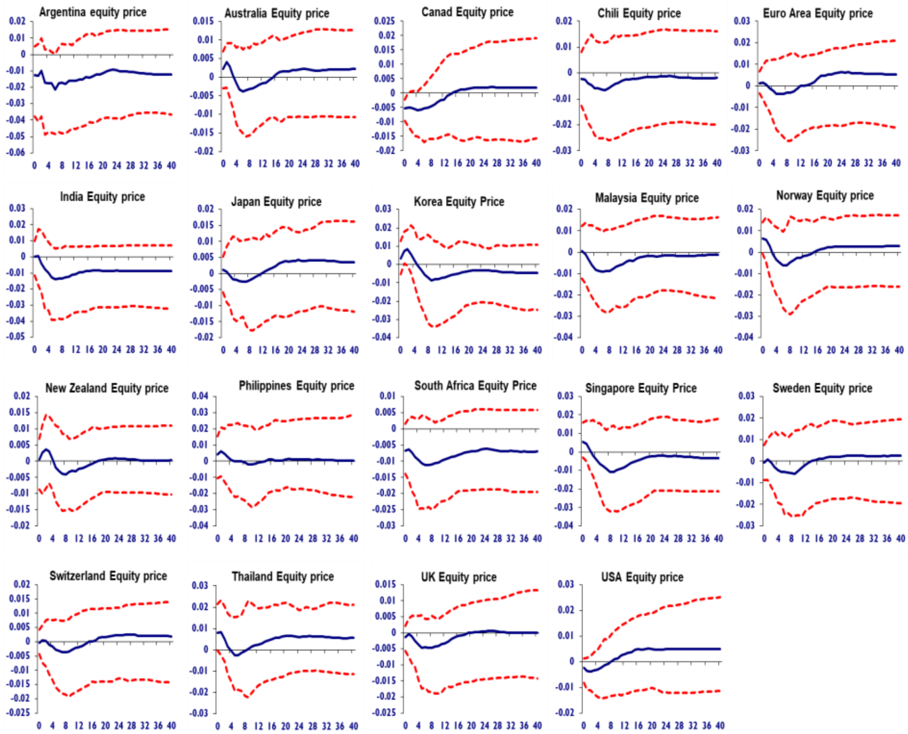

Figure B.3. Structural Impulse Responses of a Negative Unit Shock to Iranian Oil Supply

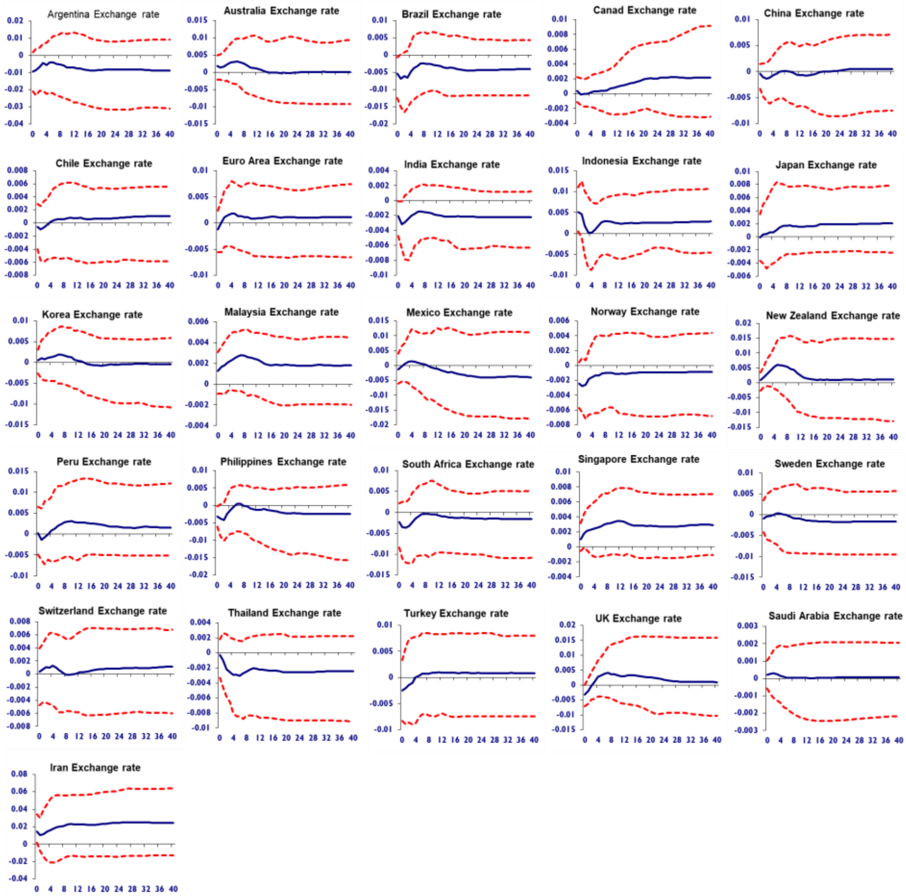

Figure B.4. Structural Impulse Responses of a Negative Unit Shock to Iranian Oil Supply

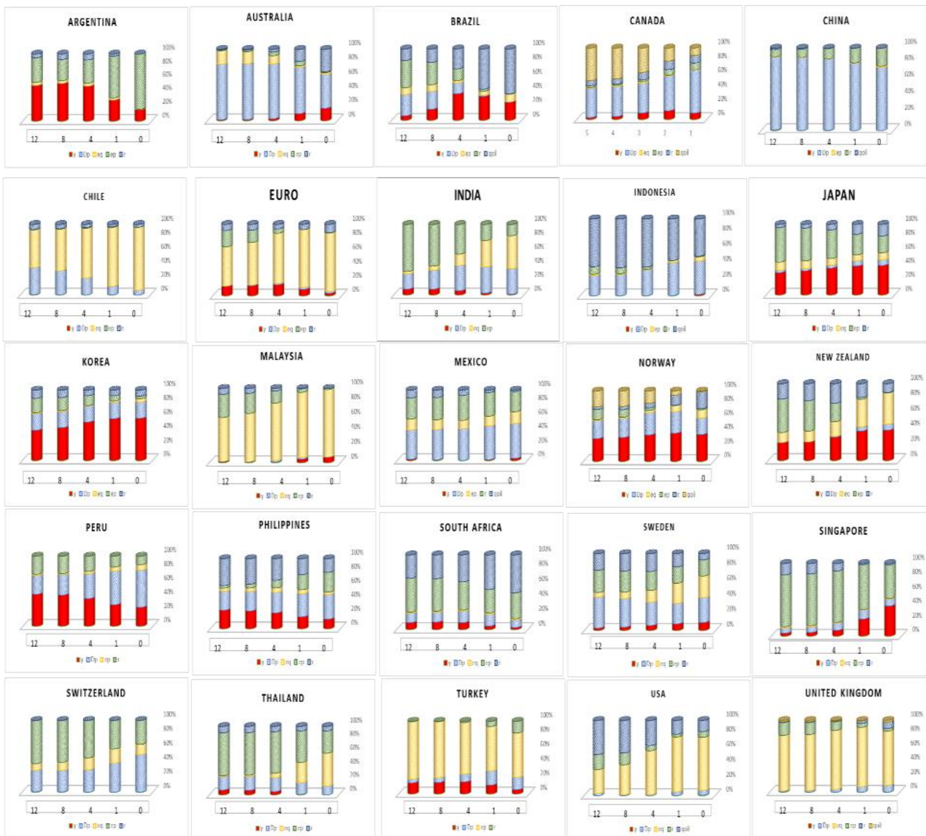

Figure B.5. GDP Variance Decomposition

Table B.1. Lag Order of the country-specific VARX* (S,S*) Models together with the Number of Cointegrating Relations(r) †

Country	VARX* order		Cointegrating relations(r^i)	Country	VARX* Order		Cointegrating relations(r^i)
	S^i	S^*i			S^i	S^*i	
Argentina	2	1	2	Norway	2	1	3
Australia	1	1	3	New zealand	2	1	3
Brazil	2	1	2	Peru	2	1	2
Canada	2	1	3	Philippines	2	1	3
China	2	1	2	South Africa	2	1	2
Chile	2	1	2	Saudi Arabia	2	1	1

Euro Area	2	1	1	Singapore	2	1	1
India	2	1	2	Sweden	2	1	2
Indonesia	2	1	3	Switzerland	1	1	3
Iran	2	1	1	Thailand	2	1	2
Japan	2	1	2	Turkey	2	1	1
Korea	2	1	3	UK	1	1	2
Malaysia	1	1	2	USA	2	1	2
Mexico	1	1	2				

† Notes: s^i and s^ i denote the estimated lag orders for the domestic and foreign variables, respectively, chosen by the Akaike Information Criterion, with the maximum lag orders set to 2. The number of cointegrating equations (r^i) are chosen applying the trace test statistics based on the 95% critical values from for all countries except for Norway, South Africa, Saudi Arabia, and the UK, for which we reduced ri below that suggested by the trace statistic to ensure the stability of the global model.