Oil price shocks and GCC capital markets: who drives whom?

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Oil price shocks and GCC capital markets: who drives whom?

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Abstract

Global reliance on Hydrocarbon sector has dramatically increased multi-fold which has led to rise to dominance of GCC. GCC is home to 45% of the proven oil reserves and contributes nearly 35% of the world oil exports annually. With such heavy reliance of the world on GCC for its oil produce, and the GCC's economic reliance on Oil and Gas exports, the matter of world oil price shocks and its transmission to other areas of economy is of immense importance to the GCC economies. With Oil wealth accumulating in GCC with some estimates of over $500 billion, oil shocks and stock market volatility in GCC has emerged as a key concern area. Our paper focuses on understanding the short term and long term correlation between oil price shocks and GCC stock market's volatility and the presence of any lead lag relationships. This study provides unique findings, different from earlier studies as we are able to analyze with non-linearity and least restrictive assumptions. The findings of this study are paramount for portfolio managers for their diversification benefit as well as timing of investment and divestment purposes.

JEL Classification: O13, Q43

Key Words: GCC, Oil Price Shocks, Stock Market Volatility, Hydrocarbon Exports

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I. Introduction

Gulf Cooperation Council was established in 1981 with six member nations namely Bahrain, Oman, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates (UAE). All these countries have gained importance in regards to global development owing to their status as global business hubs backed by 47% of the proven world oil reserves. GCC produces nearly upto 20% of all world oil, while controlling nearly 35% of world oil exports. For these economies, their governmental earning and fiscal planning and expenditures are largely determined by the oil exports and the international oil prices.

The past quarter of a century has seen the GCC countries focusing extensively their hydrocarbon policies on two aspects. Firstly the hydrocarbon sector has been the focal point for funding resources for government spending on infrastructural development and heavy transfer payments to citizens, and attracting foreign services industry and workforce with a tax free environment. Secondly heavy investments have gone into cross border instruments, primarily in Europe and United States, in the form of capital market investments.

In regards to the capital market structures in GCC, quite a few limitations exist as compared to the developed world, like regulatory weaknesses and relatively small numbers of listed firms with large institutional holdings, and a positive Skewness of listed firms to oil dependent sectors.

Last few years, especially post the 2007 oil price shocks and the 2008 global economic crisis, much effort has been put into by GCC countries in strengthening the legal, regulatory, and supervisory structures for efficient markets.

GCC member countries represent very attractive and lucrative emerging economies. Apart from Bahrain, and to Dubai, (an emirate under UAE) are relatively unknown

to the global investors. The promising potential of the GCC markets has recently becoming more prominent with the economies opening up their capital markets. While Bahrain, Kuwait, and recently Qatar have allowed foreign stock ownership, Saudi Arabia permits foreign ownership via investment in mutual funds.

A structural and attractive benefit of the opening up of GCC markets for foreign investors is the benefit of diversification they allow. Structurally the markets in GCC are different from other emerging economies as they are largely segmented from global equity markets but overly sensitive to regional political events, and high dependency of economies on hydrocarbon exports

The last few decades have seen tremendous fluctuations in the oil prices as earlier mentioned is evident from Chart 1 and Chart 2. Between March 2007 and June 2008, the international crude oil prices experienced a phenomenal increase of 76% and then a rapid decline during the global economic crisis of 48% between July 2008 and October 2008. Regardless of these absolute numbers indicating rapid decline and upswing in prices, Chart 1, shows worrying pattern of high volatility in daily fluctuations in prices.

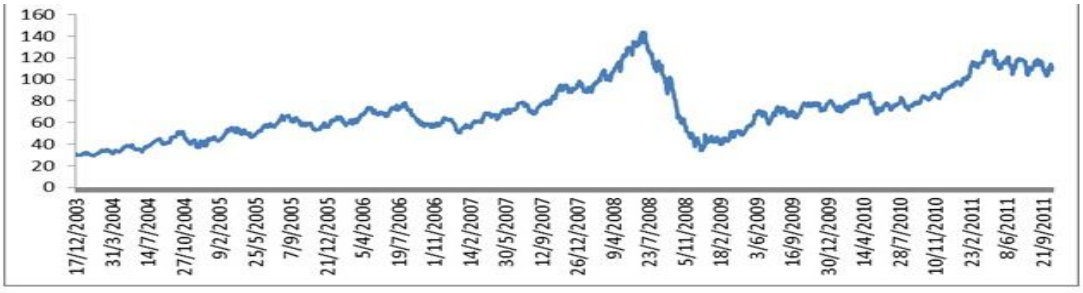
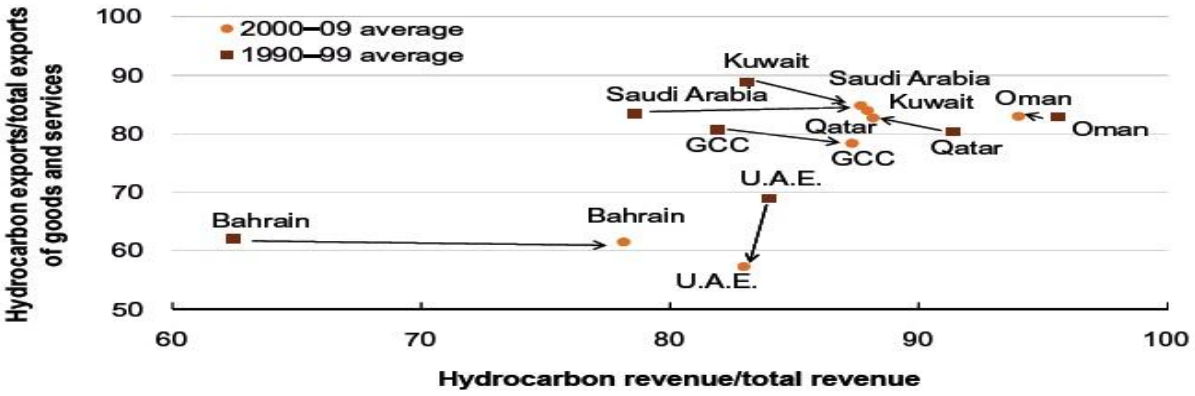


Fig. 1. Daily Crude Oil Price

An interesting aspect to the GCC economies and which relatively complicates any macroeconomic investigation in the GCC countries is the effective tying of exchange rate to US dollar. This implies that their monetary policies and thus their short-term

interest rates follow the US monetary policy and its short-term interest rates (Karam, 2001).

From a global portfolio management comprehension of the linkage of volatility of oil price with GCC markets is imminent for making informed decision making. At the same time, the understanding of this relationship is essential for policy makers and monetary managers for policy making and implementation.



Sources: Country authorities; and IMF staff estimates.

Fig. 2. GCC hydrocarbon Dependency

The dependence on the hydrocarbon has been at a steady increase in these economies over the past two decades as evident in Chart 3. Most GCC countries now range above 75% on hydrocarbon revenue as a ratio of total revenue. Except UAE, all other GCC member countries have over 60% of their exports in hydrocarbons, primarily oil. With such high dependence of the GCC regions on hydrocarbon production it sounded natural to investigate the impact of oil prices on the capital markets of the region.

From literature there are multiple channels via which oil price changes impact the stock market of a country. The most invoked of these channels is through the

discount rate factor for achieving at stock price. Oil prices directly impact the productivity and macroeconomics of the country, in turn the macroeconomic changes impacting the cash-flows and the discounting factor.

A number of studies in the recent past have been undertaken within the framework of linear models using low frequency data for net oil importing countries, to investigate the short and long term relationship of oil price shocks and stock markets.

Our study is unique in the nature since we attempt to shed away with the assumption of linearity and stationarity assumptions regarding the time series variables. Linearity and stationarity has been a user imposed restriction in the econometric models employed in studying oil-stock market relationships till now. But recently with the advancement of methods, we are able to let go of these restrictive assumptions.

The question that we are attempting to investigate is twofold:

1) Is there any coherence between oil price shocks and stock market fluctuations in short and long-term?

2) If there exists coherence, What is the lag and direction of this relationship?

In light of these research objectives, the paper is structured in a manner where the following section discusses literature on oil-stock market relationship. Section 3 sheds a quick look into the data followed by a brief explanation of wavelet methodology incorporated in this study in Section 4. This is followed by the empirical evidence in Section 5, and lastly the Conclusion of our study in Section 6.

II. Literature Review

Much empirical studies have been undertaken on the topic of oil shocks and impact on economic variables. Hamilton (1983), Cunado and Perez de Garcia (2005), and Kilian (2008) all found strong evidence of oil price shocks having a causal relation on recessions, inflation and economic growth in emerging economies.

Regarding specific research on causal relationship of oil price shocks and stock markets and cointegrating relationship is relatively a newer field in literature. In recent studies the focus has been primarily on the Oil exporting economies Jones and Kaul (1996) investigate four developed stock markets reaction to oil shocks based on standard cash flow dividend valuation model and find evidence of significant impact of oil changes in US and Canada, while inconclusive evidence for Japan and UK.

VAR Models have been recently employed to investigate the oil-stock market relationship, but surprisingly the evidence has been inconsistent over studies. Sadorsky (1999) and Ciner (2001) found evidence of asymmetric and nonlinear linkages in oil – stock market relationship.

Papapetrou(2001), Basher and Sadorsky(2006), Maghyereh and Al-Kandari (2007) all have found significant impact of oil shocks in emerging economies both on short term as well as long run.

Amongst specific focus on GCC countries we find surprisingly scarce research on the impact of oil price shocks to equity markets. The oil-stock market link in GCC should be of immense importance since GCC countries are major suppliers of oil in world energy markets, their stock markets are likely to be affected by changes in oil prices.

Hammoudeh and Alesia (2004) show using VAR models and cointegration tests, evidence of bidirectional relationship between Saudi stock returns and oil price

movements. Evidence of predictive price power of oil price change on GCC stock markets in Oman and Saudi Arabia was found by Zarour (2006) employing VAR analysis.

Hammoudeh and Choi (2006) in their investigation of long-run relationship among the GCC stock markets in the presence of the US oil market, the S&P 500 index and the US Treasury bill rate, report that oil and S&P 500 have an indirect impact on these markets while evidence of direct impact of T-Bill rate was found.

Hamilton (2003), Zhang (2008), Lardic and Mignon (2006, 2008) and Cologni and Manera (2009) all contributed to the literature, finding evidence of link between oil and economic activity to be not entirely linear implying that negative oil price shocks tend to have larger impact on growth than positive shocks.

Arouri and Rault (2009) using panel data approach of Konya (2006) found strong statistical evidence of causal relationship being consistently bi-directional for Saudi Arabia. In line with standard thought they also found that Oil price shocks, Granger cause stock prices, and not vice versa.

In the long-term, the influence of oil price on GCC stock prices was investigated by Ravuchandaran and Alkhatalan (2010) and found the a prevailing influence that the effect of oil price changes transmit to fundamental macroeconomic indicators, which in turn affect the long-term equilibrium linkage between these markets.

The non-linearity of the relationships between oil prices and stock markets in GCC was investigated by Arouri, Lahiani and Bellalah (2010). Their found that stock market returns significantly react to oil price changes in Qatar, Oman, Saudi Arabia and UAE. But their results also pointed to non-linear relationship switching according to the oil price values. However, for Bahrain and Kuwait they found evidence of no effect of oil price changes to stock market returns.

From a review of the literature it is evident that results of few studies on GCC markets and globally are heterogeneous. Intuitively the results are confusing, since GCC countries are heavily reliant on oil export with similar economic structures.

III. Data

The aim of the authors is to investigate the correlation of international oil price shocks to the GCC capital markets. Till now almost all of the studies that have been undertaken have been restricted either due to datasets or due to the restrictive and assumptive econometric models.

Previous studies in this area have mainly used low frequency data, and have been restricted by growth phases, of either pre crisis or crisis specific studies. For this study we use daily data for all our variables to adequately capture interaction between oil and stock prices in the GCC.

The data set stretches from December 17th 2003 upto October 21st 2011 with 2048 observations of daily returns Brent crude oil and the equity indices of the six GCC member countries. Stock market indices and Oil prices are obtained from Thomson Reuters, data repository. For oil, we use the daily Brent spot price since Brent is often used as reference prices for crude oil globally. Descriptive statistics for the daily returns are summarized in Table 1.

	Mean	Standard Deviation	Skewness	Kurtosis
Brent Crude Oil	0.090726%	0.022631	0.160227	3.144321
Saudi Arabia	0.033181%	0.018793	-0.220409	9.709315

Bahrain	-0.005183%	0.006338	-0.365930	5.705680
Oman	0.042495%	0.011761	-0.598977	12.877561
Kuwait	0.011217%	0.011174	-0.126810	6.564698
Qatar	0.052129%	0.016643	-0.180260	5.247653
UAE (Abu Dhabi)	0.032751%	0.018753	6.549679	261.023671

Table 1: Descriptive Statistics

GCC markets on average show stock markets have higher volatilities, with Abu Dhabi Stock Exchange showing the highest volatility. Surprisingly during this period the Bahrain Stock Market has shown a negative mean return. Oil prices on an average showed more volatility than all GCC stock markets over our sample period. Skewness is negative in most cases except UAE which also has a very high kurtosis.

IV. Methodology - Wavelet Analysis

For this study, wavelet is employed in a step by step process for coherence analysis. Wavelet Analysis has two main categories which have been implemented in economics and finance lately: the discrete wavelet analysis (DWT) and the continuous wavelet analysis (CWT). For some time now, almost a decade DWT was the dominant methodology for economic applications (Gencay et al., 2002; Ramsay, 2002; Gallegati and Gallegati, 2007). In the last year or so the CWT has emerged as a popular choice of academicians for studying the interaction and co-movement of time series data.

Important part of the continuous wavelet analysis is the ability to study interactions or co-movement between two time series in time-frequency domain using the cross-

wavelet tools (Aguiar-Conraria et al., 2008; Rua and Nunes, 2009). In this study we use the continuous wavelet analysis tools: wavelet coherence for measuring the local correlation of two time series in time-frequency domain.

In literature on wavelet it is a common practice to use terminology of scale instead of frequency. It should be remembered that frequency has an inverse relationship with scale. This is imminent as throughout this paper, the world scale would refer to frequency in an inverse relationship i.e. low scale means high frequency, while high scale means low frequency.

Wavelet

A wavelet is a real-valued or a complex-valued function ψ(.) defined over the real axis. There are several conditions that the wavelet must fulfill. Admissibility condition that allows for reconstruction of a time series from its continuous wavelet transform:

$$C\varphi = \int_0^\infty \frac{|\,\varphi(f).|2}{f}\, df < \infty$$

Where Ψ(f) is the Fourier transform of the wavelet ψ(.) The wavelet must have a zero mean to comply with admissibility condition of a wavelet having zero frequency.

$$\int_{-x}^{x} \varphi(t) dy = 0$$

This condition assures that any movement from zero must be cancelled out by an opposite movement so the wavelet looks like a wave.

There are different types of wavelets, with every wavelet having some specific characteristics making it useful for different and unique purposes. For financial market co-movement analysis, mostly the Morlet wavelet has been utilized.

The continuous wavelet transform

The continuous wavelet transform $W_x(u, s)$ is obtained by projecting the specific wavelet $\psi(.)$ onto the examined time series $x(t) \in L_2(R)$. The continuous wavelet transform is defined as:

$$W_x(u,s) = \int_{-x}^{x} x(t) \frac{1}{\sqrt{s}} \varphi \left(\frac{t-u}{s}\right) dt.$$

The important feature of wavelet transform is the ability to decompose and then subsequently perfectly reconstruct the function $x(t) \in L_2(R)$:

$$\boldsymbol{x(t) - \frac{1}{C\varphi} \int_{-\infty}^{\infty} [\int_{-\infty}^{\infty} W_x(u,s) \varphi_{u.s}(t) du] \frac{ds}{s^2}}$$

Wavelet coherence

Moving on from univariate to cross-wavelet approach the main tool for analysis is wavelet coherence. Cross wavelet transform has been defined by (Torrence and Compo, 1998; Grinsted et al., 2004) for two time series x(t) and y(t) with the continuous wavelet transforms $W_x(u, s)$ and $W_y(u, s)$by:

$$W_{xy}(u, s) = W_x(u, s)W^*_y(u, s)$$

Where u is a position index and s denotes the scale, symbol $*$ denotes a complex conjugate.

Furthermore, we define cross wavelet power as $|W_{xy}(u, s)|$ (Hudgins et al., 1993; Torrence and Compo, 1998). The cross wavelet power uncovers areas in time–scale space where the two time series show high common power, i.e. it represents the local covariance between the time series at each scale. Since our analysis is based on financial variables we are also interested in the regions where the two time series in time–scale space co-move, but does not necessarily have high power. Useful wavelet tool that can uncover these co-movements is the wavelet coherence.

The wavelet coherence is a measure of local correlation of the two time series both in time and scale. Following approach of Torrence and Webster (1999), we define the wavelet coherence as the squared absolute value of the smoothed cross wavelet spectra normalized by the product of the smoothed individual wavelet power spectra of each series where S is a smoothing operator. i.e.

$$R^2(u,s) = \frac{|S\left(s^{-1}W_{xy}(u,s)\right)|^2}{S(s^{-1}W_x(u,s)|^2)S(s^{-1}|W_y(u,s)|^2)}$$

The squared wavelet coherence coefficient is in the range $0 \leq R_2(u, s) \leq 1$, values close to zero represent a weak correlation while values close to one are an evidence of strong correlation. Since no firm theoretical distribution analysis is available on statistical significance of distribution of wavelet coherence, we utilize the 5% statistical significance level determined using Monte Carlo methods.

Phase Difference

To understand the relationship between the time series we use wavelet coherence phase differences The phase difference gives details about delays of oscillation (cycles) of the two examined time series. Following Torrence and Webster (1999), we define the wavelet coherence phase difference as:

$$\emptyset_{xy}(u,s) = tan^{-1}\left(\frac{\vartheta\{S\left(s^{-1}W_{xy}(u,s)\right)\}}{R\{S\left(s^{-1}\left|W_{xy}(u,s)\right.\right)\}}\right)$$

Phase is indicated by arrows on the wavelet coherence plots. A zero phase difference means that the examined time series move together at a particular scale s. Arrows pointing to the right (left) when the time series positively (negatively) correlated. Arrow pointing up means that the first time series leads the second one by 90^0, arrow pointing down indicates that the second time series leads the first one by 90^0. For our plots we observe a mixture of positions.

V. Empirical Findings

Moving towards the empirical results for our study, we analyze the daily returns of the six stock markets and Brent crude oil price, as a proxy for world oil prices, transformed into wavelet coherence pattern.

To initiate our empirical study, breaking down the oil price volatility into continuous wavelet transform (CWT), it is evident that there are periods of high volatility in the basic daily returns of oil prices during two eras in our sample period. The first one is in 2003- 2004, and secondly in 2008-2009. The simple volatility plot of the daily fluctuations as in Chart 2 earlier provides partial understanding of the impact of this volatility and the long term effect of these oil shocks that occurred. With CWT of the daily fluctuations in oil prices, a much clearer and unique perspective of these shocks is provided.

In the Wavelet transform it is evident two periods of high volatility represented by darker phases on the plot. Both are chronologically similar to the basic daily volatility plot, in 2004 and in 2008-09. Interestingly the CWT plot identifies that the

volatility impact of oil price in the first oil shock of 2003-04 had an impact of upto 8 days maximum, and it died out on a longer time scale, as represented by blue area. The plausible reason for the short impact of this price spike is related to fundamental changes in the underlying factors. At a glance at the reasons for the oil price shock of 2003-04, the primary source was the initiation of military action in Iraq. During 2004 and 2005 the excess oil production capacity was less than a million barrels per day, not enough to cover an interruption of supply from most OPEC producers. This fear of disruption of oil supply caused this spike, but with smooth sailing for the war in Iraq and oil supply, the shock did not cause fundamental shifts to impact oil prices over the long run.

The second oil shock was a for a longer time period, starting in 2008 and leading into 2009. Referring to CWT plot, it is noticeable that the higher volatility of oil shock this time had a longer impact of upto 16 days on the short run, with high impact in the shortest run of upto 4 days. In the analysis of the actual movement of the prices we notice in Chart 1 earlier, that this oil shock was in reality a negative drive of oil

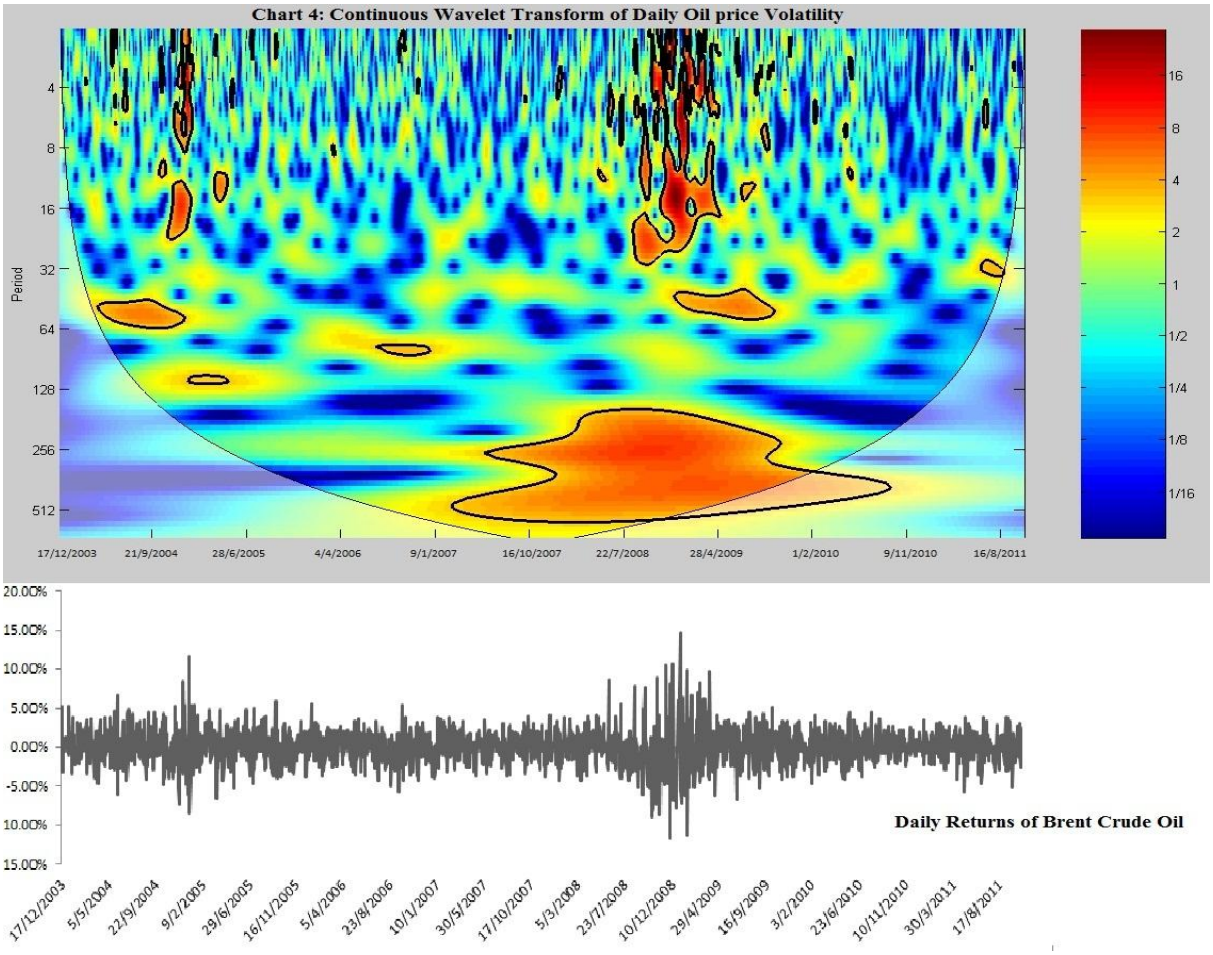


Fig. 3. CWT plot of Oil Price Volatilty

prices on the back of recession, with the oil price showing a very erratic behavior, but with a steady downward trend. This phase of oil price volatility not only had impacts on short run but it is noticeable that the in the long run there has been a relatively higher impact than before as evident by the yellow zone in the lag of 256. This has two meanings for our economic interpretation, firstly the high volatility phase lasted for over 256 days, and secondly and more importantly, and this oil shock plausibly caused structural change in the oil price movements. The structural change argument in the view of author intuitively explains as this volatility period coincides with the global economic slowdown. The petroleum demand contracted initially spectacularly in the face of recession the price fell throughout 2008 to a bottom of $40 in December. Following an OPEC cut of 4.2 million barrels per day in

early 2009 which led to increase in prices steadily supported by rising demand in Asia.

Moving on to our key focus area of this study, we delve into the coherence patterns for oil price fluctuations and the GCC Markets one by one. The rationale behind studying the markets separately is that although these countries share numerous common traits, as dependence on energy trade, fixed exchange rate regimes, high consumption item imports, and monarchy rule systems. But with all the common traits, the capital market openness varies and the composition of sector weights in each market varies. Owing to these differences we are led to make a cautious effort to study every markets reaction to oil shocks separately rather than generalizing it.

Kingdom of Saudi Arabia

For the Saudi Arabian Stock Market Returns and Oil Price Returns coherence pattern, we have an output which is defying to great extent the rational thinking, There is an observation of some dark high correlation patterns in the 4 day lag period during 2008 -2009 oil price shocks, but the high correlation disappears very quickly and medium range correlation patterns seem to appear at random points in medium term range, at a 64 day lag period. Intuitively this leads the authors to deduce, that in short run there is a co-movement of the oil price and KSA Stock Market, but the short periods does not lead us to make any conclusion with conviction regarding impact of stock price changes with world oil price changes. Over the longer term lag period of 128 days and above, it is observed that there is a high correlation between the two financial variables, implying that volatility in one of the variables is transmitted to the other variable by a lag of 128 days. Mere understanding of the correlations does not answer our research objectives and we look towards phase

difference to figure out the lead lag relationship. During both the short lag and long lag high coherence phases, it is observed that there is no determinable lead-lag relationship.

The question that arises out of these observations is why these unique observations are not in-line with any past findings. In our humble understanding the past findings of strong correlation between oil shocks and volatility in Saudi Market may have been a result of the linearity assumption. In the economic sense the authors believe that since the Saudi market does not allow international investors to directly invest in their market and only via mutual funds, results in a shielding effect from global oil price shocks. Due to these restrictions the investors in KSA Stock market are primarily local institutions and high net worth individuals, who do not take a volatile entry and exit approach based on global factors. This understanding is also further reaffirmed, by relatively thin trading volumes in the market as compared to other developed markets.

Bahrain

For the Bahraini Stock market fluctuation and oil price volatility coherence plot provides interesting insight, with the shortest lag it is observable slight traces of high correlation time periods and during 2009-10 the high correlation between our two variables with a lag of 8 to 16 days. Over the long term lag, of 128 days as expected there is a high correlation between the two variables. Studying the Bahraini economy, the results are somewhat in line, as Bahrain is a service based economy, with negligible reliance on hydrocarbon exports. In addition to this, Bahraini stock market is relatively open to international investors, and has been trying hard over the past decade to develop itself as the gateway to the Middle East for western investor.

With this structure of capital markets and economy, and oil price shocks are deemed negative for the world economy are transmitted to the Bahraini economy, in the form of slowing down of services sector growth, and reduction in international investment portfolios or transfer to safer securities. This understanding of the authors is further reaffirmed by the phase difference, which points towards a lead lag relationship during high correlation phases for oil price volatility to be the lead variable. This helps us understand that any price volatility in oil markets would impact the Bahraini Stock Market with a short lag of 4 to 8 days but that effect dies out over that lag, but the long lasting impact of that can be observed over the long term period.

Kuwait

Kuwait is one of the largest oil producers in the region behind Saudi Arabia only. On the capital markets front, it has recently opened up to attract foreign investors. The coherence plot between Kuwait stock market changes and oil price fluctuations, shows towards rare instances of correlation in the shortest time lag of 4 to 8 days, and but scattered high correlation during the high oil price volatility on a time lag scale of 6 to 10 day scale, with a long lag high correlation plot. On the investigation of the lead lag relationship there is no clear indication the short lag period with slight traces of oil being the leader in the longer lag period. This observation of no short term lead lag relationship is understandable in the view of authors, since it has been only the recent past when Kuwait opened up its capital markets to foreign portfolio manager who may be sensitive to global oil shocks. The long term effect of oil price shocks is plausibly transmitted through the macroeconomic channels of the whole economy readjusting to oil price shocks, since Kuwait similar to Saudi Arabia is heavily dependent on oil exports.

Oman

Oman is one of the more unique economies in the region, which has over the last decade maintained a level of no national debt with reasonably sized sovereign fund having exposures globally. Compared to its counterparts in the GCC, the oil production of the country is lesser but in recent years it has discovered much oil reserves and proven oil wealth has drastically increased. Oman has been off the radar of global investors in terms of stock markets, and this is further reaffirmed by the coherence plot for oil price fluctuations and stock market volatility. There is evidence of high correlation between during the short lag period at paused intervals during the 2007 -2009 oil price downslide. Also similar to our observation for other countries there is a high correlation over a longer lag with traces of high correlation periods in medium term lag. But with all these correlation patterns, the phase difference analysis, returns random results, with lead lag relation switching between the two variables in short term, and in long term no clear direction of lead lag relationship. This leads us to make a careful inference that the oil price shocks do not have an existing relationship to the stock market volatility in Oman, which is rational in our opinion, owing to low base of international investors.

Qatar

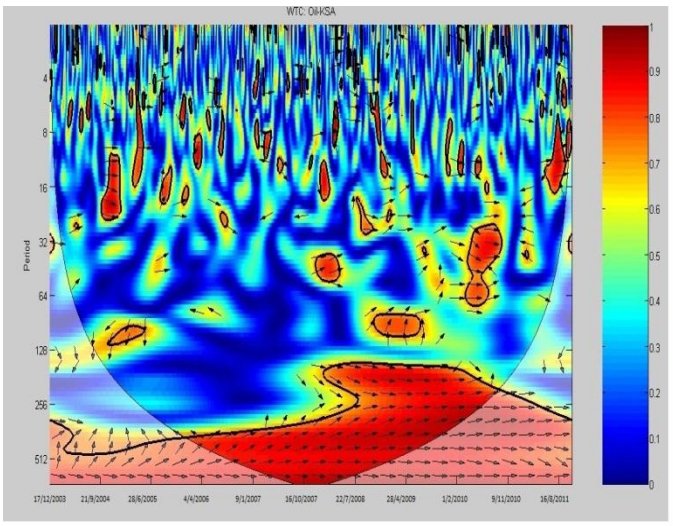
Qatar economy has seen a dramatic growth in the past decade backed by oil and gas export revenues. Qatar is slated in the top 3 countries according to GDP per capita, but a highly dependent economy on hydrocarbon. Oil and gas account for nearly 50% of GDP translated into around 85% of export earnings and 70% of government revenues. With this preview of the economy, the understanding of the CWT coherence plot for the Qatar Stock market fluctuations and oil price volatility is

further clarified. The coherence plot indicates towards non-existence of high correlation areas in the lag period of upto 4 days. There are slight traces of high correlation in 4-10 days lag during March and April 2009 oil price volatility era. The phase difference points towards a relationship of Oil volatility positively leading the stock market volatility. This same oil price shock is transmitted over longer lags as well with the same lead lag relationship.2009 onwards we observe a high correlation phases coinciding with sudden oil price movements, but its observable that the impact is after a lag of roughly 4 days. The observations of the author at first are spurious, but then the effect of contagion being observed from 2009 onwards is intuitively understandable, since Qatar's Stock Exchange has shown tremendous growth from 2008 onwards, backed by opening up of business and investment sector to international investors. In the longer lag period the correlation is as expected high, owing to the heavy reliance of the economy on the hydrocarbon sector.

United Arab Emirates

United Arab Emirates is one of the modern day examples of hydrocarbon growth based transformations. In the past 3 decades, UAE has transformed itself from an impoverished desert state one of the most economically stable state in the Middle East. Over the past decades, UAE has successfully liberalized and transformed it economy to reduce dependence on hydrocarbon sector. Merely 25% of the GDP is based on oil and gas according to recent estimates. UAE's Economy although reliant on oil to only one fourth of the GDP was hard hit in the recent oil price crash of 2008 which coincided with the world economic slowdown. Out of the 7 member states, Dubai was the worst hit, an economy primarily based on services industry suffered drastically reaching a near sovereign default state before being bailed out by neighboring state of Abu Dhabi, a part of UAE.

Keeping in mind these realities, the coherence plot of Oil price volatility and the stock price shows traces of high correlations over short lag period 0 to 8 days, during late 2009 and early 2010. But the phase difference provides a set of indefinite pattern, implying that in short lag periods, stock market volatility lead the oil price volatility. Intuitively this does not seem a valid relationship. Over a longer lag period of 128 days and more, our results provide interesting insights with the oil price volatility having a high positive correlations and a leading relationship with stock market volatility.


WTC: Oil-KSA
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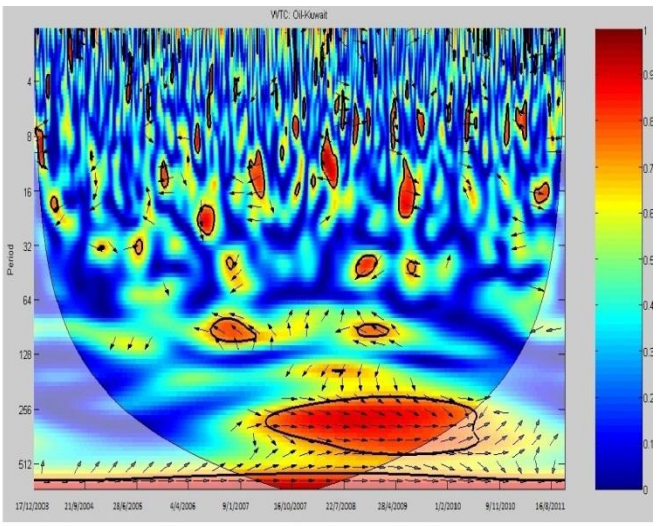
WTC: Oil-Kuwait
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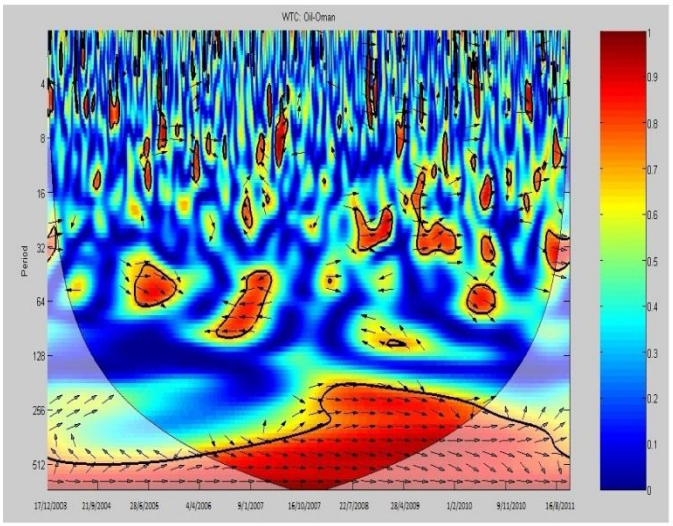
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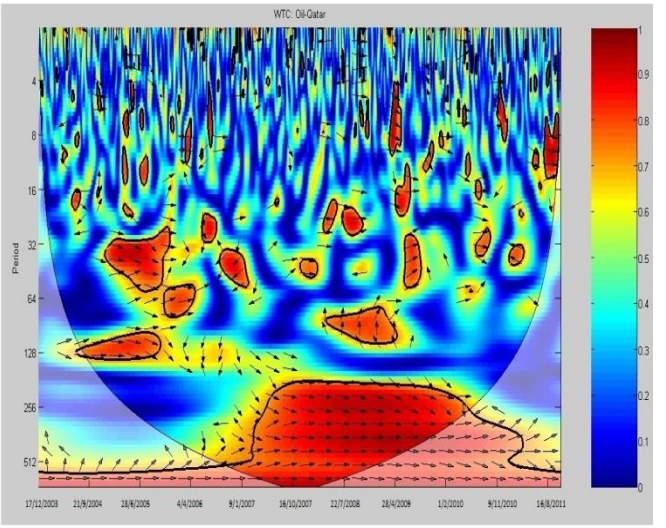
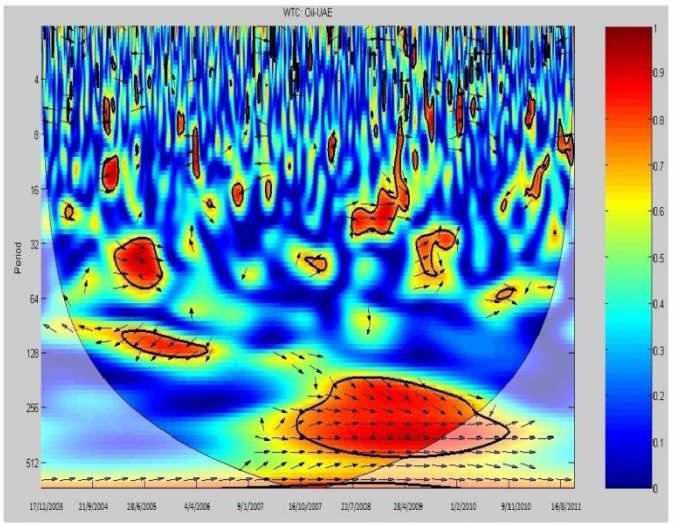

WTC: Oil-Qatar
Period
4
8
16
32
64
128
256
512
17/12/2003
21/9/2004
28/6/2005
4/4/2006
9/1/2007
16/10/2007
22/7/2008
28/4/2009
1/2/2010
9/11/2010
16/8/2011
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0


WTC: Oil-UAE
Period
4
8
16
32
64
128
256
512
17/12/2003
21/9/2004
28/6/2005
4/4/2006
9/1/2007
16/10/2007
22/7/2008
28/4/2009
1/2/2010
9/11/2010
16/8/2011
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

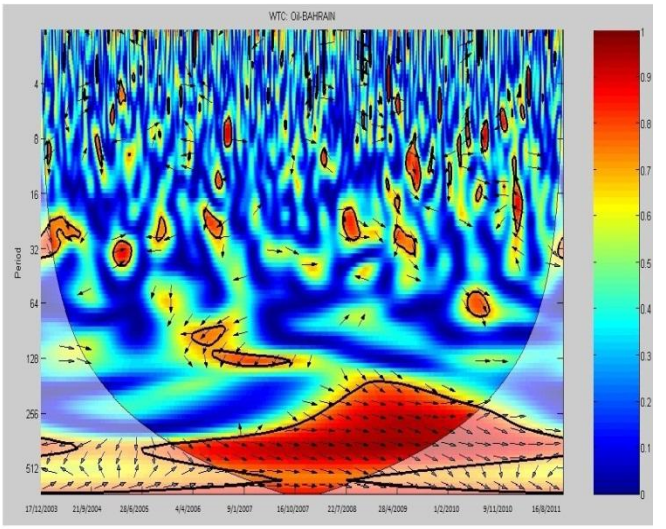

WTC: Oil-BAHRAIN
Period
4
8
16
32
64
128
256
512
17/12/2003
21/9/2004
28/6/2005
4/4/2006
9/1/2007
16/10/2007
22/7/2008
28/4/2009
1/2/2010
9/11/2010
16/8/2011
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

Fig. 4. Cross Wavelet Transform Coherence Plot of Oil Price Volatility and Stock Market Volatility

VI. Conclusion

Oil Price volatility and local stock markets in GCC has been an area of much interest to many research works, mainly due to such critical role of hydrocarbon sector in the economies of these nations. Our findings provide an interesting and unique perspective, and lead us to make cautious deductions, that being heavily reliant on one commodity for a country does not expose its stock markets blindly to price shocks of that commodity, in our case Oil.

Our findings provide a better insight for international portfolio managers and sovereign funds in the form of an understanding of which markets in GCC are impacted by Oil Price Shocks and by how much lag. This comprehension of lead-lag relationship is of utmost importance to every portfolio manager, for timing his entry and exit between exposures in markets and asset classes.

Our research questions which were laid out laid out in the first section were:

3) Is there any coherence between oil price shocks and stock market fluctuations in short and long-term?
4) If there exists coherence, what is the lag and direction of this relationship?

Our findings are concluded and summarized country by country in reference to our research objective is as follows:

- **Kingdom of Saudi Arabia:** In case of an oil price shock, there is no determinable impact on the investments in the Saudi Stock Market in the short and the longer lag period.

- **Bahrain:** Any Oil price shock would be transmitted to Bahrain Stock market with a lag of 8 to 16 days, and then dies out, but leaves traces of long term impact in a lag period of 128+ days.
- **Kuwait:** Similar to KSA, there exists no lead lag relationship between oil price and stock market, but an oil price shock has impact on the stock market in longer time periods. This lead lag relationship is plausibly owing to the impact of oil price changes on the macroeconomic variables in Kuwait which leads to impact on the Stock market.
- **Oman:** According to our findings, although there are traces of high correlation between oil price and stock market volatilities in medium term, but no definitive lead relationship could be deduced. This implies that oil price shocks do not impact the local stock market.
- **Qatar:** Post 2009, once the Qatar economy has started opening up to foreign investors, there are signs of a lead lag relationship between oil price shocks being transmitted to the Oil stock market, with a positive correlation with a lag of in 4-10. There are also strong signs of long term impact of oil price shocks as well.
- **United Arab Emirates:** Oil Price Shocks do not have a definite lead lag relationship with the local stock market, although they show traces of high correlation. But oil prices shocks tend to have a high correlation with the local stock market with a leading role over a lag period of 128 days and more.

References

Arouri, M., Fouquau, J., 2009. On the short-term influence of oil price changes on stock markets in GCC countries: linear and nonlinear analyses. Economics Bulletin, 29, 806-815.

Barassi, M.R., Caporale, G.M., Hall, S.G., 2005. Interest rate linkages: a Kalman filter approach to detecting structural change. Economic Modelling, 22, 253-284.

Basher, S.A., Sadorsky, P., 2006. Oil price risk and emerging stock markets. Global Finance Journal, 17, 224-251.

Choi, K., Hammoudeh, S., 2010. Volatility behavior of oil, industrial commodity and stock markets in a regime-switching environment. Energy Policy, 38, 4388-4399.

Ciner, C., 2001. Energy shock and financial market nonlinear linkages. Studies in Nonlinear Dynamics and Econometrics, 5, 203-212.

Cologni, M., Manera, M., 2008. Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries. Energy Economics, 30, 856-888.

Cologni, M., Manera, M., 2009. The asymmetric effects of oil shocks on output growth: A Markov-switching analysis for the G-7 countries. Economic Modelling, 26, 1-29.

Cunado, J., Perez de Garcia, F., 2005. Oil prices, economic activity and inflation: evidence for some Asian countries. Quarterly Review of Economics and Finance, 45, 65-83.

Ewing, B.T., Malik, F., Ozfidan, O., 2002. Volatility transmission in the oil and natural gas markets. Energy Economics, 24, 525-538.

Fama, E.F., 1991. Efficient capital markets II. Journal of Finance, 46, 1575-1617.

Forbes, K., Rigobon, R., 2002. No contagion, only interdependence: measuring stock market comovements. Journal of Finance, 57, 2223-2261.

Hamilton, J.D., 1983. Oil and the macroeconomy since World War II. Journal of Political Economy, 91, 228-248.

Hamilton, J.D., 2003. What is an oil shock? Journal of Econometrics, 113, 363-398.

Hammoudeh, S., Aleisa, E., 2004. Dynamic relationship among GCC stock markets and NYMEX oil futures. Contemporary Economic Policy, 22, 250-269.

Hammoudeh, S., Choi, K., 2006. Behavior of GCC stock markets and impacts of US oil and financial markets. Research in International Business and Finance, 20, 22-44.

Hammoudeh, S., Yuan, Y., McAleer, M., 2009. Shock and volatility spillovers among equity sectors of the Gulf Arab stock markets. Quarterly Review of Economics and Finance, 49, 829-842.

Huang, R.D., Masulis, R.W., Stoll, H.R., 1996. Energy shocks and financial markets. Journal of Futures Markets, 16, 1-27.

Jones, C.M., Kaul, G., 1996. Oil and the stock markets. Journal of Finance, 51, 463-491.

Kang, S.H., Kang, S.M., Yoon, S.M., 2009. Forecasting volatility of crude oil markets. Energy Economics, 31, 119-125.

Kilian, L., 2008. Exogenous oil supply shocks: how big are they and how much do they matter for the US economy? Review of Economics and Statistics, 90, 216-240.

Maghyereh, M., Al-Kandari, A. Oil prices and stock markets in GCC countries: new evidence from nonlinear cointegration analysis. Managerial Finance, 33, 449-460.

Malik, F., Ewing, B.T., 2009. Volatility transmission between oil prices and equity sector returns. International Review of Financial Analysis, 18, 95-100.

Sadorsky, P., 1999. Oil price shocks and stock market activity. Energy Economics, 2, 449-469.