Oil shocks and equity markets returns during bull and bear markets: the case of oil importing and exporting nations

Salem Adel Ziadat, Faculty of Business, Amman Ahlieh Univeristy
David G McMillan, Division of Accounting and Finance, University of Stirling
Patrick Herbst, Division of Accounting and Finance, University of Stirling

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Abstract

This paper examines the impact of oil price shocks on global equities. The focus is on the heterogeneity of responses to stocks depending on three characteristics: the type of the shock; whether the country is an oil importer/exporter; the bull/bear state of the stock market. We utilise the Kilian (2009) structural VAR to distil the oil price shocks and regress stock returns on these oil shocks using a quantile regression. In addition to oil price shocks, we consider the role of both economic policy uncertainty and stock market volatility. The results reveal that equity markets in oil-importing economies do not exhibit specific patterns in response to oil shocks, whereas those in oil-exporting economies are affected by precautionary oil demand shocks. Across these markets, precautionary demand shocks have a positive effect on stock markets, although for the GCC nations it predominantly impacts only during bear markets.

Keywords: Stock Returns, Oil Shocks, Quantile Regression, Oil-Importers/Exporters
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Address for Correspondence: Professor David McMillan,
Accounting and Finance Division, University of Stirling, FK9 4LA
Telephone: +44(0)1786-467309
Fax: +44(0)1786-467308
E-mail: david.mcmillan@stir.ac.uk

1. Introduction.

Globalisation, growing economic integration and business cycle synchronisation can lead to higher correlations between stock markets (see, Bekaert, 1995) with global factors dominating local country ones (Cavaglia et al., 2000; Hargis and Mei, 2006). Thus, determining which global factors exert patterns of influence on financial markets is essential for international investors. The price of oil is one such global factor. Since oil is a production variable, oil price movements can impact firms cash flows, and thereby, stock markets (Miller and Ratti, 2009). The empirical literature shows that oil price innovations coincide with movements in financial markets (Jones and Kaul, 1996; Park and Ratti, 2008; Sadorsky, 1999). Between 2007 and 2016, the oil price fluctuated substantially between $145 and $30. Despite these fluctuations, investors consider the oil market as an alternative destination for funds given the positive correlation with inflation and low correlation with equities (Silvennoinen and Thorp, 2013). The increased activity of investors in oil markets without interest in the commodity itself is referred to as the financialization of oil markets. Alquist and Kilian (2010) and Sadorsky (2014) report the increasing importance of this financialization of oil, which can lead to a higher a connection between oil and equity markets. Accordingly, this study seeks to detail the influence of oil shocks on global equity markets by considering the type of oil shock, the nature of the energy profile of the country (i.e., an exporter/importer of oil) and market conditions.

Over time, the landscape of oil-exporting and importing countries has changed; for example, the UK has become a net oil importer after previously being an oil exporter (Filis and Chatziantoniou, 2014). The US, thanks to the shale oil revolution, is moving in the opposite direction, and emerging as one of the biggest oil producers. These shifts warrant a more in-depth examination of oil and equity market linkages. Understanding the nature of these links will provide policymakers with additional tools to absorb potential oil market spillovers, specifically in the light of the increasing activities of investors in both markets.

The literature pioneered by Hamilton (1983) considers oil effects to be exogenous to the economy. Barsky and Kilian (2001, 2004) challenge this idea and suggest that the oil price is instead endogenous to economic activity. Kilian (2009) proposes that an oil price rise should be decomposed according to its underlying source. Using a structural vector autoregressive (VAR) model, Kilian (2009) identifies the following sources of oil price rise: supply-side shocks attributable to shortfalls in oil production, demand-side shocks due to growth in the world economy, and precautionary (or oil-specific) demand caused by expectations of future oil supply disturbances. Following this, a specific strand of research emerged to study the impact of oil shocks on stock market returns. Initial work includes that of, for example, Kilian and Park (2009) on the US and Abhyankar et al. (2013) on Japan. Gupta and Modise (2013) examine the impact of oil shocks on the oil-importing nation of South Africa, while Basher et al. (2018) study oil shocks on a group of oil exporters (Canada, Mexico, Norway, Russia, UK, Kuwait, Saudi Arabia and UAE). However, studies that focus on both oil importers and exporters remain relatively thin and do not provide conclusive results (see, for example, Apergis and Miller, 2009; Guntner, 2014; Wang et al., 2013).

Bjørnland (2009) argues for oil-importing nations, higher oil prices reduce disposable income for individuals and cash flows for firms, whereas for oil exporters, these effects are countered by income generated from selling oil and the associated wealth from investing this income. Thus, policymakers and investors perceive oil differently; in oil-exporting nations, a price increase is a source of wealth and optimism, while oil is a risk, with higher production costs in oil importing nations. Park and Ratti (2008) establish a negative association between oil price and stock returns for oil-importing nations and argue for the opposite in oil-exporting nations. Bjørnland (2009) and Jiménez-Rodríguez and Sanchez (2005) argue that higher oil prices represent a transfer of wealth from oil-importers to oil-exporters.

Given the complexity of their relation, an asymmetric influence of oil on stock markets may extend not only to oil importer and exporter countries but also across diverse market conditions. Baur (2013) argues that a quantile regression framework can describe the changing nature of dependence across market phases. Sim and Zhou (2015), You et al. (2017), Mokni (2020) and Joo and Park (2021) investigate the oil and equity returns relation by explicitly examining the dependence structure during bullish and bearish market conditions.

This study contributes to the literature by combining the three aforementioned strands of research and examines the dependence structure between the three oil shock types and the conditional distribution of equity returns in oil exporting and importing nations. We obtain equity return series for the US, UK, Germany, Italy, Spain, France, Japan, South Korea, China and India to represent oil-importers, and for Russia, Norway, Canada and the Gulf Cooperation Council[1] (GCC) nations as oil exporters. The analysis involves two steps. First, we construct oil shocks using the Kilian (2009) structural VAR. Second, we employ a quantile regression framework to examine the effects of these shocks on stock returns across market states. To ensure the accuracy of the results, and in common with Antonakakis et al. (2013), Baur and McDermott (2010) and Kang and Ratti (2013), we control for other global factors by using the Global Economic Policy Uncertainty (GEPU) Index of Davis (2016) and the VIX index.

In preview of our findings, the equity markets of oil-exporters are positively affected by precautionary demand shocks, while the GCC nations are predominantly affected during bear market conditions. The oil importers of Asia and Europe do not exhibit specific effects. These results provide a fresh overview on the link between oil shocks and equity returns.

2. Literature Review.

Since Hamilton (1983), examining the linkages between oil prices and macroeconomic

[1] The GCC bloc incorporates the nations of Saudi Arabia, Qatar, Kuwait, Bahrain, Oman and the UAE, with the latter is represented by the financial markets of Dubai and Abu Dhabi.

parameters has become a major research area. Hamilton (2003) and Jiménez-Rodríguez (2004) find evidence of a non-linear relation between oil prices and the US economy. Mork (1989), Lee et al. (1995) and Hamilton (1996) introduce non-linear transformations of oil price. These transformations are commonly referred to as oil price shocks since they are designed to capture unanticipated price movements.

Based on the view that stock markets can anticipate economic activity (e.g., Fama, 1990), research examines the impact of oil on equity returns through its effect on the cost of production and inflation.[2] Prominent examples include the work of Jones and Kaul (1996) and Huang et al. (1996). More contemporary studies model the oil-stock relation using VAR systems (see, Sadorsky, 1999; Park and Ratti, 2008; Le and Chang, 2015; Diaz et al., 2016).

Barsky and Kilian (2001) suggest that the oil price might be endogenous to economic activity, arguing that oil price movements could be influenced by economic factors. Kilian (2009) thus argues that oil price changes should be decomposed and distinguishes between supply-side shocks due to shortfalls in production, demand-side shocks due to positive developments in the world economy, and precautionary demand shocks due to expectations of future oil supply disruptions.

Kilian and Park (2009) apply the Kilian (2009) decomposition to study the impact of oil price shocks on US stock returns, using monthly data in a structural VAR from 1973 to 2006. Kilian and Park (2009) report that the response of stock returns to oil price shocks is contingent on the underlying causes of the oil price increase. They find that stock market returns are not influenced by supply-side shocks, whereas on the demand-side, a positive response follows aggregate demand shocks, while the opposite occurs with precautionary

[2] Smyth and Narayan (2018) identify multiple channels of oil's influence on equities. First, higher oil prices increase the cost of production, therefore, dampening future cash flows and dividends. Second, higher oil prices induce higher expected inflation and higher nominal interest rates. Since interest rates are integral to discounting expected future cash flows, this will lower earnings. Third, oil price volatility can influence the effect of changes in oil prices on the risk premium of the discount rate.

demand shocks. As the data period in Kilian (2009) finishes in 2006, it does not include the financial crisis of 2008. Kim and Vera (2019) update the sample of Kilian (2009) and provide evidence that the evolution of the oil price in 2008 was mainly driven by demand side shocks. Moreover, while the original methodology of Kilian (2009) includes oil production, the Kilian proxy of economic activity and the oil price, Kim and Vera (2019) provide robustness by substituting the economic index with global industrial production without altering the results. The Kilian VAR approach paves the way to further analyse the influence of oil price shocks on equity returns. This body of research associates a change in the price of oil to unanticipated changes in oil market fundamentals (i.e., global supply or demand of oil).[3]

In accordance with Kilian and Park (2009), Basher et al. (2012) find that emerging stock markets do not react to supply-side shocks, whereas a positive response is observed from both aggregate demand and precautionary demand shocks. This latter observation contradicts the findings of Kilian and Park (2009), who report that precautionary demand shocks lead to lower stock market returns given the association with uncertainty.[4] Basher et al. (2018) study the relation between oil price shocks and stock market returns in oil-exporting countries in a two-step approach. First, they identify structural oil-market shocks using the Kilian and Murphy (2014) approach.[5] Second, the distilled shocks, together with equity returns, are estimated in a Markov switching model. Their results are indicative of a dominance of demand-side shocks.

Some studies incorporate both oil-importing and exporting nations, with the aim to consider any asymmetric reactions among such blocs to oil price innovations. For example, Jiménez-Rodríguez (2015) provides evidence of parallel movements in both oil-importing and

[3] Another decomposition is devised by Ready (2018), who develops a method for classifying oil price changes as supply or demand-driven and documents that demand shocks are strongly positively correlated with market returns, while supply shocks have a strong negative correlation.
[4] Basher et al. (2012) explain this by the fact that the index represents heavy oil importers, which demand large oil quantities, regardless of its price, in order to sustain economic activity. Hence, their stock markets might be more resilient to increases in oil prices even if they take place due to geopolitical uncertainty.
[5] Kilian and Murphy (2014) extend the Kilian (2009) framework and introduce speculative shocks.

exporting nations. In contrast, Park and Ratti (2008) and Ramos and Vega (2013) argue that oil price rises have a negative effect on the stock markets of oil-importing countries, and a positive effect on the stock markets of oil-exporting countries.

Using the Kilian (2009) decomposition and studying both oil-importers and exporters, Jung and Park (2011) and Wang et al. (2013) report heterogeneous responses of stock market returns to the different oil price shocks. Jung and Park (2011) find that aggregate demand shocks exercise a positive effect on both Norwegian and Korean equities, while precautionary demand shocks stimulate Norwegian and dampen Korean stock markets. Using a wider range of countries, Wang et al. (2013) state that an oil price increase through precautionary demand shocks affect stock market returns in some oil-exporting countries but has no significant effect on oil-importing countries.

Based on the believed negative oil price effect on economies (Sadorsky, 1999; Jones and Kaul, 1996), studies attempt to establish causation between oil price increases and bear market states. Angelidis et al. (2015) and Chen (2010) state that the oil price can be an indicator of a down market. In parallel, studies consider the oil and equity returns relation by explicitly examining the dependence structure during different market conditions, isolating bear and bull markets. For example, Sim and Zhou (2015) examine the relation between oil and US equities using a quantile regression approach and find that negative oil price shocks impact US equities positively when the US market is stronger. Further, the influence of positive oil price shocks is weak, which indicates an asymmetric relation between oil prices and equities. Using a quantile regression and monthly data from 1995 to 2016, You et al. (2017) investigate the impact of oil shocks and China's economic policy uncertainty on stock returns. Results report the effects of oil price shocks are asymmetric and related to stock market conditions. In accordance with Lee and Zeng (2011), You et al. (2017) explain these findings by linking them to investor sentiment.

Ahmadi et al. (2016), Filis et al. (2011) and Apergis and Miller (2009) argue in favour of including additional control variables in the analysis of oil shocks and equity returns. They note that the absence of these variables might lead to an over-estimated impact of oil shocks on stock markets. Baur and McDermott (2010) argue that commodities and equities fluctuate with the uncertainty of stock markets. Nazlioglu et al. (2015) state that the VIX index and oil are intertwined, while Silvennoinen and Thorp (2013) note that increases in VIX are associated with higher stock and commodity correlations. Kang and Ratti (2013) maintain that oil shocks and Economic Policy Uncertainty (EPU) are interrelated and influence stock returns, by disturbing expected cash flows and discount rates. Other examples examining VIX and EPU interactions with oil and stock returns include Kang et al. (2017), Basher et al. (2018), Antonakakis et al. (2014), Berger and Uddin (2016) and You et al. (2017).

Overall, we can distinguish between lines of research, and the nature of any consensus. The first line of research considers the source of the oil price shock but does not separate bear and bull markets. Here, oil supply shocks generally have no effect, oil aggregate demand shocks stimulate equity returns, while no view is reached on the effects of precautionary demand shocks.[6] A second line of research examines the state of the stock market but does not consider the underlying factors behind the price innovations. This paper examines these together, while also considering the difference between oil importing and exporting countries.

3. Empirical Methodology.

3.1. Kilian (2009) model

Following Basher et al. (2018) and Apergis and Miller (2009), we adopt a two-stage approach. In the first step oil shocks are distilled using the Kilian (2009) structural VAR system. Kilian (2009) decomposes the oil price into distinctive shocks: oil supply shocks; aggregate demand

[6] These findings might be ascribed to the fact that oil-supplier's decisions are anticipated and therefore they are not captured as shocks. On a side note, in recent years, OPEC's 'grip' on oil prices has lessened due to Russian oil supply that compensates for OPEC supply shortages (Hamilton, 2014). This propensity is not expected to change much in light of the recent American shale oil revolution.

shocks; oil-specific demand shocks. The data consist of the percentage change in world crude oil production, the Brent oil price and the Kilian index of the global economy. We acknowledge that Apergis and Miller (2009) criticise the use of the oil price instead of oil returns in the original methodology of Kilian (2009), stating that the mixing of stationary and non-stationary variables in the VAR system could be problematic. Nonetheless, the practice of incorporating the non-stationary (logged) real price of oil alongside other stationary variables is common within the literature (see, for example, Kilian and Park, 2009). Furthermore, differencing the oil price will result in the removal of the slow-moving 'trend' component, therefore, influencing the persistent effect of aggregate demand shocks (Abhyankar et al., 2013).[7]

In the second stage, oil shocks, equity returns, the GEPU and VIX are incorporated in a quantile regression. This two-stage[8] procedure is advantageous as limiting the number of variables in the structural VAR framework will reduce the computational difficulties associated with larger VAR systems and removes the need for additional identification restrictions. In a regression context, this means that oil supply shock, aggregate demand shock, and oil-specific demand shock are considered as orthogonal variables. If orthogonality holds, these variables are uncorrelated with other included and omitted regression variables.

Based on Kilian (2009), the VAR model uses monthly data for $z_t = (\Delta prod_t,\ rea_t,\ rpo_t)'$, where $\Delta prod_t$ is the percent change in global crude oil production, rea_t denotes an index of real economic activity and rpo_t is the real price of oil. Unlike Apergis and Miller (2009) who include seven lags in their VAR model, we follow Hamilton and Herrera (2004) and use a 24-month lag length. This period is argued to be adequate by Kilian (2009) in

[7] There exists evidence from the forecasting literature that the real price of oil can be mean reverting. There is also literature including Sims et al. (1990), Inoue and Kilian (2002) and Inoue and Kilian (2019) that shows the level specification under weak conditions is robust to the inclusion of I(1) or near I(1) variables. In contrast, applying the differences is invalid when the data are not I(1). Hence, econometrically, a case can be made for using the real price of oil in levels. Notwithstanding this, we also consider the oil return with similar results.
[8] Yang et al. (2009) maintains that the two-step procedure is consistent but may lose some efficiency

capturing the dynamics of the data.[9]

The structural VAR representation is

$$A_0 z_t = \alpha + \sum_{i=1}^{24} A_i z_{t-1} + \varepsilon_t, \quad (1)$$

where ε_t denotes the vector of serially and mutually uncorrelated structural innovations. A_0^{-1} has a recursive structure such that the reduced form errors e_t can be decomposed according to

$$e_t = {A_0}^{-1} \varepsilon_t$$

$$e_t = \begin{pmatrix} e_t^{\Delta prod} \\ e_t^{rea} \\ e_t^{rpo} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{\text{oil supply shock}} \\ \varepsilon_t^{\text{aggreagate demand shock}} \\ \varepsilon_t^{\text{oil specific demand shock}} \end{pmatrix} \quad (2)$$

where the identifying restrictions are based on Kilian (2009). The crude oil supply does not respond to simultaneous changes in oil demand because of the high adjustment cost of oil production. The fluctuation in the real price of oil does not affect global real economic activity within the same month. An oil supply disruption and real aggregate demand shock will influence the real price of oil immediately, meaning that the expectations about future oil supply shortfall and/or global real economic downturn drive the precautionary demand for oil up within the same month. The estimates from the above VAR are used to construct the structural representations of the oil price shocks.

3.2. Quantile Regression

The quantile regression, developed by Koenker and Bassett (1978), estimates the effects of the explanatory variables on the conditional quantile of the dependent variable. Compared to a

[9] The (long) lag length of 24 months is used to allow for possible delays between structural oil demand and oil supply shocks and their effect on the economy. Kilian and Lutkepohl (2017) argue a long lag is essential in structural models of the global oil market as they account for the low frequency co-movement between the real price of oil and the global economic activity. The number of lags is consistent with Hamilton and Herrera (2004) and Kilian and Park (2009) who argue that allowing for high lag order is crucial in capturing the transmission of the structural shocks in the oil market. They provide evidence that cycles in the oil market are slow and short lags would fail to capture such dynamics. Another way of determining the lag order is to test for the goodness of fit using information criteria. However, Hamilton and Herrera (2004) argue in favour of long (priori) determined lags when compared to AIC information criteria as its estimates would make a lower bound.

traditional OLS regression model, the quantile regression functions present more specific information about the impact of the explanatory variables on the conditional variable of interest across the distribution (Koenker, 2005). Moreover, the quantile regression is robust to the presence of outliers and non-normality.

A quantile regression models the conditional τ quantile of the dependent variable for some value of $\tau \in (0,1)$. Thus, the conditional quantile model for r_t given x_t can be written as

$$Q_{r_t}(\tau/x) = \alpha^{\tau} + x'_t\beta^{\tau} \qquad (3)$$

where $Q_{r_t}(\tau/x)$ is the conditional τ quantile of the dependent variable r_t , α^{τ} is the intercept, which is allowed to depend on τ, β^{τ} is the vector of coefficients associated with τ quantile, and x' is a vector of explanatory variables. Coefficients of the τ quantile of the conditional distribution are defined as a solution to the minimisation problem (Koenker and Bassett 1978):

$$min_{\beta\in R^k}\left[\sum_{t:r_t\geq\alpha^{\tau}+x'_t\beta^{\tau}} \tau|r_t - \alpha^{\tau} - x'_t\beta^{\tau}| + \sum_{t:r_t\geq\alpha^{\tau}+x'_t\beta^{\tau}}(1-\tau)|r_t - \alpha^{\tau} - x'_t\beta^{\tau}|\right] \qquad (4)$$

which can be written as a minimisation of the weighted deviations from the conditional quantile

$$\beta \in R^k \sum_t \rho_{\tau}(r_t - \alpha^{\tau} - x'_t\beta^{\tau}) \qquad (5)$$

where ρ_{τ} is a weighting factor called a check function, defined for any $\tau \in (0,1)$ as

$$\rho_{\tau}(\xi_t) = \begin{cases} \tau\xi_t, & \text{if } \xi_t \geq 0 \\ (\tau-1)\xi_t, & \text{if } \xi_t < 0 \end{cases} \qquad (6)$$

where $\xi_t = r_t - \alpha^{\tau} - x'_t\beta^{\tau}$. Accordingly, different weights are conditional upon whether the points are above or beneath the line of best fit (Binder and Coad, 2011). In other words, the quantile regression model minimises sum of residuals where positive residuals receive a weight of τ and negative residuals receive a weight of $1-\tau$.

4. Data.

To extract oil price shocks, monthly global oil production, the Kilian (2009) index of global economic activity and the oil price are incorporated in a structural VAR. Kilian and Park (2009) argue that oil price shocks are intrinsically global, and this is better captured by a world price rather than country-specific prices. Consistent with Kilian (2009), we use the Brent oil price, deflated by the US CPI, since oil is priced in US$.[10] The Kilian (2009) measure of economic activity is used as a proxy of global economic activity. This index is based on dry cargo single voyage ocean freight rates, Kilian (2009) argues that this index is more reflective of the global economic activity than other measures such as the OECD industrial production because it incorporates emerging economies. This is important as Hamilton (2011) states these economies absorb two-third of the oil production increase. The logarithmic difference of global oil production is applied to calculate the percentage change.

Baker et al. (2016) construct the economic policy uncertainty (EPU) index, which is a weighted average of each country's uncertainty constituents. These constituents include, newspaper coverage of policy-related economic uncertainty, the number of federal tax code provisions set to expire in future years and a measure of disagreement among economic forecasters over future Federal government purchases and CPI inflation. Davis (2016) then constructs a monthly index of global economic policy uncertainty (GEPU), which is a GDP-weighted average of national EPU indices for 16 countries that accounts for two-thirds of global output. This echoes economic policy uncertainty from a global view. Bloom et al. (2017) highlight how EPU is both a cause and effect of recessions. Hamilton (1983) argues that recessions are a product of higher oil prices. Accordingly, as with Kang et al. (2013), it is plausible for GEPU to be interlinked with oil and the economy. The Chicago Board Options Exchange (CBOE) Volatility Index (VIX) is used to measure expected future stock market volatility. Despite both being uncertainty measures, Davis (2017) states that EPU and VIX do not necessarily co-move with each other. For example, the VIX fell swiftly after the Subprime

[10] We use Brent following Fattouh (2011) who states that while WTI is used for pricing oil imports in the US, Brent plays an important role the international oil trade. Fattouh (2011) argues that the distribution of WTI priced oil means it does not accurately reflect global demand and supply. Our choice is thus consistent with the view that Brent index is used for 70% of the world oil trade (Fattouh, 2011).

Crisis, while this was not the case with EPU. Essentially, Davis (2017) argues that VIX, as a measure of uncertainty about equity returns, provides the Wall Street perspective. Moreover, Davis (2017) states that the horizon of EPU fluctuates through time with the combination of economic and policy-related risks while the VIX has a 30-day fixed horizon.

Stock returns, VIX and GEPU are sampled monthly. The data is from January 2002 to May 2018 and includes equity return series for the US, UK, Germany, Italy, Spain, France, Japan, South Korea, China, India, Russia, Norway and Canada, Saudi Arabia, Abu Dhabi, Dubai, Qatar, Oman, Kuwait and Bahrain.[11] All indices are denominated in US$. The return series of all 20 indices are calculated by applying the natural logarithmic difference. The explanatory variables represented by the GEPU and VIX are stationary and expressed in percentage change form to allow for a common interpretation of the coefficients. The above variables are extracted from Thomson Reuters DataStream exception for the Kilian measure of global activity and the GEPU, which are obtained from the respective websites.[12]

While studies like Antonakakis et al. (2013) include a lagged dependent variable in their regression to address autocorrelation, Keele and Kelly (2006) argue that the lagged dependent variable specification is problematic. Specifically, the lagged dependent variable causes the coefficients of explanatory variables to be biased downward. For this reason, we do not include lagged returns in the regressions.

As seen in Table 1, typical stock return characteristics are observed; series are not normally distributed with high kurtosis and negative skewness. The equity markets of Italy, Kuwait and Bahrain exhibit a negative mean return. As expected, the standard deviation is higher in emerging markets when compared with their developed counterparts. Stationarity is reported for most entries using the Phillips–Perron unit root test.[13] Figure 1 presents the stock

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[11] In Dubai and Bahrain, the sample starts in 2004 and 2003 respectively due to data availability constraints.
[12] See http://www-personal.umich.edu/~lkilian/ and http://www.policyuncertainty.com/, respectively.
[13] We discuss in Section 3, the reasons behind including the log oil price despite it being a non-stationary variable.

index graphs and shows that the effect of the oil price collapse and the economic slowdown in the second half of 2014 for oil exporters. Conversely, oil importers experienced lower losses and rebounded in 2016.

5. Empirical Results.

Oil shocks timeline

From a historical perspective, Hamilton (2011) describes the periods from 1973–1996 and 1997–2010 as 'The Age of OPEC' and 'A New Industrial Age', respectively. Hamilton (2011) associates the earlier age with a shift in the emphasis of the global oil market from North America to the Persian Gulf and the rise in influence of Organisation of Petroleum Exporting Countries (OPEC). According to Balcilar et al. (2015), although OPEC dates from 1960, the organisations dominant influence over world oil prices commenced after its member countries nationalised their respective domestic oil industry. The 'New Industrial Age' is linked with the remarkable economic growth in the emerging economies, particularly China and India.

Figure 2 depicts the three oil price shocks. Considering the period from 2002 to mid-2008, in conjunction with the oil price graph in Figure 3, and similar to the findings of Hamilton (2011), the large increase in the real oil price was driven by a series of positive aggregate demand shocks associated with shifts in global real economic activity. During this period, oil supply shocks largely played a negligible role in oil price fluctuations. The oil price fall at the end of 2008 reflects a fall in aggregate demand and oil market-specific demand. Turning to the period from 2011 to mid-2014, this phase is characterised by global economic recovery from the financial crisis, and the presence of aggregate demand shocks. There are also waves of positive oil market-specific demand shocks. Further, political instability following protests the Middle East create concerns about future oil shortages. The large oil price drop that took place from 2014 to 2016 can be attributed to supply-side factors, with two notable aspects. First, the shale oil revolution, especially in North America. Second, OPEC reluctance to stabilize the oil market and its decision against cutting production at a 2014 meeting in Vienna. Also, according to the Energy Information Administration (EIA), total oil production by year-end 2015 was expected to rise to over 9.35 million barrels per day, higher than the 9.3 million barrels per day forecasted in February 2015. However, Baumeister and Kilian (2015) show that more than half of the observed cumulative decline was predictable using information publicly available at the end of June 2014.

Figure 4 illustrates the Kilian economic activity index, which is a proxy for dry bulk shipping stocks and is used to represent global economic activity. Evident is a drop between 2014 and 2016 associated with the fall in oil prices. Consequently, a negative shock to the demand for oil, associated with an unexpected weakening in the global economy, is apparent in the aggregate demand graph in Figure 2. Figure 2 also suggests that precautionary demand shocks had a major role in oil price decline. This could be associated with the US nuclear deal with Iran which allowed for more Iranian oil exports and reducing oil supply concerns.

To conclude, despite the occurrence of oil supply shocks in 2002 and 2011 as responses to the Iraq war and Arab uprising respectively, in line with Kim and Vera (2019), there is a substantial role of demand-side shocks in the oil price rally between 2003 and early 2008 and the oil price collapse in 2014.

Asian Oil Importing Bloc

Table 2 reports the estimates of the quantile regressions for the stock returns of each of the differing blocs. Table 2 Panel A presents the results for the Asian oil-importing nations of India, Japan, China, and South Korea. The results show that each of these markets is quite resilient to oil price shocks.[14] Our results contradict those of Joo and Park (2021) who find that the implied volatility of oil has a negative impact on the stock markets of China, India, Japan and South Korea especially during bearish phases. While also using a quantile regression, as considered here, the difference in results may arise from the different measures of oil shocks or risk. Joo and Park (2021) use a measure of oil market volatility, while we decompose the oil price into its constituent shocks.

Further, our results expand on those of Fang and You (2014), who attribute the lack of significance in India to the segregation of the Indian market due to regulation and capital controls. Broadstock and Filis (2014) state that Chinese[15] equity return responses to oil shocks are less pronounced than their US counterparts due to government intervention.[16] Another plausible explanation is presented by Demirer et al. (2020) who argue that China has a refined oil pricing mechanism which intervenes to counter significant and long-lasting changes in crude oil prices, hence, rendering immunity to oil supply shocks among Chinese equities. Moreover, Nguyen and Bhatti (2012) argue that rapid economic growth in China is able to offset the effects of oil shocks. Thus, given GDP growth levels in India, China and South Korea, we argue that economic expansion can absorb the oil price shocks.[17]

Although Japan is fully dependent on foreign crude oil imports, the country has a large number of strategic oil reserves (Mork et al., 1994) and a notable portion of oil supply in Japan is covered by domestic production, rendering it different from other oil-importing nations. Abhyankar et al. (2013) maintain that oil supply shocks due to unanticipated disruptions in oil production do not affect Japanese stock returns as the market recognises the strategic oil

[14] Exceptions to this are positive reactions in Japan to oil supply shocks and China to oil-specific and aggregate demand shocks.
[15] China is expanding its strategic petroleum reserves aiming to reach a level sufficient to cover 100 days of imports (Bai et al., 2012).
[16] For example, Chinese stock markets permit stock prices to vary only within 10% on any given day.
[17] South Korea GDP growth fluctuated between 3% and 6% in the last 10 years, while 7% is observed in China and India.

reserves that it possesses. The immunity of Japan to oil shocks, despite the general sluggishness of its GDP growth is also noted by Jiménez-Rodríguez and Sanchez (2005). Likewise, Blanchard and Gali (2007) argue that Japan behaves differently from other countries since oil price shocks do not influence Japanese economic indicators. Similarly, Broadstock and Filis (2014), Cong et al. (2008) and Jammazi and Aloui (2010) find that oil is not important for equities in China and Japan.

As noted, the relation between oil and equity returns is inherently complex, especially with the heightened integration of stock markets and financialization of oil. Therefore, we include VIX and GEPU to avoid omitted variable bias. As measures of uncertainty, it is expected that both variables will have a depressing influence on equity markets. The results support a negative relation and show that both the VIX and the GEPU demonstrate a reduced effect on stock returns at higher quantiles. This suggests a greater effect of uncertainty during bear market conditions. Of note, for GEPU, we observe greater levels of significance for lower and mid quantiles for Japan and South Korea, being negative and significant in the first seven and five quantiles respectively.[18] For the VIX, the coefficients are negative and significant throughout for South Korea and India, and for the lower mid quantile for Japan.

EU Oil Importing Bloc

Hamilton (2011) states that we are currently in the post-OPEC era, where a recent surge in non-OPEC oil production is flowing from Russia and the US. Kilian and Hicks (2013) show that strong growth in emerging economies steered the rise in inflation-adjusted oil price from 2003 to 2008. As a result, oil supply shocks generally have trivial effects on equity returns as documented by Kilian and Park (2009) and Kim and Vera (2019). In conformity with these

[18] The more controlled markets of China and India do not report any effects with the exception of the first quantile in India. Similar results are recorded by Christou et al. (2017) using the EPU index.

studies, Table 2 Panel B shows that supply shocks have a minimal impact on EU oil-importing nations. Interestingly, contrary to Kilian and Park (2009), Wang et al. (2013), Guntner (2014) and Joo and Park (2021) oil demand shocks, related to economic development, are not significant in most EU and Asian markets (the latter noted in Panel A). This may arise due to our combined use of extracted oil price shocks and quantile regression approach that reveals in greater detail the relation across the distribution of returns, compared to previous standard VAR frameworks. Precautionary oil demand shocks are also largely insignificant with trivial exceptions for the UK and France. The positive coefficients may be related to the arguments of Kollias et al. (2013) who suggest that an oil price increase can be interpreted as positive economic news among investors.

Both VIX and the GEPU exert a negative influence on all EU oil-importers. The VIX is negative and significant in all market phases, while the GEPU is significant in bear, normal and moderate bull periods. The upper bullish market regime, represented by the 8th and 9th percentiles, displays resilience to GEPU in Spain and the UK. The lack of significance of the GEPU is restricted to the 9th quantile in France. On the contrary, Italy and Germany are vulnerable to the GEPU influence regardless of the market phase.

US and Oil-Exporting Nations

Table 2 Panels C and D show, in comparison to Asian and EU importers, that oil exporters appear prone to precautionary demand shocks. Kilian (2009) and Alquist and Kilian (2010) link precautionary demand shocks to expected disruptions in future oil supplies. The effect is positive and significant in most quantiles in the non-GCC oil exporters of Canada, Norway and Russia. In the GCC (i.e., Saudi Arabia, Abu Dhabi, Dubai, Bahrain, Oman and Qatar), the impact is positive and strongest in Saudi Arabia and Qatar, and, in a new finding, this shock is notably significant amid bear market conditions. The lower tail dependence between equity returns and precautionary demand shocks is arguably related to their sensitivity to geopolitical stress.[19] GCC bearish phases may concur with geopolitical tensions, which are also known to trigger increases in precautionary oil demand.

While researchers such as Bjørnland (2009) and Park and Ratti (2008) support the premise of a positive relation between oil and equity returns in oil-exporting nations, we argue that an oil price increase due to precautionary demand shocks and during bear markets is the key element. Precautionary demand shocks cause an increase in the price of oil reflecting uncertainties about future oil shortages. When market participants predict an oil shock in oil-exporting regions, they appear to be willing to pay a higher premium to protect themselves from possible future shortfalls (see Alquist and Kilian, 2010).

While this result contrasts with the findings of Filis et al. (2011), who argue in favour of a similar relation for both oil-importing and exporting nations in response to oil shocks, Mokni (2020) confirms our results by maintaining that oil exporters are more sensitive to oil price fluctuations. However, Mokni (2020) reports that the impact of oil price turns from positive during bear market conditions to negative during bull phases for Russia, Canada and Norway.[20] Again, we can compare our results with this literature through our extension of the analysis to incorporate the different oil price shocks.

Likewise, while conflicting results of precautionary demand shocks are reported by Apergis and Miller (2009), Fong and You (2014) and Kang and Ratti (2013). Basher et al. (2018) find that the influence is positive for Norway, Russia, and Kuwait. Further, Basher et al. (2018) state that the influence of oil shocks is asymmetric in high and low regimes, which has some consistency with our results as precautionary demand shocks are predominantly significant in bear market conditions, during which uncertainty is high.

[19] See Cheikh et al. (2021)
[20] The oil impact on Russia is not significant during bullish phases.

The prominent role of precautionary demand shocks is exclusive to oil exporters reflecting the importance of oil in explaining their stock return variations. This mirrors the positive impact oil has on both fundamentals and investor sentiment. Within this, Wang et al. (2013) argue that oil's influence on stock returns is contingent on the level of importance of oil to the economy.

Oil supply shocks, resulting from above-expected oil production, have a limited negative effect on Qatari and Bahraini markets. As exporters of oil benefit from increases in oil prices, a negative influence is expected. More widely, the impact of oil supply shocks on oil prices is limited (Kilian, 2009) and consequently on equities (Kilian and Park, 2009). While the majority of oil exporters are not impacted, there is a positive effect on the US amid bull market phases. This bull phase significance could be ascribed to the flexibility of shale oil production compared to conventional oil extraction (Mohaddes and Raissi, 2016). Notably, it is plausible to expect shale oil producers to boost supply during strong economic phases. Thus, we would argue that a US domestic oil supply shock is considered good news for local industries (Kang et al, 2017). Of note, while oil demand shocks have limited impact on equities in Dubai and Kuwait, our findings point to stronger impact on the Qatari stock exchange.

Considering the other variables, GEPU has a negative effect on the equity indices of Norway and Canada. As with other emerging markets, such as China and India, Russia appears less affected, while the GCC markets exhibit no effect, exception for Qatar. The protective policies in GCC equity markets alongside their global segmentation (Fayyad and Daly, 2011) could explain such a finding. Concerning Qatar's vulnerability to policy uncertainty, this might be a result of the ongoing blockade on Qatar by its neighbours. The VIX is significant in explaining variation in the equity returns of Norway, Canada and Russia. Bahrain uniquely does not demonstrate any reaction to VIX innovations. The finding might be ascribed to the lack of activity in the Bahraini stock market since the 2011 political tensions and uprising.

Despite being the financial hub of the GCC in the last decade (Assaf, 2003), the negative overall return in Bahrain mirrors the current situation. Qatar, Oman, Dubai and Kuwait are affected during down markets, while the negative effects of VIX reach the sixth quantile in Saudi Arabia and Abu Dhabi. Additionally, consistent with Antononakakis et al. (2013), both the VIX and the GEPU dampen US stock returns.

As a final comment, the results remain robust when using the oil return instead of oil price, the refiner acquisition cost price instead of the Brent price and including a lagged dependent variable.

6. Summary and Conclusion.

This study extends the literature on the interlinkages between oil price and equity returns. We combine two strands in the literature that focus on the asymmetric relation according to oil import or export countries and that considers the state of the stock market. Thus, we examine the impact of oil shocks on equities in oil-importing and exporting nations and, by using a quantile regression approach, consider the effects across the return distribution. Furthermore, we extend the existing literature by decomposing the oil shocks into their constituent parts. In doing so, we provide a richer characterisation of the linkages between oil price shocks and equity markets.

Using data over a sample period from January 2002 to April 2018 and a structural VAR, we obtain oil price shocks and use these in a quantile regression for stock returns, also including GEPU and VIX to prevent omitted variable bias. Our results point to the following conclusions. First, the stock markets of oil-exporters are stimulated by precautionary demand shocks. Within this, the GCC markets are predominantly impacted during bear market conditions, while the returns of Canada, Russia and Norway are affected across all quantiles. Second, in contrast, the stock markets of the oil importers of Asia and Europe are largely unaffected by oil price shocks. The results also show that stock markets respond negatively to both GEPU and VIX, although the GCC markets are less affected. Further, the impact is stronger during bear market periods.

Overall, the results support differing stock markets responses to oil shocks according to the source of the shock, the state of the market and the oil import/export nature of the market. Given these differences, the results here provide information for both policymakers and investors. The results suggest that policymakers may need to make adjustments according to the source of the oil price shock and the potential for spillovers into domestic stock markets. For investors, the differing reactions across oil-importing and exporting nations, the source of the oil shocks and the market phase may open a window for diversification. This equally applies where developed markets are strongly impacted by movements in GEPU and VIX, while this is less observed in many emerging markets, notably, Russia, China and the GCC.

Compliance with Ethical Standards

No conflicts of interest

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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TABLE 1 DESCRIPTIVE STATISTICS

	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	PP test	Jarque-Bera
Abu Dhabi	0.0055	0.0019	0.3573	-0.2339	0.0706	0.3147	7.1402	0.0000	125.69*
Bahrain	-0.0008	-0.0011	0.0846	-0.1214	0.0346	-0.4374	4.3293	0.0000	18.150*
VIX	-0.0004	-0.0169	0.8526	-0.486	0.2011	0.6302	4.6143	0.0000	30.062*
Germany	0.0061	0.0119	0.1704	-0.3866	0.0692	-1.5416	9.3350	0.0000	355.75*
Dubai	0.0060	0.0000	0.3353	-0.536	0.1061	-0.465	7.1928	0.0000	132.19*
GEPU	0.0052	0.0028	0.6566	-0.5646	0.1944	0.3891	4.2157	0.0000	14.933*
France	0.0018	0.0074	0.1528	-0.4479	0.0673	-2.0014	13.725	0.0000	939.24*
UK	0.0013	0.0083	0.1544	-0.4266	0.0574	-2.5916	19.939	0.0000	2248.9*
Italy	-0.0019	0.0076	0.1634	-0.5347	0.0828	-1.8734	12.112	0.0000	695.68*
Spain	0.0006	0.0121	0.1503	-0.5228	0.0784	-1.9854	13.423	0.0000	891.62*
Japan	0.0039	0.0083	0.1437	-0.3305	0.0555	-1.4001	9.8319	0.0000	390.70*
S. Korea	0.0066	0.0111	0.2877	-0.5927	0.0830	-2.0786	18.045	0.0000	1746.0*
Kuwait	-0.00009	0.00005	0.1168	-0.4321	0.0532	-3.2882	27.929	0.0000	4763.8*
Oman	0.0026	0.0055	0.1953	-0.2634	0.0547	-0.6815	7.6087	0.0000	165.53*
Norway	0.0051	0.0105	0.1916	-0.6442	0.0895	-2.4588	18.482	0.0000	1891.1*
Qatar	0.0047	0.0051	0.2249	-0.301	0.0813	-0.4073	5.0078	0.0000	33.645*
Russia	0.0038	0.0087	0.2957	-0.8034	0.1084	-2.3447	19.709	0.0000	2158.5*
India	0.0081	0.0140	0.3090	-0.3874	0.0808	-0.6469	6.5864	0.0000	104.18*
Canada	0.0038	0.0110	0.1984	-0.5049	0.0657	-2.6992	22.623	0.0000	2968.5*
Saudi	0.0034	0.0123	0.2237	-0.281	0.0855	-0.8359	4.8610	0.0000	44.854*
China	0.0054	0.0106	0.2351	-0.2995	0.0816	-0.5154	4.5443	0.0000	24.708*
Oil price	3.2317	3.2313	4.076	2.2313	0.4414	-0.0757	1.8572	0.7063	12.179*
Oil Prod	1.001	1.001	1.0292	0.9760	0.0078	0.0125	3.8586	0.0000	6.7637*
US	0.0051	0.0123	0.0986	-0.302	0.0444	-2.3261	15.765	0.0000	1322.8*
Kilian index	11.378	2.7496	187.66	-163.74	74.242	0.3957	2.473	0.0281	8.288*

Notes: Entries are of the logarithmic differences of the variables. The sample is from January 2002 to May 2018 and comprising 197 observations. The shortened variable names are: Phillips–Perron test (PP), Saudi Arabia (Saudi), South Korea (South Korea), oil production (Oil prod), Standard Deviation (Std. Dev.), Chicago Board Options Exchange Volatility Index (VIX), Global Economic Policy Uncertainty Index (GEPU), Kilian measure of economic activity (Kilian index). The statistics of oil price, oil production and Kilian index are based on 221 observations as they are used in a structural VAR with a two-year lag.

TABLE 2 OIL SHOCKS IMPACT ON THE CONDITIONAL DISTRIBUTION OF EQUITY RETURNS

Panel A: Asian oil importers

		Japan		S.Korea		China		India	
Q		Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
0.1	Supply	0.0038	0.632	0.0039	0.554	-0.0033	0.750	-0.0008	0.955
0.2		0.0114	0.109	0.0062	0.383	0.0055	0.630	0.0053	0.636
0.3		0.0043	0.527	-0.0009	0.924	0.0052	0.524	-0.0047	0.573
0.4		0.0053	0.419	0.0005	0.959	0.0013	0.881	-0.0039	0.630
0.5		**0.0131**	**0.041**	-0.0075	0.391	-0.0024	0.795	0.0006	0.948
0.6		0.0110	0.079	-0.0126	0.118	0.0007	0.943	-0.0006	0.942
0.7		0.0098	0.093	-0.0126	0.114	0.0045	0.643	-0.0017	0.820
0.8		0.0115	0.073	-0.0115	0.159	-0.0014	0.891	-0.0028	0.747
0.9		0.0083	0.213	-0.0142	0.134	-0.0151	0.227	0.0016	0.911
0.1	Demand	0.0045	0.685	0.0024	0.877	**0.0185**	**0.047**	0.0105	0.556
0.2		-0.0050	0.495	-0.0109	0.261	0.0064	0.609	0.0024	0.852
0.3		-0.0034	0.664	-0.0040	0.671	0.0056	0.559	0.0112	0.224
0.4		-0.0022	0.756	-0.0027	0.776	0.0021	0.808	0.0057	0.503
0.5		-0.0030	0.599	0.0003	0.974	-0.0021	0.796	-0.0018	0.839
0.6		-0.0017	0.740	-0.0027	0.741	-0.0022	0.787	0.0020	0.831
0.7		0.0003	0.947	-0.0025	0.734	0.0003	0.974	0.0005	0.955
0.8		-0.0033	0.618	-0.0011	0.874	-0.0043	0.597	-0.0029	0.772
0.9		0.0013	0.899	-0.0038	0.570	-0.0008	0.934	0.0119	0.370
0.1	Oil	0.0161	0.111	0.0139	0.245	**0.0198**	**0.038**	0.0055	0.706
0.2		0.0137	0.139	0.0071	0.507	0.0107	0.316	0.0114	0.383
0.3		0.0030	0.629	0.0065	0.552	0.0015	0.864	-0.0036	0.757
0.4		0.0047	0.444	0.0054	0.625	-0.0060	0.476	-0.0054	0.588
0.5		0.0019	0.747	0.0067	0.509	0.0048	0.653	-0.0026	0.788
0.6		0.0019	0.742	0.0126	0.161	0.0058	0.619	-0.0017	0.845
0.7		-0.0021	0.693	0.0106	0.206	0.0127	0.206	0.0005	0.945
0.8		0.0001	0.986	0.0092	0.271	0.0085	0.373	-0.0030	0.734
0.9		-0.0072	0.379	-0.0046	0.629	-0.0019	0.898	-0.0130	0.160
0.1	VIX	-0.0514	0.194	**-0.1752**	**0.000**	-0.0624	0.062	**-0.1230**	**0.023**
0.2		-0.0080	0.777	**-0.1448**	**0.000**	-0.0715	0.069	**-0.1649**	**0.000**
0.3		**-0.0553**	**0.009**	**-0.1625**	**0.000**	-0.0789	0.063	**-0.1658**	**0.000**
0.4		**-0.0512**	**0.013**	**-0.1432**	**0.000**	-0.0479	0.222	**-0.1777**	**0.000**
0.5		**-0.0505**	**0.021**	**-0.1375**	**0.001**	-0.0476	0.196	**-0.1549**	**0.000**
0.6		-0.0433	0.101	**-0.1283**	**0.000**	-0.0462	0.213	**-0.1287**	**0.000**
0.7		-0.0431	0.100	**-0.1268**	**0.000**	0.0059	0.891	**-0.1424**	**0.000**
0.8		-0.0392	0.238	**-0.1213**	**0.000**	0.0534	0.190	**-0.1670**	**0.000**
0.9		-0.0529	0.246	**-0.1398**	**0.000**	0.0546	0.252	**-0.1801**	**0.015**
0.1	GEPU	**-0.1496**	**0.000**	**-0.1147**	**0.001**	-0.1229	0.095	**-0.0692**	**0.017**
0.2		**-0.1200**	**0.000**	**-0.0897**	**0.003**	-0.0453	0.387	-0.0361	0.245
0.3		**-0.1144**	**0.000**	**-0.0813**	**0.007**	-0.0364	0.394	-0.0548	0.156
0.4		**-0.1040**	**0.000**	**-0.0867**	**0.008**	-0.0522	0.120	-0.0278	0.507
0.5		**-0.0979**	**0.000**	**-0.0964**	**0.006**	-0.0123	0.651	-0.0092	0.833
0.6		**-0.0824**	**0.001**	**-0.0736**	**0.032**	-0.0167	0.537	-0.0212	0.659
0.7		**-0.0714**	**0.003**	-0.0563	0.124	-0.0188	0.541	0.0167	0.737
0.8		-0.0417	0.135	-0.0634	0.123	-0.0111	0.801	0.0117	0.830
0.9		-0.0547	0.180	-0.0009	0.986	0.0038	0.959	-0.0474	0.487

Panel B: EU oil-importers

		France		Italy		Spain		Germany		UK	
Q		Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
0.1	Supply	-0.0057	0.586	-0.0078	0.500	-0.0083	0.507	-0.0042	0.785	-0.0069	0.541
0.2		-0.0002	0.983	-0.0105	0.472	-0.0011	0.910	-0.0121	0.270	0.0029	0.632
0.3		-0.0095	0.246	0.0011	0.900	0.0010	0.901	-0.0084	0.420	0.0016	0.789
0.4		-0.0037	0.520	-0.0036	0.635	-0.0036	0.595	0.0003	0.968	0.0002	0.970
0.5		-0.0019	0.722	-0.0063	0.384	-0.0010	0.885	-0.0015	0.823	-0.0019	0.655
0.6		0.0005	0.916	-0.0043	0.527	-0.0039	0.547	0.0014	0.816	0.0036	0.347
0.7		0.0027	0.595	-0.0016	0.810	-0.0043	0.489	0.0003	0.954	0.0031	0.428
0.8		-0.0003	0.955	-0.0065	0.346	**-0.0132**	**0.047**	-0.0010	0.869	-0.0010	0.815
0.9		0.0003	0.973	-0.0077	0.302	-0.0077	0.360	-0.0004	0.941	0.0092	0.124
0.1	Demand	0.0003	0.981	0.0007	0.965	0.0082	0.631	0.0087	0.580	0.0015	0.893
0.2		-0.0039	0.732	0.0058	0.745	0.0096	0.459	0.0036	0.747	-0.0042	0.576
0.3		-0.0028	0.782	0.0009	0.944	-0.0001	0.989	0.0045	0.662	0.0017	0.829
0.4		0.0006	0.943	0.0014	0.897	0.0052	0.581	-0.0003	0.975	0.0028	0.616
0.5		0.0005	0.944	-0.0013	0.890	0.0038	0.654	0.0027	0.737	0.0061	0.219
0.6		0.0051	0.457	-0.0024	0.781	0.0066	0.413	0.0094	0.180	0.0061	0.168
0.7		0.0105	0.075	-0.0017	0.825	0.0040	0.584	0.0092	0.140	0.0046	0.261
0.8		0.0047	0.400	-0.0007	0.928	0.0062	0.331	0.0062	0.277	0.0039	0.313
0.9		0.0045	0.353	0.0012	0.839	-0.0052	0.509	0.0049	0.381	0.0045	0.353
0.1	Oil	0.0079	0.235	0.0113	0.167	0.0068	0.417	0.0049	0.618	0.0114	0.089
0.2		0.0024	0.763	0.0122	0.224	0.0003	0.966	0.0060	0.516	**0.0218**	**0.000**
0.3		0.0000	1.000	-0.0006	0.941	0.0005	0.943	-0.0008	0.929	0.0159	0.061
0.4		0.0005	0.934	0.0035	0.649	0.0024	0.761	0.0003	0.974	0.0065	0.255
0.5		0.0041	0.488	0.0071	0.323	0.0047	0.566	0.0000	0.995	0.0079	0.149
0.6		0.0044	0.434	0.0094	0.186	0.0067	0.397	0.0000	0.998	0.0047	0.334
0.7		**0.0109**	**0.038**	0.0089	0.218	0.0022	0.809	0.0045	0.512	0.0050	0.292
0.8		0.0101	0.056	0.0085	0.265	0.0041	0.606	0.0084	0.137	0.0053	0.285
0.9		0.0121	0.085	0.0149	0.061	0.0004	0.954	0.0073	0.166	0.0067	0.192
0.1	VIX	**-0.1839**	**0.000**	**-0.2300**	**0.000**	**-0.1869**	**0.000**	**-0.1581**	**0.010**	**-0.1116**	**0.000**
0.2		**-0.1567**	**0.000**	**-0.1555**	**0.000**	**-0.1408**	**0.000**	**-0.1260**	**0.001**	**-0.1241**	**0.000**
0.3		**-0.1456**	**0.000**	**-0.1539**	**0.000**	**-0.1334**	**0.000**	**-0.1184**	**0.006**	**-0.1223**	**0.000**
0.4		**-0.1278**	**0.000**	**-0.1174**	**0.001**	**-0.1092**	**0.003**	**-0.1195**	**0.000**	**-0.1105**	**0.000**
0.5		**-0.1190**	**0.000**	**-0.1161**	**0.000**	**-0.1131**	**0.000**	**-0.1360**	**0.000**	**-0.0839**	**0.000**
0.6		**-0.1095**	**0.000**	**-0.1116**	**0.000**	**-0.0969**	**0.000**	**-0.1309**	**0.000**	**-0.0955**	**0.000**
0.7		**-0.1114**	**0.000**	**-0.1059**	**0.000**	**-0.1148**	**0.000**	**-0.1142**	**0.000**	**-0.0989**	**0.000**
0.8		**-0.1104**	**0.000**	**-0.1016**	**0.000**	**-0.1304**	**0.000**	**-0.1292**	**0.000**	**-0.1051**	**0.000**
0.9		**-0.1142**	**0.000**	**-0.1078**	**0.000**	**-0.1424**	**0.000**	**-0.1282**	**0.000**	**-0.0997**	**0.000**
0.1	GEPU	**-0.1261**	**0.000**	**-0.1179**	**0.000**	**-0.1323**	**0.000**	**-0.1675**	**0.001**	**-0.0972**	**0.000**
0.2		**-0.0879**	**0.000**	**-0.1288**	**0.000**	**-0.1508**	**0.000**	**-0.1223**	**0.000**	**-0.0862**	**0.000**
0.3		**-0.0819**	**0.000**	**-0.1388**	**0.000**	**-0.1384**	**0.000**	**-0.0850**	**0.000**	**-0.0889**	**0.001**
0.4		**-0.1023**	**0.000**	**-0.0883**	**0.021**	**-0.0847**	**0.021**	**-0.1049**	**0.000**	**-0.0719**	**0.002**
0.5		**-0.0929**	**0.001**	**-0.0677**	**0.044**	**-0.0803**	**0.025**	**-0.0946**	**0.001**	**-0.0634**	**0.002**
0.6		**-0.0931**	**0.001**	**-0.0734**	**0.029**	-0.0531	0.139	**-0.0879**	**0.015**	**-0.0572**	**0.004**
0.7		**-0.0891**	**0.005**	**-0.0870**	**0.013**	-0.0476	0.162	**-0.0899**	**0.013**	**-0.0551**	**0.007**
0.8		**-0.0597**	**0.039**	**-0.0814**	**0.034**	-0.0481	0.173	**-0.0995**	**0.010**	-0.0435	0.073
0.9		-0.0870	0.051	**-0.0992**	**0.023**	-0.0681	0.055	**-0.0673**	**0.034**	-0.0327	0.275

Panel C: US and non-GCC oil-exporters

		US		Canada		Russia		Norway	
Q		Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
0.1	Supply	-0.0070	0.146	-0.0068	0.674	0.0058	0.600	-0.0053	0.754
0.2		-0.0018	0.767	0.0020	0.769	0.0117	0.247	-0.0016	0.883
0.3		-0.0043	0.389	-0.0001	0.992	0.0156	0.111	-0.0068	0.448
0.4		0.0019	0.641	0.0005	0.926	-0.0043	0.682	-0.0058	0.470
0.5		0.0040	0.284	0.0026	0.565	-0.0016	0.865	0.0000	0.995
0.6		0.0052	0.136	0.0086	0.055	-0.0005	0.961	-0.0005	0.938
0.7		0.0059	0.055	0.0062	0.178	0.0009	0.926	0.0031	0.660
0.8		**0.0094**	**0.003**	-0.0012	0.823	-0.0022	0.830	0.0052	0.462
0.9		**0.0085**	**0.005**	-0.0004	0.952	-0.0129	0.320	0.0027	0.771
0.1	Demand	0.0068	0.320	0.0063	0.751	-0.0075	0.673	0.0084	0.735
0.2		-0.0046	0.356	0.0088	0.335	0.0006	0.959	-0.0027	0.812
0.3		-0.0028	0.516	0.0043	0.551	0.0042	0.724	0.0031	0.721
0.4		-0.0046	0.161	-0.0008	0.915	0.0100	0.319	0.0062	0.437
0.5		-0.0057	0.093	0.0027	0.644	0.0114	0.262	0.0046	0.521
0.6		-0.0046	0.166	0.0001	0.992	0.0096	0.341	0.0072	0.315
0.7		-0.0034	0.332	0.0018	0.701	0.0097	0.292	0.0062	0.404
0.8		0.0011	0.782	0.0023	0.666	-0.0001	0.993	0.0146	0.084
0.9		0.0012	0.774	0.0047	0.446	-0.0013	0.895	0.0154	0.079
0.1	Oil	-0.0012	0.799	**0.0304**	**0.038**	**0.0331**	**0.033**	**0.0281**	**0.009**
0.2		0.0001	0.981	**0.0265**	**0.018**	**0.0447**	**0.000**	**0.0304**	**0.003**
0.3		0.0018	0.731	**0.0178**	**0.005**	**0.0409**	**0.000**	**0.0333**	**0.002**
0.4		-0.0024	0.580	**0.0162**	**0.009**	**0.0399**	**0.000**	**0.0255**	**0.012**
0.5		-0.0034	0.386	**0.0143**	**0.021**	**0.0382**	**0.000**	**0.0286**	**0.004**
0.6		-0.0006	0.873	**0.0141**	**0.016**	**0.0400**	**0.000**	**0.0253**	**0.008**
0.7		-0.0036	0.314	**0.0130**	**0.036**	**0.0332**	**0.001**	**0.0250**	**0.004**
0.8		-0.0018	0.645	**0.0131**	**0.044**	**0.0376**	**0.002**	**0.0268**	**0.000**
0.9		0.0030	0.446	**0.0187**	**0.005**	0.0206	0.274	**0.0371**	**0.000**
0.1	VIX	**-0.1521**	**0.000**	-0.1036	0.107	**-0.1088**	**0.035**	**-0.1831**	**0.000**
0.2		**-0.1149**	**0.000**	**-0.1173**	**0.000**	**-0.1322**	**0.002**	**-0.1888**	**0.000**
0.3		**-0.0961**	**0.000**	**-0.0939**	**0.001**	**-0.1624**	**0.000**	**-0.1720**	**0.000**
0.4		**-0.1091**	**0.000**	**-0.1010**	**0.000**	**-0.1525**	**0.000**	**-0.1480**	**0.000**
0.5		**-0.1076**	**0.000**	**-0.1007**	**0.000**	**-0.1248**	**0.003**	**-0.1446**	**0.000**
0.6		**-0.0991**	**0.000**	**-0.0962**	**0.000**	**-0.1341**	**0.003**	**-0.1359**	**0.000**
0.7		**-0.0905**	**0.000**	**-0.1022**	**0.000**	**-0.1012**	**0.029**	**-0.1636**	**0.000**
0.8		**-0.0995**	**0.000**	**-0.0981**	**0.000**	-0.0431	0.249	**-0.1516**	**0.000**
0.9		**-0.0790**	**0.000**	**-0.0888**	**0.000**	**-0.1110**	**0.008**	**-0.1456**	**0.000**
0.1	GEPU	**-0.0986**	**0.000**	-0.0882	0.121	**-0.0937**	**0.011**	**-0.1433**	**0.000**
0.2		**-0.0868**	**0.001**	**-0.0712**	**0.006**	**-0.0810**	**0.035**	**-0.1141**	**0.001**
0.3		**-0.0517**	**0.001**	**-0.0841**	**0.001**	-0.0613	0.079	**-0.0956**	**0.001**
0.4		**-0.0322**	**0.004**	**-0.0579**	**0.005**	-0.0323	0.340	**-0.0958**	**0.001**
0.5		**-0.0353**	**0.001**	**-0.0581**	**0.003**	-0.0589	0.106	**-0.1105**	**0.001**
0.6		**-0.0346**	**0.002**	**-0.0616**	**0.001**	**-0.0809**	**0.023**	**-0.0991**	**0.009**
0.7		**-0.0504**	**0.000**	**-0.0711**	**0.000**	**-0.1021**	**0.005**	-0.0588	0.239
0.8		**-0.0604**	**0.000**	-0.0394	0.372	-0.0909	0.063	-0.0399	0.344
0.9		**-0.0619**	**0.000**	-0.0443	0.353	-0.0369	0.632	-0.0698	0.138

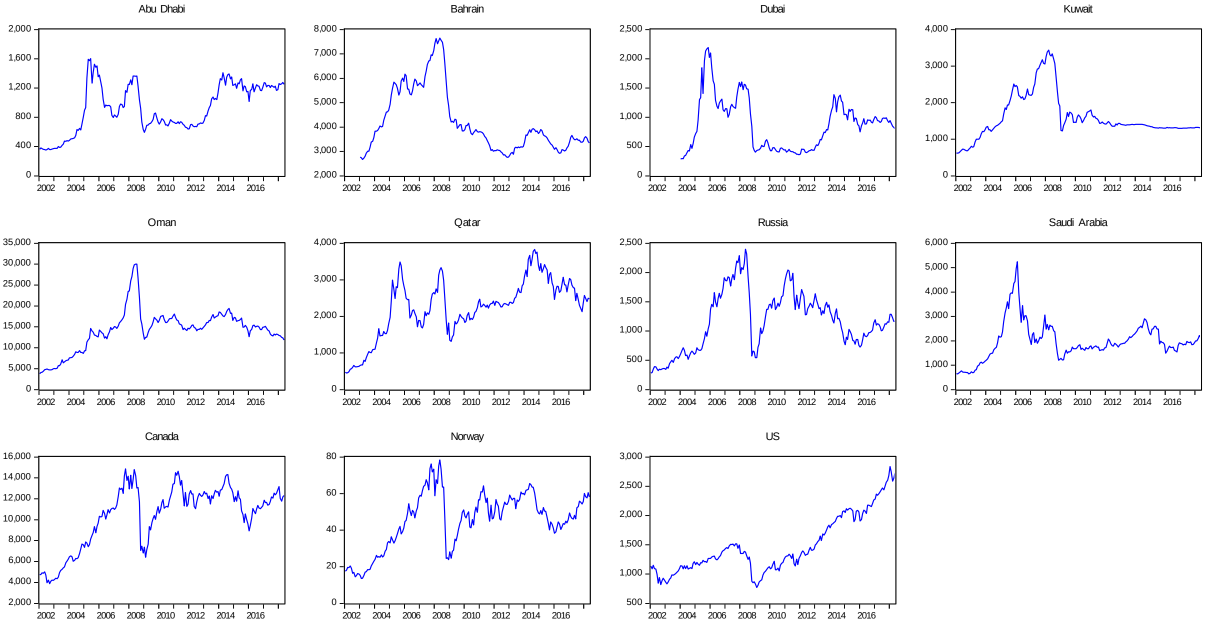
Panel D: GCC oil-exporters

		Oman		Qatar		Dubai		Bahrain		Kuwait		Abu Dhabi		Saudi	
Q		Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob	Coeff	Prob
0.1	Supply	0.0065	0.311	-0.0026	0.766	0.0025	0.832	-0.0039	0.357	0.0040	0.326	0.0117	0.286	-0.0106	0.503
0.2		0.0047	0.411	0.0051	0.482	0.0105	0.374	-0.0022	0.626	0.0064	0.124	0.0019	0.759	-0.0087	0.362
0.3		0.0018	0.776	0.0044	0.485	0.0038	0.810	-0.0064	0.168	-0.0013	0.709	0.0016	0.763	-0.0023	0.751
0.4		0.0037	0.544	0.0026	0.691	0.0091	0.534	**-0.0084**	**0.049**	-0.0002	0.951	-0.0010	0.862	-0.0030	0.652
0.5		0.0032	0.573	-0.0026	0.714	0.0112	0.446	**-0.0085**	**0.020**	-0.0012	0.746	-0.0017	0.786	-0.0027	0.681
0.6		0.0007	0.901	-0.0032	0.668	0.0120	0.401	-0.0073	0.070	0.0009	0.808	-0.0019	0.763	-0.0046	0.481
0.7		-0.0007	0.899	-0.0094	0.214	0.0096	0.473	-0.0055	0.222	0.0005	0.901	0.0015	0.852	-0.0038	0.585
0.8		-0.0050	0.258	-0.0184	0.061	0.0201	0.112	-0.0045	0.397	-0.0064	0.298	-0.0013	0.881	-0.0042	0.588
0.9		-0.0058	0.299	**-0.0287**	**0.003**	0.0349	0.103	-0.0059	0.392	-0.0040	0.678	0.0014	0.928	0.0083	0.400
0.1	Demand	0.0056	0.362	**0.0202**	**0.001**	0.0117	0.289	0.0080	0.068	**0.0218**	**0.000**	0.0092	0.449	0.0047	0.716
0.2		0.0083	0.119	**0.0140**	**0.033**	**0.0252**	**0.008**	0.0049	0.295	0.0038	0.332	0.0045	0.373	0.0022	0.818
0.3		0.0092	0.119	**0.0155**	**0.042**	0.0077	0.536	0.0037	0.366	0.0000	0.990	0.0015	0.778	0.0015	0.831
0.4		0.0080	0.189	0.0033	0.699	0.0076	0.467	0.0055	0.125	0.0015	0.568	0.0008	0.889	-0.0020	0.762
0.5		0.0045	0.429	0.0046	0.601	0.0080	0.453	0.0043	0.228	0.0007	0.797	0.0013	0.840	0.0015	0.834
0.6		0.0078	0.146	0.0006	0.945	0.0086	0.426	0.0024	0.551	0.0015	0.626	0.0026	0.703	0.0025	0.768
0.7		0.0033	0.580	0.0007	0.934	0.0074	0.529	0.0014	0.732	0.0008	0.836	0.0016	0.880	-0.0014	0.881
0.8		0.0075	0.320	-0.0040	0.763	0.0048	0.782	0.0018	0.687	0.0072	0.350	-0.0102	0.329	0.0120	0.194
0.9		0.0013	0.925	0.0129	0.501	-0.0117	0.567	**0.0129**	**0.040**	-0.0033	0.729	0.0061	0.713	0.0169	0.091
0.1	Oil	**0.0145**	**0.043**	**0.0252**	**0.007**	**0.0245**	**0.007**	**0.0146**	**0.002**	0.0041	0.335	0.0156	0.205	**0.0299**	**0.036**
0.2		**0.0119**	**0.045**	**0.0241**	**0.007**	0.0197	0.073	0.0067	0.171	-0.0009	0.810	**0.0155**	**0.044**	**0.0261**	**0.027**
0.3		0.0133	0.060	**0.0203**	**0.007**	0.0111	0.410	0.0049	0.310	0.0007	0.776	0.0117	0.141	0.0150	0.051
0.4		0.0061	0.435	**0.0166**	**0.027**	0.0143	0.288	0.0052	0.240	0.0011	0.701	0.0074	0.261	**0.0170**	**0.018**
0.5		0.0091	0.259	**0.0203**	**0.010**	0.0214	0.136	0.0045	0.225	0.0024	0.403	0.0067	0.293	**0.0169**	**0.010**
0.6		0.0058	0.436	**0.0171**	**0.030**	0.0138	0.254	0.0036	0.353	0.0046	0.173	0.0046	0.448	**0.0150**	**0.019**
0.7		0.0038	0.594	**0.0211**	**0.014**	0.0113	0.336	0.0038	0.316	0.0043	0.314	0.0136	0.059	0.0096	0.154
0.8		-0.0007	0.903	0.0062	0.588	0.0123	0.364	0.0030	0.433	0.0043	0.661	0.0051	0.594	0.0107	0.179
0.9		0.0029	0.668	0.0029	0.828	-0.0088	0.703	-0.0044	0.477	0.0061	0.539	-0.0040	0.818	0.0007	0.937
0.1	VIX	**-0.0945**	**0.000**	**-0.1208**	**0.003**	**-0.1139**	**0.002**	-0.0085	0.666	**-0.0627**	**0.000**	-0.0598	0.134	**-0.1578**	**0.000**
0.2		**-0.1054**	**0.000**	**-0.0921**	**0.001**	-0.0581	0.304	-0.0232	0.169	-0.0227	0.087	**-0.0623**	**0.046**	-0.0845	0.065
0.3		**-0.0752**	**0.007**	**-0.0857**	**0.001**	-0.0479	0.252	-0.0084	0.540	-0.0134	0.254	-0.0390	0.070	**-0.0988**	**0.011**
0.4		**-0.0474**	**0.047**	-0.0513	0.130	-0.0554	0.202	-0.0133	0.361	-0.0065	0.570	**-0.0528**	**0.019**	-0.0487	0.143
0.5		-0.0324	0.131	-0.0364	0.268	-0.0741	0.111	-0.0168	0.277	-0.0032	0.775	**-0.0483**	**0.035**	-0.0613	0.061
0.6		-0.0241	0.233	-0.0180	0.573	-0.0935	0.062	-0.0063	0.803	-0.0148	0.287	**-0.0509**	**0.036**	**-0.0746**	**0.020**
0.7		-0.0265	0.237	-0.0049	0.882	-0.0923	0.104	-0.0051	0.842	-0.0358	0.079	-0.0416	0.237	**-0.0691**	**0.031**
0.8		-0.0136	0.628	-0.0558	0.222	-0.0589	0.480	0.0191	0.408	-0.0407	0.089	-0.0091	0.861	-0.0449	0.237
0.9		-0.0192	0.668	-0.0514	0.385	-0.0461	0.683	0.0093	0.684	**-0.0463**	**0.022**	0.0197	0.853	-0.0552	0.225
0.1	GEPU	-0.0073	0.754	-0.0571	0.099	0.0623	0.298	-0.0284	0.194	-0.0274	0.173	-0.0298	0.628	-0.0278	0.521
0.2		-0.0249	0.279	-0.0571	0.111	-0.0418	0.467	-0.0029	0.882	**-0.0348**	**0.025**	0.0128	0.644	-0.0809	0.062
0.3		-0.0291	0.170	**-0.0751**	**0.023**	-0.0450	0.261	-0.0072	0.672	-0.0092	0.422	-0.0027	0.889	-0.0422	0.299
0.4		-0.0346	0.083	-0.0591	0.098	-0.0373	0.318	-0.0146	0.405	-0.0107	0.386	0.0010	0.964	-0.0378	0.231
0.5		-0.0274	0.194	-0.0587	0.065	-0.0291	0.439	-0.0095	0.576	-0.0038	0.756	0.0076	0.749	-0.0238	0.417
0.6		-0.0248	0.261	**-0.0719**	**0.016**	-0.0257	0.506	0.0010	0.955	-0.0118	0.404	-0.0076	0.780	-0.0174	0.533
0.7		-0.0158	0.590	-0.0566	0.055	-0.0190	0.673	-0.0130	0.509	-0.0234	0.237	-0.0138	0.721	-0.0248	0.407
0.8		-0.0543	0.081	-0.0773	0.079	-0.0556	0.352	-0.0231	0.227	-0.0154	0.747	-0.0292	0.405	-0.0121	0.794
0.9		**-0.0977**	**0.001**	**-0.0943**	**0.040**	-0.0627	0.556	**-0.0316**	**0.044**	0.0268	0.692	-0.0529	0.158	0.0527	0.184

Notes. Demand stands for oil aggregate demand shocks, Supply refers to for oil supply shocks, oil stands for oil-specific shock, GEPU is an acronym for Global Economic Policy Uncertainty index, and VIX is the CBOE measure of implied volatility. Statistically significant oil shocks at 5% are bolded. The constant term results are not included in the table to conserve space.

FIGURE 1 STOCK MARKET PRICE INDICES

Panel A: US and oil exporters



Panel B: oil importers

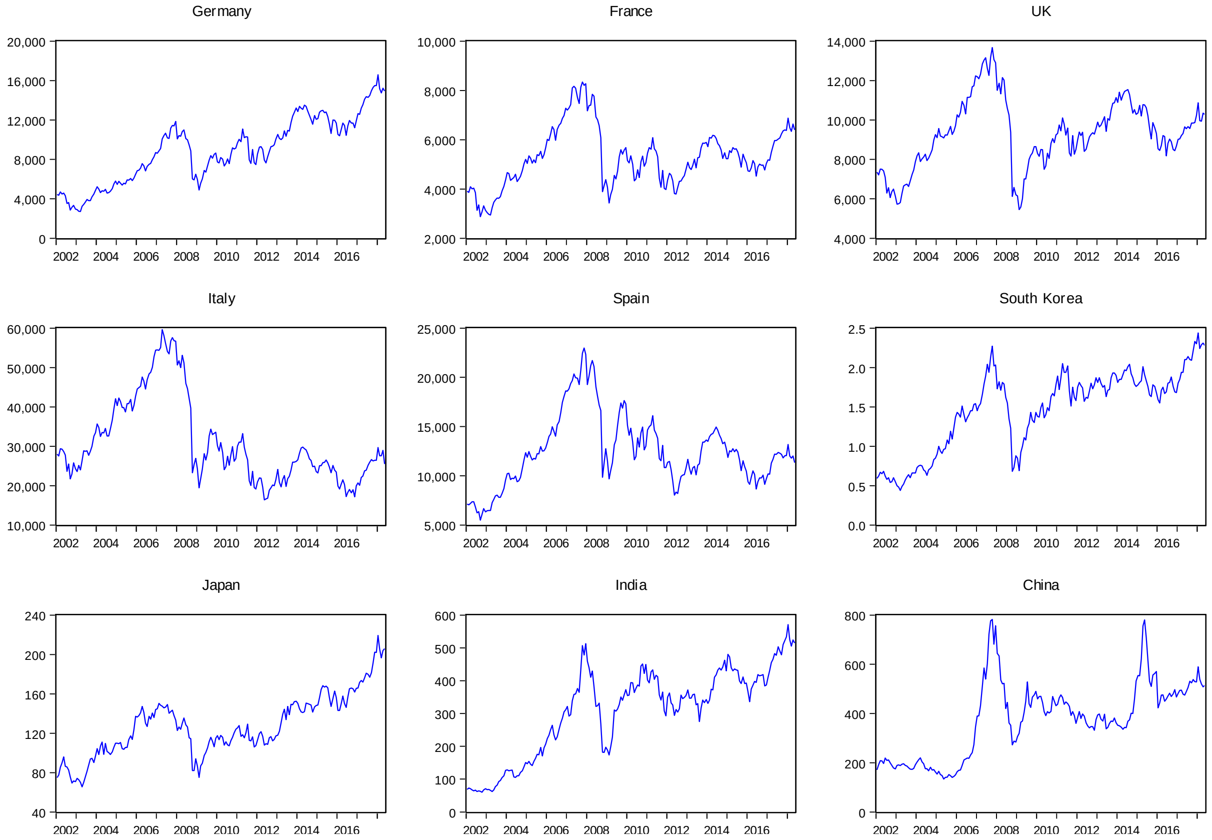


FIGURE 2 STRUCTURAL OIL PRICE SHOCKS

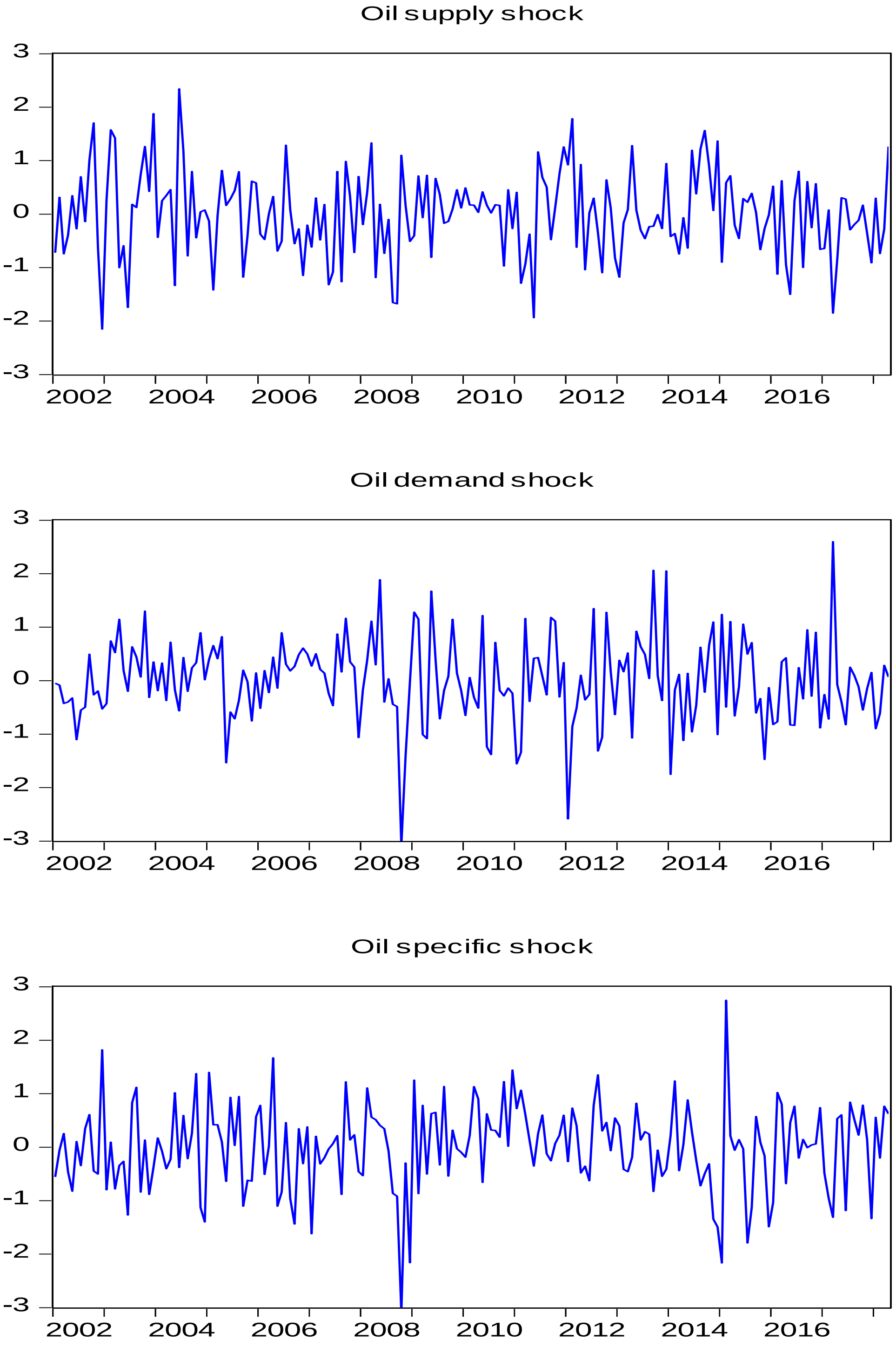


Figure 3 Brent oil price in nominal and real terms

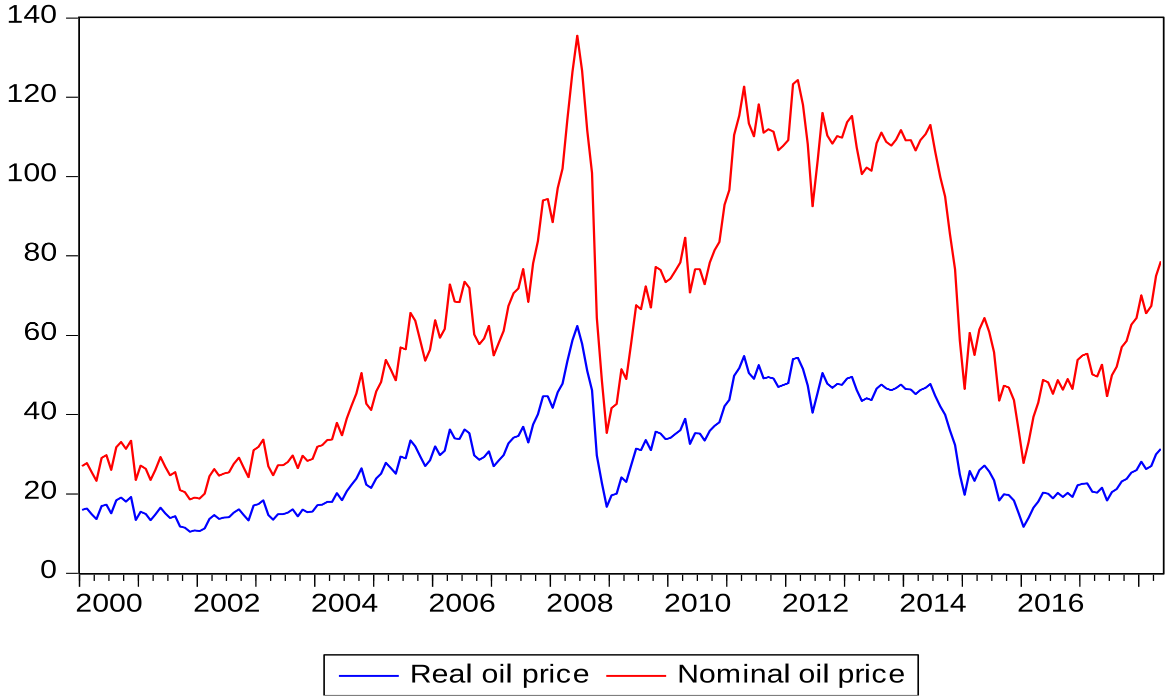


FIGURE 4 KILIAN ECONOMIC ACTIVITY INDEX