



Oil-Stock Nexus: The Role of Oil Shocks for GCC Markets

Journal:	<i>Studies in Economics and Finance</i>
Manuscript ID	SEF-12-2021-0529.R2
Manuscript Type:	Research Paper
Keywords:	Energy finance, oil price shocks, emerging financial markets

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Abstract

This study examines the links between oil price shocks and GCC stock markets from February 2004 to December 2019. Initial results show a positive oil price change increases stock returns, while greater volatility decreases returns. Shock decomposition results reveal a significant positive impact of supply-side shocks on stocks. This contrasts with the literature that argues demand-side shocks are more important. Our result reflects the unique economic structure of the GCC bloc, marked by its dependence on oil revenues. In analysing quantile-based results, oil supply shocks mainly exhibit lower-tail dependence, while we uncover some evidence of demand-side shocks affecting mid and upper-tail dependence. These results will be of interest to global investors and GCC policy-makers.

1. Introduction.

The energy finance literature highlights important links between oil prices and stock markets (see, for example, Sadorsky, 1999; Papapetrou, 2001; Bjornland, 2009; Park and Ratti, 2008; Le and Chang, 2015; Wang et al., 2013). To better understand these links, a notable advance is presented in work that decomposes the oil price into its respective shocks (Hamilton, 2009; Kilian, 2009). Given the high dependence of the Gulf Cooperation Council (GCC¹) countries on oil production,² the analysis of oil price shocks on GCC stocks is important to investors and policy-makers, as well as academics interested in modelling financial market relations. Thus, this paper seeks to examine the impact of oil price shocks using the decomposition of Ready (2018) on GCC stock returns.

As relatively young stock markets, those of the GCC are understudied. Moreover, the markets, classed as either emerging or frontier (Balcilar et al., 2015), have witnessed considerable efforts to enhance efficiency (Benlagha, 2020) and have undergone economic and financial liberalisation (Bley and Chen, 2006; Al-Khazali et al, 2006; Akoum et al., 2012). This includes, for example, structural reforms to allow foreign investors to channel funds towards GCC financial markets, improving liquidity (Al Janabi et al., 2010; Arouri and Rault, 2012). Consequently, in 2014, the MSCI re-categorised the markets of the UAE and Qatar to emerging market status, while Saudi Arabia followed in 2019. The markets of Kuwait, Oman and Bahrain remain in the frontier category. Nonetheless, the GCC markets generally enjoy many macroeconomic fundamentals equivalent to developed nations (Awartani and Maghyereh, 2013).

Given these features, several studies consider the importance of GCC markets in the context of global portfolio diversification. For example, Hammoudeh and Choi (2007) argue that, in comparison to Mexico as another big oil producer, GCC markets are less connected with world markets. Arouri and Rault (2010) and Mimouni et al. (2016) conclude that the inclusion of GCC markets improves diversification in a cross-country portfolio. Therefore, establishing what may influence GCC stock market movements is of interest to global portfolio managers.

Recently, and in pursuit of diversification, investors began to regard the oil market as a suitable alternative destination leading to the so-called financialization of oil markets

¹ Established in 1981, The Cooperation Council for the Arab States of the Gulf is a regional organisation of six members: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

² The GCC bloc holds 30.6% of proven oil reserves (BP Statistical Review of World Energy 2019). Moreover, Khalifa et al. (2014) note that the oil industry constitutes 35% of the GCC economies.

(Silvennoinen and Thorp, 2013). McMillan et al. (2021) argue that this financialisation of oil is linked with higher comovements of GCC stocks with their US counterparts. Moreover, together with the recent instability in oil prices, this motivates a new examination of the oil-stock nexus.

The literature on the links between oil prices and the economy can be traced back to the work of Hamilton (1983). Subsequently, a wave of research sought to establish a link between oil prices and financial markets using Vector Autoregressive (VAR) models. Examples include the work of Sadorsky (1999), Papapetrou (2001), Bjornland (2009), Park and Ratti (2008) and Le and Chang (2015). Hamilton (2009) argues that oil price shocks are not uniquely instigated by supply shortages, but also by innovations in the demand side. Moreover, Kilian and Park (2009) note, studies that do not recognise the causes of oil shocks, will be predisposed to uncover trivial links between oil prices and stocks.

In a notable development, Kilian³ (2009) suggests that a rise in oil price should be attributed to its underlying cause and identifies three distinctive sources of oil price increases: supply-side shock caused by shortfalls in oil production, demand-side shock due to the expansion of the global economy, and precautionary demand shock triggered by expectations of future oil supply shortfalls. In a further significant study, Ready (2018) proposes a technique to disentangle oil price shocks based on the traded asset price data of oil-producing firms. Ready (2018) argues that while oil producers benefit from price increases due to oil demand, they remain numb to supply disruptions (for example, when extraction complications arise, oil producers will sell less but at higher prices). Empirically, Ready (2018) identifies demand shocks as returns to an index of oil-producing firms that are orthogonal to innovations in the VIX index, and supply shocks as oil price changes that are orthogonal to demand shocks and to changes in VIX.

Subsequently, a number of studies examine the impact of oil price shocks on stocks. Earlier work, such as Kilian and Park (2009) and Abhyankar et al. (2013) concentrate on the major developed markets of the US and Japan, while Kang and Ratti (2015) examine the impact of oil price shocks and economic policy uncertainty on Chinese stocks. Further studies include

³ Within this framework, Kilian (2009) reports that supply and demand shocks account for 4% of the monthly variation in the oil price. Precautionary demand shocks, which are unspecified by this procedure account for 77% of the variation, which lead to some criticism. Kolodziej and Kaufmann (2014) argue that the Kilian (2009) index of global real economic activity captures little more than transportation costs such that the identified demand shock is not sufficient. Elaborating, Ready (2018) reveals that the measure will not capture anticipated variation in aggregate demand, leaving these to the precautionary demand. Likewise, Demirer et al. (2020) document the over emphasis of Kilian's (2009) decomposition on precautionary demand shocks.

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3 the work of Wang et al. (2013), Kang and Ratti (2013) and Apergis and Miller (2009). However,
4 despite the importance of oil to the GCC economies, as well as the strong role they play in the oil
5 market, examining the link between oil price shocks and GCC markets remains largely
6 neglected.
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10 Focusing on oil exporters and using the approach of Kilian and Murphy (2014), Basher et
11 al. (2018) study the influence of oil shocks on Canada, Mexico, Norway, Russia, the UK,
12 Kuwait, Saudi Arabia, and the UAE. Using a two-state Markov-switching model, they show that
13 both oil aggregate demand shocks and oil precautionary demand shocks have a significant
14 impact on stock returns in Norway, Russia, Kuwait, Saudi Arabia, and the UAE. While oil
15 supply shocks influence stocks in the UK, Kuwait, and the UAE. Therefore, to the best of our
16 knowledge, this is the only study that incorporates (some) GCC markets in an empirical analysis
17 that focuses on oil price decompositions.
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24 Building on the work of Basher et al. (2018), this paper exploits the Ready (2018)
25 decomposition of oil innovations on stock return. We also incorporate all GCC markets as we
26 believe that heterogeneity exists in terms of their economic structure and oil dependence. For
27 instance, while Kuwait has the highest level of dependence on oil, the UAE has a growing
28 diversified economy based on tourism and services. In this regard, Fenech and Vosgha (2019)
29 argue that the dependence structure between oil and GCC stock exchanges varies. Moreover,
30 Alqahtani et al. (2019) maintain that the link between oil price uncertainty and GCC markets
31 differs significantly with the smaller markets of Bahrain and Oman being less susceptible to oil
32 shocks than their Saudi and Emirati counterparts. Furthermore, Mokni and Youssef (2019) show
33 that the Saudi market displays the largest degree of persistence in the dependence with oil
34 prices. Thus, examining the heterogeneity among GCC nations in their interactions with oil
35 shocks can be an enhancement to the current literature.
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45 Therefore, we examine the impact of oil price shocks on the GCC stocks markets using
46 the method of Ready (2018). In extending this, we further examine the dependence structure
47 between oil price shocks and GCC stocks using the quantile regression of Koenker and Bassett
48 (1978). Specifically, we first consider the standard linear relation between oil return and
49 volatility. Oil volatility is included in this initial analysis as it may capture risk in the oil market.
50 Although that analysis is then subsumed in the next stage that considers oil price shocks. Second,
51 we then decompose oil price changes according to their source as supply, demand and risk
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3 shocks. Third, we consider whether the relation varies across different quantiles of the returns
4 process. In examining the impact of oil innovations on GCC stock returns, we control for global
5 factors using the VIX index, Global Economic Policy Uncertainty (GEPU) and the MSCI world
6 portfolio. Controlling for these variables is essential to ensure the accuracy of results. According
7 to Dickinson (2000) and Rigobon and Sack (2003), asset prices are intertwined, therefore,
8 analyzing a single market in segregation overlooks important information about its behaviour.
9 The MSCI world portfolio is designed to capture common fundamentals that steer global equity
10 returns. Oil price shocks are believed to be related with both VIX and GEPU as argued by
11 Antonakakis et al. (2013) and Kang and Ratti (2013). These variables can influence stock prices
12 by affecting expected cash flows and discount rates. Moreover, oil price increases caused by
13 supply-side factors may be associated with higher GEPU with the opposite for demand-side
14 factors (Kang and Ratti, 2013).

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24 This study contributes to the literature from several angles. First, we apply the Ready
25 (2018) methodology to the GCC markets while detailing the dependence structure of the oil-
26 stock nexus. Second, we include all GCC countries, hence, we highlight the heterogeneities
27 among them. This latter point could carry important information for portfolio managers
28 interested in intra-regional diversification. Third, we also consider heterogeneity across the stock
29 return distribution and thus, whether the relation with oil shocks depends on the state of the stock
30 market and whether it is a bullish or bearish phase. Of note, our results point to the importance of
31 oil supply shocks in explaining the changes in GCC equity returns, especially during bear market
32 phases.
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41 **2. Literature Review.**

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43 Oil prices and financial markets are linked through their effects on, and from, the wider
44 economy. In considering the theoretical transmission mechanisms, Mohanty and Nandha (2011)
45 argue that oil price changes impact a firm's future cash flows, positively or negatively,
46 depending on whether it is an oil-consumer or oil-producer. As rising oil prices amplify
47 production costs, Basher and Sadorsky, (2006) argue that as policy-makers increase short-term
48 interest rates in response to higher inflationary pressures, this increases borrowing costs and
49 reduces company cash flows. Brown and Yücel (2002) argue that rising oil prices cause greater
50 uncertainty in the real economy, reducing investment and future expected cash flows. Bjornland
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3 (2009) argues that, in oil-exporting nations, rising oil prices increase government and individual
4 consumption and overall wealth.
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7 In the GCC context, early research explores the long-term relations between oil and stock
8 prices. Maghyereh and Al-Kandari (2007) use a non-linear cointegration approach with daily
9 data from 1996 to 2003. They support the existence of non-linear linkages between the stock
10 markets of Bahrain, Kuwait, Oman, and Saudi Arabia and an oil price index. Arouri and Rault
11 (2012) use both panel cointegration and Seemingly Unrelated Regression (SUR) frameworks and
12 provide evidence of long-run dependence across GCC and oil markets. The SUR results show
13 that higher oil prices have a positive impact on GCC markets, except for Saudi Arabia. Using the
14 NARDL method of Shin et al. (2014), which allows for short- and long-run asymmetric
15 adjustment, Siddiqui et al. (2019) report that during the 2014 - 2016 oil price fall, negative oil
16 price changes had a larger effect than positive changes. Akoum et al. (2012) use a wavelet
17 approach for weekly data from 2002 to 2011 and show that GCC stock returns display
18 comovement over the long term with oil returns.
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27 A further direction for research considers volatility spillovers between oil and stock
28 markets. Using daily data from September 30, 2005 through October 24, 2016, Al-Yahyaee et al.
29 (2019) examine the volatility spillovers between commodity futures and the GCC stock markets.
30 Relying on dynamic equicorrelation (DECO) models and the spillover index of Diebold and
31 Yilmaz (2012), they report that oil is a considerable transmitter of volatility to the GCC markets.
32 Arouri et al. (2011) use a VAR-GARCH model and reveal significant volatility spillovers from
33 oil, particularly during market turbulence. Awartani and Maghyereh (2013) use the Diebold and
34 Yilmaz (2009, 2012) spillover index for returns and volatility between oil and GCC stocks from
35 2004 to 2012. They report that return and volatility transmission is more pronounced after the
36 financial crisis. The authors argue that despite evidence of bi-directional causality, oil constitutes
37 the larger source of spillovers. Likewise, Bouri and Demirer (2016) report volatility
38 transmissions from oil prices to Kuwait, Saudi Arabia and UAE. Khalifa et al. (2014) using
39 weekly data from 2004 to 2011 to investigate the volatility transmission among oil, the MSCI-
40 world portfolio and US and GCC markets. Using the Multi-Chain Markov Switching approach of
41 Gallo and Otranto (2008), they find evidence of interdependence between oil and the stocks of
42 Kuwait and Abu Dhabi. Additionally, spillovers from oil to Dubai are reported, with no linkages
43 between oil and the Saudi, Qatari and Omani markets.
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Ashfaq et al. (2019) use daily data from 2009 to 2018 for three oil-exporting countries (Saudi Arabia, United Arab Emirates, Iraq) and four oil-importing countries (China, Japan, India, South Korea). They measure correlations and spillovers between oil and stock prices using DCC and BEKK GARCH models. They conclude that the sensitivity of stock returns to oil shocks is higher in oil-exporting nations than oil-importing nations. Using the Kilian (2009) method, Ziadat et al. (2022) find that oil exporters display susceptibility to oil precautionary demand shocks. The effect is positive and important in all market conditions in the oil exporters of Canada, Norway and Russia. In the GCC market of Saudi Arabia, Abu Dhabi, Dubai, Bahrain, Oman and Qatar, the impact is positive and significant during bear market phases.

McMillan et al. (2021) use the Asymmetric DCC model and monthly data from 2003 to 2019 to investigate the impact of oil on the interdependence of the GCC and US stocks. They find that oil returns and volatility significantly explain changes in the US-GCC correlation.

Overall, despite the absence⁴ of the application of oil price decompositions in examining the relation with GCC stock returns, the literature, using a variety of empirical designs, documents a significant impact of oil prices on the GCC markets. However, the heterogeneity of links between oil and individual GCC markets remains a matter of debate.

3. Methodology.

To examine the impact of oil shocks on GCC market returns, we use the following regression:

$$r_{i,t} = \alpha_0 + \sum_i \beta_i x_{i,t} + \varepsilon_t \quad (1)$$

Where $r_{i,t}$ refers to the stock return series at time period t , $x_{i,t}$ are the explanatory variables and ε_t is the random error term. The explanatory variables include oil returns, oil volatility and oil shocks as well as the control variables, MSCI world index return, VIX and GEPV.

Oil Price Decomposition

Ready (2018) introduces a methodology to decompose oil price changes into supply, demand and risk shocks. Following Ready (2018), we use the World Integrated Oil and Gas Producer Index as a proxy of oil producing firms stock returns, one-month crude oil futures returns on the second nearest maturity contract on the New York Mercantile Exchange to reflect oil price changes and the VIX index.

⁴ McMillan et al. (2021) apply the Kilian (2009) oil price decomposition to explain the US-GCC correlation.

Based on the view that the return to oil producers is affected by the level of demand and risk shocks, risk shocks are identified as the residuals from an ARMA(1,1) model on VIX.⁵ Demand shocks are measured as the segment of current returns to oil producing firms that is orthogonal to risk shocks. Supply shocks are defined as that portion of the current oil return that is orthogonal to both demand and risk shocks. Oil supply, demand and risk shocks are normalised and constrained to sum to the total oil price change.

Quantile regression

The quantile regression, developed by Koenker and Bassett (1978), estimates the effect of the explanatory variables on the conditional quantile of the dependent variable. This presents information on average dependence as well as the upper and lower tail dependence and is robust to both outliers and non-normality.

The quantile regression therefore extends the linear model in equation (1) by allowing a different coefficient for each specified quantile:

$$r_{i,t} = \alpha^{(q)} + \sum_i \beta_i^{(q)} x_{i,t} + \varepsilon_t \quad (2)$$

where $\alpha^{(q)}$ represents the constant term for each estimated quantile (q), $\beta^{(q)}$ is the slope coefficient that reveals the relation between the correlation and the explanatory variable at each quantile, and ε_t is the error term.

4. Data.

Following Ready (2018), we use the WTI benchmark as a proxy of oil prices, which is obtained from the EIA website. For the volatility of oil, we apply the realised volatility approach of Schwert (1989) by summing the daily squared oil returns. We obtain the oil price shocks using the approach of Ready (2018). Thus, we obtain data on the world integrated oil and gas producer index to represents oil producers stock price, the second nearest maturity of the NYMEX WTI futures contract and the VIX index.

All share indexes are obtained for Dubai, Saudi Arabia, Abu Dhabi, Qatar, Oman, Bahrain, and Kuwait. Except where noted, the data is from DataStream and sampled monthly

⁵ Bollerslev et al. (2009) note the risk premium captured by the VIX index correlates negatively with stock returns and has the ability to forecast them. Therefore, supporting the argument of Ready regarding the ability of VIX to capture changes in risk.

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3 from February 2004 to December 2019. The stock return series are denominated in US dollars to
4 be comparable across countries and to be regarded as more pertinent for global investors.
5 Returns are generated by applying the natural logarithmic difference. This study incorporates a
6 set of global factors including the MSCI world index (following Demirer et al., 2020), the VIX
7 index (Whaley, 1993)
8 and Global Economic Policy Uncertainty index (GEPU). The GEPU Index (Davis, 2016), is a
9 GDP-weighted average of national Economic Policy Uncertainty indices (EPU) for 16 countries
10 that account for two-thirds of global output.

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12 Table 1 presents summary statistics for our data. The GCC stock return series exhibit a
13 positive mean for returns, exception for Kuwait, while Dubai has the highest standard deviation.
14 With the exception of the oil demand shock, the Jarque-Bera test reveals that all series display
15 non-normality. The Philip-Perron unit root test shows that stationarity holds for all sampled data.
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17 **5. Empirical Results.**

18 *Oil Price changes and GCC markets*

19 As much of the literature on the oil-stock nexus focuses on the effect of the oil price return and
20 volatility on stocks, we first examine these to provide comparability.
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22 Table 2 presents the results of regressing GCC stock returns on oil price changes, oil
23 volatility, VIX, GEPU and the World portfolio. The results indicate that oil, either the return or
24 volatility, affects the stock markets of all GCC countries, except for Qatar, for which gas is the
25 main export commodity. Across the seven GCC countries, there is a positive relation between
26 stocks and oil returns and a negative relation between stock returns and oil volatility. The
27 positive stock and oil return relation is statistically significant for Saudi Arabia, Dubai, Oman
28 and Abu Dhabi, with the highest coefficient magnitude for Dubai and Saudi Arabia. The negative
29 relation between stock returns and oil volatility is significant for Bahrain, Kuwait and Oman.
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31 Given that higher oil prices are expected to boost wealth, economic activity and firm cash
32 flows in oil-exporting nations (Bjørnland, 2009), the previous literature establishes a positive
33 link between oil and stocks. For example, Park and Ratti (2008) and Ramos and Vega (2013)
34 argue that oil price increases boost the stock market of oil-exporting countries, and harm those of
35 oil-importing countries. In the GCC context, Mokni and Youssef (2019) show that the GCC
36 markets have a positive relation with oil prices. Mokni and Youssef (2019) and Mohanty et al.
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(2011) argue that, except for Kuwait, GCC stocks have positive exposures to oil price innovations. Thus, our results are broadly consistent with these findings, in that we note a positive relation as well as the Kuwaiti market isolation from oil shocks. As noted, the insignificant result for Qatar may arise as gas is its main export, while for Bahrain, the oil industry there is comparatively small. Nonetheless, our findings do contrast with those of Fayyad and Daly (2011) who argue that Qatar and the UAE exhibit the highest sensitivity to oil shocks in the GCC bloc. Equally, the results contrast with Al Janabi et al. (2010), who find that the relation between oil price and GCC stock markets are weak. Further, it is of interest to note that the large oil producers, Saudi Arabia and Abu Dhabi, are not affected by oil price volatility despite the positive oil return relation. For the UAE this may arise from its increased economic diversification with now established service and tourism industries (see Callen et al, 2014). Equally, the large nature of the Saudi Arabian market, with 50% of the total GCC market capitalisation, may provide some resilience to oil price swings. Conversely, the smaller GCC markets in Bahrain and Oman are more vulnerable to oil return volatility.

In regard of the other coefficients, the signs of VIX and GEPV are negative but not significant (except the VIX for Saudi Arabia). The world portfolio is strongly positive especially in the markets of Dubai and Qatar where the coefficient is twice as large as its Kuwaiti, Omani and Bahraini counterparts. Such results hint at higher levels of global integration in the markets of Dubai and Qatar (see Ziadat et al, 2020).

Oil shocks and GCC markets

Having conducted an initial examination of the effect of oil price changes on stock returns, we now consider the impact of different oil price shocks. The oil price shocks are intended to capture unexpected oil price innovations. For this, we use the decomposition of Ready (2018) and examine the effect of supply, demand, and risk shocks. We consider this first in the usual linear regression before turning to the quantile regression framework.

Table 3 illustrates the impact of the different oil price shocks on the GCC markets while controlling for the influence of GEPV and the MSCI world index.⁶ The results presented here suggest an interesting pattern of influence emerges and one that appears to contradict the results of similar and recent analysis across global markets. Notably, where research finds the influence

⁶ The effect of VIX is now captured within the oil price shocks.

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3 of shocks is significant and negative (see Ready, 2018; Demirer et al., 2020), our results support
4 a positive effect arising only from oil supply shocks.

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6 Demirer et al. (2020), Wang et al. (2013), Guntner (2014) and Jung and Park (2011)
7 show that oil price increases, triggered by stronger global demand for oil, are associated with
8 higher stock market returns across all countries, regardless of the classification of the country as
9 an exporter/importer of oil. However, our results do not share such a conclusion. Although the
10 coefficient on demand shocks is positive throughout, it is only significant for Qatar (and
11 marginally for Dubai). Given that oil demand shocks constitute good news for the global
12 economy, the relative high integration of Qatar and Dubai (when compared with the rest of GCC
13 markets) into the world economy, might explain this result. A further channel to this effect may
14 arise through spillovers from global financial markets given the integration of Qatar and Dubai
15 (see Ziadat et al., 2020).
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24 The strongest factor influencing GCC stock returns is evidently oil supply shocks. The
25 influence is positive and significant in all GCC markets, albeit only at the 10% significance level
26 for the UAE markets of Dubai and Abu Dhabi. This result runs counter to the literature that relies
27 on the Kilian (2009) decomposition method (see, Kilian and Park, 2009; Abhyankar et al., 2013;
28 Kim and Vera, 2019) where the findings point to only a trivial impact of oil supply shocks.
29 Using the Ready (2018) decomposition, Demirer et al. (2020) find that supply shocks have a
30 significant and negative effect on stock market returns for the majority of 21 countries examined.
31 Interestingly, Demirer et al. (2020) incorporate the oil-exporters of Canada, Mexico and Norway
32 in their analysis, however, they only find positive links between oil supply shocks and Canadian
33 stocks whereas, similar to oil-importers, a negative effect is found for Mexico and Norway.
34 Accordingly, the positive link between oil supply shocks and stocks appears to be a unique
35 feature of the GCC region.
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44 In the method of Ready (2018), the oil supply shock is obtained as the residual after
45 incorporating both the demand and risk shocks. Ready reports that this shock is responsible for
46 80% of the change in oil prices. Hence, the results reported here may stem from a broad range of
47 underlying variables. For instance, Malik and Umar (2019) argues that oil supply shocks could
48 be triggered by issues linked to unexpected changes in proven reserves, technologies related to
49 oil well completions and oil recovery. Clements et al. (2019) argue that the oil supply shocks,
50 defined by Ready (2018), can be linked to an exogenous measure of precautionary demand,
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3 reflecting future oil supply uncertainty rather than contemporaneous supply changes. In seeking
4 to understand the results for the GCC markets, while acknowledging the strong ties between the
5 GCC economies as well as the impact of supply shocks on the price of oil, Filis and
6 Chatziantoniou (2014) argue that the magnitude of the stock market reaction to oil price shocks
7 is higher for new or less liquid stock markets, which will apply to several GCC markets. Further,
8 the lack of hedging instruments in emerging markets can increase their sensitivity to oil shocks
9 (Balcilar et al., 2019).

16 17 *Oil price shocks and the state of the market*

18 While the above results examine the links between oil price shocks and GCC stock markets in a
19 linear model, here, we consider the impact of oil shocks across different market states.
20 Developed by Koenker and Bassett (1978), the quantile regression estimates the effects of the
21 explanatory variables on the conditional quantile of the dependent variable. Therefore, in
22 addition to the average (median) dependence, the quantile regression offers information
23 regarding the tail dependence. There are several advantages in using the quantile regression
24 approach, for example, Baur (2013) notes the ability of the model to capture the changing nature
25 of dependence across different market conditions, from bullish to bearish. Moreover, this allows
26 examination of the whole return distribution rather than, for example, two or three market states
27 in a regime switching model. Further, quantile regression estimators are robust to
28 heteroskedasticity and skewness of the dependent variable (Koenker and Hallock, 2001).

29 Table 4 depicts the quantile coefficient estimates for oil supply, demand and risk shocks
30 for each GCC market. The first two quantiles correspond to the bear market phase, the upper
31 quantiles reflect bull market conditions, with the middle quantiles representing normal market
32 states. As a general observation, the coefficients of oil demand shocks tend to increase with the
33 quantiles, while those for oil supply shocks decrease and with no clear pattern for the risk shock.
34 An interesting pattern also develops in the statistical significance of the demand and supply
35 shocks over the quantiles, with the demand shocks typically significant at higher (bull market)
36 quantiles and supply shocks significant at lower (bear market) quantiles.

37 Oil demand shocks exhibits mid and upper tail dependence with the stock returns
38 conditional distribution in Saudi Arabia, Qatar, Kuwait and Dubai, while upper-tail⁷ only

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56 ⁷ The markets of Dubai and Kuwait also exhibit lower-tail dependence with oil demand shocks.

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3 dependence is reported for Abu Dhabi. This leaves the markets of Oman and Bahrain for which
4 oil demand shocks are wholly insignificant. An oil demand shock is associated with higher
5 demand for oil due to expansion in the global economy and the findings here are consistent with
6 those of Ready (2018) in supporting a positive link between stock markets and oil demand
7 shocks.⁸

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11 The quantile process estimates show a clear evidence of lower-tail dependence between
12 oil supply shocks and GCC returns. For the first quantile (Q1), which represents a bear market
13 phase, oil price shocks exert a significant positive impact on all GCC markets. When comparing
14 our results with those of Ziadat et al. (2022), they report lower tail dependence between oil
15 precautionary demand shocks and GCC markets. The discrepancy is a result of the different
16 approach in constructing oil shocks. Nonetheless, our results appears consistent with the view of
17 Balcilar et al. (2019) who state that financial markets responses to oil shocks are stronger during
18 extreme market conditions. Moreover, given the general view in the literature, which points to a
19 negative impact of oil supply shocks on stocks, among oil importers and some oil exporters, the
20 results here convey important insights for the potential of cross-regional diversification.

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29 You et al. (2017) and Le and Zheng (2011) report that the impact of oil price shocks on
30 stocks mainly occurs when stock markets are in a bull or bear phase, indicating that the relation
31 between stocks and oil shocks are governed by investor (optimistic or pessimistic) sentiments.
32 Furthermore, citing factors related to less sophisticated investors in emerging markets, You et al.
33 (2017) and Le and Zheng (2011) argue that investors might display irrational behaviour when
34 facing instabilities in oil markets. This argument is therefore applicable to the GCC markets
35 given GCC investor profiles and the importance of oil to GCC economies. Thus, the positive oil
36 price supply shock may be an indicator of improving economic conditions in GCC economies,
37 thus, boosting their confidence in future stock market behaviour.

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45 To further elaborate on the lower-tailed dependence between oil supply shocks and GCC
46 markets, we consider the role of geopolitical factors. This is motivated by the fact that a
47 considerable share of the global oil supply is produced in the region, which has experienced a
48 history of conflict and wars. Hammoudeh and Li (2008) report substantial sensitivity of GCC
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⁸ The lack of significance for Bahrain and Oman may arise from their relatively small market capitalisation (Oman and Bahrain combined constitute only 4% of total GCC market capitalisation as of 2016). While smaller firms are likely to be less globally connected, the low capitalisation is also associated with poor liquidity, which will be less attractive to global investors. Indeed, we can see only a small response to changes in the world portfolio (see Table 3) when compared with other GCC markets.

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3 markets to geopolitical stress. Antonakakis et al. (2017) maintain that aggregate demand shocks
4 transmit most of the information to stock markets during periods characterised by economic-
5 driven events, while supply and oil precautionary demand shocks prevail during periods of
6 geopolitical unrest. Such events can trigger change in both financial markets and portfolio
7 allocations (Kollias et al., 2013). This supports the view that when oil supply shocks concur with
8 geopolitical tensions, the changing risk appetite of investors can lead to such results.
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17 **6. Summary and Conclusion.**

18 Motivated by the importance of oil as a commodity to the world economy and especially the
19 GCC bloc, this study characterises the links between oil price shocks and the GCC stock
20 markets. The analysis utilises the oil price decomposition of Ready (2018) and monthly data
21 from February 2004 to December 2019. The results reveal that the type of shock is important for
22 GCC markets. While the previous literature argues that supply-side shocks have a negative or
23 negligible impact on global markets, our results support a significant positive effect on GCC
24 stocks. Such a result reflects the heavy dependence on oil revenue and the structure of the GCC
25 economies. That said, when examining the relation across the stock return distribution, we also
26 find the oil demand shocks exhibit a positive relation with stock returns during a bull market,
27 while the effect of the supply shock is more evidence in bear market conditions.
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35 From an academic standpoint, this study provides a comprehensive and up-to-date
36 examination of the oil-stock nexus for the GCC markets using decomposed measures of oil price
37 innovations. The results convey important information to global investors, as the characterisation
38 of the links between individual GCC markets and oil shocks enhance our understanding of inter-
39 market relations and the effects on portfolio compositions in an inter and intra-regional
40 perspective. Moreover, given that portfolio diversification is achieved by investing in different
41 classes of assets or investing in similar classes of assets in multiple markets through international
42 diversification, the results here can improve decision making for asset allocation.
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Table.1 Summary Statistics

	Abu Dhabi	Bahrain	Dubai	Kuwait	Oman	Qatar	Saudi Arabia	World	GEPU
Mean	0.005	0.001	0.005	0.000	0.002	0.005	0.003	0.005	0.000
Median	0.004	0.001	-0.001	0.000	0.002	0.004	0.009	0.011	-0.012
Maximum	0.359	0.092	0.382	0.139	0.162	0.260	0.187	0.096	0.769
Minimum	-0.196	-0.135	-0.408	-0.224	-0.250	-0.272	-0.278	-0.173	-0.496
Std. Dev.	0.065	0.033	0.096	0.047	0.049	0.078	0.076	0.037	0.176
Skewness	0.586	-0.404	0.052	-0.912	-0.575	-0.304	-0.694	-1.112	0.730
Kurtosis	8.235	4.942	6.128	7.960	6.936	4.759	4.486	5.743	5.022
Jarque-Bera	229.013	35.225	77.940	222.227	133.837	27.569	32.897	99.253	49.487
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PP test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Oil demand shock	Oil supply shock	Oil risk shock	VIX	Oil	Oil volatility	GEPU
Mean	-0.103	-0.467	-0.027	0.001	0.003	0.011	0.000
Median	-0.002	-4.096	0.304	-0.017	0.017	0.007	-0.012
Maximum	11.317	73.905	19.859	0.853	0.297	0.110	0.769
Minimum	-12.246	-43.897	-26.878	-0.486	-0.533	0.001	-0.496
Std. Dev.	4.615	19.257	7.197	0.205	0.105	0.014	0.176
Skewness	-0.045	1.000	-0.653	0.619	-1.234	3.755	0.730
Kurtosis	2.873	4.581	4.499	4.353	8.007	20.510	5.022
Jarque-Bera	0.193	51.731	31.444	26.773	247.968	2888.971	49.487
Probability	0.908	0.000	0.000	0.000	0.000	0.000	0.000
PP test	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes. The sample period runs from February 2004 to December 2019 including 191⁹ monthly observations. Std. Dev. and PP test stand for Standard deviation and Phillip-Perron test. GEPU is the Global Economic Policy Uncertainty. GCC national return series, MCSI world index, oil, VIX, and GEPU are calculated using the first logarithmic difference.

⁹ An exception to this is the GCC spillover index where the sample runs from December 2009 to December 2019 generating 137 observations.

Table.2 GCC returns response to oil price change and volatility

Country		C	Oil	Oil Vol	VIX	GEPU	World	Adj. R2
Abu Dhabi	Coeff	0.010	0.090	-0.534	-0.015	-0.001	0.285	0.076
	P Value	0.082	0.022	0.248	0.502	0.967	0.029	
Bahrain	Coeff	0.010	0.026	-0.939	0.000	0.000	0.170	0.264
	P Value	0.000	0.138	0.000	1.000	0.958	0.006	
Dubai	Coeff	0.012	0.178	-0.912	-0.024	-0.013	0.682	0.177
	P Value	0.163	0.005	0.087	0.444	0.644	0.000	
Kuwait	Coeff	0.009	0.038	-0.981	-0.022	0.014	0.390	0.271
	P Value	0.050	0.303	0.021	0.100	0.257	0.006	
Oman	Coeff	0.008	0.094	-0.753	-0.023	0.004	0.340	0.237
	P Value	0.050	0.029	0.002	0.197	0.779	0.003	
Qatar	Coeff	0.004	0.116	-0.227	-0.039	0.043	0.749	0.195
	P Value	0.602	0.224	0.528	0.128	0.236	0.005	
Saudi Arabia	Coeff	0.002	0.141	-0.243	-0.055	0.022	0.690	0.205
	P Value	0.708	0.003	0.428	0.021	0.395	0.000	

Notes. The regressions above are generated by regressing oil returns, oil realised volatility, the VIX index, and Global Policy Uncertainty (GEPU) and the MSCI world portfolio on GCC equity returns. C, Coeff and Oil Vol stand for constant, coefficient and oil volatility, respectively. The equations runs as follows: $GCC\ market\ return_{i,t} = C_{0,i} + \beta_1 Oil_{i,t} + \beta_2 Oil\ Vol_{i,t} + \beta_3 VIX_{i,t} + \beta_4 GEPU_{i,t} + \beta_5 World_{i,t} + \varepsilon_{i,t}$. The P Value is based on the robust standard errors of Newey-West (1987). The sample ranges from February 2004 to December 2019 yielding a total of 191 observations.

Table.3 GCC returns response to oil price shocks

Country		C	Supply	Demand	Risk	GEPU	World	Adj. R2
Abu Dhabi	Coeff	0.003	0.002	0.000	0.000	0.004	0.486	0.071
	P Value	0.568	0.093	0.785	0.581	0.841	0.054	
Bahrain	Coeff	-0.001	0.001	0.001	0.000	0.003	0.370	0.171
	P Value	0.760	0.021	0.374	0.454	0.782	0.027	
Dubai	Coeff	0.002	0.003	0.003	0.000	-0.013	0.812	0.168
	P Value	0.859	0.083	0.070	0.985	0.658	0.066	
Kuwait	Coeff	-0.003	0.001	0.000	0.000	0.017	0.665	0.216
	P Value	0.513	0.042	0.516	0.325	0.213	0.023	
Oman	Coeff	0.000	0.002	0.002	0.000	0.005	0.401	0.196
	P Value	0.994	0.011	0.124	0.783	0.729	0.036	
Qatar	Coeff	0.002	0.002	0.004	0.000	0.034	0.849	0.240
	P Value	0.771	0.014	0.013	0.346	0.356	0.013	
Saudi Arabia	Coeff	0.000	0.002	0.003	0.000	0.020	0.734	0.192
	P Value	0.978	0.013	0.129	0.746	0.440	0.001	

Notes. C, Coeff, Supply, Demand and Risk stand for constant, coefficient, oil supply shocks, oil demand shocks and oil risk shocks, respectively. Oil price shocks are measured using the method of Ready (2018). The rest of the variables are the VIX index, and Global Policy Uncertainty (GEPU) and the MSCI world portfolio and the dependent variable is the stock market return of each GCC nation. The equations runs as follows: GCC market return_{i,t} = C_{0,i} + β₁Supply_t + β₂Demand_t + β₃Risk_t + β₄GEPU_t + β₅World_t + ε_{i,t}. The P Value is based on the robust standard errors of Newey-West. The sample ranges from February 2004 to December 2019 yielding a total of 191 observations.

Table. 4 GCC returns dependence structure with oil price shocks

		Abu Dhabi		Bahrain		Dubai		Kuwait	
	Q	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.
Oil supply shock	0.100	0.003	0.000	0.001	0.023	0.003	0.000	0.002	0.007
	0.200	0.001	0.098	0.001	0.120	0.002	0.065	0.001	0.007
	0.400	0.001	0.129	0.001	0.088	0.001	0.488	0.000	0.950
	0.600	0.001	0.139	0.000	0.239	0.001	0.213	0.000	0.393
	0.800	0.000	0.958	0.001	0.050	0.001	0.412	0.001	0.058
	0.900	0.001	0.426	0.001	0.048	0.001	0.832	0.002	0.077
Oil Demand shock	0.100	-0.001	0.599	0.000	0.907	0.000	0.938	-0.002	0.049
	0.200	0.001	0.679	0.000	0.817	0.003	0.031	-0.001	0.488
	0.400	0.001	0.244	0.001	0.351	0.003	0.038	0.001	0.254
	0.600	0.002	0.120	0.001	0.446	0.002	0.216	0.001	0.020
	0.800	0.003	0.006	0.000	0.842	0.006	0.001	0.003	0.001
	0.900	0.003	0.014	0.002	0.127	0.009	0.001	0.002	0.380
Oil Risk shock	0.100	0.001	0.114	0.000	0.801	0.001	0.331	0.001	0.078
	0.200	0.000	0.764	0.000	0.688	0.000	0.514	0.000	0.294
	0.400	0.000	0.664	0.000	0.603	-0.001	0.171	0.000	0.543
	0.600	0.000	0.921	0.000	0.492	0.000	0.817	0.000	0.644
	0.800	0.000	0.760	0.000	0.561	0.000	0.687	0.000	0.417
	0.900	0.000	0.748	0.000	0.935	0.000	0.828	0.000	0.846
		Oman		Qatar		Saudi Arabia			
	Q	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.		
Oil supply shock	0.100	0.002	0.017	0.001	0.043	0.003	0.015		
	0.200	0.001	0.062	0.001	0.052	0.002	0.076		
	0.400	0.001	0.059	0.002	0.030	0.001	0.186		
	0.600	0.001	0.281	0.001	0.076	0.001	0.220		
	0.800	0.001	0.233	0.001	0.282	0.001	0.659		
	0.900	0.001	0.396	0.001	0.339	0.002	0.121		
Oil Demand shock	0.100	0.001	0.303	0.001	0.710	0.001	0.581		
	0.200	0.002	0.281	0.003	0.090	0.002	0.262		
	0.400	0.001	0.226	0.003	0.036	0.003	0.044		

	0.600	0.001	0.359	0.004	0.020	0.005	0.002		
	0.800	0.001	0.252	0.006	0.008	0.004	0.009		
	0.900	0.003	0.075	0.007	0.001	0.004	0.026		
Oil Risk shock	0.100	0.000	0.584	0.002	0.019	0.001	0.393		
	0.200	-0.001	0.265	0.001	0.025	0.001	0.413		
	0.400	0.000	0.607	0.000	0.365	0.000	0.895		
	0.600	0.000	0.373	0.000	0.594	-0.001	0.248		
	0.800	0.000	0.874	0.000	0.415	0.001	0.238		
	0.900	0.000	0.891	0.000	0.643	0.000	0.852		

Notes. The table depicts the quantile process coefficients estimated from quantile regression framework wherein stock returns are regressed on oil supply shocks, oil demand shocks, oil risk shocks, GEPU and world index. The latter two variables are controlled for but their results are not reported to conserve space. Q stands for quantile.

Oil-Stock Nexus: The Role of Oil Shocks for GCC Markets

Abstract

Purpose: This study examines the links between oil price shocks and GCC stock markets from February 2004 to December 2019. Knowledge of such links is important to both investors and policymakers in understanding the transmission of shocks across markets.

Methodology: We employ the Ready (2018) oil price decomposition method and the quantile regression to conduct our analysis.

Findings: Initial results show a positive oil price change increases stock returns, while greater volatility decreases returns. The oil shock decomposition results reveal a significant positive impact of supply-side shocks on stocks. This contrasts with the literature that argues demand-side shocks are more important. While factors such as the liquidity and the lack of hedging instruments can increase the vulnerability of GCC equities to oil price shocks, our result reflects the unique economic structure of the GCC bloc, marked by its dependence on oil revenues. In analysing quantile-based results, oil supply shocks mainly exhibit lower-tail dependence, while we do uncover some evidence of demand-side shocks affecting mid and upper-tail dependence.

Originality: Acknowledging the presence of endogeneity in the relation between oil and economic activity, the study is the first to combine the oil price decompositions of Ready (2018) with the quantile regression frameworks in the GCC context. Our results reveal notable difference to those previously reported in the literature.

1. Introduction.

The energy finance literature highlights important links between oil prices and stock markets (see, for example, Sadorsky, 1999; Papapetrou, 2001; Bjornland, 2009; Park and Ratti, 2008; Le and Chang, 2015; Wang *et al.*, 2013; Batten *et al.*, 2019; Batten *et al.*, 2021). To better understand these links, a notable advance is presented in work that decomposes the oil price into its respective shocks (Hamilton, 2009; Kilian, 2009). Given the high dependence of the Gulf Cooperation Council (GCC¹) countries on oil production,² the analysis of oil price shocks on GCC stocks is important to investors and policymakers, as well as academics interested in modelling financial market relations. Thus, this paper seeks to examine the impact of oil price shocks using the decomposition of Ready (2018) on GCC stock returns.

As relatively young stock markets, those of the GCC are understudied. Moreover, the markets, classed as either emerging or frontier (Balcilar *et al.*, 2015), have witnessed considerable efforts to enhance efficiency (Benlagha, 2020) and have undergone economic and financial liberalisation (Bley and Chen, 2006; Al-Khazali *et al.*, 2006; Akoum *et al.*, 2012). This includes, for example, structural reforms to allow foreign investors to channel funds towards GCC financial markets and so improving liquidity (Al Janabi *et al.*, 2010; Arouri and Rault, 2012). Consequently, in 2014, the MSCI re-categorised the markets of the UAE and Qatar to emerging market status, while Saudi Arabia followed in 2019. The markets of Kuwait, Oman and Bahrain remain categorised as frontier. Nonetheless, the GCC markets generally enjoy many macroeconomic fundamentals equivalent to developed nations (Awartani and Maghyereh, 2013), and the inclusion of GCC markets improves diversification in a cross-country portfolio (Arouri and Rault, 2010; Mimouni *et al.*, 2016). Acknowledging these features, we contribute to the existing literature by detailing the dependence structure between oil and GCC stocks using the Ready (2018) decomposition and quantile regression frameworks.

Recently, and in pursuit of diversification, investors began to regard the oil market as a suitable alternative destination leading to the so-called financialization of oil markets (Silvennoinen and Thorp, 2013). McMillan *et al.* (2021) argue that this financialisation of oil is

¹ Established in 1981, The Cooperation Council for the Arab States of the Gulf is a regional organisation of six members: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

² The GCC bloc holds 30.6% of proven oil reserves (BP Statistical Review of World Energy 2019). Moreover, Khalifa *et al.* (2014) note that the oil industry constitutes 35% of the GCC economies.

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3 linked with higher comovements of GCC stocks with their US counterparts. Moreover, together
4 with the recent instability in oil prices, this motivates a new examination of the oil-stock nexus.
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7 The literature on the links between oil prices and the economy can be traced back to the
8 work of Hamilton (1983). Subsequently, a wave of research sought to establish a link between oil
9 prices and financial markets using Vector Autoregressive (VAR) models. Examples include the
10 work of Sadorsky (1999), Papapetrou (2001), Bjornland (2009), Park and Ratti (2008) and Le and
11 Chang (2015). Hamilton (2009) argues that oil price shocks are not uniquely instigated by supply
12 shortages, but also by innovations on the demand side. Moreover, Kilian and Park (2009) note,
13 studies that do not recognise the causes of oil shocks will be predisposed to uncover trivial links
14 between oil prices and stocks.
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17 In a notable development, Kilian³ (2009) suggests that a rise in oil price should be attributed
18 to its underlying cause and identifies three distinctive sources of oil price increases: supply-side
19 shocks caused by shortfalls in oil production, demand-side shocks due to global economic
20 expansion, and precautionary demand shocks triggered by expectations of future oil supply
21 shortfalls. In a further significant study, Ready (2018) proposes a technique to disentangle oil price
22 shocks based on the traded asset price data of oil-producing firms. Ready (2018) argues that while
23 oil producers benefit from price increases due to oil demand, they remain numb to supply
24 disruptions (for example, when extraction complications arise, oil producers will sell less but at
25 higher prices). Empirically, Ready (2018) identifies demand shocks as returns to an index of oil-
26 producing firms that are orthogonal to innovations in the VIX index, and supply shocks as oil price
27 changes that are orthogonal to demand shocks and to changes in VIX.
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30 Subsequently, a number of studies examine the impact of oil price shocks on stocks. Earlier
31 work, such as Kilian and Park (2009) and Abhyankar *et al.* (2013) concentrate on the major
32 developed markets of the US and Japan, while Kang and Ratti (2015) examine the impact of oil
33 price shocks and economic policy uncertainty on Chinese stocks. Further studies include the work
34 of Wang *et al.* (2013), Kang and Ratti (2013) and Apergis and Miller (2009). However, despite
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³ Within this framework, Kilian (2009) reports that supply and demand shocks account for 4% of the monthly variation in the oil price. Precautionary demand shocks, which are unspecified by this procedure account for 77% of the variation, which lead to some criticism. Kolodziej and Kaufmann (2014) argue that the Kilian (2009) index of global real economic activity captures little more than transportation costs such that the identified demand shock is not sufficient. Elaborating, Ready (2018) reveals that the measure will not capture anticipated variation in aggregate demand, leaving these to the precautionary demand. Likewise, Demirer *et al.* (2020) document the over emphasis of Kilian's (2009) decomposition on precautionary demand shocks.

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3 the importance of oil to the GCC economies, as well as the strong role they play in the oil market,
4 examining the link between oil price shocks and GCC markets remains largely neglected.

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6 Focusing on oil exporters and using the approach of Kilian and Murphy (2014), Basher *et*
7 *al.* (2018) study the influence of oil shocks on Canada, Mexico, Norway, Russia, the UK, Kuwait,
8 Saudi Arabia, and the UAE. Using a two-state Markov-switching model, they show that both oil
9 aggregate demand shocks and oil precautionary demand shocks have a significant impact on stock
10 returns in Norway, Russia, Kuwait, Saudi Arabia, and the UAE. While oil supply shocks influence
11 stocks in the UK, Kuwait, and the UAE. Using a sample that incorporates the GCC markets and
12 the Kilian (2009) methodology, Ziadat *et al.* (2022) examine the impact of oil shocks on equities
13 in both oil-importing and exporting nations. They distinguish the market feedback to oil shocks
14 during bull, normal and bear phases. Their results show that oil-exporters are stimulated by
15 precautionary demand shocks. Also, among oil-exporters, the GCC markets are predominantly
16 impacted during bear market conditions.

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18 Building on the work of Basher *et al.* (2018) and Ziadat *et al.* (2022), this paper exploits
19 the Ready (2018) decomposition of oil innovations on stock return. We also incorporate all GCC
20 markets as we believe that heterogeneity exists in terms of their economic structure and oil
21 dependence. For instance, while Kuwait has the highest level of dependence on oil, the UAE has
22 an increasingly diversified economy based on tourism and services. In this regard, Fenech and
23 Vosgha (2019) argue that the dependence structure between oil and GCC stock exchanges varies.
24 Moreover, Alqahtani *et al.* (2019) maintain that the link between oil price uncertainty and GCC
25 markets differs significantly with the smaller markets of Bahrain and Oman being less susceptible
26 to oil shocks than their Saudi and Emirati counterparts. Furthermore, Mokni and Youssef (2019)
27 show that the Saudi market displays the largest degree of persistence in the dependence with oil
28 prices. Thus, examining the heterogeneity among GCC nations in their interactions with oil shocks
29 is an enhancement to the current literature.

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31 Therefore, we examine the impact of oil price shocks on the GCC stocks markets using the
32 method of Ready (2018). In extending this, we further examine the dependence structure between
33 oil price shocks and GCC stocks using the quantile regression of Koenker and Bassett (1978).
34 Specifically, we first consider the standard linear relation between oil return and volatility. Oil
35 volatility is included in this initial analysis as it may capture risk in the oil market. Although that
36 analysis is then subsumed in the next stage that considers oil price shocks. Second, we then
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3 decompose oil price changes according to their source as supply, demand and risk shocks. Third,
4 we consider whether the relation varies across different quantiles of the returns process. In
5 examining the impact of oil innovations on GCC stock returns, we control for global factors using
6 the VIX index, Global Economic Policy Uncertainty (GEPU) and the MSCI world portfolio.
7 Controlling for these variables is essential to ensure the accuracy of results. According to
8 Dickinson (2000) and Rigobon and Sack (2003), asset prices are intertwined, therefore, analysing
9 a single market in segregation overlooks important information about its behaviour. The MSCI
10 world portfolio is designed to capture common fundamentals that steer global equity returns. Oil
11 price shocks are believed to be related with both VIX and GEPU as argued by Antonakakis *et al.*
12 (2013) and Kang and Ratti (2013). These variables can influence stock prices by affecting expected
13 cash flows and discount rates. Moreover, oil price increases caused by supply-side factors may be
14 associated with higher GEPU with the opposite for demand-side factors (Kang and Ratti, 2013).
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18 This study contributes to the literature from several angles. First, we apply the Ready
19 (2018) oil price decomposition methodology to the GCC markets, detailing the dependence
20 structure of the oil-stock nexus. Second, we include all GCC countries, hence, we highlight the
21 heterogeneities among them. This latter point could carry important information for portfolio
22 managers interested in intra-regional diversification. Third, we consider heterogeneity across the
23 stock return distribution and whether the relation with oil shocks depends on the state of the stock
24 market, notably whether it is in a bullish or bearish phase. Our results point to the importance of
25 oil supply shocks in explaining the changes in GCC equity returns, especially during bear market
26 phases.
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30 The remainder of this paper is organised as follows. Section 2 presents a brief review of
31 literature. Section 3 introduces the methodology. Section 4 presents the data and Section 5
32 discusses the results. Section 6 concludes the paper.
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39 40 41 42 43 44 45 46 **2. Literature Review.**

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48 Oil prices and financial markets are linked through their effects on, and from, the wider economy.
49 In considering the theoretical transmission mechanisms, Mohanty and Nandha (2011) argue that
50 oil price changes impact a firm's future cash flows, positively or negatively, depending on whether
51 it is an oil-consumer or oil-producer. As rising oil prices amplify production costs, Basher and
52 Sadorsky, (2006) argue that as policymakers increase short-term interest rates in response to higher
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3 inflationary pressures, this increases borrowing costs and reduces company cash flows. Brown and
4 Yücel (2002) argue that rising oil prices cause greater uncertainty in the real economy, reducing
5 investment and future expected cash flows. While economic theory proposes that the current stock
6 price reflects its discounted future cash flow (Huang *et al.*, 1996), uniquely, in the context of oil
7 exporting nations, we can explain the links between oil and the macroeconomy via the fiscal
8 channel. Within this, Degiannakis *et al.* (2018) and Bjornland (2009) argue that, in oil-exporting
9 nations, rising oil prices increase government and individual consumption. In this environment,
10 higher cash flows are expected in enhance firm profitability. The latter, in turn, is anticipated to
11 stimulate the stock market of oil exporting nations.
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19 In the GCC context, early research explores the long-term relations between oil and stock
20 prices. Maghyereh and Al-Kandari (2007) use a non-linear cointegration approach with daily data
21 from 1996 to 2003. They support the existence of non-linear linkages between the stock markets
22 of Bahrain, Kuwait, Oman, and Saudi Arabia and an oil price index. Arouri and Rault (2012) use
23 both panel cointegration and Seemingly Unrelated Regression (SUR) frameworks and provide
24 evidence of long-run dependence across GCC and oil markets. The SUR results show that higher
25 oil prices have a positive impact on GCC markets, except for Saudi Arabia. Using the NARDL
26 method of Shin *et al.* (2014), which allows for short- and long-run asymmetric adjustment,
27 Siddiqui *et al.* (2019) report that during the 2014 - 2016 oil price fall, negative oil price changes
28 had a larger effect than positive changes. Akoum *et al.* (2012) use a wavelet approach for weekly
29 data from 2002 to 2011 and show that GCC stock returns display comovement over the long term
30 with oil returns.
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39 A further direction for research considers volatility spillovers between oil and stock
40 markets. Using daily data from September 30, 2005, to October 24, 2016, Al-Yahyaee *et al.* (2019)
41 examine volatility spillovers between commodity futures and GCC stock markets. Relying on
42 dynamic equicorrelation (DECO) models and the spillover index of Diebold and Yilmaz (2012),
43 they report that oil is a considerable transmitter of volatility to the GCC markets. Arouri *et al.*
44 (2011) use a VAR–GARCH model and reveal significant volatility spillovers from oil, particularly
45 during market turbulence. Awartani and Maghyereh (2013) use the Diebold and Yilmaz (2009,
46 2012) spillover index for returns and volatility between oil and GCC stocks from 2004 to 2012.
47 They report that return and volatility transmission is more pronounced after the financial crisis.
48 The authors argue that despite evidence of bi-directional causality, oil constitutes the larger source
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of spillovers. Likewise, Bouri and Demirer (2016) report volatility transmissions from oil prices to Kuwait, Saudi Arabia and UAE. Khalifa *et al.* (2014) use weekly data from 2004 to 2011 to investigate the volatility transmission among oil, the MSCI-world portfolio and US and GCC markets. Using the Multi-Chain Markov Switching approach of Gallo and Otranto (2008), they find evidence of interdependence between oil and the stocks of Kuwait and Abu Dhabi. Additionally, spillovers from oil to Dubai are reported, with no linkages between oil and the Saudi, Qatari and Omani markets.

Ashfaq *et al.* (2019) use daily data from 2009 to 2018 for three oil-exporting countries (Saudi Arabia, United Arab Emirates, Iraq) and four oil-importing countries (China, Japan, India, South Korea). They measure correlations and spillovers between oil and stock prices using DCC and BEKK GARCH models. They conclude that the sensitivity of stock returns to oil shocks is higher in oil-exporting nations than oil-importing nations. Using the Kilian (2009) method, Ziadat *et al.* (2022) find that oil exporters display susceptibility to oil precautionary demand shocks. The effect is positive and important in all market conditions in the oil exporters of Canada, Norway and Russia. In the GCC market of Saudi Arabia, Abu Dhabi, Dubai, Bahrain, Oman and Qatar, the impact is positive and significant during bear market phases.

McMillan *et al.* (2021) use the Asymmetric DCC GARCH model and monthly data from 2003 to 2019 to investigate the impact of oil on the interdependence of the GCC and US stocks. They find that oil returns and volatility significantly explain changes in the US-GCC correlation. Parallel to that, Ziadat and McMillan (2021) establish a link between oil price shocks on the connectedness among GCC markets.

Overall, despite the limited application of oil price decompositions in examining the relation with GCC stock returns, the literature, using a variety of empirical designs, documents a significant impact of oil prices on the GCC markets. However, the heterogeneity of links between oil and individual GCC markets remains a matter of debate.

3. Methodology.

To examine the impact of oil shocks on GCC market returns, we use the following regression:

$$r_t = \alpha_0 + \sum_i \beta_i x_{i,t} + \varepsilon_t \quad (1)$$

Where r_t refers to the stock return series at time period t , $x_{i,t}$ are the i explanatory variables and ε_t is a random error term. The explanatory variables include oil returns, oil volatility and oil shocks as well as the control variables, MSCI world index return, VIX and GEPU.

Oil Price Decomposition

Ready (2018) introduces a methodology to decompose oil price changes into supply, demand and risk shocks. Following Ready (2018), we use the World Integrated Oil and Gas Producer Index as a proxy of oil producing firms stock returns, one-month crude oil futures returns on the second nearest maturity contract on the New York Mercantile Exchange to reflect oil price changes, and the VIX index.

Based on the view that the return to oil producers is affected by the level of demand and risk shocks, risk shocks are identified as the residuals from an ARMA(1,1) model on VIX.⁴ Demand shocks are measured as the segment of current returns to oil producing firms that is orthogonal to risk shocks. Supply shocks are defined as that portion of the current oil return that is orthogonal to both demand and risk shocks. Oil supply, demand and risk shocks are normalised and constrained to sum to the total oil price change.

Quantile regression

The quantile regression, developed by Koenker and Bassett (1978), estimates the effect of the explanatory variables on the conditional quantile of the dependent variable. This presents information on average dependence as well as the upper and lower tail dependence and is robust to both outliers and non-normality.

The quantile regression therefore extends the linear model in equation (1) by allowing a different coefficient for each specified quantile:

$$r_t = \alpha^{(q)} + \sum_i \beta_i^{(q)} x_{i,t} + \varepsilon_t \quad (2)$$

where $\alpha^{(q)}$ represents the constant term for each estimated quantile (q), $\beta^{(q)}$ is the slope coefficient that reveals the relation between the correlation and the explanatory variable at each quantile, and ε_t is the error term.

⁴ Bollerslev et al. (2009) note the risk premium captured by the VIX index correlates negatively with stock returns and has the ability to forecast them. Therefore, supporting the argument of Ready regarding the ability of VIX to capture changes in risk.

4. Data.

Following Ready (2018), we use the WTI benchmark as a measure of oil prices, which is obtained from the EIA website. For the volatility of oil, we apply the realised volatility approach of Schwert (1989) by summing the daily squared oil returns. To construct the oil price shocks using the approach of Ready (2018). Thus, we obtain data on the world integrated oil and gas producer index to represent oil producers stock price, the second nearest maturity of the NYMEX WTI futures contract and the VIX index.

All-share indexes are obtained for Dubai, Saudi Arabia, Abu Dhabi, Qatar, Oman, Bahrain, and Kuwait. Except where noted, the data is from DataStream and sampled monthly from February 2004 to December 2019. The stock return series are denominated in US dollars to be comparable across countries and to be regarded as more pertinent for global investors. Returns are generated by applying the natural logarithmic difference. This study incorporates a set of global factors including the MSCI world index (following Demirer *et al.*, 2020), the VIX index (Whaley, 1993) and Global Economic Policy Uncertainty index (GEPU). The GEPU Index (Davis, 2016), is a GDP-weighted average of national Economic Policy Uncertainty indices (EPU) for 16 countries that account for two-thirds of global output.

Table 1 presents summary statistics for our data. The GCC stock return series exhibit a positive mean for returns, except for Kuwait, while Dubai has the highest standard deviation. With the exception of the oil demand shock, the Jarque-Bera test reveals that all series display non-normality. The Philip-Perron unit root test shows that stationarity holds for all sampled data.

5. Empirical Results.⁵

Oil Price changes and GCC markets

As much of the literature on the oil-stock nexus focuses on the effect of the oil price return and volatility on stocks, we first examine these to provide comparability.

Table 2 presents the results of regressing GCC stock returns on oil price changes, oil volatility, VIX, GEPU and the World portfolio. The results indicate that oil, either the return or volatility, affects the stock markets of all GCC countries, except for Qatar, for which gas is the

⁵ As robustness checks against the results presented in this section, including any potential issues arising from endogeneity, we re-estimate the models presented in Section 3 using lagged values of the explanatory variables. These results are qualitatively similar to those reported below and are available upon request.

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3 main export commodity. Across the seven GCC countries, there is a positive relation between
4 stocks and oil returns and a negative relation between stock returns and oil volatility. The positive
5 stock and oil return relation is statistically significant for Saudi Arabia, Dubai, Oman and Abu
6 Dhabi, with the highest coefficient magnitude for Dubai and Saudi Arabia. The negative relation
7 between stock returns and oil volatility is significant for Bahrain, Kuwait and Oman.
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11 Given that higher oil prices are expected to boost wealth, economic activity and firm cash
12 flows in oil-exporting nations (Bjørnland, 2009), the previous literature establishes a positive link
13 between oil and stocks. For example, Park and Ratti (2008) and Ramos and Vega (2013) argue
14 that oil price increases boost the stock market of oil-exporting countries, and harm those of oil-
15 importing countries. In the GCC context, Mokni and Youssef (2019) show that the GCC markets
16 have a positive relation with oil prices. Mokni and Youssef (2019) and Mohanty *et al.* (2011) argue
17 that, except for Kuwait, GCC stocks have positive exposures to oil price innovations. Thus, our
18 results are broadly consistent with these findings, in that we note a positive relation as well as the
19 Kuwaiti market isolation from oil shocks. As noted, the insignificant result for Qatar may arise as
20 gas is its main export, while for Bahrain, the oil industry is comparatively small. Nonetheless, our
21 findings do contrast with those of Fayyad and Daly (2011) who argue that Qatar and the UAE
22 exhibit the highest sensitivity to oil shocks in the GCC bloc. Equally, the results contrast with Al
23 Janabi *et al.* (2010), who find that the relation between oil prices and GCC stock markets is weak.
24 Further, it is of interest to note that the large oil producers, Saudi Arabia and Abu Dhabi, are not
25 affected by oil price volatility despite the positive oil return relation. For the UAE this may arise
26 from its increased economic diversification with recently established service and tourism
27 industries (see Callen *et al.*, 2014). Equally, the large nature of the Saudi Arabian market, with 50%
28 of total GCC market capitalisation, may provide some resilience to oil price swings. Conversely,
29 the smaller GCC markets in Bahrain and Oman are more vulnerable to oil return volatility.
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44 In regard of the other coefficients, the signs of VIX and GEPV are negative but not
45 significant (except the VIX for Saudi Arabia). The world portfolio is strongly positive especially
46 in the markets of Dubai and Qatar where the coefficient is twice as large as its Kuwaiti, Omani
47 and Bahraini counterparts. Such results hint at higher levels of global integration in the markets of
48 Dubai and Qatar (see Ziadat *et al.*, 2020).
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55 *Oil shocks and GCC markets*
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3 Having conducted an initial examination of the effect of oil price changes on stock returns, we
4 now consider the impact of different oil price shocks. The oil price shocks are intended to capture
5 unexpected oil price innovations. For this, we use the decomposition of Ready (2018) and examine
6 the effect of supply, demand, and risk shocks. We consider this first in the usual linear regression
7 before turning to the quantile regression framework.
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12 Table 3 illustrates the impact of the different oil price shocks on the GCC markets while
13 controlling for the influence of GEPU and the MSCI world index.⁶ The results presented here
14 suggest an interesting pattern of influence emerges and one that appears to contradict the results
15 of similar and recent analysis across global markets. Notably, where research finds the influence
16 of shocks is significant and negative (see Ready, 2018; Demirer *et al.*, 2020), our results support
17 a positive effect arising only from oil supply shocks.
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22 Demirer *et al.* (2020), Wang *et al.* (2013), Guntner (2014) and Jung and Park (2011) show
23 that oil price increases, triggered by stronger global demand for oil, are associated with higher
24 stock market returns across all countries, regardless of the classification of the country as an
25 exporter/importer of oil. However, our results do not share such a conclusion. Although the
26 coefficient on demand shocks is positive throughout, it is only significant for Qatar (and marginally
27 for Dubai). Given that oil demand shocks constitute good news for the global economy, the relative
28 high integration of Qatar and Dubai (when compared with the rest of GCC markets) into the world
29 economy, might explain this result. A further channel to this effect may arise through spillovers
30 from global financial markets given the integration of Qatar and Dubai (see Ziadat *et al.*, 2020).
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35 The strongest factor influencing GCC stock returns is evidently oil supply shocks. The
36 influence is positive and significant in all GCC markets, albeit only at the 10% significance level
37 for the UAE markets of Dubai and Abu Dhabi. This result run counter to the literature that relies
38 on the Kilian (2009) decomposition method (see, Kilian and Park, 2009; Abhyankar *et al.*, 2013;
39 Kim and Vera, 2019) where the findings point to only a trivial impact of oil supply shocks. Using
40 the Ready (2018) decomposition, Demirer *et al.* (2020) find that supply shocks have a significant
41 and negative effect on stock market returns for the majority of 21 countries examined.
42 Interestingly, Demirer *et al.* (2020) incorporate the oil-exporters of Canada, Mexico and Norway
43 in their analysis. However, they only find positive links between oil supply shocks and Canadian
44 stocks whereas, similar to oil-importers, a negative effect is found for Mexico and Norway.
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⁶ The effect of VIX is now captured within the oil price shocks.

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3 Accordingly, the positive link between oil supply shocks and stocks appears to be a unique feature
4 of the GCC region.
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6 In the method of Ready (2018), the oil supply shock is obtained as the residual after
7 incorporating both the demand and risk shocks. Ready reports that this shock is responsible for
8 80% of the change in oil prices. Hence, the results reported here may stem from a broad range of
9 underlying variables. For instance, Malik and Umar (2019) argues that oil supply shocks could be
10 triggered by issues linked to unexpected changes in proven reserves, technologies related to oil
11 well completions and oil recovery. Clements *et al.* (2019) argue that the oil supply shocks, defined
12 by Ready (2018), can be linked to an exogenous measure of precautionary demand, reflecting
13 future oil supply uncertainty rather than contemporaneous supply changes. In seeking to
14 understand the results for the GCC markets, while acknowledging the strong ties between the GCC
15 economies as well as the impact of supply shocks on the price of oil, Filis and Chatziantoniou
16 (2014) argue that the magnitude of the stock market reaction to oil price shocks is higher for new
17 or less liquid stock markets, which will apply to several GCC markets. Further, the lack of hedging
18 instruments in emerging markets can increase their sensitivity to oil shocks (Balcilar *et al.*, 2019).
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30 *Oil price shocks and the state of the market*

31 While the above results examine the links between oil price shocks and GCC stock markets in a
32 linear model, here, we consider the impact of oil shocks across different market states. Developed
33 by Koenker and Bassett (1978), the quantile regression estimates the effects of explanatory
34 variables on the conditional quantile of the dependent variable. Therefore, in addition to the
35 average (median) dependence, the quantile regression offers information regarding tail
36 dependence. There are several advantages in using the quantile regression approach, for example,
37 Baur (2013) notes the ability of the model to capture the changing nature of dependence across
38 different market conditions, from bullish to bearish. Moreover, this allows examination of the
39 whole return distribution rather than, for example, two or three market states in a regime switching
40 model. Further, quantile regression estimators are robust to heteroskedasticity and skewness of the
41 dependent variable (Koenker and Hallock, 2001).
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51 Table 4 depicts the quantile coefficient estimates for oil supply, demand and risk shocks
52 for each GCC market. The first two quantiles correspond to a bear market phase, the upper
53 quantiles reflect bull market conditions, with the middle quantiles representing normal market
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3 states. As a general observation, the coefficients of oil demand shocks tend to increase with the
4 quantiles, while those for oil supply shocks decrease and with no clear pattern for the risk shock.
5 An interesting pattern also develops in the statistical significance of the demand and supply shocks
6 over the quantiles, with the demand shocks typically significant at higher (bull market) quantiles
7 and supply shocks significant at lower (bear market) quantiles.
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12 Oil demand shocks exhibits mid and upper tail dependence with the stock returns
13 conditional distribution in Saudi Arabia, Qatar, Kuwait and Dubai, while upper-tail⁷ only
14 dependence is reported for Abu Dhabi. This leaves the markets of Oman and Bahrain for which
15 oil demand shocks are wholly insignificant. An oil demand shock is associated with higher demand
16 for oil due to expansion in the global economy and the findings here are consistent with those of
17 Ready (2018) in supporting a positive link between stock markets and oil demand shocks.⁸
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22 The quantile process estimates show clear evidence of lower-tail dependence between oil
23 supply shocks and GCC returns. For the first quantile (Q1), which represents a bear market phase,
24 oil price shocks exert a significant positive impact on all GCC markets. When comparing our
25 results with those of Ziadat *et al.* (2022), they report lower tail dependence between oil
26 precautionary demand shocks and GCC markets. The discrepancy is a result of the different
27 approach in constructing oil shocks. Nonetheless, our results appear consistent with the view of
28 Balcilar *et al.* (2019) who state that financial market responses to oil shocks are stronger during
29 extreme market conditions. Moreover, given the general view in the literature, which points to a
30 negative impact of oil supply shocks on stocks, among oil importers and some oil exporters, the
31 results here convey important insights for the potential of cross-regional diversification.
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36 You *et al.* (2017) and Le and Zheng (2011) report that the impact of oil price shocks on
37 stocks mainly occurs when stock markets are in a bull or bear phase, indicating that the relation
38 between stocks and oil shocks are governed by investor (optimistic or pessimistic) sentiment.
39 Furthermore, citing factors related to less sophisticated investors in emerging markets, You *et al.*
40 (2017) and Lee and Zeng (2011) argue that investors might display irrational behaviour when
41 facing instabilities in oil markets. This argument is therefore applicable to the GCC markets given
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51 ⁷ The markets of Dubai and Kuwait also exhibit lower-tail dependence with oil demand shocks.

52 ⁸ The lack of significance for Bahrain and Oman may arise from their relatively small market capitalisation (Oman
53 and Bahrain combined constitute only 4% of total GCC market capitalisation as of 2016). While smaller firms are
54 likely to be less globally connected, the low capitalisation is also associated with poor liquidity, which will be less
55 attractive to global investors. Indeed, we can see only a small response to changes in the world portfolio (see Table 3)
56 when compared with other GCC markets.
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3 GCC investor profiles and the importance of oil to GCC economies. Thus, the positive oil price
4 supply shock may be an indicator of improving economic conditions (possibly via the
5 aforementioned fiscal channel) in GCC economies, thus, boosting their confidence in future stock
6 market behaviour.
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10 To further elaborate on the lower-tailed dependence between oil supply shocks and GCC
11 markets, we consider the role of geopolitical factors. This is motivated by the fact that a
12 considerable share of the global oil supply is produced in the region, which has experienced a
13 history of conflict and wars. Cheikh *et al.* (2021) report substantial sensitivity of GCC markets to
14 geopolitical stress. Antonakakis *et al.* (2017) maintain that aggregate demand shocks transmit most
15 of the information to stock markets during periods characterised by economic-driven events, while
16 supply and oil precautionary demand shocks prevail during periods of geopolitical unrest. Such
17 events can trigger change in both financial markets and portfolio allocations (Kollias *et al.*, 2013).
18 This supports the view that when oil supply shocks concur with geopolitical tensions, the changing
19 risk appetite of investors can lead to such results.
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29 **6. Summary and Conclusion.**

30 Motivated by the importance of oil as a commodity to the world economy and especially the GCC
31 bloc, this study characterises the links between oil price shocks and GCC stock markets. The
32 analysis utilises the oil price decomposition of Ready (2018) and monthly data from February 2004
33 to December 2019. The results reveal that the type of shock is important for GCC markets. While
34 the previous literature argues that supply-side shocks have a negative or negligible impact on
35 global markets, our results support a significant positive effect on GCC stocks. Such a result
36 reflects the heavy dependence on oil revenue and the structure of the GCC economies. That said,
37 when examining the relation across the stock return distribution, we also find that oil demand
38 shocks exhibit a positive relation with stock returns during a bull market, while the effect of the
39 supply shock is more evident in bear market conditions.
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48 From an academic⁹ standpoint, this study provides a comprehensive and up-to-date
49 examination of the oil-stock nexus for the GCC markets using decomposed measures of oil price
50 innovations. The results convey important information to global investors, as the characterisation
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54 ⁹ Error in variable is a potential issue in a two-step approach that we adopted in this paper. Using the quantile
55 connectedness approach of Ando *et al.* (2018) can be a good avenue of future research.
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3 of the links between individual GCC markets and oil shocks enhance our understanding of inter-
4 market relations and the effects on portfolio compositions in an inter and intra-regional
5 perspective. Moreover, given that portfolio diversification is achieved by investing in different
6 classes of assets or investing in similar classes of assets in multiple markets through international
7 diversification, the results here can improve decision making for asset allocation. Finally, future
8 research can use these outcomes to provide additional insights in hedging strategies that involves
9 oil, especially during phases of market turbulence.
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Table.1 Summary Statistics

	Abu Dhabi	Bahrain	Dubai	Kuwait	Oman	Qatar	Saudi Arabia	World	GEPU
Mean	0.005	0.001	0.005	0.000	0.002	0.005	0.003	0.005	0.000
Median	0.004	0.001	-0.001	0.000	0.002	0.004	0.009	0.011	-0.012
Maximum	0.359	0.092	0.382	0.139	0.162	0.260	0.187	0.096	0.769
Minimum	-0.196	-0.135	-0.408	-0.224	-0.250	-0.272	-0.278	-0.173	-0.496
Std. Dev.	0.065	0.033	0.096	0.047	0.049	0.078	0.076	0.037	0.176
Skewness	0.586	-0.404	0.052	-0.912	-0.575	-0.304	-0.694	-1.112	0.730
Kurtosis	8.235	4.942	6.128	7.960	6.936	4.759	4.486	5.743	5.022
Jarque-Bera	229.013	35.225	77.940	222.227	133.837	27.569	32.897	99.253	49.487
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PP test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Oil demand shock	Oil supply shock	Oil risk shock	VIX	Oil	Oil volatility	GEPU
Mean	-0.103	-0.467	-0.027	0.001	0.003	0.011	0.000
Median	-0.002	-4.096	0.304	-0.017	0.017	0.007	-0.012
Maximum	11.317	73.905	19.859	0.853	0.297	0.110	0.769
Minimum	-12.246	-43.897	-26.878	-0.486	-0.533	0.001	-0.496
Std. Dev.	4.615	19.257	7.197	0.205	0.105	0.014	0.176
Skewness	-0.045	1.000	-0.653	0.619	-1.234	3.755	0.730
Kurtosis	2.873	4.581	4.499	4.353	8.007	20.510	5.022
Jarque-Bera	0.193	51.731	31.444	26.773	247.968	2888.971	49.487
Probability	0.908	0.000	0.000	0.000	0.000	0.000	0.000
PP test	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes. The sample period runs from February 2004 to December 2019 including 191¹⁰ monthly observations. Std. Dev. and PP test stand for Standard deviation and Phillip-Perron test. GEPU is the Global Economic Policy Uncertainty. GCC national return series, MCSI world index, oil, VIX, and GEPU are calculated using the first logarithmic difference.

¹⁰ An exception to this is the GCC spillover index where the sample runs from December 2009 to December 2019 generating 137 observations.

Table.2 GCC returns response¹¹ to oil price change and volatility

Country		C	Oil	Oil Vol	VIX	GEPU	World	Adj. R2
Abu Dhabi	Coeff	0.010	0.090	-0.534	-0.015	-0.001	0.285	0.076
	P Value	0.082	0.022	0.248	0.502	0.967	0.029	
Bahrain	Coeff	0.010	0.026	-0.939	0.000	0.000	0.170	0.264
	P Value	0.000	0.138	0.000	1.000	0.958	0.006	
Dubai	Coeff	0.012	0.178	-0.912	-0.024	-0.013	0.682	0.177
	P Value	0.163	0.005	0.087	0.444	0.644	0.000	
Kuwait	Coeff	0.009	0.038	-0.981	-0.022	0.014	0.390	0.271
	P Value	0.050	0.303	0.021	0.100	0.257	0.006	
Oman	Coeff	0.008	0.094	-0.753	-0.023	0.004	0.340	0.237
	P Value	0.050	0.029	0.002	0.197	0.779	0.003	
Qatar	Coeff	0.004	0.116	-0.227	-0.039	0.043	0.749	0.195
	P Value	0.602	0.224	0.528	0.128	0.236	0.005	
Saudi Arabia	Coeff	0.002	0.141	-0.243	-0.055	0.022	0.690	0.205
	P Value	0.708	0.003	0.428	0.021	0.395	0.000	

Notes. The regressions above are generated by regressing oil returns, oil realised volatility, the VIX index, and Global Policy Uncertainty (GEPU) and the MSCI world portfolio on GCC equity returns. C, Coeff and Oil Vol stand for constant, coefficient and oil volatility, respectively. The equations runs as follows: $GCC\ market\ return_{i,t} = C_{0,i} + \beta_1 Oil_{i,t} + \beta_2 Oil\ Vol_{i,t} + \beta_3 VIX_{i,t} + \beta_4 GEPU_{i,t} + \beta_5 World_{i,t} + \varepsilon_{i,t}$. The P Value is based on the robust standard errors of Newey-West (1987). The sample ranges from February 2004 to December 2019 yielding a total of 191 observations.

¹¹ We acknowledge that the coefficients are small in value. This is in common in this stream of literature. For example, using the decomposition method of Kilian (2009), Ziadat et al. (2022) report significant results in the GCC context, yet, similar to our paper, the coefficients are small. Similar findings are reported by Apergis and Miller (2009).

Table.3 GCC returns response to oil price shocks

Country		C	Supply	Demand	Risk	GEPU	World	Adj. R2
Abu Dhabi	Coeff	0.003	0.002	0.000	0.000	0.004	0.486	0.071
	P Value	0.568	0.093	0.785	0.581	0.841	0.054	
Bahrain	Coeff	-0.001	0.001	0.001	0.000	0.003	0.370	0.171
	P Value	0.760	0.021	0.374	0.454	0.782	0.027	
Dubai	Coeff	0.002	0.003	0.003	0.000	-0.013	0.812	0.168
	P Value	0.859	0.083	0.070	0.985	0.658	0.066	
Kuwait	Coeff	-0.003	0.001	0.000	0.000	0.017	0.665	0.216
	P Value	0.513	0.042	0.516	0.325	0.213	0.023	
Oman	Coeff	0.000	0.002	0.002	0.000	0.005	0.401	0.196
	P Value	0.994	0.011	0.124	0.783	0.729	0.036	
Qatar	Coeff	0.002	0.002	0.004	0.000	0.034	0.849	0.240
	P Value	0.771	0.014	0.013	0.346	0.356	0.013	
Saudi Arabia	Coeff	0.000	0.002	0.003	0.000	0.020	0.734	0.192
	P Value	0.978	0.013	0.129	0.746	0.440	0.001	

Notes. C, Coeff, Supply, Demand and Risk stand for constant, coefficient, oil supply shocks, oil demand shocks and oil risk shocks, respectively. Oil price shocks are measured using the method of Ready (2018). The rest of the variables are the VIX index, and Global Policy Uncertainty (GEPU) and the MSCI world portfolio and the dependent variable is the stock market return of each GCC nation. The equations runs as follows: GCC market $return_{i,t} = C_{0,i} + \beta_1 Supply_{i,t} + \beta_2 Demand_{i,t} + \beta_3 Risk_{i,t} + \beta_4 GEPU_{i,t} + \beta_5 World_{i,t} + \varepsilon_{i,t}$. The P Value is based on the robust standard errors of Newey-West. The sample ranges from February 2004 to December 2019 yielding a total of 191 observations.

Table. 4 GCC returns dependence structure with oil price shocks

		Abu Dhabi		Bahrain		Dubai		Kuwait	
	Q	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.
Oil supply shock	0.100	0.003	0.000	0.001	0.023	0.003	0.000	0.002	0.007
	0.200	0.001	0.098	0.001	0.120	0.002	0.065	0.001	0.007
	0.400	0.001	0.129	0.001	0.088	0.001	0.488	0.000	0.950
	0.600	0.001	0.139	0.000	0.239	0.001	0.213	0.000	0.393
	0.800	0.000	0.958	0.001	0.050	0.001	0.412	0.001	0.058
	0.900	0.001	0.426	0.001	0.048	0.001	0.832	0.002	0.077
Oil Demand shock	0.100	-0.001	0.599	0.000	0.907	0.000	0.938	-0.002	0.049
	0.200	0.001	0.679	0.000	0.817	0.003	0.031	-0.001	0.488
	0.400	0.001	0.244	0.001	0.351	0.003	0.038	0.001	0.254
	0.600	0.002	0.120	0.001	0.446	0.002	0.216	0.001	0.020
	0.800	0.003	0.006	0.000	0.842	0.006	0.001	0.003	0.001
	0.900	0.003	0.014	0.002	0.127	0.009	0.001	0.002	0.380
Oil Risk shock	0.100	0.001	0.114	0.000	0.801	0.001	0.331	0.001	0.078
	0.200	0.000	0.764	0.000	0.688	0.000	0.514	0.000	0.294
	0.400	0.000	0.664	0.000	0.603	-0.001	0.171	0.000	0.543
	0.600	0.000	0.921	0.000	0.492	0.000	0.817	0.000	0.644
	0.800	0.000	0.760	0.000	0.561	0.000	0.687	0.000	0.417
	0.900	0.000	0.748	0.000	0.935	0.000	0.828	0.000	0.846
		Oman		Qatar		Saudi Arabia			
	Q	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.		
Oil supply shock	0.100	0.002	0.017	0.001	0.043	0.003	0.015		
	0.200	0.001	0.062	0.001	0.052	0.002	0.076		
	0.400	0.001	0.059	0.002	0.030	0.001	0.186		
	0.600	0.001	0.281	0.001	0.076	0.001	0.220		
	0.800	0.001	0.233	0.001	0.282	0.001	0.659		
	0.900	0.001	0.396	0.001	0.339	0.002	0.121		
Oil Demand shock	0.100	0.001	0.303	0.001	0.710	0.001	0.581		
	0.200	0.002	0.281	0.003	0.090	0.002	0.262		
	0.400	0.001	0.226	0.003	0.036	0.003	0.044		

	0.600	0.001	0.359	0.004	0.020	0.005	0.002		
	0.800	0.001	0.252	0.006	0.008	0.004	0.009		
	0.900	0.003	0.075	0.007	0.001	0.004	0.026		
Oil Risk shock	0.100	0.000	0.584	0.002	0.019	0.001	0.393		
	0.200	-0.001	0.265	0.001	0.025	0.001	0.413		
	0.400	0.000	0.607	0.000	0.365	0.000	0.895		
	0.600	0.000	0.373	0.000	0.594	-0.001	0.248		
	0.800	0.000	0.874	0.000	0.415	0.001	0.238		
	0.900	0.000	0.891	0.000	0.643	0.000	0.852		

Notes. The table depicts the quantile process coefficients estimated from quantile regression framework wherein stock returns are regressed on oil supply shocks, oil demand shocks, oil risk shocks, GEPU and world index. The latter two variables are controlled for but their results are not reported to conserve space. Q stands for quantile.

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3 Re: Oil-Stock Nexus: The Role of Oil Shocks for GCC Markets
4 SEF-12-2021-0529
5

6 We would like to thank the reviewers for their thoughtful remarks towards refining our paper.
7 We address comments specific to each reviewer below.
8
9

10 Editorial comments

11 1. The authors should provide a structured abstract (see SEF submission guidelines).
12

13 Reply:

14 The structured abstract is now provided.
15
16
17

18 2. Improve the introduction:
19

20 a) The second paragraph of the introduction should contain the contribution to the literature.
21
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23 Reply:

24 Thanks for this, the Introduction has been enhanced to highlight the contribution in the second
25 paragraph.
26
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28 b) The last paragraph of the introduction should contain a remainder of the paper.
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30

31 Reply:

32 A paragraph is added clarifying that is added at the end of the introduction.
33
34
35

36 3. Eq. (2): The error term should also contain the subscript "i".
37

38 Reply:

39 In revising this equation (and the same issue applies to equation (1)), the i for the dependent
40 variable is different to the i attributed to the explanatory variables. The former refers to the
41 different GCC markets and the latter to the alternative 'X' variables. Therefore, we have dropped
42 the i associated with the dependent variable and so a similar subscript is no longer required for the
43 error term. The alternative would be to add a further subscript (e.g., j), however, we believe that
44 this unnecessarily clutters the paper.
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48 4. The literature review should provide some contributions from the recent literature that
49 deal with oil price and financial market linkages, for example, Batten et al. (2019).
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51

52 Reply:

53 The references mentioned, among other relevant ones, are incorporated into the revised version of
54 the paper, notably in the Introduction and Literature Review.
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3 5. The authors conclude that their analysis of the oil-stock nexus provides useful implications
4 for portfolio management. The authors may mention additional economic benefits such as hedging
5 (see Batten et al. 2021).
6

7
8 Reply:

9 The discussion regarding implications in the concluding section is enhanced by incorporating the
10 potential hedging benefits.
11

12
13
14 Reviewer One

15 1. Statistically significant quantile regression coefficients both for oil supply and demand shocks
16 are quite small overall. Is this related to the low average returns of GCC stock markets? In other
17 words, you should explain why the quantile regression coefficients are quite small.
18

19 Reply:

20 We thank the referee for raising this point and note that such results are common in this stream of
21 literature. For example, using the decomposition method of Kilian (2009), Ziadat et al. (2022)
22 report significant results in the GCC context, yet, similar to our paper, the coefficients are small.
23 This outcome is consistent with the findings of Apergis and Miller (2009).
24
25
26

27 2. Unlike previous studies, oil supply shocks affect positively and significantly stock returns based
28 on the economic structure of the GCC bloc. Moreover, why oil price shocks (demand and supply
29 shocks) impact stock returns positively at bear and bull markets should be explained at least with
30 a few sentences.
31

32
33 Reply:

34 We argue that may arise due to the factors including the uniqueness of GCC market in terms of
35 liquidity and available hedging instruments. We make note of this point in both the discussion of
36 the results as well as the Abstract.
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40 Reviewer Two

41
42 1. Abstract: Add a short sentence showing the methodology used
43

44 Reply:

45 This is adjusted in the new version of the paper
46
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48

49 2. Introduction: Clearly provide the readers with an outline of the structure of the rest of the article.
50

51 Reply:

52 A paragraph supplying this information is added at the end of the Introduction.
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3 3. Literature review; The literature review should provide a background and serve as a motivation
4 for the objectives and hypothesis that guide your own research. Consider adding the theory and or
5 conceptual framework. The theoretical framework introduces and describes the theory that
6 explains why the research problem under study exists. This is missing from the literature review.
7

8
9 Reply:

10 The first paragraph of the Literature Review has been improved to incorporate discussion of the
11 theory behind the links between oil and stocks.
12

13
14
15 4. Methodology; Investigate or test for endogeneity issues within the independent variable and
16 heteroskedasticity.
17

18 Reply:

19 We thank the referee for this point. In the 'robustness' file, we run regressions using lags of the oil
20 variables with the results remaining qualitatively similar. Hopefully, this answers the concerns
21 regarding endogeneity and general robustness. Also, we use the Newey-West estimator, which is
22 robust to the presence of heteroskedasticity.
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26 5. You may introduce a robustness check to your analysis.
27

28 Reply:

29 In common with point #4, we include a 'robustness' file that hopefully captures this requirement.
30
31

32
33 6. Relate also your finding to the theory after introducing it in the literature review section.
34

35 Reply:

36 The fiscal channel to explain the links between oil and GCC equities is incorporated in page 14 to
37 further explain the results.
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39

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41 7. There are implications for policymakers and other stakeholders such as employees in the oil
42 industry. What are the limitations of your research? Make recommendations for future research.
43

44 Reply:

45 The implication section is enhanced. Concerning the limitations, we acknowledge that the 'error
46 in variable' issue is potential concern in our two-step approach. Hence, using the quantile
47 connectedness approach of Ando et al. (2018) can be a good contribution in this stream of research.
48 This is now noted in the concluding section.
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53 8. Other; A number of the in-text citation is missing from the reference section, for example,
54 Kollias et al., 2013 on page 14, You et al 2017, Le and Zheng, 2011, Hammoudeh and Li, 2008
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all on page 13, etc. Finally, your references have not all been drafted according to the Journals of Studies in Economics and Finance requirement.

Reply:
These issues are corrected in the new document.

Studies in Economics and Finance

Robustness

The first robustness exercise involves using the lagged oil price shocks in the regressions. The results remain broadly similar to those reported in the paper. Moreover, these results relief potential endogeneity concerns.

Lagged oil price shocks

Table 1. Lagged oil price shocks for Saudi Arabia

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001973	0.006341	0.311110	0.7561
OIL_SUPPLY_SHOCK(-1)	0.001762	0.000756	2.331203	0.0208
OIL_DEMAND_SHOCK(-1)	0.001375	0.001471	0.935065	0.3510
OIL_RISK_SHOCK(-1)	0.000527	0.000525	1.002909	0.3172
GEP(-1)	0.004946	0.033397	0.148112	0.8824
WORLD(-1)	0.319555	0.247330	1.292017	0.1980
R-squared	0.053350			
Adjusted R-squared	0.027626			

Table 2. Lagged oil price shocks for Kuwait

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002204	0.003990	-0.552384	0.5814
OIL_SUPPLY_SHOCK(-1)	0.001114	0.000728	1.531861	0.1273
OIL_DEMAND_SHOCK(-1)	0.001181	0.000763	1.546977	0.1236
OIL_RISK_SHOCK(-1)	-8.97E-05	0.000147	-0.611004	0.5420
GEP	0.019198	0.014121	1.359602	0.1756
WORLD	0.475184	0.142760	3.328538	0.0011
R-squared	0.228760			
Adjusted R-squared	0.207802			

Table 3. Lagged oil price shocks for Qatar

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004107	0.005989	0.685846	0.4937
OIL_SUPPLY_SHOCK(-1)	0.000736	0.000800	0.920436	0.3586
OIL_DEMAND_SHOCK(-1)	0.001650	0.001963	0.840526	0.4017
OIL_RISK_SHOCK(-1)	-0.000200	0.000648	-0.308788	0.7578
GEP(-1)	0.007659	0.035544	0.215473	0.8296
WORLD(-1)	0.058438	0.372753	0.156775	0.8756
R-squared	0.022858			
Adjusted R-squared	-0.003694			

Table 4. Lagged oil price shocks for Bahrain

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000402	0.003335	-0.120440	0.9043
OIL_SUPPLY_SHOCK(-1)	0.000751	0.000533	1.407864	0.1609
OIL_DEMAND_SHOCK(-1)	0.000500	0.000554	0.901565	0.3685
OIL_RISK_SHOCK(-1)	1.46E-05	0.000205	0.071006	0.9435
GEP(-1)	0.013070	0.015317	0.853259	0.3946
WORLD(-1)	0.234052	0.135842	1.722969	0.0866
R-squared	0.116291			
Adjusted R-squared	0.092277			

Table 5. Lagged oil price shocks for Oman

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000624	0.004563	0.136799	0.8913
OIL_SUPPLY_SHOCK(-1)	0.002145	0.000622	3.451053	0.0007
OIL_DEMAND_SHOCK(-1)	0.000470	0.001034	0.454571	0.6500
OIL_RISK_SHOCK(-1)	7.45E-05	0.000379	0.196625	0.8443
GEP(-1)	0.036083	0.017048	2.116508	0.0356
WORLD(-1)	0.257508	0.197186	1.305912	0.1932
R-squared	0.152962			
Adjusted R-squared	0.129945			

Table 6. Lagged oil price shocks for Dubai

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002842	0.008713	0.326164	0.7447
OIL_SUPPLY_SHOCK(-1)	0.002496	0.001140	2.190022	0.0298
OIL_DEMAND_SHOCK(-1)	0.000874	0.001761	0.496220	0.6203
OIL_RISK_SHOCK(-1)	-4.76E-05	0.000549	-0.086737	0.9310
GEP(-1)	0.064001	0.035349	1.810535	0.0718
WORLD(-1)	0.500146	0.369090	1.355078	0.1771
R-squared	0.097647			
Adjusted R-squared	0.073126			

Table 7. Lagged oil price shocks for Abu Dhabi

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004706	0.006195	0.759720	0.4484
OIL_SUPPLY_SHOCK(-1)	0.001383	0.000830	1.666311	0.0974
OIL_DEMAND_SHOCK(-1)	0.001279	0.001658	0.771250	0.4415
OIL_RISK_SHOCK(-1)	-9.89E-05	0.000421	-0.235072	0.8144
GEP(-1)	0.038500	0.025351	1.518671	0.1306
WORLD(-1)	0.155518	0.246528	0.630832	0.5289
R-squared	0.062972			
Adjusted R-squared	0.037509			

The second robustness test involves using the lagged oil return and volatility in the regressions. The results remain broadly similar to those reported in the paper.

Figure 8. Lagged oil return and volatility for Abu Dhabi

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009967	0.005622	1.772764	0.0779
WTI(-1)	0.053543	0.059520	0.899575	0.3695
WTI_VOLATILITY(-1)	-0.500464	0.360295	-1.389040	0.1665
VIX(-1)	-0.042156	0.019779	-2.131406	0.0344
GEP(-1)	0.037523	0.023426	1.601733	0.1109
WORLD(-1)	0.183175	0.120693	1.517686	0.1308
R-squared	0.074264			
Adjusted R-squared	0.049108			

Figure 9. Lagged oil return and volatility for Saudi Arabia

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004705	0.007224	0.651254	0.5157
WTI(-1)	0.064002	0.050768	1.260667	0.2090
WTI_VOLATILITY(-1)	-0.246538	0.465475	-0.529648	0.5970
VIX(-1)	-0.095990	0.034000	-2.823222	0.0053
GEP(-1)	0.004333	0.033482	0.129401	0.8972
WORLD(-1)	0.182859	0.207521	0.881158	0.3794
R-squared	0.088613			
Adjusted R-squared	0.063847			

Figure 10. Lagged oil return and volatility for Qatar

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.016560	0.007285	2.273167	0.0242
WTI(-1)	0.005524	0.047488	0.116327	0.9075
WTI_VOLATILITY(-1)	-1.141601	0.549205	-2.078642	0.0390
VIX(-1)	-0.080246	0.031551	-2.543346	0.0118
GEP(-1)	0.008950	0.035212	0.254164	0.7997
WORLD(-1)	0.147810	0.192353	0.768433	0.4432
R-squared	0.093666			
Adjusted R-squared	0.069037			

Figure 11. Lagged oil return and volatility for Oman

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009574	0.005578	1.716305	0.0878
WTI(-1)	0.056883	0.036144	1.573791	0.1173
WTI_VOLATILITY(-1)	-0.776193	0.447022	-1.736366	0.0842
VIX(-1)	-0.057714	0.019538	-2.953915	0.0035
GEP(-1)	0.030233	0.016414	1.841878	0.0671
WORLD(-1)	0.159525	0.132845	1.200836	0.2314
R-squared	0.185656			
Adjusted R-squared	0.163527			

Figure 12. Lagged oil return and volatility for Kuwait

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012352	0.005552	2.224536	0.0273
WTI(-1)	0.029460	0.028229	1.043617	0.2980
WTI_VOLATILITY(-1)	-1.148908	0.552655	-2.078889	0.0390
VIX(-1)	-0.052172	0.019215	-2.715224	0.0073
GEP(-1)	-0.008141	0.018239	-0.446375	0.6559
WORLD(-1)	0.107743	0.123271	0.874030	0.3832
R-squared	0.207317			
Adjusted R-squared	0.185777			

Figure 13. Lagged oil return and volatility for Dubai

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012192	0.008286	1.471399	0.1429
WTI(-1)	0.081438	0.074118	1.098758	0.2733
WTI_VOLATILITY(-1)	-0.851561	0.560431	-1.519476	0.1304
VIX(-1)	-0.099293	0.027765	-3.576181	0.0004
GEP(-1)	0.057815	0.033282	1.737104	0.0840
WORLD(-1)	0.484941	0.228620	2.121170	0.0352
R-squared	0.135469			
Adjusted R-squared	0.111977			

Figure 14. Lagged oil return and volatility for Bahrain

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008261	0.003230	2.557507	0.0113
WTI(-1)	0.020582	0.025737	0.799735	0.4249
WTI_VOLATILITY(-1)	-0.744859	0.139913	-5.323747	0.0000
VIX(-1)	-0.025597	0.011813	-2.166936	0.0315
GEPU(-1)	0.011330	0.014498	0.781446	0.4355
WORLD(-1)	0.162342	0.072581	2.236709	0.0265
R-squared	0.212548			
Adjusted R-squared	0.191150			

Oil-Stock Nexus: The Role of Oil Shocks for GCC Markets

Abstract

Purpose: This study examines the links between oil price shocks and GCC stock markets from February 2004 to December 2019. Knowledge of such links is important to both investors and policymakers in understanding the transmission of shocks across markets.

Methodology: We employ the Ready (2018) oil price decomposition method and the quantile regression approach to conduct our analysis.

Findings: Initial results show a positive oil price change increases stock returns, while greater volatility decreases returns. The oil shock decomposition results reveal a significant positive impact of supply-side shocks on stocks. This contrasts with the literature that argues demand-side shocks are more important. While factors such as liquidity and the lack of hedging instruments can increase the vulnerability of GCC equities to oil price shocks, our result reflects the unique economic structure of the GCC bloc, notably, marked by dependency on oil revenues. In analysing quantile-based results, oil supply shocks mainly exhibit lower-tail dependence, while we do uncover some evidence of demand-side shocks affecting mid and upper-tail dependence.

Originality: Acknowledging the presence of endogeneity in the relation between oil and economic activity, this study is the first to combine the oil price decompositions of Ready (2018) with a quantile regression framework in the GCC context. Our results reveal notable difference to those previously reported in the literature.

1. Introduction.

The energy finance literature highlights important links between oil prices and stock markets (see, for example, Sadorsky, 1999; Papapetrou, 2001; Bjornland, 2009; Park and Ratti, 2008; Le and Chang, 2015; Wang *et al.*, 2013; Batten *et al.*, 2019; Batten *et al.*, 2021). To better understand these links, a notable advance is presented in work that decomposes the oil price into its respective shocks (Hamilton, 2009; Kilian, 2009). Given the high dependence of the Gulf Cooperation Council (GCC¹) countries on oil production,² the analysis of oil price shocks on GCC stocks is important to investors and policymakers, as well as academics interested in modelling financial market relations. Thus, this paper seeks to examine the impact of oil price shocks using the decomposition of Ready (2018) on GCC stock returns.

As relatively young stock markets, those of the GCC are understudied. Moreover, the markets, classified as either emerging or frontier (Balcilar *et al.*, 2015), have witnessed considerable efforts to enhance efficiency (Benlagha, 2020) and have undergone economic and financial liberalisation (Bley and Chen, 2006; Al-Khazali *et al.*, 2006; Akoum *et al.*, 2012). This includes, for example, structural reforms to allow foreign investors to channel funds towards GCC financial markets and so improving liquidity (Al Janabi *et al.*, 2010; Arouri and Rault, 2012). Consequently, in 2014, the MSCI re-categorised the markets of the UAE and Qatar to emerging market status, while Saudi Arabia followed in 2019. The markets of Kuwait, Oman and Bahrain remain categorised as frontier. Nonetheless, the GCC markets generally enjoy many macroeconomic fundamentals equivalent to developed nations (Awartani and Maghyereh, 2013), and the inclusion of GCC markets improves diversification in a cross-country portfolio (Arouri and Rault, 2010; Mimouni *et al.*, 2016). Acknowledging these features, we contribute to the existing literature by detailing the dependence structure between oil and GCC stocks using the Ready (2018) decomposition and quantile regression frameworks.

Recently, and in pursuit of diversification, investors began to regard the oil market as a suitable alternative destination leading to the so-called financialization of oil markets (Silvennoinen and Thorp, 2013). McMillan *et al.* (2021) argue that this financialisation of oil is

¹ Established in 1981, The Cooperation Council for the Arab States of the Gulf is a regional organisation of six members: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates.

² The GCC bloc holds 30.6% of proven oil reserves (BP Statistical Review of World Energy 2019). Moreover, Khalifa *et al.* (2014) note that the oil industry constitutes 35% of the GCC economies.

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3 linked with higher comovements of GCC stocks with their US counterparts. Moreover, together
4 with the recent instability in oil prices, this motivates a new examination of the oil-stock nexus.
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7 The literature on the links between oil prices and the economy can be traced back to the
8 work of Hamilton (1983). Subsequently, a wave of research sought to establish a link between oil
9 prices and financial markets using Vector Autoregressive (VAR) models. Examples include the
10 work of Sadorsky (1999), Papapetrou (2001), Bjornland (2009), Park and Ratti (2008) and Le and
11 Chang (2015). Hamilton (2009) argues that oil price shocks are not uniquely instigated by supply
12 shortages, but also by innovations on the demand side. Moreover, Kilian and Park (2009) note,
13 studies that do not recognise the causes of oil shocks will be predisposed to uncover trivial links
14 between oil prices and stocks.
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17 In a notable development, Kilian³ (2009) suggests that a rise in oil price should be attributed
18 to its underlying cause and identifies three distinctive sources of oil price increases: supply-side
19 shocks caused by a shortfall in oil production, demand-side shocks due to global economic
20 expansion, and precautionary demand shocks triggered by expectations of future oil supply
21 shortfalls. In a further significant study, Ready (2018) proposes a technique to disentangle oil price
22 shocks based on the traded asset price data of oil-producing firms. Ready (2018) argues that while
23 oil producers benefit from price increases due to oil demand, they remain numb to supply
24 disruptions (for example, when extraction complications arise, oil producers will sell less but at
25 higher prices). Empirically, Ready (2018) identifies demand shocks as returns to an index of oil-
26 producing firms that are orthogonal to innovations in the VIX index, and supply shocks as oil price
27 changes that are orthogonal to demand shocks and to changes in VIX.
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30 Subsequently, a number of studies examine the impact of oil price shocks on stocks. Earlier
31 work, such as Kilian and Park (2009) and Abhyankar *et al.* (2013) concentrate on the major
32 developed markets of the US and Japan, while Kang and Ratti (2015) examine the impact of oil
33 price shocks and economic policy uncertainty on Chinese stocks. Further studies include the work
34 of Wang *et al.* (2013), Kang and Ratti (2013) and Apergis and Miller (2009). However, despite
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³ Within this framework, Kilian (2009) reports that supply and demand shocks account for 4% of the monthly variation in the oil price. Precautionary demand shocks, which are unspecified by this procedure account for 77% of the variation, which lead to some criticism. Kolodziej and Kaufmann (2014) argue that the Kilian (2009) index of global real economic activity captures little more than transportation costs such that the identified demand shock is not sufficient. Elaborating, Ready (2018) reveals that the measure will not capture anticipated variation in aggregate demand, leaving these to the precautionary demand. Likewise, Demirer *et al.* (2020) document the over emphasis of Kilian's (2009) decomposition on precautionary demand shocks.

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3 the importance of oil to the GCC economies, as well as the strong role they play in the oil market,
4 examining the link between oil price shocks and GCC markets remains largely neglected.
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7 Focusing on oil exporters and using the approach of Kilian and Murphy (2014), Basher *et*
8 *al.* (2018) study the influence of oil shocks on Canada, Mexico, Norway, Russia, the UK, Kuwait,
9 Saudi Arabia, and the UAE. Using a two-state Markov-switching model, they show that both oil
10 aggregate demand shocks and oil precautionary demand shocks have a significant impact on stock
11 returns in Norway, Russia, Kuwait, Saudi Arabia, and the UAE. While oil supply shocks influence
12 stocks in the UK, Kuwait, and the UAE. Using a sample that incorporates the GCC markets and
13 the Kilian (2009) methodology, Ziadat *et al.* (2022) examine the impact of oil shocks on equities
14 in both oil-importing and exporting nations. They distinguish the market feedback to oil shocks
15 during bull, normal and bear phases. Their results show that oil-exporters are stimulated by
16 precautionary demand shocks. Also, among oil-exporters, the GCC markets are predominantly
17 impacted during bear market conditions.
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21 Building on the work of Basher *et al.* (2018) and Ziadat *et al.* (2022), this paper exploits
22 the Ready (2018) decomposition of oil innovations on stock return. We also incorporate all GCC
23 markets as we believe that heterogeneity exists in terms of their economic structure and oil
24 dependence. For instance, while Kuwait has the highest level of dependence on oil, the UAE has
25 an increasingly diversified economy based on tourism and services. In this regard, Fenech and
26 Vosgha (2019) argue that the dependence structure between oil and GCC stock exchanges varies.
27 Moreover, Alqahtani *et al.* (2019) maintain that the link between oil price uncertainty and GCC
28 markets differs significantly with the smaller markets of Bahrain and Oman being less susceptible
29 to oil shocks than their Saudi and Emirati counterparts. Furthermore, Mokni and Youssef (2019)
30 show that the Saudi market displays the largest degree of persistence in the dependence with oil
31 prices. Thus, examining the heterogeneity among GCC nations in their interactions with oil shocks
32 is an enhancement to the current literature.
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36 Therefore, we examine the impact of oil price shocks on the GCC stocks markets using the
37 method of Ready (2018). In extending this, we further examine the dependence structure between
38 oil price shocks and GCC stocks using the quantile regression of Koenker and Bassett (1978).
39 Specifically, we first consider the standard linear relation between stocks with oil returns and
40 volatility. Oil volatility is included in this initial analysis as it may capture risk in the oil market.
41 Although that analysis is then subsumed in the next stage that considers oil price shocks. Second,
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we then decompose oil price changes according to their source as supply, demand and risk shocks. Third, we consider whether the relation varies across different quantiles of the returns process. In examining the impact of oil innovations on GCC stock returns, we control for global factors using the VIX index, Global Economic Policy Uncertainty (GEPU) and the MSCI world portfolio. Controlling for these variables is essential to ensure the accuracy of results. According to Dickinson (2000) and Rigobon and Sack (2003), asset prices are intertwined, therefore, analysing a single market in segregation overlooks important information about its behaviour. The MSCI world portfolio is designed to capture common fundamentals that steer global equity returns. Oil price shocks are believed to be related with both VIX and GEPU as argued by Antonakakis *et al.* (2013) and Kang and Ratti (2013). These variables can influence stock prices by affecting expected cash flows and discount rates. Moreover, oil price increases caused by supply-side factors may be associated with higher GEPU with the opposite for demand-side factors (Kang and Ratti, 2013).

This study contributes to the literature from several angles. First, we apply the Ready (2018) oil price decomposition methodology to the GCC markets, detailing the dependence structure of the oil-stock nexus. Second, we include all GCC countries, hence, we highlight the heterogeneities among them. This latter point could carry important information for portfolio managers interested in intra-regional diversification. Third, we consider heterogeneity across the stock return distribution and whether the relation with oil shocks depends on the state of the stock market, notably whether it is in a bullish or bearish phase. Our results point to the importance of oil supply shocks in explaining the changes in GCC equity returns, especially during bear market phases.

The remainder of this paper is structured as follows. Section 2 provides a brief literature review from which the research hypotheses are developed. This is followed by Section 3 that introduces the study method, and Section 4 providing a description of our data collection and variable definitions. Empirical results and discussion are presented in Section 5. The final section concludes the paper and indicates its limitations.

2. Literature Review.

Oil prices and financial markets are linked through their effects on, and from, the wider economy. In considering the theoretical transmission mechanisms, Mohanty and Nandha (2011) argue that oil price changes impact a firm's future cash flows, positively or negatively, depending on whether

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3 it is an oil-consumer or oil-producer. As rising oil prices amplify production costs, Basher and
4 Sadorsky, (2006) argue that as policymakers increase short-term interest rates in response to higher
5 inflationary pressures, this increases borrowing costs and reduces company cash flows. Brown and
6 Yücel (2002) argue that rising oil prices cause greater uncertainty in the real economy, reducing
7 investment and future expected cash flows. While economic theory proposes that the current stock
8 price reflects its discounted future cash flow (Huang *et al.*, 1996), uniquely, in the context of oil
9 exporting nations, we can explain the links between oil and the macroeconomy via the fiscal
10 channel. Within this, Degiannakis *et al.* (2018) and Bjornland (2009) argue that, in oil-exporting
11 nations, rising oil prices increase government and individual consumption. In this environment,
12 higher cash flows are expected to enhance firm profitability. The latter, in turn, is anticipated to
13 stimulate the stock market of oil exporting nations.

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15 In the GCC context, early research explores the long-term relations between oil and stock
16 prices. Maghyereh and Al-Kandari (2007) use a non-linear cointegration approach with daily data
17 from 1996 to 2003. They support the existence of non-linear linkages between the stock markets
18 of Bahrain, Kuwait, Oman, and Saudi Arabia and an oil price index. Arouri and Rault (2012) use
19 both panel cointegration and Seemingly Unrelated Regression (SUR) frameworks and provide
20 evidence of long-run dependence across GCC and oil markets. The SUR results show that higher
21 oil prices have a positive impact on GCC markets, except for Saudi Arabia. Using the NARDL
22 method of Shin *et al.* (2014), which allows for short- and long-run asymmetric adjustment,
23 Siddiqui *et al.* (2019) report that during the 2014 - 2016 oil price fall, negative oil price changes
24 had a larger effect than positive changes. Akoum *et al.* (2012) use a wavelet approach for weekly
25 data from 2002 to 2011 and show that GCC stock returns display comovement over the long term
26 with oil returns.

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28 A further direction for research considers volatility spillovers between oil and stock
29 markets. Using daily data from September 30, 2005, to October 24, 2016, Al-Yahyaee *et al.* (2019)
30 examine volatility spillovers between commodity futures and GCC stock markets. Relying on
31 dynamic equicorrelation (DECO) models and the spillover index of Diebold and Yilmaz (2012),
32 they report that oil is a considerable transmitter of volatility to the GCC markets. Arouri *et al.*
33 (2011) use a VAR-GARCH model and reveal significant volatility spillovers from oil, particularly
34 during market turbulence. Awartani and Maghyereh (2013) use the Diebold and Yilmaz (2009,
35 2012) spillover index for returns and volatility between oil and GCC stocks from 2004 to 2012.

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3 They report that return and volatility transmission is more pronounced after the financial crisis.
4 The authors argue that despite evidence of bi-directional causality, oil constitutes the larger source
5 of spillovers. Likewise, Bouri and Demirer (2016) report volatility transmissions from oil prices
6 to Kuwait, Saudi Arabia and UAE. Khalifa *et al.* (2014) use weekly data from 2004 to 2011 to
7 investigate the volatility transmission among oil, the MSCI-world portfolio and US and GCC
8 markets. Using the Multi-Chain Markov Switching approach of Gallo and Otranto (2008), they
9 find evidence of interdependence between oil and the stocks of Kuwait and Abu Dhabi.
10 Additionally, spillovers from oil to Dubai are reported, with no linkages between oil and the Saudi,
11 Qatari and Omani markets.

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13 Ashfaq *et al.* (2019) use daily data from 2009 to 2018 for three oil-exporting countries
14 (Saudi Arabia, United Arab Emirates, Iraq) and four oil-importing countries (China, Japan, India,
15 South Korea). They measure correlations and spillovers between oil and stock prices using DCC
16 and BEKK GARCH models. They conclude that the sensitivity of stock returns to oil shocks is
17 higher in oil-exporting nations than oil-importing nations. Using the Kilian (2009) method, Ziadat
18 *et al.* (2022) find that oil exporters display susceptibility to oil precautionary demand shocks. The
19 effect is positive and important in all market conditions in the oil exporters of Canada, Norway
20 and Russia. In the GCC market of Saudi Arabia, Abu Dhabi, Dubai, Bahrain, Oman and Qatar, the
21 impact is positive and significant during bear market phases.

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23 McMillan *et al.* (2021) use the Asymmetric DCC GARCH model and monthly data from
24 2003 to 2019 to investigate the impact of oil on the interdependence of the GCC and US stocks.
25 They find that oil returns and volatility significantly explain changes in the US-GCC correlation.
26 Parallel to that, Ziadat and McMillan (2021) establish a link between oil price shocks on the
27 connectedness among GCC markets.

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29 Overall, despite the limited application of oil price decompositions in examining the
30 relation with GCC stock returns, the literature, using a variety of empirical designs, documents a
31 significant impact of oil prices on the GCC markets. However, the heterogeneity of links between
32 oil and individual GCC markets remains a matter of debate.

3. Methodology.

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34 To examine the impact of oil shocks on GCC market returns, we use the following regression:

$$r_t = \alpha_0 + \sum_i \beta_i x_{i,t} + \varepsilon_t \quad (1)$$

Where r_t refers to the stock return series at time period t , $x_{i,t}$ are the i explanatory variables and ε_t is a random error term. The explanatory variables include oil returns, oil volatility and oil shocks as well as the control variables, MSCI world index return, VIX and GEPU.

Oil Price Decomposition

Ready (2018) introduces a methodology to decompose oil price changes into supply, demand and risk shocks. Following Ready (2018), we use the World Integrated Oil and Gas Producer Index as a proxy for oil producing firms stock returns, one-month crude oil futures returns on the second nearest maturity contract on the New York Mercantile Exchange to reflect oil price changes, and the VIX index.

Based on the view that the return to oil producers is affected by the level of demand and risk shocks, risk shocks are identified as the residuals from an ARMA(1,1) model on VIX.⁴ Demand shocks are measured as the segment of current returns to oil producing firms that is orthogonal to risk shocks. Supply shocks are defined as that portion of the current oil return that is orthogonal to both demand and risk shocks. Oil supply, demand and risk shocks are normalised and constrained to sum to the total oil price change.

Quantile regression

The quantile regression, developed by Koenker and Bassett (1978), estimates the effect of the explanatory variables on the conditional quantile of the dependent variable. This presents information on average dependence as well as the upper and lower tail dependence and is robust to both outliers and non-normality.

The quantile regression therefore extends the linear model in equation (1) by allowing a different coefficient for each specified quantile:

$$r_t = \alpha^{(q)} + \sum_i \beta_i^{(q)} x_{i,t} + \varepsilon_t \quad (2)$$

where $\alpha^{(q)}$ represents the constant term for each estimated quantile (q), $\beta^{(q)}$ is the slope coefficient that reveals the relation between the correlation and the explanatory variable at each quantile, and ε_t is the error term.

⁴ Bollerslev et al. (2009) note the risk premium captured by the VIX index correlates negatively with stock returns and has the ability to forecast them. Therefore, supporting the argument of Ready regarding the ability of VIX to capture changes in risk.

4. Data.

Following Ready (2018), we use the WTI benchmark as a measure of oil prices, which is obtained from the EIA website. For the volatility of oil, we apply the realised volatility approach of Schwert (1989) by summing the daily squared oil returns. To construct the oil price shocks using the approach of Ready (2018). Thus, we obtain data on the world integrated oil and gas producer index to represent oil producers stock price, the second nearest maturity of the NYMEX WTI futures contract and the VIX index.

All-share indexes are obtained for Dubai, Saudi Arabia, Abu Dhabi, Qatar, Oman, Bahrain, and Kuwait. Except where noted, the data is from DataStream and sampled monthly from February 2004 to December 2019. The stock return series are denominated in US dollars to be comparable across countries and to be regarded as more pertinent for global investors. Returns are generated by applying the natural logarithmic difference. This study incorporates a set of global factors including the MSCI world index (following Demirer *et al.*, 2020), the VIX index (Whaley, 1993) and Global Economic Policy Uncertainty index (GEPU). The GEPU Index (Davis, 2016), is a GDP-weighted average of national Economic Policy Uncertainty indices (EPU) for 16 countries that account for two-thirds of global output.

Table 1 presents summary statistics for our data. The GCC stock return series exhibit a positive mean for returns, except for Kuwait, while Dubai has the highest standard deviation. With the exception of the oil demand shock, the Jarque-Bera test reveals that all series display non-normality. The Philip-Perron unit root test shows that stationarity holds for all sampled data.

5. Empirical Results.⁵

Oil Price changes and GCC markets

As much of the literature on the oil-stock nexus focuses on the effect of the oil price returns and volatility on stocks, we first examine these to provide comparability.

Table 2 presents the results of regressing GCC stock returns on oil price changes, oil volatility, VIX, GEPU and the World portfolio. The results indicate that oil, either the return or volatility, affects the stock markets of all GCC countries, except for Qatar, for which gas is the

⁵ As robustness checks against the results presented in this section, including any potential issues arising from endogeneity, we re-estimate the models presented in Section 3 using lagged values of the explanatory variables. These results are qualitatively similar to those reported below and are available upon request.

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3 main export commodity. Across the seven GCC countries, there is a positive relation between
4 stocks and oil returns and a negative relation between stock returns and oil volatility. The positive
5 stock and oil return relation is statistically significant for Saudi Arabia, Dubai, Oman and Abu
6 Dhabi, with the highest coefficient magnitude for Dubai and Saudi Arabia. The negative relation
7 between stock returns and oil volatility is significant for Bahrain, Kuwait and Oman.
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11 Given that higher oil prices are expected to boost wealth, economic activity and firm cash
12 flows in oil-exporting nations (Bjørnland, 2009), the previous literature establishes a positive link
13 between oil and stocks. For example, Park and Ratti (2008) and Ramos and Vega (2013) argue
14 that oil price increases boost the stock market of oil-exporting countries, and harm those of oil-
15 importing countries. In the GCC context, Mokni and Youssef (2019) show that the GCC markets
16 have a positive relation with oil prices. Mokni and Youssef (2019) and Mohanty *et al.* (2011) argue
17 that, except for Kuwait, GCC stocks have positive exposures to oil price innovations. Thus, our
18 results are broadly consistent with these findings, in that we note a positive relation as well as the
19 Kuwaiti market isolation from oil shocks. As noted, the insignificant result for Qatar may arise as
20 gas is its main export, while for Bahrain, the oil industry is comparatively small. Nonetheless, our
21 findings do contrast with those of Fayyad and Daly (2011) who argue that Qatar and the UAE
22 exhibit the highest sensitivity to oil shocks in the GCC bloc. Equally, the results contrast with Al
23 Janabi *et al.* (2010), who find that the relation between oil prices and GCC stock markets is weak.
24 Further, it is of interest to note that the large oil producers, Saudi Arabia and Abu Dhabi, are not
25 affected by oil price volatility despite the positive oil return relation. For the UAE this may arise
26 from its increased economic diversification with recently established service and tourism
27 industries (see Callen *et al.*, 2014). Equally, the large nature of the Saudi Arabian market, with 50%
28 of total GCC market capitalisation, may provide some resilience to oil price swings. Conversely,
29 the smaller GCC markets in Bahrain and Oman are more vulnerable to oil return volatility.
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44 In regard of the other coefficients, the signs of VIX and GEPV are negative but not
45 significant (except the VIX for Saudi Arabia). The world portfolio is strongly positive especially
46 in the markets of Dubai and Qatar where the coefficient is twice as large as its Kuwaiti, Omani
47 and Bahraini counterparts. Such results hint at higher levels of global integration in the markets of
48 Dubai and Qatar (see Ziadat *et al.*, 2020).
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55 *Oil shocks and GCC markets*
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3 Having conducted an initial examination of the effect of oil price changes on stock returns, we
4 now consider the impact of different oil price shocks. The oil price shocks are intended to capture
5 unexpected oil price innovations. For this, we use the decomposition of Ready (2018) and examine
6 the effect of supply, demand, and risk shocks. We consider this first in the usual linear regression
7 before turning to the quantile regression framework.
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12 Table 3 illustrates the impact of the different oil price shocks on the GCC markets while
13 controlling for the influence of GEPU and the MSCI world index.⁶ The results presented here
14 suggest an interesting pattern of influence emerges and one that appears to contradict the results
15 of similar and recent analysis across global markets. Notably, where research finds the influence
16 of shocks is significant and negative (see Ready, 2018; Demirer *et al.*, 2020), our results support
17 a positive effect arising only from oil supply shocks.
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22 Demirer *et al.* (2020), Wang *et al.* (2013), Guntner (2014) and Jung and Park (2011) show
23 that oil price increases, triggered by stronger global demand for oil, are associated with higher
24 stock market returns across all countries, regardless of the classification of the country as an
25 exporter/importer of oil. However, our results do not share such a conclusion. Although the
26 coefficient on demand shocks is positive throughout, it is only significant for Qatar (and marginally
27 for Dubai). Given that oil demand shocks constitute good news for the global economy, the relative
28 high integration of Qatar and Dubai (when compared with the rest of GCC markets) into the world
29 economy, might explain this result. A further channel to this effect may arise through spillovers
30 from global financial markets given the integration of Qatar and Dubai (see Ziadat *et al.*, 2020).
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35 The strongest factor influencing GCC stock returns is evidently oil supply shocks. The
36 influence is positive and significant in all GCC markets, albeit only at the 10% significance level
37 for the UAE markets of Dubai and Abu Dhabi. This result run counter to the literature that relies
38 on the Kilian (2009) decomposition method (see, Kilian and Park, 2009; Abhyankar *et al.*, 2013;
39 Kim and Vera, 2019) where the findings point to only a trivial impact of oil supply shocks. Using
40 the Ready (2018) decomposition, Demirer *et al.* (2020) find that supply shocks have a significant
41 and negative effect on stock market returns for the majority of 21 countries examined.
42 Interestingly, Demirer *et al.* (2020) incorporate the oil-exporters of Canada, Mexico and Norway
43 in their analysis. However, they only find positive links between oil supply shocks and Canadian
44 stocks whereas, similar to oil-importers, a negative effect is found for Mexico and Norway.
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⁶ The effect of VIX is now captured within the oil price shocks.

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3 Accordingly, the positive link between oil supply shocks and stocks appears to be a unique feature
4 of the GCC region.
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6 In the method of Ready (2018), the oil supply shock is obtained as the residual after
7 incorporating both the demand and risk shocks. Ready reports that this shock is responsible for
8 80% of the change in oil prices. Hence, the results reported here may stem from a broad range of
9 underlying variables. For instance, Malik and Umar (2019) argue that oil supply shocks could be
10 triggered by issues linked to unexpected changes in proven reserves, technologies related to oil
11 well completions and oil recovery. Clements *et al.* (2019) argue that the oil supply shocks, defined
12 by Ready (2018), can be linked to an exogenous measure of precautionary demand, reflecting
13 future oil supply uncertainty rather than contemporaneous supply changes. In seeking to
14 understand the results for the GCC markets, while acknowledging the strong ties between the GCC
15 economies as well as the impact of supply shocks on the price of oil, Filis and Chatziantoniou
16 (2014) argue that the magnitude of the stock market reaction to oil price shocks is higher for new
17 or less liquid stock markets, which will apply to several GCC markets. Further, the lack of hedging
18 instruments in emerging markets can increase their sensitivity to oil shocks (Balcilar *et al.*, 2019).
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30 *Oil price shocks and the state of the market*

31 While the above results examine the links between oil price shocks and GCC stock markets in a
32 linear model, here, we consider the impact of oil shocks across different market states. Developed
33 by Koenker and Bassett (1978), the quantile regression estimates the effects of explanatory
34 variables on the conditional quantile of the dependent variable. Therefore, in addition to the
35 average (median) dependence, the quantile regression offers information regarding tail
36 dependence. There are several advantages in using the quantile regression approach, for example,
37 Baur (2013) notes the ability of the model to capture the changing nature of dependence across
38 different market conditions, from bullish to bearish. Moreover, this allows examination of the
39 whole return distribution rather than, for example, two or three market states in a regime switching
40 model. Further, quantile regression estimators are robust to heteroskedasticity and skewness of the
41 dependent variable (Koenker and Hallock, 2001).
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51 Table 4 depicts the quantile coefficient estimates for oil supply, demand and risk shocks
52 for each GCC market. The first two quantiles correspond to a bear market phase, the upper
53 quantiles reflect bull market conditions, with the middle quantiles representing normal market
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3 states. As a general observation, the coefficients of oil demand shocks tend to increase with the
4 quantiles, while those for oil supply shocks decrease and with no clear pattern for the risk shock.
5 An interesting pattern also develops in the statistical significance of the demand and supply shocks
6 over the quantiles, with the demand shocks typically significant at higher (bull market) quantiles
7 and supply shocks significant at lower (bear market) quantiles.
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12 Oil demand shocks exhibit mid and upper tail dependence with the stock return conditional
13 distribution in Saudi Arabia, Qatar, Kuwait and Dubai, while upper-tail⁷ only dependence is
14 reported for Abu Dhabi. This leaves the markets of Oman and Bahrain for which oil demand
15 shocks are wholly insignificant. An oil demand shock is associated with higher demand for oil due
16 to expansion in the global economy and the findings here are consistent with those of Ready (2018)
17 in supporting a positive link between stock markets and oil demand shocks.⁸
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23 The quantile process estimates show clear evidence of lower-tail dependence between oil
24 supply shocks and GCC returns. For the first quantile (Q1), which represents a bear market phase,
25 oil price shocks exert a significant positive impact on all GCC markets. When comparing our
26 results with those of Ziadat *et al.* (2022), they report lower tail dependence between oil
27 precautionary demand shocks and GCC markets. The discrepancy is a result of the different
28 approach in constructing oil shocks. Nonetheless, our results appear consistent with the view of
29 Balcilar *et al.* (2019) who state that financial market responses to oil shocks are stronger during
30 extreme market conditions. Moreover, given the general view in the literature, which points to a
31 negative impact of oil supply shocks on stocks, among oil importers and some oil exporters, the
32 results here convey important insights for the potential of cross-regional diversification.
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40 You *et al.* (2017) and Le and Zheng (2011) report that the impact of oil price shocks on
41 stocks mainly occurs when stock markets are in a bull or bear phase, indicating that the relation
42 between stocks and oil shocks are governed by investor (optimistic or pessimistic) sentiment.
43 Furthermore, citing factors related to less sophisticated investors in emerging markets, You *et al.*
44 (2017) and Lee and Zeng (2011) argue that investors might display irrational behaviour when
45 facing instabilities in oil markets. This argument is therefore applicable to the GCC markets given
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52 ⁷ The markets of Dubai and Kuwait also exhibit lower-tail dependence with oil demand shocks.

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54 ⁸ The lack of significance for Bahrain and Oman may arise from their relatively small market capitalisation (Oman
55 and Bahrain combined constitute only 4% of total GCC market capitalisation as of 2016). While smaller firms are
56 likely to be less globally connected, the low capitalisation is also associated with poor liquidity, which will be less
57 attractive to global investors. Indeed, we can see only a small response to changes in the world portfolio (see Table 3)
58 when compared with other GCC markets.
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3 GCC investor profiles and the importance of oil to GCC economies. Thus, the positive oil price
4 supply shock may be an indicator of improving economic conditions (possibly via the
5 aforementioned fiscal channel) in GCC economies, thus, boosting their confidence in future stock
6 market behaviour.
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10 To further elaborate on the lower-tailed dependence between oil supply shocks and GCC
11 markets, we consider the role of geopolitical factors. This is motivated by the fact that a
12 considerable share of global oil supply is produced in the region, which has experienced a history
13 of conflict and wars. Cheikh *et al.* (2021) report substantial sensitivity of GCC markets to
14 geopolitical stress. Antonakakis *et al.* (2017) maintain that aggregate demand shocks transmit most
15 of the information to stock markets during periods characterised by economic-driven events, while
16 supply and oil precautionary demand shocks prevail during periods of geopolitical unrest. Such
17 events can trigger change in both financial markets and portfolio allocations (Kollias *et al.*, 2013).
18 This supports the view that when oil supply shocks concur with geopolitical tensions, the changing
19 risk appetite of investors can lead to such results.
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29 **6. Summary and Conclusion.**

30 Motivated by the importance of oil as a commodity to the world economy and especially the GCC
31 bloc, this study characterises the links between oil price shocks and GCC stock markets. The
32 analysis utilises the oil price decomposition of Ready (2018) and monthly data from February 2004
33 to December 2019. The results reveal that the type of shock is important for GCC markets. While
34 the previous literature argues that supply-side shocks have a negative or negligible impact on
35 global markets, our results support a significant positive effect on GCC stocks. Such a result
36 reflects the heavy dependence on oil revenue and the structure of the GCC economies. That said,
37 when examining the relation across the stock return distribution, we also find that oil demand
38 shocks exhibit a positive relation with stock returns during a bull market, while the effect of the
39 supply shock is more evident in bear market conditions.
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48 From an academic standpoint, this study provides a comprehensive and up-to-date
49 examination of the oil-stock nexus for the GCC markets using decomposed measures of oil price
50 innovations. The results convey important information to global investors, as the characterisation
51 of the links between individual GCC markets and oil shocks enhance our understanding of inter-
52 market relations and the effects on portfolio compositions in an inter and intra-regional
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3 perspective. Moreover, given that portfolio diversification is achieved by investing in different
4 classes of assets or investing in similar classes of assets in multiple markets through international
5 diversification, the results here can improve decision making for asset allocation. Likewise,
6 hedging is of interest to investors and policymakers. In particular, the severe global uncertainties
7 of recent years have experienced a resurgence of extreme losses in financial markets and provide
8 and impetus to the need for having the tools to predict them. Within this, the potential for empirical
9 frameworks to foresee extreme events is dependent on their ability to account for tail dependencies,
10 which typically portray financial returns.
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13 Finally, in terms of limitations, we acknowledge that the ‘error-in-variables’ issue is a
14 potential concern in the two-step approach adopted in this paper. Moreover, given that the impact
15 of oil shocks can be contingent on the nature of the industry, a natural extension to our study may
16 involve a sectoral examination of the links between oil price shocks and GCC markets.
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Table.1 Summary Statistics

	Abu Dhabi	Bahrain	Dubai	Kuwait	Oman	Qatar	Saudi Arabia	World	GEPU
Mean	0.005	0.001	0.005	0.000	0.002	0.005	0.003	0.005	0.000
Median	0.004	0.001	-0.001	0.000	0.002	0.004	0.009	0.011	-0.012
Maximum	0.359	0.092	0.382	0.139	0.162	0.260	0.187	0.096	0.769
Minimum	-0.196	-0.135	-0.408	-0.224	-0.250	-0.272	-0.278	-0.173	-0.496
Std. Dev.	0.065	0.033	0.096	0.047	0.049	0.078	0.076	0.037	0.176
Skewness	0.586	-0.404	0.052	-0.912	-0.575	-0.304	-0.694	-1.112	0.730
Kurtosis	8.235	4.942	6.128	7.960	6.936	4.759	4.486	5.743	5.022
Jarque-Bera	229.013	35.225	77.940	222.227	133.837	27.569	32.897	99.253	49.487
Probability	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PP test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Oil demand shock	Oil supply shock	Oil risk shock	VIX	Oil	Oil volatility	GEPU
Mean	-0.103	-0.467	-0.027	0.001	0.003	0.011	0.000
Median	-0.002	-4.096	0.304	-0.017	0.017	0.007	-0.012
Maximum	11.317	73.905	19.859	0.853	0.297	0.110	0.769
Minimum	-12.246	-43.897	-26.878	-0.486	-0.533	0.001	-0.496
Std. Dev.	4.615	19.257	7.197	0.205	0.105	0.014	0.176
Skewness	-0.045	1.000	-0.653	0.619	-1.234	3.755	0.730
Kurtosis	2.873	4.581	4.499	4.353	8.007	20.510	5.022
Jarque-Bera	0.193	51.731	31.444	26.773	247.968	2888.971	49.487
Probability	0.908	0.000	0.000	0.000	0.000	0.000	0.000
PP test	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes. The sample period runs from February 2004 to December 2019 including 191⁹ monthly observations. Std. Dev. and PP test stand for Standard deviation and Phillip-Perron test. GEPU is the Global Economic Policy Uncertainty. GCC national return series, MCSI world index, oil, VIX, and GEPU are calculated using the first logarithmic difference.

⁹ An exception to this is the GCC spillover index where the sample runs from December 2009 to December 2019 generating 137 observations.

Table.2 GCC returns response¹⁰ to oil price change and volatility

Country		C	Oil	Oil Vol	VIX	GEPU	World	Adj. R2
Abu Dhabi	Coeff	0.010	0.090	-0.534	-0.015	-0.001	0.285	0.076
	P Value	0.082	0.022	0.248	0.502	0.967	0.029	
Bahrain	Coeff	0.010	0.026	-0.939	0.000	0.000	0.170	0.264
	P Value	0.000	0.138	0.000	1.000	0.958	0.006	
Dubai	Coeff	0.012	0.178	-0.912	-0.024	-0.013	0.682	0.177
	P Value	0.163	0.005	0.087	0.444	0.644	0.000	
Kuwait	Coeff	0.009	0.038	-0.981	-0.022	0.014	0.390	0.271
	P Value	0.050	0.303	0.021	0.100	0.257	0.006	
Oman	Coeff	0.008	0.094	-0.753	-0.023	0.004	0.340	0.237
	P Value	0.050	0.029	0.002	0.197	0.779	0.003	
Qatar	Coeff	0.004	0.116	-0.227	-0.039	0.043	0.749	0.195
	P Value	0.602	0.224	0.528	0.128	0.236	0.005	
Saudi Arabia	Coeff	0.002	0.141	-0.243	-0.055	0.022	0.690	0.205
	P Value	0.708	0.003	0.428	0.021	0.395	0.000	

Notes. The regressions above are generated by regressing oil returns, oil realised volatility, the VIX index, and Global Policy Uncertainty (GEPU) and the MSCI world portfolio on GCC equity returns. C, Coeff and Oil Vol stand for constant, coefficient and oil volatility, respectively. The equations runs as follows: $GCC\ market\ return_{i,t} = C_{0,i} + \beta_1 Oil_{i,t} + \beta_2 Oil\ Vol_{i,t} + \beta_3 VIX_{i,t} + \beta_4 GEPU_{i,t} + \beta_5 World_{i,t} + \varepsilon_{i,t}$. The P Value is based on the robust standard errors of Newey-West (1987). The sample ranges from February 2004 to December 2019 yielding a total of 191 observations.

¹⁰ We acknowledge that the coefficients are small in value. This is in common in this stream of literature. For example, using the decomposition method of Kilian (2009), Ziadat et al. (2022) report significant results in the GCC context, yet, similar to our paper, the coefficients are small. Similar findings are reported by Apergis and Miller (2009).

Table.3 GCC returns response to oil price shocks

Country		C	Supply	Demand	Risk	GEPU	World	Adj. R2
Abu Dhabi	Coeff	0.003	0.002	0.000	0.000	0.004	0.486	0.071
	P Value	0.568	0.093	0.785	0.581	0.841	0.054	
Bahrain	Coeff	-0.001	0.001	0.001	0.000	0.003	0.370	0.171
	P Value	0.760	0.021	0.374	0.454	0.782	0.027	
Dubai	Coeff	0.002	0.003	0.003	0.000	-0.013	0.812	0.168
	P Value	0.859	0.083	0.070	0.985	0.658	0.066	
Kuwait	Coeff	-0.003	0.001	0.000	0.000	0.017	0.665	0.216
	P Value	0.513	0.042	0.516	0.325	0.213	0.023	
Oman	Coeff	0.000	0.002	0.002	0.000	0.005	0.401	0.196
	P Value	0.994	0.011	0.124	0.783	0.729	0.036	
Qatar	Coeff	0.002	0.002	0.004	0.000	0.034	0.849	0.240
	P Value	0.771	0.014	0.013	0.346	0.356	0.013	
Saudi Arabia	Coeff	0.000	0.002	0.003	0.000	0.020	0.734	0.192
	P Value	0.978	0.013	0.129	0.746	0.440	0.001	

Notes. C, Coeff, Supply, Demand and Risk stand for constant, coefficient, oil supply shocks, oil demand shocks and oil risk shocks, respectively. Oil price shocks are measured using the method of Ready (2018). The rest of the variables are the VIX index, and Global Policy Uncertainty (GEPU) and the MSCI world portfolio and the dependent variable is the stock market return of each GCC nation. The equations runs as follows: GCC market $\text{return}_{i,t} = C_{0,i} + \beta_1 \text{Supply}_{i,t} + \beta_2 \text{Demand}_{i,t} + \beta_3 \text{Risk}_{i,t} + \beta_4 \text{GEPU}_{i,t} + \beta_5 \text{World}_{i,t} + \varepsilon_{i,t}$. The P Value is based on the robust standard errors of Newey-West. The sample ranges from February 2004 to December 2019 yielding a total of 191 observations.

Table. 4 GCC returns dependence structure with oil price shocks

		Abu Dhabi		Bahrain		Dubai		Kuwait	
	Q	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.
Oil supply shock	0.100	0.003	0.000	0.001	0.023	0.003	0.000	0.002	0.007
	0.200	0.001	0.098	0.001	0.120	0.002	0.065	0.001	0.007
	0.400	0.001	0.129	0.001	0.088	0.001	0.488	0.000	0.950
	0.600	0.001	0.139	0.000	0.239	0.001	0.213	0.000	0.393
	0.800	0.000	0.958	0.001	0.050	0.001	0.412	0.001	0.058
	0.900	0.001	0.426	0.001	0.048	0.001	0.832	0.002	0.077
Oil Demand shock	0.100	-0.001	0.599	0.000	0.907	0.000	0.938	-0.002	0.049
	0.200	0.001	0.679	0.000	0.817	0.003	0.031	-0.001	0.488
	0.400	0.001	0.244	0.001	0.351	0.003	0.038	0.001	0.254
	0.600	0.002	0.120	0.001	0.446	0.002	0.216	0.001	0.020
	0.800	0.003	0.006	0.000	0.842	0.006	0.001	0.003	0.001
	0.900	0.003	0.014	0.002	0.127	0.009	0.001	0.002	0.380
Oil Risk shock	0.100	0.001	0.114	0.000	0.801	0.001	0.331	0.001	0.078
	0.200	0.000	0.764	0.000	0.688	0.000	0.514	0.000	0.294
	0.400	0.000	0.664	0.000	0.603	-0.001	0.171	0.000	0.543
	0.600	0.000	0.921	0.000	0.492	0.000	0.817	0.000	0.644
	0.800	0.000	0.760	0.000	0.561	0.000	0.687	0.000	0.417
	0.900	0.000	0.748	0.000	0.935	0.000	0.828	0.000	0.846
		Oman		Qatar		Saudi Arabia			
	Q	Coeff	Prob.	Coeff	Prob.	Coeff	Prob.		
Oil supply shock	0.100	0.002	0.017	0.001	0.043	0.003	0.015		
	0.200	0.001	0.062	0.001	0.052	0.002	0.076		
	0.400	0.001	0.059	0.002	0.030	0.001	0.186		
	0.600	0.001	0.281	0.001	0.076	0.001	0.220		
	0.800	0.001	0.233	0.001	0.282	0.001	0.659		
	0.900	0.001	0.396	0.001	0.339	0.002	0.121		
Oil Demand shock	0.100	0.001	0.303	0.001	0.710	0.001	0.581		
	0.200	0.002	0.281	0.003	0.090	0.002	0.262		
	0.400	0.001	0.226	0.003	0.036	0.003	0.044		

	0.600	0.001	0.359	0.004	0.020	0.005	0.002		
	0.800	0.001	0.252	0.006	0.008	0.004	0.009		
	0.900	0.003	0.075	0.007	0.001	0.004	0.026		
Oil Risk shock	0.100	0.000	0.584	0.002	0.019	0.001	0.393		
	0.200	-0.001	0.265	0.001	0.025	0.001	0.413		
	0.400	0.000	0.607	0.000	0.365	0.000	0.895		
	0.600	0.000	0.373	0.000	0.594	-0.001	0.248		
	0.800	0.000	0.874	0.000	0.415	0.001	0.238		
	0.900	0.000	0.891	0.000	0.643	0.000	0.852		

Notes. The table depicts the quantile process coefficients estimated from quantile regression framework wherein stock returns are regressed on oil supply shocks, oil demand shocks, oil risk shocks, GEPU and world index. The latter two variables are controlled for but their results are not reported to conserve space. Q stands for quantile.