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# On the relationship between world oil prices and GCC stock markets

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## **ABSTRACT**

We provide comprehensive evidence on the relationship between oil prices and stock markets for six GCC countries. Unlike previous contributions, a wide range of modern econometric techniques are applied in order to: *i*) capture both short- and long-term interactions between considered markets; *ii*) deal with the potential asymmetry in such interactions and *iii*) control for the effects of relevant global financial variables. Empirical results show strong causal linkages in the short-run with the impact direction running usually from oil to stocks, but no long-run links. Stock returns seem also to be more sensitive to negative than to positive oil shocks.

*Keywords:* oil prices, stock markets, GCC countries, causal linkages, linear and nonlinear modelling.

*JEL classifications:* G12, F3, Q43

## 1. Introduction

The causal relationship between oil prices and stock markets has been recently investigated by a number of works given the importance of oil in industrial and real economic activity. The theory suggests that the rise of oil prices would cause aggregate stock prices to decrease since oil price fluctuations negatively affect real output which, in turn, lowers corporate earnings (Hamilton, 1983; Cunado and Perez de Garcia, 2005; Cologni and Manera, 2008; and Lardic and Mignon, 2008). Inversely, changes in stock markets may predict oil price movements to the extent that they represent the performance of the whole financial markets and reflect closely market conditions. There is, to date, empirical evidence that oil prices and stock markets exhibit some degree of interdependence. In a pioneer paper, Jones and Kaul (1996) examine the reaction of four well-established stock markets to oil shocks based on a standard present value model and find that the latter can be partially accounted for by the effect of oil price changes on the current and future cash-flows. Subsequent studies including, among the others, Huang et al. (1996), Sadorsky (1999), Papapetrou (2001), Basher and Sadorsky (2006), Anoruo and Mustafa (2007), Park and Ratti (2008), and Arouri *et al.* (2010,2011,2012), reach similar conclusions using various methodologies such as Vector Autoregressive (VAR) model, international asset pricing models, and cointegration and Vector Error-Correction Model (VECM).<sup>1</sup> For example, Papapetrou (2001) find that oil price risk is priced in explaining stock price dynamics in the Greek market, while Basher and Sadorsky (2006) extend their research scope and empirical findings to emerging stock markets. In addition, Ciner (2001) documents the presence of nonlinear linkages between oil shocks and stock market returns in the US. Discussions of oil impacts on stock returns from a sectorial perspective can be found in Hammoudeh et al. (2004), and Nandha and Faff (2008).

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<sup>1</sup> It is worth noting that Huang et al. (1996) document a significant link between some American companies' stock price changes and oil price movements, but the relationship between oil prices and stock market indices cannot be confirmed by their empirical results.

In this paper our motivation is to provide comprehensive evidence on the existence and the nature of the dynamic relationships between oil prices and stock markets in the net oil-exporting countries of the Gulf Corporation Council (GCC). We investigate the potential of bi-directional oil-stock impacts in the six GCC countries (Bahrain, Kuwait, Oman, Qatar, United Arab Emirates, and Saudi Arabia) for the period 2005-2009. It is equally important to stress that, compared to oil-importing countries where the expected relation of oil to stock markets is negative (i.e., oil price increases lead to decrease real output and stock market returns), such relation in net oil-exporting countries is not clear-cut because the influence of oil shocks on national revenues, production activities, and corporate earnings are not always the same.

Our contributions to the related literature are in two principal aspects. First, there is still little empirical evidence on how oil prices are associated with stock markets in the context of the GCC countries (Hammoudeh and Aleisa, 2004; Zarour, 2006; Hammoudeh and Choi, 2006; Maghyereh and Al-Kandari, 2007). The investigation of such relationship in these countries is thus interesting because the GCC markets have recently become attractive to global investors seeking for international diversification benefits owing to their numerous structural reforms in the 1990s. Relevant results from the study also help governments and regulatory authority to make sound decisions when they have to regulate stock markets and oil price policies. Second, as shown in Table 1, empirical findings related to the oil-stock market relationship in the GCC countries are not consistent across past studies, albeit these countries share many features in common. Indeed, they can be characterized by highly oil-dependent economies and their stock markets by low level of market activity, financial depth and liquidity. Of the possible explanations for this divergence of results, we think that the differences in terms of methodological approaches, sample periods, and data used are important sources. This pattern thus renders impossible the compar-

ison among related studies, and puts in advance the necessity for a comprehensive study that combines all methodologies and works on the same dataset to make final conclusions. Moreover, to the extent that the dynamic linkages between oil prices and stock markets may be subject to structural changes and nonlinearity as well, the use of linear models in most of the previous researches seems to be very restricted. For instance, the only one exception is Maghyereh and Al-Kandari (2007) who apply a nonlinear cointegration technique to oil and stock market data of the GCC countries, but these authors do not consider the possible structural changes as well as check for the robustness of their results using different data frequencies.

**Table 1**  
**Summary of previous studies on the dynamic linkages between oil price movements and stock markets in the GCC countries**

Study	Purpose	Sample markets	Study period	Empirical method	Key findings
Hammoudeh and Aleisa (2004)	This paper investigates the effect of NYMEX WTI (West Texas Intermediate) oil futures returns on the GCC market returns	Bahrain, Kuwait, Oman, Saudi Arabia, and UAE	Daily data from February 15, 1994 to December 25, 2001	Vector Error-Correction (VEC) model	The authors suggest that most of the markets considered are sensitive to the movements of the NYMEX 3-month WTI futures price, but only Saudi Arabia has a bidirectional relationship with the oil price.
Zarour (2006)	This paper addresses the effect of the sharp oil price increases on stock market returns.	Bahrain, Kuwait, Oman, Saudi Arabia, and UAE	Daily data from May 25, 2001 to May 24, 2005	Vector Autoregressive (VAR) model	Changes in oil prices significantly affect stock market returns in all the markets, while only Saudi and Omani stock markets appear to have the predictive power of oil price movements.
Hammoudeh and Choi (2006)	This study examines the long-run interaction between five GCC stock markets and three global factors (oil spot price indices, US 3-month Treasury bill rate, and S&P index).	Bahrain, Kuwait, Oman, Saudi Arabia, and UAE	Weekly data from February 15, 1994 to December 28, 2004	Cointegration tests and VEC model	The oil price movements do not have direct effects on any GCC stock markets, while the latter counts for less than 4% of the variations in oil prices after a 20-week period.
Maghyereh and Al-Kandari (2007)	This paper focuses on the long-run analysis of oil-stock market linkages.	Bahrain, Kuwait, Oman, and Saudi Arabia	Daily data from January 1, 1996 to December 31, 2003	Rank tests for nonlinear cointegration analysis proposed by Breitung and Gouriéroux (1997) and Breitung (2001)	The results support the hypothesis that oil prices affect stock markets in a nonlinear manner.

Hence, to the best of our knowledge, our study is the first attempt to reconcile the findings of previous studies based on various econometric techniques and a comprehensive dataset. We perform both short- and long-term analysis which allow for capturing not only nonlinear adjustments, but also structural changes in the dynamic interaction between oil prices and stock markets. Using weekly data from oil and stock market indices, the key empirical findings of this paper can be summarized as follows. Our short-term analysis shows some evidence of positive links between the two variables. The effects of oil price changes on stock returns in GCC countries seem however to be asymmetric: negative oil price changes have larger impact on stock returns than positive oil price changes. In addition, our findings suggest that when causality exists, it runs from oil prices to stock markets in most cases. As for our long-term analysis, we show evidence of no long-term link between oil prices and stock markets in GCC countries.

The remainder of the paper is structured as follows. Section 2 presents the data used and empirical modeling issues. Section 3 reports the empirical results and discusses their implications. Some concluding remarks are provided in Section 4.

## **2. Data and Preliminary Results**

This paper aims to provide comprehensive evidence on the relationship between oil prices and stock markets in the six member countries of the GCC. Our analysis thus considers the Qatari market, which is generally excluded in previous studies (see, Table 1). As in Hamoudeh and Choi (2006), we use weekly data because they seem to adequately capture the interaction between oil and stock prices in the region. Daily data are not used in order to avoid biases owing to time difference problems when dealing with international markets. Note for this purpose that GCC equity markets are generally closed on Thursdays and Fridays, while the developed and international oil markets close for trading on Saturdays and

Sundays. In addition, for the common open days, the GCC markets close just before US stock and commodity markets open. As a result, we decide to use weekly data and choose Tuesday as the weekday for all variables considered because the latter lies in the middle of the three common trading days for all markets. It is equally important to remark that since the data used in all analysis predate the end of 2005 (Table 1), previous studies missed the spectacular evolutions that took place in the GCC and world oil markets in recent years. Therefore, our sample period goes from June 7, 2005 to December 31, 2009, and stock market data are market price indices provided by MSCI (Morgan Stanley Capital International).

As for oil, we use the weekly Brent spot prices, obtained from the US Energy Information Administration (EIA). Of the three types of oil prices commonly used in international petroleum trade (Brent, West Texas Intermediate, and Dubai), Brent oil serves as a reference price for almost two third of the world's crude-oil production including oil produced by the GCC countries, and pricing benchmark for many oil-related products and derivatives instruments. We also employ the MSCI world index and the US 1-month Treasury bill interest rate as control variables for the empirical relationship between oil and stock markets. These financial data are obtained from MSCI database. All data are measured in US dollar.

Table 2 summarizes the main descriptive statistics for our sample data (price and return series) and the results from some statistical tests. Overall, we observe that most stock returns are negative due to the international 2007-2009 financial crisis. On average, GCC stock markets have higher risk than the world market. Skewness is negative in most cases, except for Bahrain, and Kurtosis is significantly higher than 3 in almost all cases. The presence of these characteristics thus leads to the rejection of the normal distribution of all the return series with an exception for Kuwait. The Jarque-Bera test for normality confirms

effectively this finding. We also carry out the Ljung-Box test for return autocorrelations of order 6 and the results show strong evidence of serial correlations for Bahrain, Oman and for the oil.

**Table 2**  
**Descriptive statistics of return series and their stochastic properties**

<i>Panel A: Log price series</i>									
	Bahrain	Kuwait	Oman	Qatar	Saudi A.	UAE	World	Brent oil	Interest
Mean	4.512	4.994	4.658	4.630	4.475	4.478	4.836	4.256	1.206
Std. Dev.	0.146	0.203	0.228	0.247	0.267	0.211	0.124	0.272	0.500
Skewness	0.669	0.137	0.783	-0.112	0.431	0.206	-0.448	0.813	-1.622
Kurtosis	2.475	1.533	2.424	1.814	2.254	2.134	2.449	2.597	5.303
JB	15.2 <sup>+++</sup>	16.4 <sup>+++</sup>	20.5 <sup>+++</sup>	10.7 <sup>+++</sup>	9.6 <sup>+++</sup>	6.8 <sup>++</sup>	8.2 <sup>++</sup>	20.7 <sup>+++</sup>	116.8 <sup>+++</sup>
Q(6)	933.6 <sup>+++</sup>	964.6 <sup>+++</sup>	1011.0 <sup>+++</sup>	977.1 <sup>+++</sup>	902.2 <sup>+++</sup>	826.3 <sup>+++</sup>	791.3 <sup>+++</sup>	955.9 <sup>+++</sup>	732.8 <sup>+++</sup>
<i>Panel B: Return series computed as <math>\ln(P_t/P_{t-1})</math></i>									
	Bahrain	Kuwait	Oman	Qatar	Saudi A.	UAE	World	Brent oil	Interest
Mean <sup>a</sup>	-0.0009	0.0024	2.27*10 <sup>-5</sup>	-0.0003	-0.003	-0.004	-0.001	0.002	-0.011
Std. Dev.	0.026	0.028	0.030	0.039	0.051	0.042	0.026	0.036	0.107
Skewness	0.490	-0.186	-0.971	-0.563	-1.113	-2.059	-3.893	-0.803	-4.086
Kurtosis	6.568	3.237	8.080	6.866	7.051	15.040	32.020	4.693	39.079
JB	100.4 <sup>+++</sup>	1.50	216.9 <sup>+++</sup>	118.9 <sup>+++</sup>	156.7 <sup>+++</sup>	1187.5 <sup>+++</sup>	6620.6 <sup>+++</sup>	39.9 <sup>+++</sup>	10035.7 <sup>+++</sup>
Q(6)	15.288 <sup>++</sup>	4.066	26.264 <sup>+++</sup>	7.520	4.890	7.874	5.193	27.369 <sup>+++</sup>	7.303
<i>Panel C: Unconditional correlations for return series computed as <math>\ln(P_t/P_{t-1})</math></i>									
	Bahrain	Kuwait	Oman	Qatar	Saudi A.	UAE	World	Brent oil	Interest
Bahrain	1.000	0.232	0.300	0.250	0.203	0.308	0.181	0.062	0.112
Kuwait		1.000	0.294	0.251	0.271	0.348	0.092	-0.037	0.016
Oman			1.000	0.432	0.266	0.516	0.302	0.254	0.105
Qatar				1.000	0.361	0.618	0.168	0.374	0.230
Saudi A.					1.000	0.504	0.166	0.101	0.141
UAE						1.000	0.309	0.292	0.275
World							1.000	0.187	0.150
Brent oil								1.000	0.271
Interest									1.000

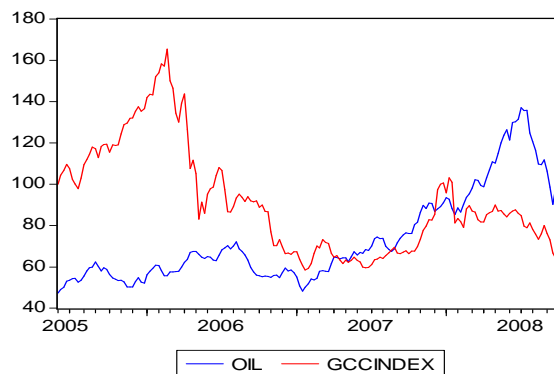
Notes: This table reports descriptive statistics for weekly log price and return series. The sample data covers stock market indices of six GCC countries, the World stock market index, Brent oil price index, and the US interest rate. JB refers to the empirical statistics of the Jarque-Bera test for normality based on skewness and excess kurtosis. Q(6) is the Ljung-Box test for autocorrelation of order 6. +, ++ and +++ indicate the rejection of null hypothesis of statistical tests at the 10%, 5% and 1% levels respectively. <sup>a</sup> indicate that coefficients are multiplied by 10.

Unconditional correlations among the GCC markets, MSCI World index, oil returns and US interest rate are shown in Panel C. Cross-market correlations of GCC stock and oil returns range from -0.037 (Kuwait/Brent) to 0.374 (Qatar/Brent). Only Kuwait has a negative correlation with oil returns. Stock returns on MSCI World index are positively associated with oil price changes. Correlations of the GCC markets with world stock market are relatively weak but in general higher than their correlations with Brent oil returns, except for Qatar. These findings suggest that the GCC stock markets are still segmented from the



world oil and stock market trends, and as a result global investors can still get substantial benefits from adding both financial assets of the Gulf region and oil assets into their internationally diversified portfolios. To further apprehend the joint dynamics of Brent oil and the GCC stock market prices, we depict, in Figure 1, their time-paths over the study period. A high degree of time trend association is observed between April 2006 and January 2008, which thus indicates some interdependencies between these series.

**Figure 1**  
**Oil prices and GCC stock market index**



Before we can implement further analysis of the interactions between oil prices and stock market returns, two commonly used unit root tests including Phillips-Perron (PP) test, and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test are performed in order to examine the stationarity property of the series considered. The PP test is based on the null hypothesis of a unit root, while the KPSS test investigates the null hypothesis of no unit root. Summary results of these statistical tests for both price and return series are reported in Table 3. As expected, all the price series appear to be integrated of order one;  $I(1)$ , while the hypothesis of stationarity cannot be rejected for the corresponding return series. So, we can straightforwardly employ price series to investigate the long-term dependencies between variables of interest, and return series to examine the short-term linkages.

**Table 3**  
**Unit root and stationarity test results for log price and return series**

	PP			KPSS	
	a	b	c	b	c
<i>Log price series</i>					
Bahrain	-0.416	-1.522	-2.115	0.948	0.259
Kuwait	1.007	-1.927	-1.078	1.397	0.154
Oman	-0.048	-1.142	-1.168	0.843	0.339
Qatar	-0.140	-1.278	-1.259	0.378	0.365
Saudi A.	-0.722	-1.101	-1.824	0.899	0.246
UAE	-0.952	-0.818	-1.301	0.527	0.301
World index	-0.308	-0.883	2.242	1.037	0.353
Brent oil	0.494	-1.663	-1.458	1.302	0.252
Interest rate	-0.698	1.866	0.178	0.960	0.407
<i>Return series</i>					
Bahrain	-10.813	-10.790	-10.760	0.184	0.179
Kuwait	-14.008	-14.038	-14.138	0.300	0.146
Oman	-10.868	-10.836	-10.807	0.202	0.217
Qatar	-11.869	-11.839	-11.809	0.160	0.176
Saudi A.	-11.723	-11.718	-11.681	0.117	0.119
UAE	-10.951	-10.985	-10.991	0.175	0.163
World	-12.183	-12.154	-12.685	0.731	0.163
Brent oil	-8.254	-8.250	-8.297	0.171	0.132
Interest rate	-14.245	-14.323	-14.941	0.653	0.068

Notes: PP, Philips-Perron tests; KPSS, Kwiatkowski-Phillips-Schmidt-Shin tests. All variables are expressed in natural logs. (a) indicates a model without neither constant nor deterministic trend; (b) model with constant without deterministic trend; and (c) model with constant and deterministic trend respectively.

The PP test critical values are -2.578 (1%), -1.943 (5%) and -1.615 (10%) for the model a, -3.468 (1%), -2.878 (5%) and -2.575 (10%) for the model b, and -4.011 (1%), -3.435 (5%) and -3.142 (10%) for the model c. The KPSS test critical values are 0.739 (1%), 0.463 (5%) and 0.347 (10%) for the model b, and 0.216 (1%), 0.146 (5%) and 0.119 (10%) for the model c.

### 3. Empirical Evidence on the Oil-Stock Market Relationships

In this section, we report and discuss the empirical results regarding the sensitivity of stock markets to world oil price variations and inversely. We begin with the short-term analysis based on standard Granger causality tests, and VAR (Vector Autoregressive) modeling approach in order to compare the results across studies. Note that in this study we extend previous works by adding two control variables (World stock market and interest rate on 1-month US T-bill) to check for the robustness of the obtained results. As for the long-run analysis, we rely on the application of Johansen's cointegration framework.

#### 3.1 Granger causality tests

Granger causality is a specific form of causality in time-series analysis, which is based on the simple concept that a variable  $X$  Granger-causes  $Y$  if  $Y$  can be better predicted using the

past values of both  $X$  and  $Y$  than it can using solely the past values of  $Y$ . Accordingly, Granger causality test is thus a simple and suitable way for us to assess the statistical causality between oil price changes and stock returns in GCC countries. We employ the direct Granger method by regressing each variable on its own past values and those of the other, and by using the  $F$ -test to examine the null hypothesis of no-causality. Since considered variables and their bilateral effects are likely to be sensitive to the choice of lag number in regression models, we decide to implement this test for different lags. Table 4 reports the obtained results.

**Table 4**  
**Causal relationships between raw returns on world oil and stock markets**

Lags	1	2	3	4	5	6
<b>Bahrain</b>						
S→O	0.405 (0.525)	1.447 (0.238)	1.413 (0.241)	1.560 (0.187)	1.280 (0.275)	1.400 (0.218)
O→S	2.135 (0.146)	1.154 (0.318)	<b>2.179</b> <b>(0.092)</b>	1.705 (0.151)	1.454 (0.208)	1.311 (0.255)
<b>Kuwait</b>						
S→O	<b>4.347</b> <b>(0.038)</b>	2.330 (0.101)	1.962 (0.122)	1.618 (0.172)	1.513 (0.188)	1.644 (0.138)
O→S	0.373 (0.542)	0.775 (0.462)	1.332 (0.266)	1.250 (0.292)	1.292 (0.270)	1.386 (0.223)
<b>Oman</b>						
S→O	<b>10.710</b> <b>(0.001)</b>	<b>5.923</b> <b>(0.003)</b>	<b>3.395</b> <b>(0.019)</b>	<b>2.500</b> <b>(0.045)</b>	<b>2.871</b> <b>(0.016)</b>	<b>3.361</b> <b>(0.004)</b>
O→S	1.372 (0.243)	0.566 (0.568)	1.731 (0.163)	1.392 (0.239)	1.019 (0.408)	0.973 (0.445)
<b>Qatar</b>						
S→O	1.542 (0.216)	1.102 (0.334)	0.842 (0.472)	0.837 (0.503)	1.021 (0.407)	1.144 (0.339)
O→S	<b>8.035</b> <b>(0.005)</b>	<b>4.374</b> <b>(0.014)</b>	<b>3.605</b> <b>(0.015)</b>	<b>2.633</b> <b>(0.036)</b>	<b>2.785</b> <b>(0.019)</b>	<b>2.203</b> <b>(0.045)</b>
<b>Saudi A.</b>						
S→O	0.382 (0.537)	0.990 (0.374)	0.582 (0.628)	0.506 (0.731)	0.396 (0.851)	0.323 (0.924)
O→S	0.188 (0.665)	1.201 (0.303)	1.380 (0.251)	1.043 (0.387)	0.782 (0.564)	0.690 (0.658)
<b>UAE</b>						
S→O	<b>4.359</b> <b>(0.038)</b>	<b>2.457</b> <b>(0.089)</b>	1.997 (0.116)	1.704 (0.152)	1.171 (0.326)	1.067 (0.385)
O→S	<b>2.910</b> <b>(0.090)</b>	<b>7.470</b> <b>(0.001)</b>	<b>6.372</b> <b>(0.001)</b>	<b>4.762</b> <b>(0.002)</b>	<b>4.406</b> <b>(0.001)</b>	<b>3.680</b> <b>(0.002)</b>

Notes: This table reports the results of Granger causality tests applied to raw returns on oil and stock markets. S→O designates the causal impact from stock market returns to oil price changes, and O→S the causal impact from oil price changes to stock market returns at different lags. The  $p$ -values are reported in parenthesis.

The results typically show that, in the short-run, stock market returns in Qatar and UAE are significantly Granger-caused by oil price shocks at the conventional levels whatever the lag being considered. The “oil to stock” causal direction is significant in Bahrain for the third lag at the 10% level. We also find evidence of significant causality from stock market returns to oil price changes in Oman for all the lags under consideration, in Kuwait for the first lag, and in the UAE for the first two lags. There is, in addition, absence of causal interactions between world oil and stock markets in Saudi Arabia.

**Table 5**  
**Causal relationships between stock returns and positive oil shocks**

Lags	1	2	3	4	5	6
<b>Bahrain</b>						
S→O <sup>+</sup>	0.097 (0.756)	2.137 (0.121)	1.394 (0.246)	1.074 (0.371)	1.258 (0.285)	1.016 (0.417)
O <sup>+</sup> →S	0.779 (0.379)	0.610 (0.544)	1.752 (0.158)	1.338 (0.258)	1.241 (0.292)	1.332 (0.246)
<b>Kuwait</b>						
S→O <sup>+</sup>	1.773 (0.185)	0.917 (0.401)	1.784 (0.152)	1.251 (0.292)	1.007 (0.415)	0.990 (0.434)
O <sup>+</sup> →S	0.212 (0.646)	0.327 (0.722)	0.650 (0.584)	0.575 (0.681)	1.111 (0.356)	1.206 (0.306)
<b>Oman</b>						
S→O <sup>+</sup>	<b>4.052</b> <b>(0.046)</b>	<b>2.796</b> <b>(0.064)</b>	1.581 (0.196)	1.088 (0.364)	1.058 (0.386)	1.228 (0.294)
O <sup>+</sup> →S	0.293 (0.589)	0.057 (0.945)	0.616 (0.605)	0.516 (0.724)	0.495 (0.779)	0.577 (0.749)
<b>Qatar</b>						
S→O <sup>+</sup>	2.139 (0.145)	1.319 (0.270)	0.843 (0.472)	0.789 (0.534)	1.105 (0.360)	1.127 (0.349)
O <sup>+</sup> →S	<b>3.984</b> <b>(0.047)</b>	<b>2.718</b> <b>(0.069)</b>	<b>2.255</b> <b>(0.084)</b>	1.725 (0.147)	1.317 (0.259)	1.069 (0.383)
<b>Saudi A.</b>						
S→O <sup>+</sup>	0.267 (0.606)	1.222 (0.297)	0.724 (0.539)	0.621 (0.648)	0.488 (0.785)	0.496 (0.811)
O <sup>+</sup> →S	0.888 (0.347)	1.863 (0.158)	1.467 (0.225)	1.056 (0.380)	0.809 (0.545)	0.895 (0.500)
<b>UAE</b>						
S→O <sup>+</sup>	1.502 (0.222)	1.002 (0.369)	0.762 (0.517)	0.616 (0.652)	0.521 (0.760)	0.607 (0.724)
O <sup>+</sup> →S	<b>2.955</b> <b>(0.087)</b>	<b>8.081</b> <b>(0.001)</b>	<b>5.493</b> <b>(0.001)</b>	<b>4.140</b> <b>(0.003)</b>	<b>3.376</b> <b>(0.006)</b>	<b>3.184</b> <b>(0.006)</b>

Notes: This table reports the results of the Granger causality test applied to GCC stock market returns and oil price increases. S→O<sup>+</sup> designates the causal impact from stock market returns to oil price increases, and O<sup>+</sup>→S the causal impact from oil price increases to stock market returns at different selected lags. The associated *p*-values are reported in parenthesis.

However, some recent papers have shown that the link between oil and economic activity is not entirely linear and that negative and positive oil price shocks tend to have dif-

ferent impacts on economic growth (Hamilton, 2003; Zhang, 2008; Cologni and Manera, 2009). Thus, we should expect that oil prices equally affect stock markets in a nonlinear fashion. In Tables 5-7, we show the causal relationship between stock market returns on the one hand, and positive oil shocks, negative oil shocks and net oil shocks on the other hand, respectively.<sup>2</sup>

**Table 6**  
**Causal relationships between stock returns and negative oil shocks**

Lags	1	2	3	4	5	6
<b>Bahrain</b>						
S→O <sup>-</sup>	1.420 (0.235)	1.081 (0.342)	1.242 (0.296)	<b>2.437</b> <b>(0.049)</b>	1.560 (0.174)	<b>1.847</b> <b>(0.093)</b>
O <sup>-</sup> →S	2.500 (0.116)	1.445 (0.239)	1.491 (0.219)	1.400 (0.236)	1.136 (0.343)	0.923 (0.480)
<b>Kuwait</b>						
S→O <sup>-</sup>	<b>3.162</b> <b>(0.077)</b>	1.692 (0.187)	<b>2.382</b> <b>(0.071)</b>	1.749 (0.142)	<b>1.903</b> <b>(0.097)</b>	<b>1.871</b> <b>(0.089)</b>
O <sup>-</sup> →S	2.069 (0.152)	2.157 (0.119)	<b>2.195</b> <b>(0.090)</b>	1.903 (0.112)	1.724 (0.132)	1.511 (0.178)
<b>Oman</b>						
S→O <sup>-</sup>	<b>9.875</b> <b>(0.002)</b>	<b>4.991</b> <b>(0.008)</b>	<b>3.325</b> <b>(0.021)</b>	<b>2.547</b> <b>(0.041)</b>	<b>3.108</b> <b>(0.010)</b>	<b>3.321</b> <b>(0.004)</b>
O <sup>-</sup> →S	2.038 (0.155)	1.044 (0.354)	2.088 (0.104)	1.648 (0.165)	1.264 (0.282)	1.111 0.358
<b>Qatar</b>						
S→O <sup>-</sup>	0.299 (0.585)	0.276 (0.759)	0.375 (0.771)	0.430 (0.787)	0.591 (0.706)	0.593 (0.736)
O <sup>-</sup> →S	<b>7.134</b> <b>(0.008)</b>	<b>3.577</b> <b>(0.030)</b>	<b>2.771</b> <b>(0.043)</b>	1.942 (0.106)	<b>3.239</b> <b>(0.008)</b>	<b>2.844</b> <b>(0.012)</b>
<b>Saudi A.</b>						
S→O <sup>-</sup>	0.054 (0.817)	0.241 (0.786)	0.142 (0.935)	0.315 (0.868)	0.251 (0.937)	0.263 (0.953)
O <sup>-</sup> →S	0.030 (0.862)	0.237 (0.789)	0.682 (0.564)	0.702 (0.592)	0.724 (0.607)	0.553 (0.767)
<b>UAE</b>						
S→O <sup>-</sup>	<b>3.968</b> <b>(0.048)</b>	<b>2.504</b> <b>(0.085)</b>	<b>2.697</b> <b>(0.048)</b>	<b>2.119</b> <b>(0.081)</b>	1.330 (0.254)	1.120 (0.353)
O <sup>-</sup> →S	1.330 (0.250)	<b>2.776</b> <b>(0.065)</b>	<b>3.953</b> <b>(0.009)</b>	<b>3.079</b> <b>(0.018)</b>	<b>3.176</b> <b>(0.009)</b>	<b>2.865</b> <b>(0.011)</b>

Notes: This table reports the results of the Granger causality test applied to GCC stock market returns and oil price decreases. S→O<sup>-</sup> designates the causal impact from stock market returns to oil price decreases, and O<sup>-</sup>→S the causal impact from oil price decreases to stock market returns at different selected lags. The associated *p*-values are reported in parenthesis.

A close inspection of the results in Table 5 indicates a lower degree of oil-stock causality in that world oil and stock markets in Bahrain and Kuwait do not Granger-cause each other, as compared to what is found in Table 4. Moreover, the bi-directional causal

<sup>2</sup> The net oil shock is defined as the difference between the observed return in period *t* and the largest return over the four last weeks.

effects become significant only for some lags in Oman and Qatar. When negative oil shocks are accounted for, the patterns of oil-stock causality is similar to those we display in Table 4, but the causal linkage seems to be particularly pronounced. As for net oil price shocks, we find some weak causality from stock market to oil prices for Kuwait, Qatar and UAE. Taken together, stock returns in the GCC countries appear to asymmetrically respond to oil price decreases and increases. The higher sensitivity of stock returns to negative oil shocks can be easily explained by lower corporate earnings due to the decline in industrial production activity.

**Table 7**  
**Causal relationships between stock returns and net oil shocks**

Lags	1	2	3	4	5	6
<b>Bahrain</b>						
S→ONet	0.013 (0.911)	0.171 (0.843)	0.109 (0.955)	0.246 (0.912)	0.087 (0.994)	0.322 (0.925)
ONet→S	0.440 (0.508)	0.261 (0.770)	0.532 (0.661)	0.735 (0.569)	0.642 (0.668)	0.525 (0.789)
<b>Kuwait</b>						
S→ONet	1.833 (0.178)	1.167 (0.314)	1.072 (0.363)	0.909 (0.460)	1.648 (0.151)	<b>1.879</b> <b>(0.089)</b>
ONet→S	2.096 (0.150)	1.244 (0.291)	0.920 (0.433)	0.757 (0.555)	0.709 (0.617)	1.097 (0.367)
<b>Oman</b>						
S→ONet	0.749 (0.388)	0.998 (0.371)	0.807 (0.492)	0.772 (0.545)	0.968 (0.439)	1.284 (0.268)
ONet→S	0.483 (0.488)	1.666 (0.192)	1.675 (0.175)	1.273 (0.283)	0.876 (0.499)	0.918 (0.484)
<b>Qatar</b>						
S→ONet	<b>5.221</b> <b>(0.024)</b>	<b>2.852</b> <b>(0.061)</b>	1.801 (0.149)	<b>3.042</b> <b>(0.019)</b>	<b>2.321</b> <b>(0.046)</b>	<b>2.090</b> <b>(0.058)</b>
ONet→S	0.293 (0.589)	0.573 (0.565)	0.491 (0.689)	0.487 (0.746)	0.449 (0.814)	0.459 (0.837)
<b>Saudi A.</b>						
S→ONet	1.677 (0.197)	1.672 (0.191)	1.311 (0.273)	1.448 (0.221)	1.506 (0.191)	1.392 (0.221)
ONet→S	0.096 (0.757)	0.050 (0.952)	0.240 (0.868)	0.550 (0.699)	0.448 (0.814)	0.923 (0.480)
<b>UAE</b>						
S→ONet	1.951 (0.164)	<b>2.779</b> <b>(0.065)</b>	2.008 (0.115)	1.459 (0.217)	0.917 (0.471)	0.918 (0.484)
ONet→S	0.525 (0.470)	0.482 (0.619)	0.603 (0.614)	0.913 (0.458)	0.735 (0.598)	1.369 (0.231)

Notes: This table reports the results of the Granger causality test applied to GCC stock market returns and net oil price changes. S→ONet designates the causal impact from stock market returns to net oil price measure, and ONet→S the causal impact from net oil price measure to stock market returns at different selected lags. The associated *p*-values are reported in parenthesis.

### 3.2 Oil-stock's causal relationships within VAR models

The bivariate vector autoregressive (VAR) model is a useful alternative to the direct causality test we presented previously. Since the unrestricted-form VAR analysis treats simultaneously all variables as endogenous, the results of Granger causality tests within a bivariate VAR system are considerably more general and reliable as compared to univariate case. We can further detect feedback relations among the series through impulse response functions and variance decomposition.<sup>3</sup> Given that the Akaike Information Criterion (AIC) chooses one lag for all bivariate VAR systems, we then estimate six VAR(1) models and present the obtained results in Table 8.

**Table 8**  
**Results of VAR(1) model estimation for oil and stock returns**

<b>Bahrain</b>	<i>Stock returns</i>	<i>Oil returns</i>	<b>Kuwait</b>	<i>Stock returns</i>	<i>Oil returns</i>	<b>Oman</b>	Stock returns	Oil returns
Stock returns (-1)	<b>0.187</b> (2.512)	0.062 (0.620)	Stock returns (-1)	-0.041 (-0.555)	<b>0.194</b> (2.112)	Stock returns (-1)	<b>0.175</b> (2.297)	<b>0.281</b> (3.273)
Oil returns (-1)	0.079 (1.426)	<b>0.377</b> (5.066)	Oil returns (-1)	0.041 (0.698)	<b>0.381</b> (5.202)	Oil returns (-1)	0.077 (1.157)	<b>0.319</b> (4.283)
<b>Qatar</b>	<i>Stock returns</i>	<i>Oil returns</i>	<b>Saudi Arabia</b>	<i>Stock returns</i>	<i>Oil returns</i>	<b>UAE</b>	Stock returns	Oil returns
Stock returns (-1)	0.028 (0.343)	0.086 (1.226)	Stock returns (-1)	0.093 (1.192)	0.031 (0.589)	Stock returns (-1)	<b>0.149</b> (1.911)	<b>0.128</b> (2.033)
Oil returns (-1)	<b>0.259</b> (2.809)	<b>0.341</b> (4.222)	Oil returns (-1)	0.041 (0.365)	<b>0.374</b> (4.965)	Oil returns (-1)	0.150 (1.564)	<b>0.331</b> (4.269)

Notes: This table reports the estimation results of a 2-variable VAR(1) model for stock market returns in each GCC country and world oil returns. Empirical *t*-statistics are reported in parenthesis. Coefficients which are significant at conventional levels are marked by a bold character.

Ignoring constant terms, the most important results pertain to the coefficients related to lagged values of explanatory variables as well as those of explained variables themselves. Accordingly, we learn from these coefficients that stock returns in the GCC countries have a substantial influence on oil returns in three countries (Kuwait, Oman and UAE), while the inverse direction of causality does occur in only one market (Qatar). This finding, which does not seem to corroborate with the results of univariate Granger causality tests, indicates very weak causal relations between world oil and stock markets. Note al-

<sup>3</sup> See Sims (1980) for a rigorous discussion of the VAR analysis.

so that it typically contrasts the results by Hammoudeh and Aleisa (2004), and Zarour (2006) providing empirical evidence to suggest that oil price changes significantly affect stock returns in almost all GCC markets. The use of weekly data instead of daily data may be the reason for explaining this difference.

We also check the robustness of the above-mentioned results by introducing two control variables (i.e., returns on world stock market index and growth rate of US 1-month T-bill interest rate) into the existing 2-variable VAR(1) systems. They are treated both as endogenous and exogenous. Table 9 present the results. It is observed that the oil-stock causal relations are not different from the results in Table 8. In particular, oil price movements are, not surprisingly, found to be positively affected by world market returns, and negatively by interest rate changes in all markets. As such, the rise in US short-term interest rates leads to decrease oil prices because it has negative effects on industrial activity, and reduces the world's demand for oil.<sup>4</sup>

We now analyse the short-run dynamics of the stock market and oil returns by using the generalized impulse response functions which estimate the response of a variable to shock in another variable at some time horizons.<sup>5</sup> The impulse response functions of stock and oil returns without and with control variables are shown in Figures 2 and 3 respectively. They indicate that the responses of stock market returns in GCC countries to a one standard deviation (SD) of innovations in Brent oil returns and the responses of Brent oil

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<sup>4</sup> We have also estimated a VAR model with positive, negative and net oil changes instead of the oil returns series (the results are not reported here to keep the paper short). The results for the positive oil changes indicate that when ignoring the control variables, the drawn conclusions are the same for Bahrain and Saudi A. and slightly affected for the other countries in comparison with the case where the oil returns series is included in the analysis. When introducing the control variables, there are some changes in the results in terms of significance of the variables. For the negative oil changes, the conclusions are the same for Bahrain, Oman, Qatar and Saudi A. when only the oil and stock variables are introduced in the VAR system. However, for the other cases the results show some differences in comparison with the case where the oil returns are considered as endogenous variable. For the case of net oil changes, the conclusions are changed except for Bahrain and Saudi A. when the VAR system is estimated without taking into account the control variables.

<sup>5</sup> Unlike the Cholesky factorization used to obtain the orthogonalized impulse response functions, we determine here the generalized versions, which do not depend on the ordering of the variables in the VAR system. Consequently, the obtained results produce the same conclusions.



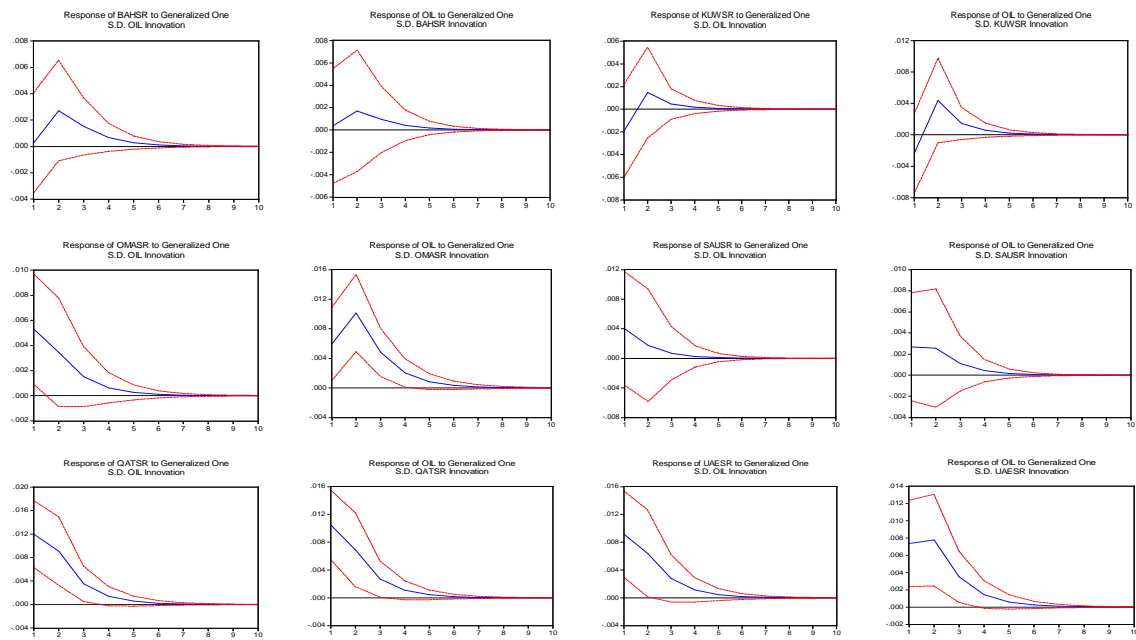
returns to a one SD of innovation in GCC stock market returns follow almost similar patterns for all countries. Indeed, the inspection of Figure 2 shows that a positive shock to oil returns (stock returns) begins affecting the stock returns (oil returns) after the first period (1<sup>st</sup> week), and the reaction to shock disappears from the 5<sup>th</sup> week. The sole exception is Kuwait where we find a negative reaction from stock returns (oil returns) to standardized innovations in oil returns (stock returns) within the first period. The same conclusions can be drawn when world market returns and interest rate are introduced into the VAR system (Figure 3).

**Table 9**  
**Results of VAR(1) model estimation for oil and stock returns in presence of control variables**

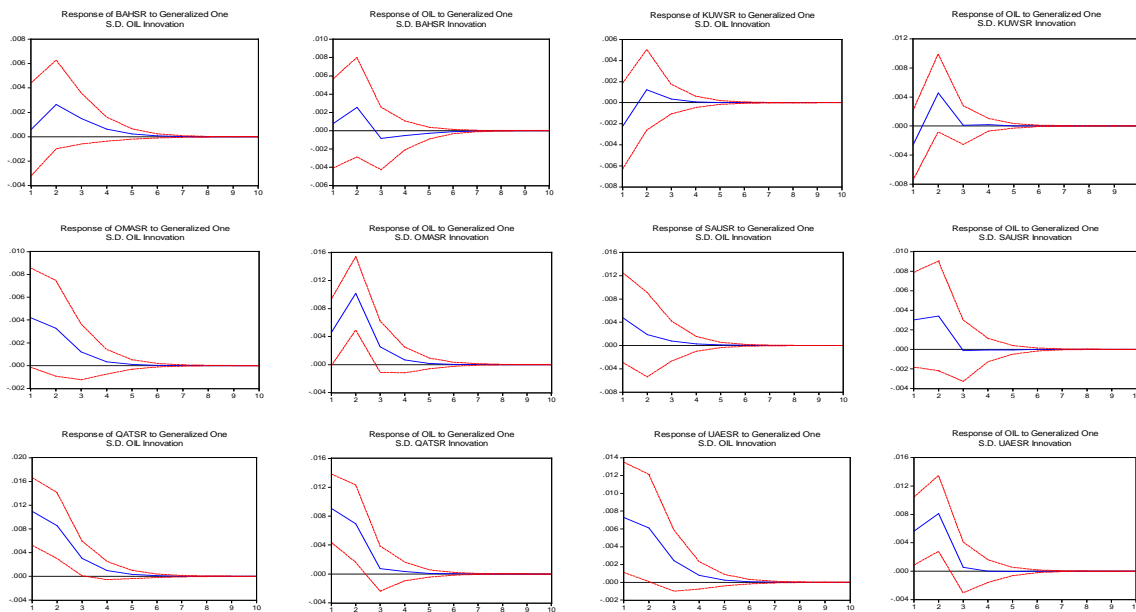
<b>Bahrain</b>	Stock returns	Oil returns	World return	US T-bill rate	<b>Kuwait</b>	Stock returns	Oil returns	World return	US T-bill rate
Stock returns (-1)	<b>0.190</b> (2.494)	0.020 (0.208)	<b>-0.150</b> (-1.900)	0.159 (0.503)	Stock returns (-1)	-0.050 (-0.676)	<b>0.168</b> (1.930)	-0.078 (-1.086)	0.240 (0.837)
Oil returns (-1)	0.081 (1.396)	<b>0.340</b> (4.618)	0.012 (0.200)	0.220 (0.915)	Oil returns (-1)	0.005 (0.088)	<b>0.344</b> (4.717)	0.007 (0.116)	0.228 (0.951)
World returns (-1)	-0.032 (-0.412)	<b>0.427</b> (4.349)	0.094 (1.179)	<b>1.001</b> (3.127)	World returns (-1)	0.081 (0.993)	<b>0.416</b> (4.311)	0.079 (0.988)	<b>1.004</b> (3.163)
US T-bill rate (-1)	<b>0.005</b> (0.252)	<b>-0.053</b> (-2.222)	-0.001 (-0.025)	<b>-0.154</b> (-1.996)	US T-bill rate (-1)	0.031 (1.553)	<b>-0.053</b> (-2.265)	-0.004 (-0.188)	<b>-0.152</b> (-1.973)
<b>Oman</b>	Stock returns	Oil returns	World return	US T-bill rate	<b>Qatar</b>	Stock returns	Oil returns	World return	US T-bill rate
Stock returns (-1)	0.123 (1.574)	<b>0.205</b> (2.340)	<b>-0.151</b> (-2.151)	0.034 (0.120)	Stock returns (-1)	0.022 (0.274)	0.091 (1.343)	<b>-0.100</b> (-1.817)	0.112 (0.505)
Oil returns (-1)	0.045 (0.661)	<b>0.307</b> (4.158)	0.033 (0.550)	0.218 (0.891)	Oil returns (-1)	<b>0.233</b> (2.466)	<b>0.304</b> (3.873)	0.050 (0.775)	0.178 (0.692)
World returns (-1)	<b>0.224</b> (2.472)	<b>0.368</b> (3.717)	0.118 (1.445)	<b>1.014</b> (3.088)	World returns (-1)	<b>0.213</b> (1.831)	<b>0.423</b> (4.365)	0.080 (1.014)	<b>1.016</b> (3.200)
US T-bill rate (-1)	0.005 (0.240)	<b>-0.053</b> (-2.274)	-0.004 (-0.184)	<b>-0.151</b> (-1.957)	US T-bill rate (-1)	-0.013 (-0.451)	<b>-0.057</b> (-2.407)	0.002 (0.083)	<b>-0.157</b> (-2.012)
<b>Saudi Arabia</b>	Stock returns	Oil returns	World return	US T-bill rate	<b>UAE</b>	Stock returns	Oil returns	World return	US T-bill rate
Stock returns (-1)	0.101 (1.260)	0.024 (0.478)	-0.058 (-1.416)	0.062 (0.376)	Stock returns (-1)	0.132 (1.613)	<b>0.105</b> (1.657)	<b>-0.139</b> (-2.710)	0.352 (0.708)
Oil returns (-1)	0.060 (0.506)	<b>0.337</b> (4.545)	0.018 (0.300)	0.213 (0.882)	Oil returns (-1)	0.137 (1.406)	<b>0.312</b> (4.155)	0.046 (0.764)	0.127 (0.519)
World returns (-1)	-0.078 (-0.504)	<b>0.426</b> (4.366)	0.082 (1.036)	<b>1.014</b> (3.184)	World returns (-1)	<b>0.252</b> (1.969)	<b>0.393</b> (3.970)	0.121 (1.512)	<b>0.900</b> (2.788)
US T-bill rate (-1)	-0.009 (-0.242)	<b>-0.054</b> (-2.258)	-0.001 (-0.005)	<b>-0.155</b> (-1.990)	US T-bill rate (-1)	-0.036 (-1.149)	<b>-0.061</b> (-2.538)	0.008 (0.390)	<b>-0.180</b> (-2.299)

Notes: This table reports the estimation results of a 4-variable (oil and stock market returns) VAR(1) model for each GCC country in the sample data. Empirical t-statistics are reported in parenthesis.

**Figure 2**  
**Impulse response functions of stock and oil returns**



**Figure 3**  
**Impulse response functions of stock and oil returns in presence of control variables**



We have also computed the impulse response functions using the positive, negative and net oil shocks instead of the oil returns.<sup>6</sup> Similar results are obtained for the case of positive oil shocks for Kuwait, Oman, Qatar and UAE. However, during the first period, shocks to Bahraini stock market induce a negative impact on oil returns, while no reaction

<sup>6</sup> Detailed results can be made available under request.

is found whatever the shocks. Regarding the case of negative oil shocks, the results for the case of oil return shocks hold for all countries, except for Bahrain where the first-period impulse response becomes negative for both oil and stock returns. More significant changes are observed when using the net oil shocks to conduct the impulse response analysis, as compared to the reported findings (i.e., the case of oil returns). Indeed, for Bahrain and Kuwait, we observe positive reaction, whereas the latter becomes negative for Saudi Arabia. Once again, these findings remain unchanged when world market returns and interest rate are controlled for.

To sum up, our analysis shows some evidence of positive short-term relationships between oil price changes and stock market returns in most GCC countries. However, both the Granger causality tests and impulse response analysis reveal the fact that considering the raw, positive, negative or net returns on world oil market index affects the obtained results, and consequently the conclusions of the study. In the following section, we investigate the long-term linkages between oil prices and stock markets in GCC countries.

### *3.3 Long-term analysis*

The linear cointegration introduced by Granger (1981) and developed by Engle and Granger (1987), and Johansen (1988), among others, indicates that two integrated series of order one,  $I(1)$ ,  $X_t$  and  $Y_t$  (i.e., two interest rate series) can evolve together in the long run if a linear combination between them is stationary. Two series are said to be cointegrated in this case and the theory suggests the existence of a long-run equilibrium to which the system converges over time.

The Engle and Granger (1987) analysis of cointegration suffers, however, from a major methodological limitation since it only permits to examine a unique cointegrating vector at a time. To the extent that multiple cointegrating vectors may exist simultaneously, information about the real linkages among considered variables can be lost due to the

restriction of a bilateral relationship. That is why we decided to employ the multivariate cointegration framework, developed by Johansen (1988), to test for cointegration between oil and stock prices.

**Table 10**  
**Johansen's cointegration tests applied to oil and stock markets: country by country analysis**

	Model without trend		Model with trend	
	$\Lambda_{\max}^*$	Trace	$\Lambda_{\max}$	Trace
<b>Bahrain</b>				
H0 : r = 0 vs. H1 : r > 0	12.901	14.174	12.538	13.803
H0 : r = 1 vs. H1 : r = 2	1.273	1.273	1.265	1.265
<b>Kuwait</b>				
H0 : r = 0 vs. H1 : r > 0	11.005	14.300	10.633	13.366
H0 : r = 1 vs. H1 : r = 2	3.295	3.295	2.734	2.734
<b>Oman</b>				
H0 : r = 0 vs. H1 : r > 0	6.972	8.106	6.697	7.823
H0 : r = 1 vs. H1 : r = 2	1.134	1.134	1.126	1.126
<b>Qatar</b>				
H0 : r = 0 vs. H1 : r > 0	3.304	4.969	2.980	4.417
H0 : r = 1 vs. H1 : r = 2	1.566	1.566	1.438	1.438
<b>Saudi</b>				
H0 : r = 0 vs. H1 : r > 0	2.743	5.445	2.713	4.762
H0 : r = 1 vs. H1 : r = 2	2.702	2.702	2.049	2.049
<b>UAE</b>				
H0 : r = 0 vs. H1 : r > 0	4.250	6.936	2.706	4.645
H0 : r = 1 vs. H1 : r = 2	2.686	2.686	1.938	1.938

Notes:  $\Lambda_{\max}$  is the likelihood ratio test based on the maximal eigenvalue of the stochastic matrix. Trace is the empirical statistic of the likelihood test based on the trace of the stochastic matrix. At the 5% level, the critical values of the trace test are 20.261 (H0: r = 0 vs. H1: r > 0) and 9.164 (H0: r = 1 vs. H1: r = 2) for the model without trend, and 15.494 (H0: r = 0 vs. H1: r > 0) and 3.841 (H0: r = 1 vs. H1: r = 2) for the model with trend, where r is the number of cointegration relations. At the 5% level, the critical values of the maximum eigenvalue test are 15.892 (H0: r = 0 vs. H1: r = 1) and 9.164 (H0: r = 1 vs. H1: r = 2) for the model without trend, and 14.264 (H0: r = 0 vs. H1: r = 1) and 3.841 (H0: r = 1 vs. H1: r = 2) for the model with trend.

\* For the  $\Lambda_{\max}$  test, the first hypothesis test consists in testing H0: r = 0 vs. H1: r = 1.

The results reported in Table 10 show that there is no cointegration between oil and stock markets of the GCC countries. This finding points to the absence of long-run equilibrium between the evolutions of oil and stock prices in GCC countries, i.e., information contained in oil prices does and not help to predict future movements in stock prices and inversely. Also these two markets must be treated as independent over the long-run and a VAR model is sufficient for modelling their short-term linkages. Note finally that very similar results were obtained when adding the MSCI world index and the US T-bill interest rate as control variables.

#### **4. Concluding Remarks**

The aim of this paper was to investigate the relationships between oil prices and GCC stock markets using different econometric techniques. Our short-term analysis shows some evidence of positive links between the two variables. However, the effects of oil price changes on stock returns in GCC countries seem to be asymmetric: negative oil price changes have larger impact on stock returns than positive oil price changes. Moreover, our results indicate that when causality exists, it runs from oil prices to stock markets in most cases. As for our long-term analysis, we show that there is no long-term link between oil prices and stock markets in GCC countries.

Our findings should be of interest to researchers, regulators, and market participants. In particular, most GCC countries as policy makers in OPEC should keep an eye on the effects of oil price fluctuations on their own economies and stock markets. For investors, the significant relationship between oil prices and stock markets imply some degree of predictability in the GCC stock markets. In particular, portfolio diversification, speculation, arbitrage and hedging strategies have to be built differently when one expects increase or decrease in oil prices.

Our empirical results on the effects of oil price shocks on GCC stock returns offer several avenues for future research. First, the link between oil and stock markets in GCC countries can be expected to vary across different economic sectors. A sector analysis of this link would be informative. Second, evidence from international equity markets should be produced to examine the robustness of the findings. Third, the methodology applied in this article can be used to examine the effects of other energy products such as gas. Finally, further research could compare causality between oil and stock markets in GCC countries and other oil exporting countries.

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