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International and Macroeconomic Determinants of Oil Price: Evidence from Gulf Cooperation Council Countries

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ABSTRACT

This study investigates the long- and short-run relationships between oil prices and stock market returns, exchange rates, gold prices, and linear and non-linear output, for the six Gulf Cooperation Council (GCC) countries. The study performs a panel and time-series cointegration and causality analysis based on monthly data from 2005 to 2015. The results indicate co-movement among these variables in the long run. The causality test shows a one-way relationship between oil prices and gross domestic product (GDP), and a two-way relationship between stock returns and oil prices. For robustness, the sample was divided into two sub-periods: Before and after the 2007/2008 global financial crisis. A long-run relationship was found among the variables, but there was no short-run relationship between the variables and oil prices before the crisis. Oil shocks had a significant impact on gold returns and exchange rate growth, while the GDP growth rate affected oil prices. The individual countries' results suggest the presence of a long-run relationship as well as short-run dynamics between selected variables and oil price for a majority of the GCC countries. These results suggest the need for policies aimed at further reducing dependence on oil, since the effect of oil shocks is still significant in these economies.

Keywords: Oil Price, Macroeconomic Dynamics, Panel Cointegration, Dumitrescu-Hurlin Panel Causality Test, Gulf Cooperation Council
JEL Classifications: C23, E31, Q30, Q31, Q35

1. INTRODUCTION

The Gulf Cooperation Council (GCC) is a political and economic alliance comprising Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates (UAE). The GCC owns one-third of the world's total crude oil reserves and is composed of the world's largest oil-exporting countries, with exports of more than 15 million oil barrels/day (OPEC, 2016). The combined gross domestic product (GDP) of the GCC countries amounted to $1635 billion in 2014. Saudi Arabia's GDP represents 46% of the GCC's GDP, followed by the UAE with around 25% (GCC Statistical Center 2014). While some GCC countries (UAE and Qatar) have made more progress than others in diversifying their economies, they are still largely dependent on oil revenue.

Crude oil price, the engine of the GCC economies, shapes these countries' economic developments by directly affecting most macroeconomic variables. Therefore, the price of oil has become a critical issue for governments, enterprises, and investors in the GCC. Recently, oil markets have been affected by substantial price fluctuations. In particular, between 2003 and 2015, large swings in oil prices were associated with significant financial volatility in the GCC. Oil prices have strongly increased since 2003 and peaked in July 2008 to the great benefit of the GCC countries. However, oil prices fell to a 5-year low in December 2008, after the Lehman Brothers bankruptcy, and sharply rebounded after the crisis, rising to $100 per barrel at the end of January 2011. In the period between February 2011 and the end of 2013, the oil price has fluctuated above this level.

The main reason for the dramatic drop in oil prices over the last 2 years has been America's shale oil production boom. Shale oil production has grown to about 4 million barrels per day since 2008. This substantial rise in unconventional oil production was the primary driver of the recent oil supply glut, which has caused a significant fall in oil prices since July 2014 (Mustafa 2016). On 20 January 2016, oil prices dropped to a 13-year low, hitting $27 per barrel before recovering to the $40–50 range.

These price movements had a significant impact on the GCC economies.

Over the past decade, the markets for commodities, such as gold and oil, have experienced a rapid growth in liquidity and volatility. The large swings in gold and oil prices have been associated with the financial crises in 2009 and the huge jump in the price of gold, which was considered a 'safe haven' in 2011/2012, during the Greek debt crisis. In many GCC countries, GDP fluctuations move in alignment with the oil price, showing a high correlation between these oil-based economies and oil prices. Moreover, the GCC stock market index also shows a positive correlation with the oil price, which was very high during the last financial crisis but fell dramatically during the last 2 years. Figure 1 shows the relationship between oil prices and the cumulative GDP of the GCC economies; the gold price and the stock market index represent all GCC economies. We observe both a positive and a negative relationship between these variables during the study period. Therefore, we need to assess this relationship in the long term and address its dynamic causality in the short term to hedge against future risks and design suitable policies for GCC economies.

In the last decades, the price of crude oil has attracted the attention of many scholars, and a large body of literature has focused on the impact of oil prices on GCC countries (Mohanty et al., 2011; Arouri and Rault, 2012; Jouini and Harrathi, 2014). In general, previous related literature indicates that, in these countries, the stock markets benefit from rising oil prices, and shows a positive relationship between oil prices and economic growth. However, little attention has been devoted to the link between oil prices and macroeconomic variables in the GCC area (Nusair, 2016). Recently, several researchers have focused on stock markets and their implications for investment and risk management (Awartani and Maghyereh, 2013; Ma et al., 2014). However, there are other channels through which shocks in oil prices can result in changes in commodity markets and the economic growth rate (Baumeister and Peersman, 2008; Hamilton, 2009a; Kilian and Murphy, 2014; Morana, 2013). Furthermore, previous studies indicate that the impact of macroeconomic variables on oil prices depends on whether a country is an oil-exporting or oil-importing one (Filis et al., 2011; Nazlioglu et al., 2015). Hamilton (2009b) found that the degree of oil price shocks and their impact on the economy have been smaller in recent years compared to the period before 2000. The GCC economies were dependent on oil before 2000 and were characterized by poor macroeconomic performance (Kilian, 2010a). Therefore, it is important to investigate whether GCC economies are moving away from oil dependency or are still relying on oil as their primary revenue source. This study extends previous research by examining the long- and short-term dynamics between oil prices and selected macroeconomic variables. The macroeconomic variables are linear and non-linear industrial production as a proxy for the business cycle, gold price, stock market index, and special drawing rights (SDR) as a proxy for the exchange rate. The contribution of this study is three-fold. First, we analyze oil producing and exporting economies using recent data, i.e., after the last drop in oil prices and the global financial crisis. Further, this study differs from previous studies by avoiding focusing on one explanatory variable only such as the stock market (Arouri and Rault, 2012). Second, this study investigates the impact of a set of domestic internal and international variables on oil prices, while previous studies (Narayan and Smyth, 2007; Apergis and Miller, 2009; Arouri and Rault, 2012) primarily focused on internal factors. Finally, this study investigates the linear and non-linear impact of GDP on oil prices. Previous works mostly assumed a linear relationship with GDP, although few studies looked at the non-linear relationship between stock prices and oil prices (Maghyereh and Al-Kandari, 2007).

The remainder of the paper is organized as follows. Section 2 summarizes the related literature. Section 3 describes the data used in the study, while Section 4 introduces the econometric framework. Section 5 discusses the main findings and Section 6 provides the concluding remarks.

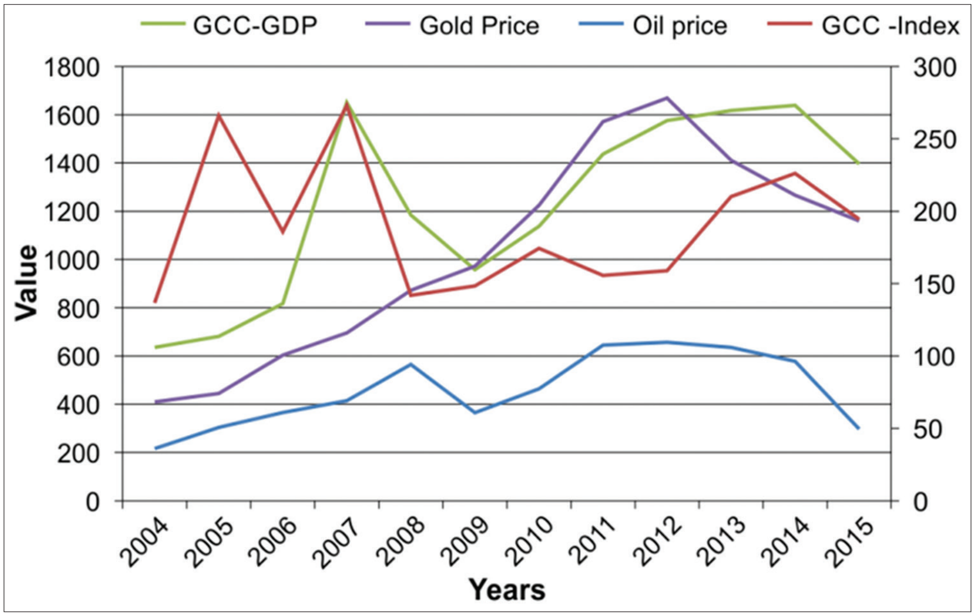
2. BACKGROUND AND LITERATURE REVIEW

In this section, we summarize the theoretical and empirical relationship between oil prices and the selected variables. Historically, gold was considered as money, and still represents "fiat money[1]." Gold is used as input in many industries, such as electronics, medical industry, and space vehicle production. However, the highest demand for gold is driven by precautionary and speculative motives (Street et al., 2016). Gold is often used to hedge against future risk and this use represents 71% of the total gold demand. Previous studies suggest that gold is considered a good hedge against fiat money (Ciner et al., 2013), against inflation (Narayan et al., 2010), and against oil price movements (Reboredo, 2013). Gold as a commodity has been found to have a long-run relationship with oil price (Sari et al., 2010; Zhang and Wei, 2010). Additionally, Le and Chang (2011) found that the oil price could be a predictor of gold price. Since oil is one of the most valuable commodities in both importing and exporting economies, a drop in its price leads to slow economic growth and reduces asset prices. This may induce investors to seek other assets, such as gold, to hedge against this outcome. This is what happened during the recent global financial crisis when oil prices fell sharply, leading investors to target gold as a hedging mechanism. The implications of an oil price increase are stronger for oil-exporting economies than for oil-importing countries. The former invest high revenues derived from soaring oil prices into purchasing gold, which causes the gold price to soar (Le and Chang, 2011). Therefore, a positive correlation between the oil and gold markets is expected. Moreover, a sharp increase in the oil price can cause inflation in the economy and this, in turn, may push investors to search for alternative assets to hedge against inflation. One of the obvious options is gold, which has proven to be a good hedge against inflation (Narayan et al., 2010).

The oil price and exchange rate nexus has been established by several studies focusing on different markets worldwide. Some

1 Fiat money is currency (paper money) that a government has declared to be legal tender but it is not backed by a physical commodity, such as gold or silver. Fiat money is a substantially worthless object; its value is derived from the relationship between supply and demand rather than the objective value of the material the money is made of.

Figure 1: Oil prices, Gulf Cooperation Council (GCC)-gross domestic product, gold prices, and the GCC stock market index from 2005 to 2015



studies suggested a positive relationship, while others found a negative correlation. Moreover, the causality between the oil price and exchange rate was shown to run both ways (Aimer 2016; Altarturi et al., 2016; Arfaoui and Ben, 2016; Beckmann et al., 2016). Narayan (2013) studied a number of Asian economies and found that a higher oil price leads to the appreciation or depreciation of local currencies. This result can be explained by the wealth effect of oil price fluctuations. Backus and Crucini (2000), Kilian and Park (2009), Bodenstein et al. (2011), and Altarturi et al. (2016) indicate that an increase in the oil price shifts wealth from oil-importing countries to oil-exporting economies. This change in wealth depreciates the currency, leading to a current account deficit and portfolio rebalancing (Bénassy-Quéré et al., 2007). Thus, the relationship between the exchange rate and oil price appears to be positive. However, other studies found a negative correlation between the oil price and exchange rate through oil supply, oil demand, and financial market channels. Oil is priced against the US dollar and thus, a dollar depreciation lowers oil prices, potentially inducing oil producers and exporters to reduce oil supply to force the price upward (Yousefi and Wirjanto, 2003; 2005). Similarly, the depreciation of the US dollar may cause the demand for oil to increase (Akram, 2009; Beckmann et al., 2016). The oil price and exchange rate are linked negatively through financial markets due to the described hedging mechanism against US dollar depreciations. Oil futures can help fund managers to hedge and diversify against the US dollar depreciation. Fan and Xu (2011) suggest that, in the last 10 years, many global hedge funds have begun to invest massively in energy futures creating a commodity price bubble. This bubble, which already existed in 2004 and ended before the global financial crisis, implied that the oil market has gone through structural changes (Kaufmann and Ullman, 2009). In other words, the oil price was influenced more by speculation than market forces.

The link between stock returns and the oil price has been extensively studied in the past two decades. Oil price fluctuations influence stock market returns in several ways. For example, oil price volatility can affect economic activity by increasing or decreasing general production cost and consequently, increasing or decreasing asset prices (Huang et al., 1996; Basher et al., 2012; Ciner et al., 2013). This situation can also cause high or low inflation, forcing investors to either buy or dump their stocks for a better hedge (Wang et al., 2013). Similarly, oil price changes can influence corporate earnings by changing production costs, thereby affecting firms' profits (Arouri et al., 2012). Fama (1972) analyzed the efficient market hypothesis and stated that the price of any asset should reflect all the available information about current and future returns. Therefore, stock markets are expected to quickly reflect any new information obtained from oil price fluctuations. According to the traditional efficient market theory, asset prices are calculated using the discounted value of expected future earnings. This means that the impact of oil price fluctuations is reflected in the current and future cash flows of the firms and their stock prices (Apergis and Miller, 2009; Filis et al., 2011; Degiannakis et al., 2014). Previous studies focusing on developed and developing economies found that oil prices are negatively related to stock market returns (Nandha and Faff, 2008; Park and Ratti, 2008; Cunado and de Garcia, 2014). This negative association seems to be related to oil being a possible input in firms' production processes. If the oil price changes, production cost may also change, which is reflected in stock prices. However, other studies found that an increase in oil prices is not always bad news. At the micro level, oil and gas industries are positively affected by oil prices (Huang et al., 1996; Sadorsky, 2001; Boyer and Filion, 2007; McSweeney and Worthington, 2008). When oil prices increase, the stock price of oil and gas companies also rises, causing the relationship to be positive. At the macro level, studies regarding oil-exporting economies found that an increase in oil prices leads to higher stock prices (Jiménez-Rodríguez and Sanchez, 2005; Lescaroux and Mignon, 2008; Bjørnland, 2009; Mohanty et al., 2011; Jammazi, 2012; Guesmi and Fattoum, 2014). The positive link between oil prices and the stock market seems to stem from increases in the income level, which causes more investment in the equity market and results in higher economic activity. In other words, oil-importing economies suffer from an oil price increase, while oil-exporting economies benefit through a wealth transfer phenomenon. Therefore, in our sample, we expect to find a positive link between the oil price and stock market returns.

Economic activity and its link with the main macroeconomic variables have been heavily studied in the past. Similarly, many studies have investigated the relationship between oil price and economic activity, proxied by GDP, gross national product (GNP), GDP per capita, and industrial production (Hamilton, 2003; Lippi and Nobili, 2012). Hamilton (1983; 2005) found that an oil price increase may cause the US GNP to decrease and concluded that an oil price increase could be a major cause of the US recessions. However, a positive link between oil price increases and economic activity was found in oil-exporting economies (Jiménez-Rodríguez and Sanchez, 2005; Lescaroux and Mignon, 2008; Berument et al., 2010). In contrast, recent studies found that a negative link was found in oil-importing economies and weakened many economies. Kilian (2010b) argued that this negative relationship might depend on decreased oil dependence and weak macroeconomic performance. Similarly, not all oil exporting economies maintained the positive link between higher oil prices and economic activity (Mehrara, 2009; Berument, et al., 2010; Filis et al., 2011). Some studies focused on the fact that, in 1986, the collapse in oil prices was not followed by a recession (Kilian, 2008; Hamilton, 2009a). Thus, the non-linear relationship between these variables began being investigated after the 1986 oil price fall. Mork (1989), extending Hamilton's (1983) work, proved that an asymmetric relationship existed between oil price and economic activity after 1986. In other words, the effect of the negative and positive oil price shocks on GDP or economic activity is not symmetric. Mork (1994) found that an oil price decrease might have the opposite effect on economic activity. In contrast, Jiménez-Rodríguez (2009) found that the asymmetric relationship between oil price and GDP is negative. Additionally, he argued that this asymmetric relationship already existed before 1986 and even before 1977. Similarly, Lardic and Mignon (2006) used a normal cointegration procedure and did not find a long-run relationship between the oil price and GDP, while asymmetric cointegration detected their long-run relationship.

3. DATA

The current study's dataset comprises monthly observations collected between January 2005 and December 2015, which generates 132 total observations for all the variables. This number of observations is higher than that generated by Chen et al. (2007), who studied 10 Asian economies from 1971 to 2001 on an annual basis, and is similar to that of Lardic and Mignon (2008), who studied G7 economies from 1970 to 2004 on a quarterly basis. From previous literature, we observed that there is neither a specific data frequency nor interval length required for using panel cointegration tests. The rationale for selecting this period is three-fold. First, the dataset includes observations both before and after the global financial crisis. Second, some economies do not have complete data for industrial production, which is a proxy for the aggregate income or GDP, before 2005. Third, the data covers the most recent drop in oil prices. As mentioned earlier, we provide evidence from the GCC economies and include a set of variables to represent equity, currency, gold, aggregate income, aggregate income squared, and oil prices. Equities are represented by the local stock market index in each GCC country. We use the SDR as a proxy for exchange rates because most GCC countries have a fixed exchange rate against the US currency. For gold, we use the international price of gold obtained from the data stream database. Finally, the oil price is the closing price of the West Texas crude oil index. All variables are expressed in US dollars to ensure consistency. All data are obtained from the data stream database. The GCC countries are oil-exporting economies and are therefore, considered as net exporting countries.

Our final multivariate model utilizes the following variables: Oil price (lnoil), industrial production and industrial production squared in US dollar (lnip and lnips), SDR against each currency of the GCC (lnSDR), gold prices in US dollars (lngold), and the closing prices of the local stock market index (lnindex). Previous results regarding the links between oil price and the selected variables can be summarized as follows. In the relationship between the gold price and oil price, Zhang and Wei (2010), Le and Chang (2012), Reboredo (2013), and Wang and Chueh (2013) observed a long-run relationship between the two variables. Studies focusing on the link between a stock market index and oil price as well as the relationship between oil price and exchange rate, found that these links exist in the long run (Cunado and de Garcia, 2014; Narayan and Gupta, 2015; Bondia et al., 2016). Lastly, the link between GDP and oil price was one of the most heavily studied relationships in previous literature, and these two variables were proved to be linked both in the long and short run (Apergis and Payne, 2014; Chai et al., 2015). In this study, all selected variables were transformed using natural logarithms to ensure consistency in the magnitude of the coefficients. These variables are selected due to their links to oil price. For instance, oil price was found to be highly correlated with economic activity (Hamilton 2003; Lippi and Nobili, 2012). However, Hamilton (2009a) showed that this link is not as strong as it was before 2000. Moreover, the relationship between oil price and economic activity has a spillover on the exchange rate and stock market. In oil-exporting economies, a higher oil price increases revenues and results in a current account surplus. However, the GCC economies maintain a fixed exchange rate against the US dollar, and thus, SDR is chosen as a proxy for the exchange rate. Additionally, shocks in oil prices are linked to stock market fluctuations, considered as a hedge against the inflation caused by higher production costs. Therefore, the individual stock market index of each GCC economy is used to control for this relationship.

Oil is considered a commodity and is used as an investment tool to obtain future returns. Similarly, gold is also considered a commodity and is used to hedge against oil price fluctuations. Previous studies found that gold price movements could be predicted by shocks in oil prices, implying that gold is accepted as a substitute for oil when its price decreases. To account for this link, we included gold prices in our data.

Table 1 shows the descriptive statistics of the selected variables after calculating the natural logarithm of the original values. The growth rate of oil price is 4.33% on average for all GCC countries across the sample period. The variable lnSDR showed the lowest growth rate (0.54%). The industrial production squared, stock market index, and gold price scored the highest growth rates of 9.33%, 6.69%, and 5.56%, respectively (Figure 2).

Since this study aims to examine the long-run relationship between oil price and the selected variables, the level of integration of these series must be detected. To determine the variables' order of integration in a panel framework, a unit root test must be implemented. Breitung (2000) and Im et al. (2003) used the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, respectively. These tests assume either homogeneity (Breitung, 2000) or heterogeneity (Im et al., 2003) in the cross-sections.

Table 1: Descriptive statistics of the selected variables

Statistic	lnoil	lnips	lnip	lngold	lnSDR	lnindex
Mean	4.33	9.33	4.66	5.56	0.54	6.74
Median	4.35	9.31	4.65	5.62	0.57	6.69
SD	0.28	0.22	0.11	0.34	1.18	0.46
Skewness	−0.44	0.27	0.27	−0.35	−0.02	0.24
Kurtosis	2.41	2.80	2.80	2.23	1.03	2.99
Observations	792	792	792	792	792	792

SD: Standard deviation, SDR: Special drawing rights

Table 2: Unit root test results

Variable	Level		First difference	
	Breitung	Im et al.	Breitung	Im et al.
lnoil	1.09	−0.48	−9.49*	−11.32*
lnip	−0.25	−1.24	−2.85*	−2.79*
lnindex	−0.22	−1.49	−12.34*	−15.21*
lnSDR	1.92	2.07	−12.19*	−14.42*
lngold	4.86	5.89	−15.85*	−24.46*
lnips	−0.35	−0.25	−11.38*	−15.01*

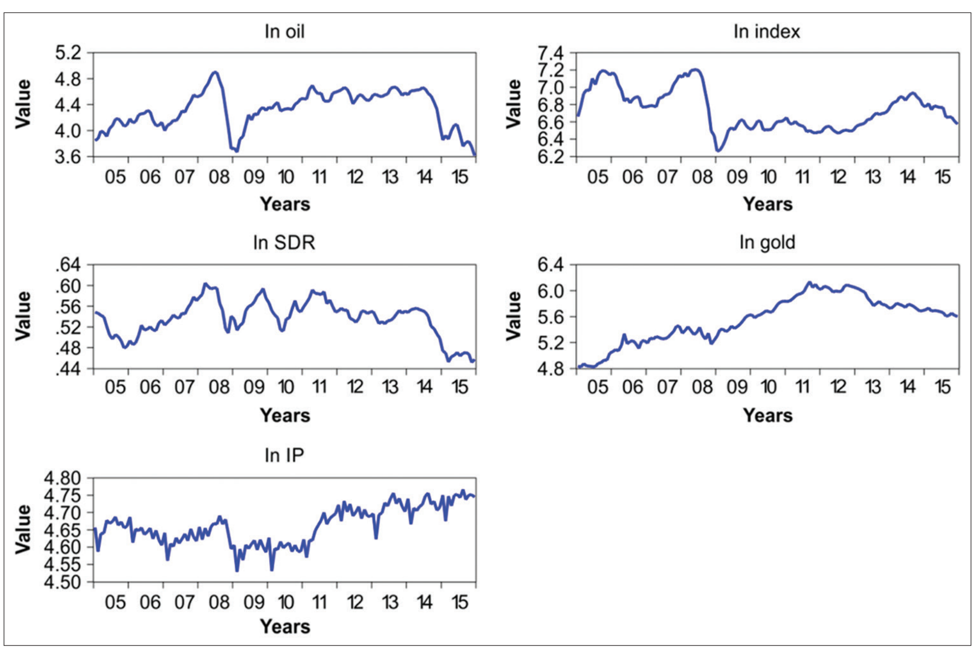
The lag length selection is based on the Schwarz information criterion. *Indicates significance at 1% level. SDR: Special drawing rights

In this study, we use both Breitung's (2000) and Im et al. (2003) approaches. The former is based on the assumption that all cross-sections follow a common unit root process, while Im et al., (2003) imply that each cross-section has an individual unit root process. Both tests investigate the null hypothesis of the absence of a unit root against the alternative of a unit root. If the null hypothesis is not rejected in any of these tests, the series are considered non-stationary. Table 2 reports the unit root tests' results: Oil price, aggregate income squared, SDR, gold price, and stock market prices are integrated to the order of one or I(1).

4. METHODOLOGY

The next step is to assess whether the selected variables are cointegrated. In other words, we need to examine the existence of a long-run relationship between the variables or whether such variables co-move in the long run. We used Pedroni's (1999) and Kao's (1999) panel cointegration tests to investigate this relationship. Both tests are based on the Engle-Granger two-stage cointegration test framework, which examines the stationarity of the residuals of the long-term regression model. To verify the stationarity of the residuals from equation (1), Pedroni (1999) proposed two groups of cointegration tests. First, the 'within' dimension test, which presents four statistics: Panel v, panel ρ, panel PP, and panel ADF, assumes homogeneity within the cross sections and examines the regression residuals by pooling the within dimension of the panel residuals. The second test uses the 'between' dimension and includes three statistics: Group ρ, Group PP, and Group ADF. Kao's (1999) procedure resembles Pedroni's (1999) test but specifies a cross-section-specific intercept and assumes a homogenous coefficient during the first stage. In other words, it assumes heterogeneity in intercept a_i and homogeneity in b_i, and all of the trend's coefficients, φ_t, are assumed to be zero. The representation of the test is as follows:

Figure 2: Dynamics of oil price, exchange rate, stock price index, and gross domestic product for Gulf Cooperation Council economies from 2005 to 2015



$$\text{lnoil}=\alpha_i+\phi t+\beta_{1i}\text{lnip}+\beta_{2i}\text{lngold}+\beta_{3i}\text{lnSDR}+\beta_{4i}\text{index}+\varepsilon_{it} \quad (1)$$

Where t = 1, 2,…T; i = 1,2,….N; a_i and φ_i represent the intercept and time trend, respectively.

To estimate the long-run causality between all selected variables and oil price, we used Stock and Watson's (1993) dynamic ordinary least squares (DOLS) approach and Kao and Chiang's (2000) panel DOLS estimator. These two tests include leads and lags of the independent variables when estimating the relationships of interest. Previous studies used several other methodologies; however, Kao and Chiang (2000) found that the DOLS method is superior to other methods, such as OLS and fully modified OLS.

Additionally, in this study, Granger and Lee's (1989) two-step model was modified. In the first step, the long-run model is estimated and the residuals are obtained. In the second step, the residuals obtained from the first stage are used to determine the speed of adjustment in the error correction model[2]. Finally, the lag length criterion used for the unit root, cointegration, and causality tests is the one that minimizes the Schwarz information criterion.

5. RESULTS AND DISCUSSION

As mentioned in the previous section, the observations are classified into three samples. The full sample covers the period from January 2005 to December 2015, the second sample comprises the period before the crisis, from January 2005 to July 2008, and the last sub-sample covers the period after the global financial crisis, from February 2009 to December 2015. We split the sample based on the apparent structural break in the oil price, as shown in Figure 1.

Table 3 reports the cointegration results of the Pedroni panel cointegration test with three specifications: The seven statistics and weighted statistics (except the Panel ADF for no intercept and no trend) reject the null hypothesis of no cointegration in the full sample. Furthermore, based on the Kao panel cointegration test, we found long-run relationships between the variables in the full sample. In other words, these variables tend to co-move in the long run although they might diverge in the short term. Therefore, we provide evidence of the existence of long-run relationships among these variables, meaning that there is a causal relationship between the variables in at least one direction; however, the direction of causality is unknown. The results of the cointegration analysis are in line with Zhang and Wei (2010), Le and Chang (2012), Wang and Chueh (2013), and Reboredo (2013) regarding the relationship between the gold price and oil price; with Halaç et al. (2013), Cunado and de Garcia (2014), Narayan and Gupta (2015), and Bondia et al., (2016) regarding the link between oil price, stock market price, and exchange rate; and with Apergis and Payne (2014) and Chai et al. (2015) regarding the relation between the oil price and GDP.

2 If the speed of the adjustment coefficient is significant, a causal relationship exists.

Since these variables are found to be cointegrated, the Dumitrescu and Hurlin (2012) panel causality test is applied to specify the direction of the causal relationship. The Dumitrescu-Hurlin procedure has been used in several studies linking energy prices to different variables (Candelon et al., 2013; Herrerias et al., 2013; Bilgili and Ozturk, 2015; Alam et al., 2017). The short-run dynamics between each variable and the oil price are reported in Table 4 for the three different samples.

Table 4 reports the results of the Granger causality test between the oil price change and the selected variables for the full sample. The results suggest that an oil price change leads to the linear and non-linear growth of the GDP, while a gold price change causes shifts in the oil price. In term of feedback or bi-directional causality, only stock market returns show feedback causality with the oil price. Further, the gold price change and stock market returns show feedback causality in the full sample. The exchange rate change appears to cause gold price change and stock market returns in the short run. Lastly, stock market returns unidirectionally cause linear growth in the GDP of GCC countries.

In contrast, the gold price and exchange rate cause an oil price change in the period before the financial crisis. Additionally, stock market returns seem to lead the oil price change. However, the oil price change appears to cause the linear growth of the GDP in all samples, while the non-linear output is caused by oil price growth in the two sub-samples. The growth of the exchange rate, proxied by SDR, is caused by the oil price change in the full sample as well as the sub-sample after the crisis. Lastly, stock market returns are caused by the oil price change in all samples, but, only in the full sample and in the sub-sample before the crisis, stock market returns is caused by an oil price change. In other words, the only variable that shows feedback causality with the oil price change is stock market returns. This result is similar to Beckmann and Czudaj (2013), Benhmad (2013), Chang et al. (2013), Pradhan et al. (2015), and Jain and Biswal (2016) with respect to the relationship between oil price, gold price, exchange rate, stock market returns, and the GDP growth rate.

With respect to the long-run relationship in individual countries, Tables 5–7 report the results of the DOLS regression. The first part of these tables reports the results of the DOLS to test the long-run relationship between the oil price and all selected variables for each country and for the panel of countries.

Table 5 shows that, in the full sample, all variables influence oil prices in the long run, except linear and non-linear industrial production, which are significant only for Qatar. The results indicate that, in the long term, the linear and non-linear economic situations do not influence the oil price. Concerning the panel coefficient, all variables are positively correlated with oil prices. Regarding the short-run causality, Panel B of Table 6 shows that the exchange rate growth and stock market returns significantly cause oil price changes, except in Oman. The linear and non-linear economic growth rates influence oil prices in Kuwait, Qatar, and Saudi Arabia. The return on gold does not influence oil prices in any country. The error correction term (ECT) for all countries is negative and significant, ranging from 0.10 in Oman to 0.28 in

Table 3: Panel cointegration tests (2005–2015)

Pedroni test	Individual intercept		Individual intercept and trend		No intercept/trend	
	Statistics	Weighted statistics	Statistics	Weighted statistics	Statistics	Weighted statistics
Within dimension						
Panel v-statistics	5.10*	4.52*	3.29*	2.82*	3.30*	3.15*
Panel ρ-statistics	−2.81*	−2.45*	−1.58***	−1.32***	−2.12**	−2.05**
Panel PP-statistics	−2.55*	−2.23**	−1.79**	−1.49***	−1.98**	−1.90**
Panel ADF-statistics	−1.84**	−1.60***	−1.72**	−1.39***	−1.12	−1.02
Between dimension						
Group ρ-statistic	−2.86*		−1.37***		−1.47***	
Group PP-statistic	−2.74*		1.74**		−1.65**	
Group ADF-statistic	−1.93**		−1.63***		−0.62	
Kao test ADF	−7.53*					

*, **, and ***indicate significance at 1%, 5%, and 10% level, respectively. ADF: Augmented Dickey-Fuller, PP: Phillips-Perron

Table 4: Dumitrescu-Hurlin panel causality test results

Null hypothesis	Full sample	
	Zbar-Stat.	P
D (lnip) does not homogeneously cause D (lnoil)	−0.50	0.62
D (lnoil) does not homogeneously cause D (lnip)	9.99*	0.00
D (lngold) does not homogeneously cause D (lnoil)	−2.01**	0.04
D (lnoil) does not homogeneously cause D (lngold)	1.21	0.23
D (lnSDR) does not homogeneously cause D (lnoil)	−1.01	0.31
D (lnoil) does not homogeneously cause D (lnSDR)	0.67	0.50
D (lnindex) does not homogeneously cause D (lnoil)	2.31**	0.02
D (lnoil) does not homogeneously cause D (lnindex)	8.99*	0.00
D (lngold) does not homogeneously cause D (lnip)	−0.95	0.34
D (lnip) does not homogeneously cause D (lngold)	−1.09	0.28
D (lnSDR) does not homogeneously cause D (lnip)	−1.24	0.21
D (lnip) does not homogeneously cause D (lnSDR)	0.78	0.44
D (LNINDEX) does not homogeneously cause D (lnip)	3.54*	0.00
D (lnip) does not homogeneously cause D (lnindex)	0.20	0.84
D (lnSDR) does not homogeneously cause D (lngold)	6.39*	0.00
D (lngold) does not homogeneously cause D (lnSDR)	1.61	0.11
D (lnindex) does not homogeneously cause D (lngold)	−1.68***	0.09
D (lngold) does not homogeneously cause D (lnindex)	1.87***	0.06
D (lnindex) does not homogeneously cause D (lnSDR)	0.47	0.64
D (lnSDR) does not homogeneously cause D (lnindex)	5.36*	0.00
D (lnips) does not homogeneously cause D (lnoil)	−0.50	0.62
D (lnoil) does not homogeneously cause D (lnips)	9.99*	0.00

*, **, and ***indicate significance at 1%, 5%, and 10% respectively. SDR: Special drawing rights

Table 5: DOLS long-run and short-run coefficients (full sample)

Country	lnSDR	lnip	lngold	lnindex	lnips	ECT
Bahrain	5.12*	0.20	0.53*	0.66*	0.10	
Kuwait	5.19**	0.61	0.65*	0.75*	0.31	
Oman	3.15*	−0.50	0.41*	0.51*	−0.25	
Qatar	3.15*	1.98*	0.54*	0.40*	0.99*	
Saudi Arabia	5.86*	−0.19	0.47*	0.54*	−0.10	
UAE	5.32*	−0.52	0.63*	0.37*	−0.26	
Penal	5.16*	0.34**	0.36*	0.29*	0.17**	
Panel B: Short-run coefficients						ETC(−1)
Bahrain	2.72**	1.03	0.45	0.91*	0.52	−0.17*
Kuwait	3.65**	0.74***	0.42	0.87*	0.55***	−0.11**
Oman	1.62	−0.62	0.51	1.10	−0.31	−0.10**
Qatar	1.90***	1.06**	0.47	0.74*	0.53**	−0.22*
Saudi Arabia	4.50*	0.5***	0.15	0.57*	0.43***	−0.28*
UAE	3.62*	0.21	0.47	0.47*	0.11	−0.22*

*, **, and ***indicate significance at 1%, 5% and 10%, respectively. SDR: Special drawing rights, UAE: United Arab Emirates, DOLS: Dynamic ordinary least squares

Saudi Arabia, supporting the long-run causality, since all variables seem to influence the oil price. Concerning the individual long-run coefficients, the results indicate that a 1% increase in the oil price leads to an increase in the exchange rate from 3.15% to 5.86% on average. Similarly, oil price changes lead to an increase in the gold price from 0.41% to 0.65% and in the stock market index from 0.40% to 0.75%. Lastly, a 1% increase in the oil price leads to an increase of 1.98% and 0.99% in the linear and non-linear economic activity, respectively.

Panel B in Table 5 reports the short-run dynamics estimated using DOLS. The results suggest that the exchange rate influences oil price, except in Oman, while the linear and non-linear economic activity is significant in Kuwait, Qatar, and Saudi Arabia. In contrast, a change in the gold price is not significant for any country. Stock market returns are positive and significant in all countries, except Oman and the UAE. The ECT term ranges between 0.1 and 0.28 and is negative and statistically significant. This means that a change in oil price converges to its long-term

Table 6: DOLS long-run and short-run coefficients (2005–2008)

Country	lnSDR	lnip	lngold	lnindex	lnips	ECT
Bahrain	2.74*	5.93*	0.96*	0.21	2.97*	
Kuwait	0.80	5.27*	1.15*	0.04	2.64*	
Oman	0.70	1.18***	0.98*	0.40	1.40***	
Qatar	0.17	2.28*	1.22*	0.45*	1.14*	
Saudi Arabia	3.65*	2.85**	1.04*	0.13	1.42**	
UAE	4.11*	2.37***	0.34*	0.27***	1.18***	
Panel	2.97*	2.40*	0.97*	0.26*	1.30*	
Panel B: Short-run elasticity						ETC(−1)
Bahrain	1.93	4.25**	0.63	0.10	2.12**	−0.50**
Kuwait	−1.25	3.22*	0.62	−0.20	1.61*	−0.68*
Oman	1.34	2.00	0.61	0.20	1.00	−0.34
Qatar	0.31	1.86*	0.81	0.34**	0.93*	−0.35
Saudi Arabia	2.84	1.81***	0.27	0.15	0.91***	−0.34***
UAE	3.10	0.51	0.10	0.14	0.26	−0.39***

*, **, and ***indicate significance at the 1%, 5%, and 10% levels, respectively. SDR: Special drawing rights, UAE: United Arab Emirates, DOLS: Dynamic ordinary least squares

Table 7: DOLS long-run and short-run coefficients (2009-2015)

Country	lnSDR	lnip	lngold	lnindex	lnips	ECT
Bahrain	5.60*	−0.16	0.67*	0.64*	−0.08	
Kuwait	6.26*	0.55***	0.76*	1.02*	0.28***	
Oman	3.70*	−1.34	0.84*	1.14*	−0.67	
Qatar	4.28*	1.85***	0.32**	0.45*	0.92***	
Saudi Arabia	5.02*	−0.62	0.58*	0.65*	−0.31	
UAE	4.60*	−0.96	0.90*	0.36*	−0.48	
Panel	5.05*	−0.02	0.59*	0.28*	0.01	
Panel B: Short-run elasticity						ETC(−1)
Bahrain	2.53***	0.22	0.40	1.17*	0.11	−0.28*
Kuwait	4.49**	0.86	0.10	1.02*	0.43	−0.26*
Oman	3.03**	−0.56	0.32	1.07*	−0.28	−0.31*
Qatar	2.19	−1.14	0.23	1.07*	−0.07	−0.26*
Saudi Arabia	2.93**	0.02	0.14	1.05*	0.01	−0.32*
UAE	2.81***	−0.15	0.46	0.42***	−0.07	−0.33*

*, **, and ***indicate significance at the 1%, 5%, and 10% levels, respectively. SDR: Special drawing rights, UAE: United Arab Emirates, DOLS: Dynamic ordinary least squares

equilibrium value by 10% for Oman, 11% in Kuwait, 17% in Bahrain, 22% in both Qatar and the UAE, and 28% in Saudi Arabia. In other words, the adjustment speed of the exchange rate, economic activity, gold price, and stock returns is the fastest in Saudi Arabia and the slowest in Oman.

6. ROBUSTNESS CHECK

Tables 8 and 9 report the results of the cointegration tests for the two sub-samples. The results show weak evidence of cointegration among the variables. However, some of the tests showed a significant cointegration, in line with the results reported in Table 3. Therefore, we concluded that these series are cointegrated in the long run, regardless of structural breaks. Pedroni's panel cointegration test assesses both the homogeneity within dimensions and heterogeneity between dimensions. Therefore, it addresses individual countries' lack of data when the sample is split into subsamples (Mehmood et al., 2014; Mohammadi and Ram, 2015; Tiba and Omri, 2017).

Table 10 reports the results of the Dumitrescu and Hurlin (2012) panel causality test for the two sub-samples. The results suggest that, before the global financial crisis, an oil price change was neither caused nor influenced by any of the selected variables. However, the exchange rate shows a feedback causality with the gold price change. In contrast, the linear growth rate of GDP was caused by exchange rate change and stock market returns, and is found to cause the gold price change.

For the period after the global financial crisis, the results indicate that the linear and non-linear growth of the GDP causes the oil price change, while the latter seems to lead the gold price change and exchange rate. Moreover, exchange rate changes induce linear growth rate of the GDP and gold price change. Lastly, stock market returns lead the exchange rate change.

Additionally, DOLS regression was performed on the two sub-samples. Table 6 reports the results for the pre-crisis sub-sample: The linear and non-linear business cycle and the gold price are significant and positive in all countries. The exchange rate is positive and significant only in Bahrain, Saudi Arabia, and the UAE, while the stock market is significant in Qatar and the UAE. In line with the full sample, the results show that the panel coefficients are positive and significant before the crisis. Regarding the short-run relationship between the variables, Oman and the UAE do not provide evidence of a short-run causality between the oil price and the selected variables. Linear and non-linear economic activities are significant in Bahrain, Qatar, and Saudi Arabia, while the stock market return was significant only in Qatar. In terms of ECT, the values are negative and significant only for Bahrain, Kuwait, Saudi Arabia, and the UAE, and range between −0.34 in Saudi Arabia and −0.68 in Kuwait. This shows that, in the presence of a disequilibrium, the equilibrium is restored based on the adjustment speed.

Table 7 reports the DOLS results for the period after the global financial crisis. The individual countries' long-term coefficients show that the exchange rate, the gold price, and the stock market index are positive and significant for all countries. Additionally, the linear and non-linear levels of economic output are only positive and significant in Kuwait and Qatar. Only the exchange rate, gold price, and stock market price are significant in the panel coefficients. The short-run coefficients show that the exchange rate is significant for all countries, except Qatar, while stock market returns were significant for all GCC economies. Lastly, the ECT indicates a negative and significant adjustment in the GCC economies after the financial crisis. The speed of adjustment is −0.26 for Kuwait and Qatar, −0.28 for Bahrain, −0.31 for Oman, −0.32 for Saudi Arabia, and −0.33 for the UAE.

7. CONCLUSION AND POLICY IMPLICATIONS

This study uses different techniques to examine the long- and short-run relationships between oil prices and domestic as

Table 8: Panel cointegration tests (2005–2008)

Pedroni test	Individual intercept		Individual intercept and trend		No intercept/trend	
	Statistics	Weighted statistics	Statistics	Weighted statistics	Statistics	Weighted statistics
Within dimension						
Panel v-statistics	1.31***	1.36	0.18	0.21	−0.06	−0.08
Panel ρ-statistics	−1.91**	−1.75	−1.05	−0.82	0.69	0.54
Panel PP-statistics	−3.10*	−2.89	−2.54**	−2.24	0.67	0.46
Panel ADF-statistics	0.15	0.07	1.19	1.18	1.63	1.54
Between dimension						
Group ρ-statistic	−1.06		−0.33		1.67	
Group PP-statistic	−2.76*		−2.02		1.56	
Group ADF-statistic	0.70		1.83		2.48	
Kao test ADF	−1.6***					

*, **, and ***indicate significance at the 1%, 5% and 10% levels, respectively. ADF: Augmented Dickey-Fuller, PP: Phillips-Perron

Table 9: Panel cointegration tests (2009–2015)

Pedroni test	Individual intercept		Individual intercept and trend		No intercept/trend	
	Statistics	Weighted statistics	Statistics	Weighted statistics	Statistics	Weighted statistics
Within dimension						
Panel v-statistics	1.86	1.74	0.50	0.39	1.218	1.07
Panel ρ-statistics	−1.62	−1.62	−0.67	−0.69	−3.14*	−3.27
Panel PP-statistics	−1.92	−1.91	−1.19	−1.22	−3.52*	−3.65
Panel ADF-statistics	−1.47	−1.43	−0.79	−0.74	−1.10	−1.06
Between dimension						
Group ρ-statistic	−0.76		0.22		−2.57*	
Group PP-statistic	−1.58***		−0.66		−3.67*	
Group ADF-statistic	−1.05		−0.23		−0.86	
Kao test ADF	−4.86*					

*, **, and ***indicate significance at the 1%, 5%, and 10% levels, respectively. ADF: Augmented Dickey-Fuller, PP: Phillips-Perron

Table 10: Dumitrescu Hurlin panel causality test (2005–2008 and 2009–2015)

Null hypothesis	Before the financial crisis		After the financial crisis	
	Zbar-Stat.	P	Zbar-Stat.	P
D (lnip) does not homogeneously cause D (lnoil)	−0.98	0.33	−1.79*	0.07
D (lnoil) does not homogeneously cause D (lnip)	0.90	0.37	−0.37	0.71
D (lngold) does not homogeneously cause D (lnoil)	0.09	0.93	0.37	0.71
D (lnoil) does not homogeneously cause D (lngold)	0.67	0.50	−2.17**	0.03
D (lnSDR) does not homogeneously cause D (lnoil)	−0.90	0.37	−1.63	0.10
D (lnoil) does not homogeneously cause D (lnSDR)	1.07	0.29	2.57**	0.01
D (lnindex) does not homogeneously cause D (lnoil)	−0.23	0.82	−1.00	0.32
D (lnoil) does not homogeneously cause D (lnindex)	1.05	0.30	−1.27	0.21
D (lngold) does not homogeneously cause D (lnip)	−1.12	0.26	−0.56	0.58
D (lnip) does not homogeneously cause D (lngold)	2.97***	0.00	−0.64	0.52
D (lnSDR) does not homogeneously cause D (lnip)	−1.88*	0.06	−1.84*	0.07
D (lnip) does not homogeneously cause D (lnsdr)	0.74	0.46	−0.81	0.42
D (lnindex) does not homogeneously cause D (lnip)	0.46	0.64	−1.32	0.19
D (lnip) does not homogeneously cause D (lnindex)	1.73*	0.08	−0.83	0.41
D (lnSDR) does not homogeneously cause D (lngold)	3.91***	0.00	2.56**	0.01
D (lngold) does not homogeneously cause D (lnSDR)	2.68**	0.01	−0.03	0.98
D (lnindex) does not homogeneously cause D (lngold)	0.01	0.99	−1.56	0.12
D (lngold) does not homogeneously cause D (lnindex)	−1.32	0.19	0.90	0.37
D (lnindex) does not homogeneously cause D (lnSDR)	1.39	0.17	1.96*	0.05
D (lnSDR) does not homogeneously cause D (lnindex)	0.04	0.97	0.53	0.60
D (lnips) does not homogeneously cause D (lnoil)	−0.98	0.33	−1.79*	0.07
D (lnoil) does not homogeneously cause D (lnips)	0.90	0.37	−0.37	0.71

*, **, and ***indicate significance at the 1%, 5% and 10% levels, respectively. SDR: Special drawing rights

well as international macroeconomic variables in the GCC countries.

We found evidence of a long-run relationship between the oil price and all variables introduced by the study. Further, the results of the sub-samples indicate a weak cointegration relationship between the same sets of variables. This means that oil demand and supply explain the variables' relationship with the oil price, and these domestic and global variables move together with the oil price in the long run. It is evident that the commodity market, stock market, exchange market, and domestic output are predictors of oil price movements and can be used as a hedging mechanism. In other words, fluctuations in these markets can predict changes in the oil price in the GCC countries. To verify the long- and short-run dynamics, we used a DOLS estimation on individual countries as well as in the panel structure. The results of the full sample indicate the existence of a long-run relationship between all selected variables and the oil price, except linear and non-linear economic activity, in some cases. For example, the economic activity in Qatar is linearly and non-linearly cointegrated with the oil price while none of the other countries' economic activity seems to co-move with oil price in the long run. This could be because Qatar still relies on oil as its primary source of revenue and economic growth. In contrast, the linear and non-linear economic activity, along with gold price, appeared to be consistently significant only before the global financial crisis. Moreover, after the financial crisis, the economic activity does not significantly co-move with the oil price, except in Qatar and Kuwait. This might suggest that some of these economies have shifted away from their oil dependency to diversify their economies. Similar results for long run relationships in the GCC were found between oil prices and stock market prices (Arouri et al., 2012; Akoum et al., 2012), oil price and GDP (Magazzino 2016), oil price and exchange rate (Altarturi et al., 2016), and oil price and gold price (Zhu et al., 2011).

The results of the short-run dynamics suggest the presence of a dynamic short-run causality between the oil price change and the growth rate of all the variables of interest. The same results hold after the financial crisis. However, only Oman did not show a significant causality before the crisis. This could be because its economy is small and not as open as the other GCC economies. Therefore, its inter-relationship with the oil price may only appear in the long run.

Lastly, the ECT is negative and significant in almost all countries in the three samples, indicating short-run dynamics between the oil price and all selected variables for the GCC countries. The ECT coefficients suggest that any disequilibrium is adjusted based on the size of the ECT. Some GCC economies are faster than others in their adjustment process. This could be related to the degree of openness of these economies. For example, in the full sample, Saudi Arabia was the fastest to restore its equilibrium, while Oman was the slowest. The short run relationship confirms previous studies that examine similar relationships in GCC economies. For example, Zhu et al. (2011) found causality between oil price and stock market price, Sujit and Kumar (2011) found causality between exchange rate and gold price with oil price, and Squalli (2007) found causality between the GDP and oil price.

These techniques allow us to examine the dynamic structures at play within the six, oil-rich GCC member countries, especially regarding the inter-relationships between oil and stock market index, gold price, linear and non-linear output, and exchange rate. The empirical results suggest the following: In the panel setting, oil return is predicted in the long run by all selected variables before the crisis, but only by the exchange rate, gold price, and stock market index after the financial crisis. At the country level, the long-run relationship between the oil price and all selected variables was consistent for all countries for the linear and non-linear business cycle and gold price only before the financial crisis. On the other hand, the long-run relationship after the crisis was consistently significant for the exchange rate, gold price, and stock market index. The long-run causality was significant both before and after the 2007–2008 global financial crisis, for all countries except Oman and Qatar, which show no significant causality relationship before the financial crisis. In terms of short-run causality, the results indicate that stock market returns have a bi-directional relationship with the oil price, while only the linear and non-linear business cycle and exchange rate have a unidirectional causality with the oil price.

From an economic point of view, the results suggest the existence of a significant inter-relationship between the oil price and domestic and international variables in the GCC markets. Oil prices do affect GCC markets to varying degrees. A high priority for policy makers in GCC countries is to diversify their economies by increasing the contributions of the non-oil sectors to their GDPs. Such policy interventions are particularly needed since oil shocks seem to affect not only the GDP of GCC countries, but also their stock market returns.

The implications of this study are as follows. An increase in oil prices corresponds to good news for stock market investors, who will gain from positive shocks in the oil price. However, this suggests that the stock market is not a good hedge against oil price fluctuations. However, the equilibrium is restored quickly. Gold is not a good hedge against oil price fluctuations either. Therefore, investors need to find better instruments to hedge against oil price shocks. Lastly, all GCC economies are still oil dependent, although to varying degrees. These economies are significantly affected by decreases in the oil price, either through global demand or access supply.

This study suffers from some limitations. The analysis focuses on selected global and domestic variables; however, other variables such as inflation, interest rate, foreign stock markets, and other commodity prices should be considered in future studies. In addition, this study only examined the initial links among these variables. Future studies might consider the volatility of the oil price and spillover effect in the long and short run. Future research can also investigate the future markets in addition to spot markets.

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