REVIEW OF RESEARCH
IMPACT FACTOR : 5.7631(UIF) UGC APPROVED JOURNAL NO. 48514 ISSN: 2249-894X
VOLUME - 8 | ISSUE - 1 | OCTOBER - 2018

IMPACT OF OIL PRICE ON STOCK PRICE VOLATILITY: EVIDENCE FROM OIL IMPORTING AND EXPORTING COUNTRIES

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ABSTRACT

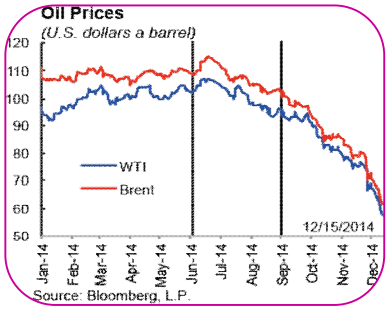
Crude oil is an inevitable source of energy for almost all sectors of an economy. Oil is a key strategic commodity and has its current revolve around power and politics. India became the third largest net importer of oil, surpassing Japan in recent time followed by US, and China. Crude oil price volatility and its impact on economy is an important aspect to study. We applied GARCH (1, 1) and TARCH (1, 1) model in a set of six oil importing and exporting countries. Our findings reveal the impact of oil price on stock price volatility in oil exporting countries such as Saudi Arabia and UAE, whereas in the case of Russia it is not having any significant influence. Results also show that exchange rate affects stock price volatility of all the oil-exporting countries. However, in case of China, which is an oil importing country, neither oil price nor exchange rate significantly affects stock price volatility.

KEYWORDS: *Oil Price, Stock Price, Exchange Rate, Volatility.*

INTRODUCTION

Considering the role of crude oil in the development of nations in the history, its impact on economic development has been widely studied. Crude oil is an inevitable source of energy for almost all sectors of an economy. It is considered as one of the important and largest commodities markets in the world (Maghyereh, 2007; Hubbar, 1998). Unlike other commodities, its price is largely controlled by shocks to the supply of and demand for oil. This may be because of the fact that more than an important energy source, oil is a key strategic commodity and has its current revolve around power and politics.

Starting from the early works by Hamilton (1983) to the latest studies by Baumeister and Kilian (2016), there has been a legion of literature documenting positive and negative effects of crude oil shocks at par with the fluctuating trend of crude oil prices. Except few, all studies substantiated the interdependence between them. Major recessions in the US post-war period were followed by high volatile crude prices Hamilton (1983). The earlier studies discussed the cash flow hypothesis as discussed by Jones and Kaul (1996), which argues that shocks in the oil price can directly reduce the cash earnings of firms and indirectly through interest rates discounting for the expected decrease in return. The crude oil price became more volatile after the 1980s due to several reasons including unrest in the West Asia and other geopolitical events. After 1990s, oil price showed an upward trend marching from around $30 per barrel to nearly $150 per barrel until the period of global financial crisis of 2008. This study at least as for India, attempted in the most relevant context as recently government deregulated the domestic price of petroleum products. Besides, India became the third largest net importer of oil, surpassing Japan in recent time followed by US, and china. Another important fact is that India imports 80% of its energy requirements and majority is



from the Middle East. Jain and Bansal (2016) in their recent article commented that changed policy on deregulation of oil price will not have impacts on domestic oil prices unless price fluctuations in the international crude oil markets are not exploited to influence the macro economic variables with its reflection in the retail domestic oil price.

It is estimated that India's annual diesel consumption could rise from 90 billion litres to150 billion litres by 2030. It is also estimated that consumption in the world's third biggest oil-consuming nation could rise to 50 billion litres by 2030 from current consumption of 30 billion litres. It is another interesting fact to note that India imports about 80% of its oil requirement.

As per the BP Statistical review of world energy during the period from 1990 -2007 real annual GDP growth rate in China and India were 10% and 6.3% respectively which are the two major developing economies in the Asian continent. During the same period average growth rate of the OECD countries were 2.5%. Over the period of 1990-2007, real GDP in China and India grew at annual rate of 10% and 6.3% respectively. OECD countries grew at an average rate of 2.5% over the same period. In 2009, US were the largest consumer of oil accounting for 22% of the global oil demand. Demand for oil in the developed countries is remaining steady or is declining as they are shifting more towards renewables sources of energy. On the contrary, the demand for oil in the developing markets are growing rapidly as rightly predicted by experts that the forthcoming century belongs to Asia and other developing countries. (BP Statistical Review of World Energy 2016)

The formation of OPEC and unrest in the west Asia always decided how the supply and price of crude oil prevail in the international market. Geopolitical factors and interest of the west to maintain unrest in the west Asia could be a reason for the peeks and downs of crude oil price in the global market. After the 2008 global financial crisis, the crude oil prices stood stable but later on in 2014 it suddenly fell down below $50 per barrel.

Theoretically, the oil price-macro economy linkage has been well established. Dynamics in crude oil market are passed onto the economy in several ways like expected inflationary pressures, fall in GDP and decline in equity returns through elevated production cost. Economic theory suggests that stock prices should accommodate trends in the future corporate performance and prospects of them. In such a context, we could consider stock performance as stethoscope to listen the beats of the economy.

Moreover, this dynamics are determined by the fact whether the economy is a net oil exporting or importing one. There will be a transfer of wealth from the later to the former in case of a price level increase. Previous studies do not differentiate oil exporting and importing countries especially the developing and Asian countries. Especially the GCC markets were not considered for various reasons like availability of data and inactive stock market.

Thus, it is very important that the quantum of dependence on imports of crude oil by an economy and its macroeconomic variables may have a dynamic linkage. An effort is made more to understand the effect of previous period volatility on current stock market return of oil importing and exporting countries considering the presence of oil prices and exchange rate movements. The following part of the paper is divided as Review of literature followed by Data and Methodology, Empirical Results and Concluding Remarks.

REVIEW OF LITERATURE

Studies by James D Hamilton (1983) were one of the notable literature to analyze impact of oil price on macroeconomic movements. He identified that increasing oil prices and stagnation in oil supply had affected the recession in USA during the 1973. Jones and Kaul (1996)using an unrestricted vector autoregressive (VAR) model, tested the reaction of stock market returns for Canada, Japan, the UK, and the US to oil price changes on the basis of the standard cash flow dividend valuation model. They find negative links between oil price changes and stock returns in the US and Canada. The results for Japan and the UK were inconclusive.

There are several studies conducted in the context of the developed market. Most of the studies cite an inverse interaction between oil price and stock market. Jones and Kaul (1996) were one among them to identify oil price as a factor of risk for stock markets. This argument has been further substantiated by many other studies like Papapetrou (2001), Sadorsky (1999), Malik and Hammoudeh (2007), Park and Ratti (2008), O'Neill, et al. (2008), Nandha and Faff (2008), Chen (2009), Miller and Ratti (2009), Filis (2010), Chen (2010) Basher et al. (2012), Lee et al. (2017).

Another study by Huang et al. (1996) find no evidence of a short-term relationship between oil prices and the S&P500 market index. The history of crude oil price began to fluctuate in the early 1970s's during the US recession. Sadorsky (1999) however, applies an unrestricted VAR model with GARCH effects to American monthly data and shows a negative short-term effect of oil-price volatility on the aggregate stock returns.

Crude oil shocks usually exert a major influence on all macro-economic activities through channelling of major economic approaches. The fact that oil price drives exchange rate movements in the international market due to the dollar dependency is widely accepted in the literature (Amano and Van Norden, 1998) Lee and Lin (2012). The exchange rate movement in the world economy has always been influenced by oil price fluctuations. Higher demand for oil leads to local currency depreciation because of the fact that international oil transactions are done largely in US Dollars Amano and Van Norden(1998).

Hammoudeh and Li (2008) provided an interesting finding in the case of GCC countries. They suggested the major events that cause changes in oil prices tend to increase the stock market volatility of the GCC countries. In addition, Arouri and Nguyen (2010) used a two-factor GARCH model to examine the effect of oil prices on European sectors' returns rather than only on aggregate stock market index returns. They concluded that oil prices tend to exert a significant influence on various European sectors.

DATA AND METHODOLOGY

Since the study includes many developing countries, data availability was a major constraint. We first checked the list of top net oil importing and exporting countries and based on the availability of data, we selected top three from each group. Selecting them would be justified, as they constitute the major portion of oil production and consumption. We have taken monthly data from January 1994 to December 2015 for Importing countries namely India China and South Korea (N=264 observations) and from January 2004 to December 2015 for Exporting countries Saudi Arabia, Russia and UAE (N=144 observations). All data sets are taken from Bloomberg database to ensure uniformity. We used WTI index as proxy for world crude oil price, which is the most commonly used index in studies. WTI crude oil prices are expressed in USD per barrel.

We formulated the following Hypothesis to test whether the previous period volatility have any impact on the current period volatility of stock market return of oil importing and exporting countries.

- H0: The previous period volatility does not have any impact on the current period volatility of stock market return of oil importing and exporting countries.
- Selected variables: log of stock returns, log of oil price return, log of exchange rate return.

We applied the following GARCH (1,1) Model for finding Stock price volatility in countries such as China, Saudi Arabia and Russia as the preliminary test for ARCH effect was not present in the case of other countries.

$$DLSP_t = \mu + \beta_1 DLOP_t + \beta_2 DLER_t + \varepsilon_t$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 + \alpha_3 DLOP_t + \alpha_4 DLER_t$$

Where, $DSLP_t$ is the stock return. $DLOP_t$ is the Oil Price Return, $DLER_t$ is the Exchange Rate Return, σ_t is conditional variance. ε_t is the disturbance term which is ideally, independently distributed with zero mean and constant variance. α_1 and α_2 are the coefficients of ARCH and GARCH terms respectively. α_3 and α_4 the coefficients of the impact of Oil price and exchange rate on Stock price volatility. The GARCH (1, 1) model allows for Stock return to be determined by oil prices changes and exchange rate return. The

conditional variance (σ_t) is linearly dependent on the past behaviour of the squared errors (past volatility shocks) and a moving average of the past conditional variances. The use of squared error terms implies that if innovations have been large in absolute value, they are likely to be large also in the future. The δ values determine the weights attached to the lagged innovations. To ensure a well-defined process, parameters α_0, α_1 and α_2 must be non-negative. The above set up is very general and allows for a variety of heteroscedasticity parameterizations. For example, when all the coefficients in variance equation, except the intercept term α_0, are zero ($\alpha_1 = \alpha_2 = 0$), the model will reduce to the traditional constant variance specification. The parameter α_0 is the time independent component of risk and is shared by all the models discussed above.

The common feature of ARCH and GARCH models is that they specify the conditional variance as a function of the past shocks allowing volatility to evolve over time and permitting volatility shocks to persist. The distinction between these two methodologies is that while ARCH incorporates a limited number of lags in derivation of the conditional variance, GARCH allows all lags to exert an influence by including the past value of the conditional variance itself, in addition to the past values of the squared errors. Thus, ARCH models are considered to be short memory models while GARCH models are of the long memory category.

For calculating the Stock price volatility in UAE we use a TARCH (1,1) model of the following form.

$$DLSP_t = \mu + \beta_1 DLOP_t + \beta_2 DLER_t + \varepsilon_t$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 + \alpha_3 DLOP_t + \alpha_4 DLER_t + \lambda \varepsilon_{t-1}^2 d_{t-1}$$

where $d_{t-1} = 1$ if $\varepsilon_t \prec 0$ and 0 otherwise

The implication of such volatility clustering is that volatility shocks today will influence the expectation of volatility many periods in the future and GARCH (p, q) measures this degree of continuity or persistence in volatility. Finally, the degree of persistence in shocks to volatility is an important factor in determining the relationship between returns and volatility since only persistent volatility changes warrant adjustment to the risk premium. All ARCH type models capture the tendency for shock persistence. A succinct measure of the shock persistence, as measured by the GARCH process, is the sum of the coefficients $\alpha_1 + \alpha_2$ which must be less than or equal to unity for stability to hold. If the magnitude of this sum is close to unity, the process is said to be integrated-in-variance, where the current information remains important for the forecasts of the conditional variance for all horizons (Engle and Bollerslev, 1986).

EMPIRICAL RESULTS

The country wise descriptive statistics and results are given in detail (see table given below). All the variables are having unit root at level and become stationary when taken into first difference.

Table 1: Descriptive Statistics-Importing Countries

	India			China			South Korea		
	DLSP	DLOP	DLER	DLSP	DLOP	DLER	DLSP	DLOP	DLER
Mean	0.007139	0.003445	0.000199	0.005798	0.003445	0.002462	0.002774	0.003445	-0.00047
Median	0.009412	0.014246	0.000000	0.006324	0.014246	0.002915	0.002834	0.014246	0.001144
Maximum	0.248851	0.204084	0.057977	0.855203	0.204084	0.043709	0.410616	0.204084	0.080222
Minimum	-0.27991	-0.33198	-0.05006	-0.34032	-0.33198	-0.04688	-0.31810	-0.33198	-0.31910
Std. Dev.	0.071065	0.083792	0.015905	0.101792	0.083792	0.015033	0.080920	0.083792	0.030134
Skewness	-0.31652	-0.77119	-0.17606	1.970085	-0.77119	-0.05773	0.259471	-0.77119	-4.91501
Kurtosis	3.740048	4.527351	4.037280	20.98002	4.527351	3.139199	6.453787	4.527351	51.41804
Jarque-Bera	10.39296	51.63333	13.14938	3712.749	51.63333	0.358423	133.6692	51.63333	26748.59

Probability	0.005536	0.000000	0.001395	0.000000	0.000000	0.835929	0.000000	0.000000	0.000000
Sum	1.877599	0.905992	0.052405	1.524936	0.905992	0.647458	0.729432	0.905992	-0.12322
Sum Sq. Dev.	1.323175	1.839516	0.066278	2.714749	1.839516	0.059214	1.715575	1.839516	0.237911
Observations	263	263	263	263	263	263	263	263	263

Table 2: Descriptive Statistics-Exporting Countries

	Saudi Arabia			Russia			UAE		
	DLSP	DLOP	DLER	DLSP	DLOP	DLER	DLSP	DLOP	DLER
Mean	0.002871	0.000564	0.001483	0.008117	0.000564	0.000167	0.007405	0.000564	0.000772
Median	0.012409	0.012924	0.001356	0.020442	0.012924	0.003676	0.001847	0.012924	0.000476
Maximum	0.178952	0.204084	0.059849	0.199343	0.204084	0.129782	0.334091	0.204084	0.050424
Minimum	-0.29775	-0.33198	-0.03045	-0.33931	-0.33198	-0.16279	-0.40378	-0.33198	-0.03271
Std. Dev.	0.080868	0.090803	0.012742	0.081152	0.090803	0.032816	0.107988	0.090803	0.012648
Skewness	-0.79830	-0.98255	0.663301	-0.89666	-0.98255	-1.19026	-0.15303	-0.98255	0.323003
Kurtosis	4.483186	4.837679	5.480467	5.364562	4.837679	10.16443	4.699718	4.837679	4.019668
Jarque-Bera	28.29613	43.13065	47.14585	52.47630	43.13065	339.6007	17.77204	43.13065	8.681571
Probability	0.000001	0.000000	0.000000	0.000000	0.000000	0.000000	0.000138	0.000000	0.013026
Sum	0.410596	0.080603	0.212048	1.160801	0.080603	0.023848	1.058903	0.080603	0.110414
Sum Sq. Dev.	0.928617	1.170810	0.023054	0.935159	1.170810	0.152917	1.655905	1.170810	0.022714
Observations	143	143	143	143	143	143	143	143	143

Table 3: Heteroskedasticity Test Results: ARCH Effect

Country	F-statistic	Prob. F	Obs*R-squared	Prob. Chi-Square
India	1.86E-05	0.9966	1.87E-05	0.9965
China	4.881098	0.0280**	4.828006	0.0280**
South Korea	0.164347	0.6855	0.165507	0.6841
Saudi Arabia	30.43844	0.0000*	25.35965	0.0000*
Russia	11.92838	0.0007*	11.14887	0.0008*
UAE	4.079683	0.0453**	4.020796	0.0449**

Note: *Significant at 1%, **Significant at 5%.

In the case of importing countries, there is evidence for ARCH effect for China and no arch effect for India and South Korea. (See results)In the case of exporting countries, there is ARCH effect for Saudi Arabia and Russia. Moreover, while considering the independent variable individually (Exchange rate return and Oil price return) we found arch effect for UAE also. Therefore, we further proceed for GARCH test only for those countries, which are having ARCH effect.

Considering the GARCH 1,1 model for China we found that there is volatility effect as well as return effect as both coefficients of ARCH and GARCH terms were significant. Which shows that both the return and volatility have impact on stock returns. Further, test for serial correlation to validate the results, are found to be robust as ARCH LM test, Correlogram Q statistics and other tests rejects the hypothesis of serial correlation. We do not consider India and South Korea for GARCH test, as there is no ARCH effect in these two oil-importing countries.

In the case of oil exporting countries, there exists an ARCH effect for all countries. For Saudi Arabia, we found results that support the existing theoretical setting, as crude oil is a highly influencing factor in determining stock returns besides the return and volatility effects. Results are found to be robust in the entire test for serial correlation. Similar results were found for Russia also except that unlike oil price return, exchange rate return is having a significant impact on determining stock returns and results are found to be robust. And finally for UAE where ARCH effect has been found significant only after considering stock return and oil price return, we found that there is both volatility effect and return effect but most importantly the exchange rate return and Oil price return are having a significant impact on stock returns.

Table 4: Impact of Oil Price and Exchange Rate on Stock Price Volatility

	China*	Saudi**	Russia**	UAE**
ARCH	0.411 (0.00)	0.400 (0.00)	0.190 (0.03)	0.260 (0.00)
GARCH	0.510 (0.00)	0.560 (0.00)	0.750 (0.00)	0.740 (0.00)
TARCH	-	-	-	- 0.220 (0.03)
DLOP	0.038 (0.34)	0.010 (0.02)	0.010 (0.10)	- 0.020 (0.00)
DLER	0.005 (0.17)	-0.005 (0.04)	0.040 (0.03)	- 0.090 (0.00)

Note: *indicates oil importing country & **indicates oil exporting countries.
Values given in the parenthesis are p-values.

Table-4 shows that oil price effect of stock volatility in oil exporting countries such as Saudi and UAE, whereas in the case of Russia it is not having any impact. Results also show that exchange rate affects stock price volatility of all the oil-exporting countries. However, in case of China, which is an oil importing country, neither oil price nor exchange rate significantly affects stock price volatility.

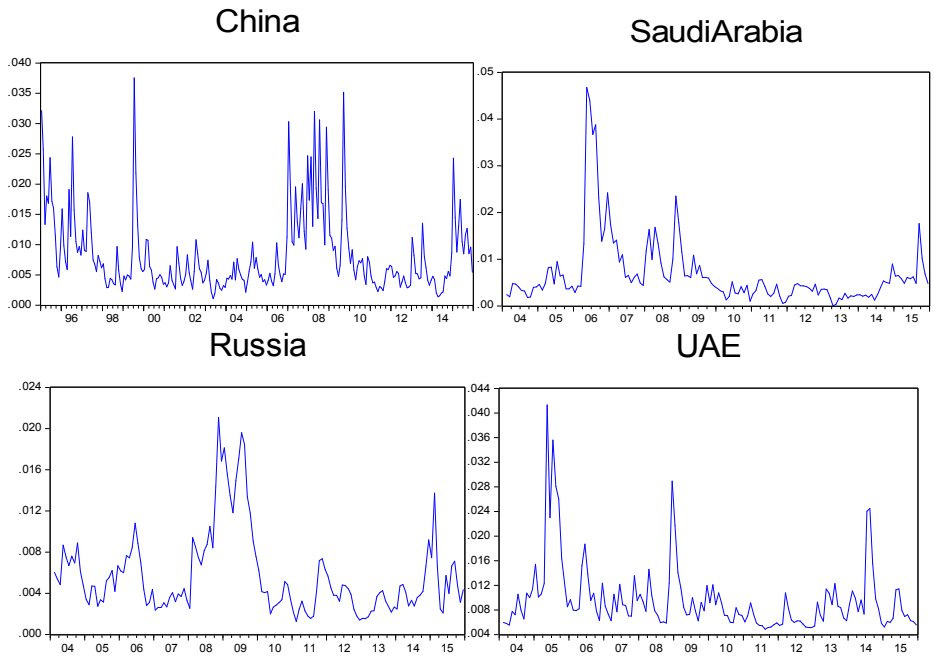


Figure 1: Stock Price Volatility of China, Saudi Arabia, Russia, and UAE

Figure-1 shows the stock price volatility of countries namely, China, Saudi Arabia, Russia, and UAE. In case of China, the volatility of stock price is all-time high during the period of 1999 to 2000. This may be due to the East Asian financial crisis. Further, the stock price showed highly volatile for a prolonged period starting from 2007 to 2009 owing to the global financial crisis. However, the stock price of the oil exporting countries such as UAE and Saudi Arabia shows highly volatile during the year 2005 and 2006 respectively. The stock price volatility is high for countries such as Russia and China when compared with UAE and Saudi Arabia on 2007-08 global financial meltdown.

CONCLUDING REMARKS

The present study has examined the impact of oil price and exchange rate on stock price volatility in selected oil exporting and importing countries. In order to test the volatility, the study employed GARCH and TARCH models. In the case of importing countries, there is evidence of ARCH effect for China whereas not for India and South Korea. In the case of exporting countries, ARCH effect exists for Saudi Arabia, Russia and UAE. The study also find the impact of oil price on stock price volatility in oil exporting countries such as Saudi Arabia and UAE, whereas in the case of Russia it is not having any impact. Results also show that exchange rate affects stock price volatility of all the oil-exporting countries. However, in case of China, which is an oil importing country, neither oil price nor exchange rate significantly affects stock price volatility.

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