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The Dynamic Co-movements between Oil and Stock Market returns in: The Case of GCC Countries

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Abstract

This paper aims at examining the impact of oil price on GCC countries' stock market returns. We apply wavelet analysis model for examining the relationship between oil and stock market returns. Using monthly data from May 2005 to December 2011, our results suggest that not all stock market in GCC region have a positive relationship with oil price as some have, instead, negative relationship with oil price. Oil price has a negative relationship with Bahrain, Saudi Arabia and United Arab Emirates. However, in consistent with literature review, oil price has a positive relationship with Kuwait, Qatar as well as Oman.

On the other hand, wavelet analysis results show that a low correlation between the two variables exist in the short run but turns to have a highly, positive correlation in the long run indicating that oil has more influential power over stock returns the longer the period is.

Furthermore, with the exception of Bahrain's stock market returns, a bidirectional impact does exist between oil and all other GCC stock markets returns. Consistent with expectation, the results of Granger causality of MODWT multi-resolution analysis show that in the long run a strong bidirectional causal relationship exists between oil and each of the stock market returns in the GCC region.

JEL classification numbers: G, E, F
Keywords: oil, stock market returns, wavelet correlation, causal relationship.

1 Introduction

In the beginning of last century, the world witnessed the discovery of lifeblood energy of modern economies; that is oil. Since then and oil is considered one of the important economic factors that has a great influence not only on the economic performance of the country but also on its financial performance. Actually, one of the essential factors that

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have resulted in world trade to be more vulnerable to increase in oil prices is globalization. Globalization' has resulted in increasing flow of goods, services and financial capital between national borders which results in interdependencies between all economies in the world. This has led the growth in world trade to be more vulnerable to increase in oil prices because of growing importance of emerging economies. As a major oil exporting countries, it is more believed that stock markets in the GCC region are positively correlated with oil.

Indeed, both investors and policy makers need to understand the relationship between GCC stock markets returns and oil price volatility. This is because understanding this relationship will help investors make necessary investment decisions and policy makers adopt appropriate policies in managing stock markets.

This study has three sections following the introduction. Section 2 provides a link between oil and stock markets in GCC. Section three presents an econometric framework with the presentation of models, which include the relevant variables and data as well as providing the model tests and interprets the results. Finally, section 4 concludes summarizing the main findings of the study.

2 Link between Oil and Stock Market

One of the most important factors for understanding fluctuations in stock prices is the changes in the price of crude oil. A large body of literature (see Kaneko and Lee (1995), Jones and Kaul (1996), Sadorsky (1999)) has been conducted on different countries, mostly developed oil imported countries, over the world to find out the relationship between the two. However, still we can't see any consensus about that relation among economists.

In theory, the value of stock equals discounted sum of expected future cash-flows. The causal relation between oil price and stock prices begins from the macroeconomic events which do affect the stock market prices and are affected by oil shocks. Therefore, it is rational to study the relation between the two, oil price and stock market prices, and try to see if this does apply in reality and what kind of correlation do we have between the two.

In this respect, this paper tries to understand the relationship between stock markets in GCC countries and oil prices as it important for three reasons. Firstly, stock markets in GCC countries may be susceptible to change in oil prices since GCC countries are considered one of the major oil suppliers in world energy markets. Secondly, excessively sensitiveness to regional political events as well as segmentation from the international markets are two reasons that make the GCC markets differ from those of developed and from other emerging countries. Thirdly, regarding regional and world portfolio diversification, GCC markets are considered one of the most important areas that investors may like to invest in them in order to reduce systematic risk.

Understanding the influential power of oil price shocks on GCC stock market returns is also crucial for policy makers in order to regulate stock markets more effectively.

In fact, there are two views recorded by researchers who study the relation between stock market and oil in GCC countries. One supports the idea that there is a relationship between stock market and oil in GCC countries (see Ravichandran and Alkhathlan 2010), whereas the other one supports the idea that there is no relationship between the two in GCC countries.

Indeed, no consensus is found about the actual impact of oil price on stock market prices in GCC countries as the results of the few available works are too heterogeneous. The underlying reasons for that confusion are that GCC countries are unique in that economies primarily depend on oil; therefore, they are very sensitive to oil price changes. Moreover, they have similar economic structure and are strongly oil exporters.

3 Methodology

In order to test the impact of oil price variations on stock market returns of each of the GCC countries, we took two steps. Firstly, we test the correlation between the variables then we apply wavelet analysis. Secondly, we test the Granger Causality between these variables then apply Granger causality of MODWT multi-resolution analysis. The underlying purpose of doing so is that Wavelet analysis helps us dig in and understand this relationship more preciously. In fact, Wavelet analysis has the advantage of being more powerful tool in the analysis of time series. This is because wavelet transforms can react to sudden changes in the time series. Furthermore, we analyze the frequency domain, represented by scale in the wavelet methodology, and the time domain at the same time as well as we look at the time series from two different points of view; i.e. short run and long run. Surely then, applying the correlation as well as Granger Causality test will help in identifying the impact of oil price variations on stock market returns in the short run and long run at the same time.

3.1 The Continuous Wavelet Transform

We can define the continuous wavelet transform (CWT) as a function W (τ, s), which projects time series onto particular wavelet Ψ. We use the derivation used by Gencay et al. (2002) (for more detailed methodology introduction see Daubechies (1992) or Adisson (2002)). The vital reason for using CWT in comparison to Fourier transform is that the former has an advantage that we analyze the frequency domain, represented by scale in the wavelet methodology, and the time domain at the same time as well as we look at the time series from two different points of view (Crowley & Lee (2005)). Consequently, function W (τ, s) has two parameters. One (τ) is for time domain (translation parameter) and another (s) for frequency (scale parameter). We have to define the general wavelet function before deriving function W (τ, s). This derivation is based on so called mother wavelet and described as follows:

$$\Psi_{\tau,s}(t) = \frac{1}{\sqrt{s}}\,\Psi\left(\frac{t-\tau}{s}\right) \tag{1}$$

Where $\frac{1}{\sqrt{s}}$ is a normalization factor, which allows us to compare wavelets in different scales. Three conditions that mother wavelets have to satisfy (Daubechies (1992), Gencay et al. (2002)):

1. Its mean should be 0

$$\int_{-\infty}^{\infty} \Psi(t)dt = 0 \tag{2}$$

2. Integral of a square mother wavelet is equal to 1

$$\int_{-\infty}^{\infty} \Psi^2(t)dt = 1 \tag{3}$$

3. Admissibility condition is defined as

$$0 < C_\Psi = \int_0^{\infty} \frac{|\widehat{\Psi}(w)|^2}{w} dw < +\infty \tag{4}$$

where $\widehat{\Psi}$ is a Fourier transform, a function of frequency w, of Ψ. This condition is very vital, as it ensures that the original time series can be obtained from its CWT using the inverse transform.

Finally we arrive to the continuous wavelet transform $W(\tau, s)$, which is given by

$$W_x(\tau, s) = \int_{-\infty}^{\infty} x(t)\, \Psi^*_{\tau,s}(t)dt = \frac{1}{\sqrt{s}} \int_{-\infty}^{\infty} x(t)\, \Psi^*\left(\frac{t-\tau}{s}\right) dt \tag{5}$$

where * denotes a complex conjugate (Daubechies (1992)). For our following analysis we also need to define the wavelet power spectrum, in our case we start with a local version of this spectrum. Following Adisson (2002) we define the wavelet power spectrum as

$$(WPS)_x(\tau, s) = |W_x(\tau, s)|^2 \tag{6}$$

In case we would like to compare derived wavelet power spectrum with the Fourier power spectrum, we generally use so called the global wavelet power spectrum. It is basically integrated the WPS over all scales, so we get the overall energy of the time series and it can be written as

$$(GWPS)_x(s) = \int_{-\infty}^{\infty} |W_x(\tau, s)|^2 \tag{7}$$

The power spectrum basically depicts the local variance of the particular time series.

4 Data

This study uses a monthly data from May 2005 to December 2011 for the six GCC countries (Bahrain, Qatar, Kuwait, Saudi Arabia, United Arab Emirates and Oman) and was obtained entirely from MSCI website[2]. With regards to oil data, data was obtained from (http://www.forecast-chart.com/chart-crude-oil.html) for oil price.

[2]Essentially identical convergence was obtained by using the Frank Russell Limited index alone.

5 Correlation

5.1 Correlation (Statistical Correlation)

Table (1) presents the correlation between oil price and GCC countries' stock market returns from May 2005 to December 2011. Since all GCC countries are oil exporting countries, we expect that oil has a positive relationship with the stock market returns in the region (see for example Mohamed El Hedi Arouri and Christophe Rault (2009))
Nonetheless, it seems that not all stock market in GCC region have a positive relationship with oil price as some have, instead, negative relationship with oil price. Oil price has a negative relationship with Bahrain, Saudi Arabia and United Arab Emirates. However, in consistent with literature review, oil price has a positive relationship with Kuwait, Qatar as well as Oman.

Table 1: Correlation for GCC countries' stock market returns and oil (May 2005-December 2011)

	BHR	**KUW**	**QAT**	**SAU**	**OMN**	**UAE**	**oil**
BHR	1						
KUW	0.813	1					
QAT	0.492	0.497	1				
SAU	0.631	0.384	0.682	1			
OMN	0.746	0.790	0.731	0.448	1		
UAE	0.883	0.656	0.713	0.868	0.683	1	
oil	-0.085	0.287	0.422	-0.163	0.442	-0.145	1

5.2 The Wavelet Correlation of Stock Markets and Crude Oil

For the results of wavelet correlation for oil and GCC countries' stock market returns see Appendix A1.
Overall, our results show that stock market returns in GCC countries have a low correlation with oil price on the lower scale but turns to have a highly, positive correlation in the higher scale indicating that oil has more impact on stock returns the longer the period is. This on the other hand, contradict the conclusion we got from the statical correlation as no negative correlation exist, rather a low correlation in the short run and strong one in the long run.

6 Granger Causality Tests

6.1 Granger Causality Tests for Stock Market returns in GCC Countries and Oil

In the second step we test the causality of the variables using Granger Causality Tests. The results are presented in Table (2). It is obvious that oil returns have a causal relationship with the returns of all GCC stock markets. However, not all of these stock markets do have a causal relationship with oil. In other words, with the exception of Bahrain's stock market returns, all GCC stock markets returns have a bidirectional impact

on oil. In addition, the coefficients of both GCC stock price and oil are statistically significant up to the second lag, except Kuwait which is in the third lag.

Table 2: Result of applied Granger Causality Tests (Stock Market Returns and OIL)

Hypothesis	Lag	F-statistics	Prob-value
BHR→OIL	2	0.49009	0.61460
OIL→BHR	2	7.93464*	0.00077
KUW→OIL	3	2.94092**	0.03910
OIL →KUW	3	3.74458**	0.01488
OMN→OIL	2	5.76460*	0.00476
OIL→OMN	2	2.47893***	0.09096
QAT→OIL	2	2.41258***	0.09679
OIL→QAT	2	5.40840*	0.00648
SAU→OIL	2	3.16256**	0.04825
OIL→SAU	2	2.47365***	0.09141
UAE→OIL	2	3.16256**	0.04825
OIL→UAE	2	2.47365***	0.09141

Note: *, **, *** Significance at Levels 1%, 5% and 10%

6.2 The Granger Causality Test of the MODWT MRA Coefficients of GCC Stock Markets and Oil

Table (3) presents the result we got for Granger causality test between oil and each of GCC stock markets returns.

Table 3: Results of Granger causality tests between oil and stock market returns - MODWT MRA coefficient

Direction of causality	Scale 1	Scale 2	Scale 3	Scale 4
BHR→OIL	**NO**	YES	**NO**	YES
OIL→BHR	YES	YES	YES	YES
KUW→OIL	YES	YES	YES	YES
OIL →KUW	YES	YES	YES	YES
OMN→OIL	YES	YES	YES	YES
OIL→OMN	YES	YES	YES	YES
QAT→OIL	YES	YES	YES	YES
OIL→QAT	YES	YES	YES	YES
SAU→OIL	**NO**	**NO**	YES	YES
OIL→SAU	YES	YES	YES	YES
UAE→OIL	YES	YES	YES	YES
OIL→UAE	YES	YES	YES	YES

In general, it is obvious that oil does affect the stock market returns of all GCC countries; in the short and long run. On the other hand, not all GCC countries are affecting oil price returns as both Saudi Arabia and Bahrain do not have any causal relationship with oil in the short run. Nonetheless, it seems that all GCC countries stock market returns have an influential power on oil returns in the long run; which is consistent with our expectations. In other words, the longer the time is, the more influential power exists between these two variables. In addition, these results confirm our conclusion from the wavelet correlation.

7 Conclusion

The importance of oil as a main source of revenue in oil exporting countries and also as an important input in production in importing countries is not deniable. Therefore, we found that large body of literature reviews has studied the impact of oil on stock market returns. Since only few studies were conducted on developing countries or more specifically on GCC region, the purpose of this paper is to investigate the dynamic impact of oil returns on stock market returns of GCC countries.

In order to examine the impact of oil returns on stock market returns, we took two steps. Firstly, we examine the correlation between the variables in general then we use wavelet analysis to check for the robustness of our result. Secondly, we test the causality between the two variables using first Granger Causality then Granger causality tests using MODWT MRA coefficient which is more precise.

We use monthly data from May 2005 to December 2011 to examine the impact of oil on the stock market returns in GCC region. We conclude that not all stock market in GCC region have a positive relationship with oil price as some have, instead, negative relationship with oil price. Oil price has a negative relationship with Bahrain, Saudi Arabia and United Arab Emirates. However, in consistent with literature review, oil price has a positive relationship with Kuwait, Qatar as well as Oman.

Conversely, our results from wavelet correlation of stock markets and oil show that stock market returns in GCC countries have a low correlation with oil price on the low scale but turns to have a highly, positive correlation in the long run indicating that oil has more impact on stock returns the longer the period is

Generally, oil returns have causal relationship with the returns of all GCC stock markets. However, not all of these stock markets do have causal relationship with oil as Bahrain's stock market returns do not have any impact on oil. In simple words, all stock market returns in GCC region have bidirectional relationships with oil except Bahrain which has a unidirectional relationship with oil.

The findings of Granger causality of MODWT multi-resolution analysis proves that in the long run a strong bidirectional causal relationship exists between oil and each of the stock market returns in the GCC region. All GCC stock markets returns have a bidirectional causal relationship in the long run.

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Appendix

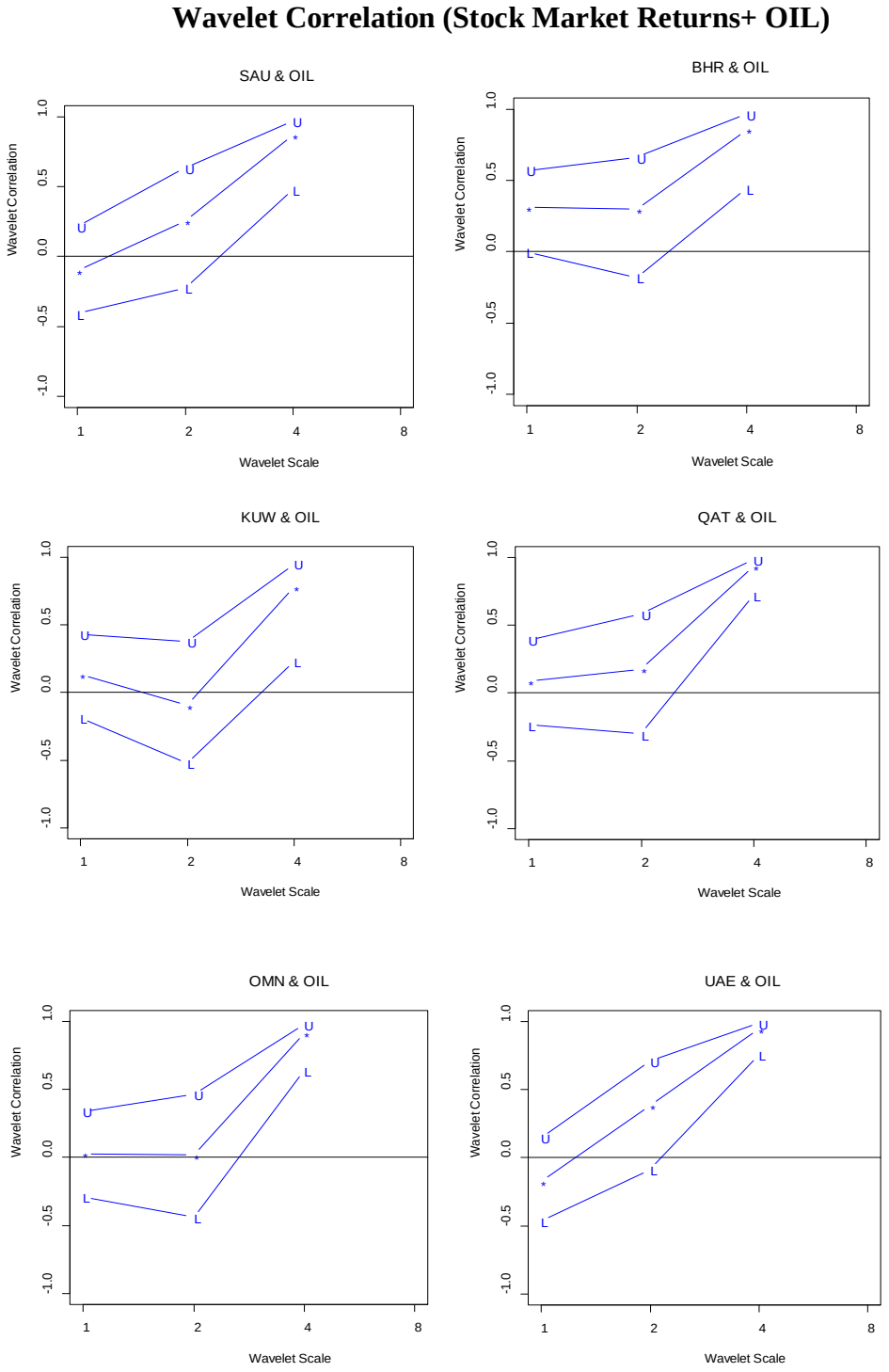
Wavelet Correlation (Stock Market Returns+ OIL)
SAU & OIL
BHR & OIL
KUW & OIL
QAT & OIL
OMN & OIL
UAE & OIL
Wavelet Correlation
Wavelet Scale
1.0
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Table A.1: Wavelet Correlation (Sock Market Returns +OIL)

	Scale Wavelet	Correlation	Lower CI	Upper CI
BHR- Oil	d1	0.314	-0.002	0.573
	d2	0.298	-0.181	0.662
	d3	0.855	0.442	0.969
KUW- Oil	d1	0.135	-0.188	0.432
	d2	-0.093	-0.525	0.377
	d3	0.776	0.230	0.950
QAT- Oil	d1	0.089	-0.233	0.393
	d2	0.176	-0.303	0.583
	d3	0.937	0.724	0.987
SAU- Oil	d1	-0.103	-0.406	0.219
	d2	0.253	-0.227	0.635
	d3	0.868	0.481	0.972
OMN- Oil	d1	0.028	-0.290	0.341
	d2	0.016	-0.441	0.467
	d3	0.914	0.636	0.982
UAE- Oil	d1	-0.174	-0.464	0.150
	d2	0.383	-0.087	0.713
	d3	0.945	0.755	0.989

Table A.2: The Granger causality test of the MODWT Multi-resolution analysis (Stock Market Returns +oil)

Hypothesis	scales	Lag	F-statistics	Prob-value
BHR→OIL	d1	5	0.90649	0.48263
	d2	18	2.30102**	0.02879
	d3	18	1.25301	0.29850
	d4	2	7.78112*	0.00087
OIL→BHR	d1	5	5.86047*	0.00017
	d2	18	3.30288*	0.00350
	d3	18	2.24156**	0.03286
	d4	2	6.53670*	0.00246
KUW→OIL	d1	2	2.70378***	0.07375
	d2	9	2.88717*	0.00778
	d3	2	15.3321*	2.8E-06
	d4	2	51.3781*	1.4E-14
OIL →KUW	d1	2	4.09692**	0.02065
	d2	9	1.84733***	0.08205
	d3	2	4.05386**	0.02146
	d4	2	66.0836*	5.1E-17
OMN→OIL	d1	2	3.94058**	0.02377
	d2	2	7.06324*	0.00158
	d3	2	23.9287*	1.10E-08
	d4	2	44.9537*	2.1E-13
OIL→OMN	d1	2	4.89306**	0.01017
	d2	2	4.80470**	0.01100
	d3	2	22.3330*	2.8E-08
	d4	2	20.3413*	9.9E-08
QAT→OIL	d1	2	8.74859*	0.00040
	d2	2	11.9789*	3.2E-05
	d3	3	4.26240*	0.00805
	d4	2	8.21592*	0.00061
OIL→QAT	d1	2	4.63776**	0.01275
	d2	2	6.08517*	0.00362
	d3	3	5.96061*	0.00113
	d4	2	29.5160*	4.3E-10

Hypothesis	scales	Lag	F-statistics	Prob-value
SAU→OIL	d1	6	1.11564	0.36412
	d2	2	1.41941	0.24854
	d3	2	5.83163*	0.00449
	d4	2	44.4893*	2.6E-13
OIL→SAU	d1	6	2.19528***	0.05572
	d2	2	7.50356*	0.00110
	d3	2	10.7255*	8.4E-05
	d4	2	15.4419*	2.6E-06
UAE→OIL	d1	10	2.33414**	0.02467
	d2	2	2.57630***	0.08305
	d3	4	4.36168*	0.00344
	d4	2	33.7375*	4.6E-11
OIL→UAE	d1	10	2.56874**	0.01414
	d2	2	3.33080**	0.04135
	d3	4	3.92372*	0.00643
	d4	2	17.3118*	7.3E-07

Note: *, **, *** Significance at Levels 1%, 5% and 10%