Jurnal
Teknologi

Full Paper

Comparing The Impacts Of Oil Price Shocks Across Stock Markets

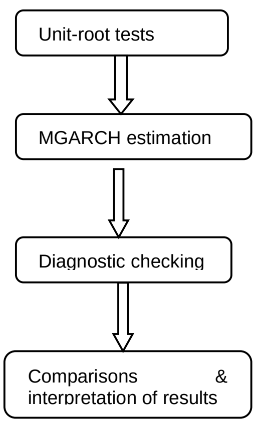
Siok Kun Sek*, Zhan Jian Ng, Wai Mun Har

School of Mathematical Sciences, Universiti Sains Malaysia, Faculty of Accountancy & Management, Universiti Tunku Abdul Rahman, Malaysia

Article history
Received
15 May 2015
Received in revised form
1 July 2015
Accepted
11 August 2015

*Corresponding author
sksek@usm.my

Graphical abstract



Abstract

We conduct empirical analyses on comparing the spillover effects of oil price shocks on the volatility of stock returns between oil importing and oil exporting countries. In particular, we seek to study how the nature of oil price shocks differs due to the oil dependency factor and how the stock markets react to such shocks. Applying the multivariate GARCH-BEKK(1,1) model, our results detect spillover effects between crude oil price and stock returns for all countries. The short run persistencies of shocks are smaller but the persistencies of shocks are very high in the long run. The results hold for both groups of countries. The results imply larger spillover effect from oil price shock into stock market in the oil importing countries.

Keywords: Oil price shock, stock return, multivariate GARCH, persistency of shock

1.0 INTRODUCTION

Crude oil plays a prominent role in shaping the state of the economy as it is the main source used in productions of many goods. The effects of oil price changes on economy can be transmitted through direct or indirect channels. The direct channel is through changes on cost of production. Changes of oil price can pass-through into changes in production cost which will then transmit to consumers through changes in the prices of final goods. The indirect effect of oil price changes on economy can be observed when changes in oil prices leads to changes in the market value of stock asset/ capital, consumer confidence/ expectations and the investments in financial market.

Although historical data showed that the relationship between oil price and economic performance (such as economic growth and inflation) had declined since the mid-1980s as compared to 1970s, this does not mean oil price has no important effect on determining the economic activities and performances. The over-fluctuated of oil prices can be detrimental to the economic stability and growth. Indeed many studies have evident on the significance impacts of oil price shock on determining the economic performance. Among them, the early study by [1] reported significance negative impacts of oil prices on macroeconomic variables (GDP, inflation and industrial activity) and that he concluded a significance link between the increases in oil prices and the US recessions. More recently, [2] investigated the effects of oil price shocks on Chinese economy. They revealed that oil price shock had negative effect on output and investment but the impact on inflation and interest rate is positive. [3] applied a DSGE model to analyze the impacts of different sources of oil price fluctuations on macroeconomy variables. The four types of oil price shocks include supply shocks driven by political events in OPEC countries, other oil supply shocks, oil demand shocks for industrial commodities and oil demand shocks specific to the crude oil market. The simulation results showed that oil demand shocks specific to the crude oil market is the major shock contributed to the fluctuations of output and inflation in China.

In the financial market, oil price can influence the stock prices through its effect on expected cash flows and discount rates. Oil price can influence the cash flow as it is used as the input for productions. Hence, higher oil price induces higher cost of production and lower demand and cash flow. Besides, higher oil price volatility will lead to higher inflation and expected interest rate due to higher uncertainty. This will then affect the discount rate and the value of stock asset [4]. Empirical studies also reported significance negative impacts of oil price on stock return/ volatility (among them include [5], [6], and [7]).

In this paper, we conduct empirical analyses to study the relationship between oil price shock volatility and stock return volatility in oil importing and oil exporting countries. In particular, we seek to reveal how the effects of oil price shocks change in determining the stock markets of these two groups of economies. Our results show that both volatility of oil price changes and stock returns are mostly determined by the long run shock compared to the short run shock. The results hold across all countries. We also detect spillover effect from oil price shock into stock market with very high persistency of shock in the long run. Comparing the results across two groups of countries, we observe higher persistency of spillover effect in the long run for oil importing countries, indicating larger spillover effect from oil price shock into stock market in the oil importing group.

The remaining paper is organized as follows: section 2 explains the theoretical counterpart; section 3 provides empirical reviews; section 4 is about data; section 5 explains the methodology; section 6 discusses the results and section 7 concludes the findings.

2.0 THEORETICAL COUNTERPART

Theoretically, oil price can affect the financial market as explained in the Discount Cash Flows approach. According to this approach, stock prices are calculated as the expected future cash flows discounted by a rate *r*, i.e.

$$p = \frac{E(c)}{E(r)} \tag{1}$$

where *p* indicates the stock price, *c* as the cash flow, *r* is the discount rate and $E(\cdot)$ refers to the expectation operator. The stock return *R* can be realized as

$$R = \frac{d\big(E(c)\big)}{E(c)} - \frac{d\big(E(r)\big)}{E(r)} \tag{2}$$

where $d(\cdot)$ is the differentiation operator. Therefore, the stock returns *R* are determined by the systematic movements in expected cash flows and discount rates and these two variables can be affected by the oil prices through different ways. Oil prices can affect the expected cash flows as oil is the commodity input used in production of many goods. Therefore, changes in oil prices may lead to changes in production costs in the same direction but the effect on the world economy stock prices is in the opposite direction. However, the effect of oil price on specific stock price is determined by the dependency on oil, i.e. whether the company is a net producer or net consumer of oil [8].

Expected oil prices can also affect the stock return through discount rate channel. Expected discount rate consists of two components, i.e. expected inflation and expected real interest rate. These two components are determined by the expected oil prices. Higher oil prices will impose a negative effect on the trade balance in net oil importing country, causing a downward pressure on the country's foreign exchange rate but imposing higher pressure on the domestic inflation rate. Higher inflation implies higher discount rate and lower stock returns. Oil prices can also influence the real interest rate as oil is the important resource in the economy. Therefore, higher oil prices relative to the general price levels is expected to cause to higher real interest rate and the increases in stock returns and volume of investments [8].

3.0 EMPIRICAL REVIEWS

The impacts of oil prices on macroeconomics have long been studied. The pioneer study was conducted by [1], who found a significance impact of oil price on the economy of U.S. Since then, there had been more studies focused in this topic and a large number of studies reported significance effect of oil prices on economic variables such as GDP growth, inflation and exchange rate ([1], [8], [9] and [10]).

While there were large studies investigating the impact of oil prices on economy variables, only in the last two decades, there had been interest to study the impact of oil prices on financial and stock markets. [5] and [8] were among the very first studies conducted on testing the reaction of international stock markets to oil price shocks. [5] detected significance impact of oil price shocks on determining cash flows of stock markets for Canada and the U.S. [8] also reported a significance link between stock returns and oil price changes in some U.S. oil companies. Since then in the 2000s, there had been increasing numbers of studies investigating the related topic. In general, these studies reported a negative relationship between oil price changes on stock market performance ([11], [12], [13], [14] and [15]). However, some studies claimed that the effects of oil prices on stock market depend on either the country or industry is a net producer or net consumer of oils (see [8] and [16]).

There are also studies investigating the effects of oil prices on stock market industrial sectors (examples include [17], [18], [19], [20], [21] and [22]). These studies found a positive effect of oil prices on energy sectors (Oil and gas sector) but the effect is negative in financial and oil user sectors (such as transportation, chemical, medical, computer, banking and manufacturing). There are also inconclusive results reported in the electricity, engineering and financial sectors. From these studies, we can conclude that oil prices impose different impacts across industrial sectors and oil-related or energy sector are benefitted from oil price shocks.

Apart from these, some studies distinguish the oil price impact from oil demand and oil supply sides. These studies argued that the origins or nature of oil shocks would trigger different responses from financial markets and economic variables. These studies include [23], [10], [19], [24], [25] and [26]. [10] showed that oil supply shocks impose a negative effect in the economy but oil demand shocks lead to a positive effect.

Based on the literature review, the two main results can be concluded. First, the effect of oil prices on stock market is dependent on whether the country (or industry) is a net oil producer or a net oil consumer. Second, the effects on oil prices on economy also depend on the origin of shocks, i.e. either the shock is oil supply or oil demand attributed.

4.0 DATA

We focus the analyses in six oil importing countries (China, India, Netherland, South Korea, Singapore and Italy) and six oil exporting countries (Saudi Arabia, United Arab Emirates, Kuwait, Nigeria, Venezuela and Qatar) respectively.

The data include the daily stock market composite indices and Brent oil price, ranging from 1st January 2009 to 31st December 2013. The stock indices are collected from Thomson Reuters Datastream financial software while the Brent oil price data, quoted in U.S. dollar per barrel is obtained from the U.S.'s Energy Information Administration website (http://www.eia.gov). The data are converted into natural logarithm form. The changes of oil price is calculated as $R_{1,t} = op_t - op_{t-1}$ while the returns of stock is indicated as $R_{2,t} = p_t - p_{t-1}$, where op_t and p_t are oil price and stock index in logarithm form respectively; op_{t-1} and p_{t-1} are their lagged one terms respectively.

5.0 METHODOLOGY

For the purpose of analysis, the multivariate GARCH BEKK model is applied. Before conducting the estimation, the Augmented Dicky-Fuller (ADF) unit-root test is performed to check for the stationarity of data. Only the stationary data (through first differencing, i.e. Δop_t and Δp_t) will be used for the model estimation. To be noted, $\Delta op_t = R_{1,t}$ and $\Delta p_t = R_{2,t}$ which are interpreted as changes in oil prices and returns of stock respectively. Finally, the Ljung-Box Q statistics is used to test for autocorrelation of the residuals of BEKK model.

5.1 MGARCH-BEKK Model

The Multivariate Generalized Autoregressive Conditional Heteroscedasticity (MGARCH) is the *n*-variate of univariate GARCH model with the conditional variance-covariance matrix conditional on an information set, assume to distributed with *n*-dimensional zero mean and variance ***H***, i.e. $\varepsilon_t \mid I_{t-1} \sim N(0, \mathbf{H}_t)$. In this study, a BEKK specification is applied which the variance-covariance matrix can be written as:

$$\mathbf{H}_t = \mathbf{CC}' + \mathbf{A}_i \mathbf{e}_{t-1} \mathbf{e}'_{t-1} \mathbf{A}'_i + \mathbf{B}_i \mathbf{H}_{t-1} \mathbf{B}'_i \tag{3}$$

where ***C*** is the lower triangular *N*×*N* matrix of constants, whereas ***Ai*** and ***Bi*** are *N*×*N* matrices of parameters. The constant term is decomposed into a product of two triangular matrices in order to guarantee the positive semi-definiteness of $\mathbf{H}_T$ [27].

We specify the model limit to MGARCH-BEKK (1,1) as previous studies show that GARCH (1,1) specification is the parsimonious representation of conditional variance that can adequately fit many econometric time series [28]. In this study, we have two variables which are stationary (changes of oil price and stock returns). We model the mean equations in the AR(1) form:

$$R_{1,t} = C(1) + C(2) R_{1,t-1} \tag{4}$$

$$R_{2,t} = C(3) + C(4) R_{2,t-1} \tag{5}$$

where $R_{1,t}$ is the changes of oil and $R_{2,t}$ is the stock returns. Since our model consists of two variables (*N*=2) so that the BEKK model can be written as follows:

$$\begin{bmatrix} h_{11,t} & h_{12,t} \\ h_{21,t} & h_{22,t} \end{bmatrix} = \begin{bmatrix} c_{11} & 0 \\ c_{21} & c_{22} \end{bmatrix} \begin{bmatrix} c_{11} & c_{21} \\ 0 & c_{22} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} \varepsilon^2_{1,t-1} & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon^2_{2,t-1} \end{bmatrix} \begin{bmatrix} a_{11} & a_{21} \\ a_{12} & a_{22} \end{bmatrix} + \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \begin{bmatrix} h_{11,t-1} & h_{12,t-1} \\ h_{21,t-1} & h_{22,t-1} \end{bmatrix} \begin{bmatrix} b_{11} & b_{21} \\ b_{12} & b_{22} \end{bmatrix}$$

Matrix ***Ai*** captures the ARCH effects while its element a_{ij} measures the degree of innovation from market *i* (oil price) to market *j* (stock return). On the other hand, matrix ***Bi*** captures the GARCH effects. Its elements b_{ij} indicate the persistence in conditional volatility between market *i* (oil price) and market *j* (stock return) [29]. In addition, the diagonal parameters in matrices ***Ai*** and ***Bi*** - a_{11}, a_{22} and b_{11}, b_{22} are interpreted as the effects of own past shocks and volatility on its current conditional variance. The off-diagonal parameters a_{ij} and b_{ij}, indicate to the cross-market influences on the conditional variances and covariances, or also known as volatility spillover effects.

Under the BEKK specification, matrices $\boldsymbol{A_i}$ and $\boldsymbol{B_i}$ are assumed to take a diagonal form where the off-diagonal elements in $\boldsymbol{A_i}$ and $\boldsymbol{B_i}$ are restricted to be zero. Due to the restrictions, now the conditional variance and conditional covariance equations can be written as:

$$h_{11,t} = c_{11}^2 + a_{11}^2\varepsilon_{1,t-1}^2 + b_{11}^2 h_{11,t-1}$$
$$h_{21,t} = h_{12,t} = c_{22}c_{11} + a_{11}a_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-2} + b_{11}b_{22}h_{21,t-1}$$
$$h_{22,t} = c_{22}^2 + a_{22}^2\varepsilon_{2,t-1}^2 + b_{22}^2 h_{22,t-1}$$

Or written as:

$$\sigma_{11,t} = C(5) + C(6)\varepsilon_{1,t-1}^2 + C(7)\sigma_{11,t-1}$$
$$\sigma_{22,t} = C(8) + C(9)\varepsilon_{2,t-1}^2 + C(10)\sigma_{22,t-1}$$
$$\sigma_{12,t} = C(11) + C(12)\varepsilon_{1,t-1}^2\varepsilon_{2,t-1}^2 + C(13)\sigma_{12,t-1} \quad (6)$$

where $\sigma_{11,t}$ and $\sigma_{22,t}$ are the two conditional variance equations or volatility of oil price changes and volatility of stock returns respectively. $\sigma_{12,t}$ is the conditional covariance equation or volatility spillover effect for the interaction between oil price changes and stock returns. C(5) and C(8) indicate the mean volatility for changes of oil and stock returns respectively; C(6) and C(9) are short run or ARCH effect of oil price shock and stock returns shock respectively; C(7) and C(10) are interpreted as the long run GARCH effect or volatility effects of oil price shock and stock returns shock respectively; C(11) indicates the mean spillover effect; C(12) and C(13) are short run and long run spillover or interaction effect between oil price changes and stock returns respectively.

5.2 Diagnostic Test – ADF test

Various parametric and non-parametric tests have been developed for finding whether a series is stationary. In this study, Augmented Dicky-Fuller (ADF) test is performed to test for stationarity of series. The null hypothesis is the series is not stationary and has unit root, while the alternative hypothesis is the series is stationary and does not have unit root.

H_0: Series is not stationary (there is unit root) $\gamma = 0$
H_1: Series is stationary (there is no unit root) $\gamma < 0$

The equations used in ADF tests are given as follows:

$$\Delta y_t = \beta_0 + \beta_1 t + \gamma y_{t-1} + \sum_{i=1}^{p-1}\varphi_i \Delta y_{t-i} + \mu_t \quad (7)$$

where y_t is the log indices of oil and stock markets at period t, Δ is the differenced operator; t is the time, y_{t-1} is the lagged term of index and μ_t is an identical and independent distribution white noise process. From Equation (3.1), $\gamma = 0$ means that the data have the unit root property and the data are non-stationary. On the other hands, $\gamma < 0$ means that the data have no unit root, thus they are stationary [30].

5.3 Diagnostic Test – Ljung-Box Q Statistics

The Ljung-Box Q statistics is used to test for randomness in the noise term, ε_t, for the estimated MGARCH model. This statistic is given by:

$$Q = T(T+2)\sum_{j=1}^{p}(T-j)^{-1}r^2(j) \quad (8)$$

where $r(j)$ is the sample autocorrelation at lag j calculated from the noise term and T is the number of observation. Q is asymptotically distributed as χ^2 with p-k degree of freedom and k is the number of explanatory variables. The Q statistic is used to test the null hypothesis that the model is correctly specified, or equivalently, that the noise terms are random [31].

6.0 RESULTS AND DISCUSSION

The results of unit-root test show that oil price and stock index (in log form) for most cases are not stationary at their levels but they are stationary after the first differenced transformation (see Table 1). Therefore, the data in first differencing are used in the estimation (oil price changes and stock returns).

The estimation results of MGARCH-BEKK(1,1) are summarized in Table 2 and 3. We focus the discussion on the variance-covariance equations. The results show that the mean volatility C(5), C(8) and C(11) for all countries are very closed to zero indicating no large spike or fluctuation in the oil price changes and stock returns and that the oil and financial market are stable.

Looking at the short run effect of shocks for both variables, C(6) and C(9), the effects are very small in the short run with larger effect in oil volatility equation. Also, the short run ARCH effect of oil volatility is higher in the oil importing oil countries than the oil exporting countries. Checking at the long run effect of shocks, C(7) and C(10), our results show that the values are very high for both oil volatility and stock returns volatility equations. In general, the long run volatility effect of shock is slightly higher in determining the oil volatility than the stock returns volatility. Comparing the results between two groups of countries, we observe that the long run volatility effect of oil price shock is slightly higher in the oil exporting countries.

Checking at the interaction between oil price and stock returns variables, our results detect the evidence of interaction with much larger long run spillover effect and relatively lower short run effect of spillover shock. The long run spillover effect is relatively higher for oil importing countries compared to oil exporting countries, implying larger oil price shock on determining the stock performance experienced in oil importing countries.

In overall, we can summarize our results as follows: First, the long run effect of shocks and spillover effect are very high compared to the short run values. Second, the long run effect of stock returns shocks and spillover effect are slightly higher in oil importing countries, but the effect of oil shock is slightly higher in the oil exporting group. Third, we detect interaction or spillover effect between oil and stock variables with slightly higher effect in oil importing countries.

Our results are well-specified and have no autocorrelation problem. Q statistics do not reject the null hypothesis of no autocorrelation. The results are summarized in Table 4 and 5.

Table 1 Results of ADF Unit-Root Test

Variable	Country	Test-statistics	
		Level	First difference
Oil price	**World**	**-3.514956****	**-45.57276*****
Stock index	Kuwait	-1.140456	-38.87070***
	Nigeria	-2.073875	-30.35574***
	Qatar	-2.763108	-27.24029***
	Saudi Arab	-2.871828	-42.99601***
	UAE	-0.692976	-35.86489***
	Venezuela	0.694012	-34.12402***
	China	-4.314132***	-44.83571***
	India	-2.615493	-43.12472***
	Italy	-2.118707	-42.32155***
	Netherlands	-2.455512	-41.91948***
	Singapore	-2.471740	-42.63244***
	South Korea	-2.923813	-43.11305***

Note: *** indicates significant at 1% level

Table 2 Results of MGARCH-BEKK – Oil Exporting Countries

	Mean equation					
Parameter	Estimated value					
	Qatar	Kuwait	Saudi Arabia	Nigeria	UAE	Venezuela
C(1)	0.0003	0.0003	0.0004	0.0003	0.0003	0.0004
C(2)	-0.0191	-0.0065	-0.0109	-0.0123	-0.0194	-0.0008
C(3)	0.0003**	0.0000	0.0002***	0.0002	0.0002	0.0013***
C(4)	0.0455**	0.1535***	0.0496*	0.2913***	0.1848***	0.1247***
	Variance-covariance equation					
C(5)	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
C(6)	0.0112***	0.0145***	0.0156***	0.0155***	0.0085***	0.0159***
C(7)	0.9828***	0.9788***	0.9773***	0.9779***	0.9855***	0.9773***
C(8)	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
C(9)	0.0674***	0.0615***	0.0770***	0.1399***	0.0769***	0.1371***
C(10)	0.9360***	0.9250***	0.9029***	0.7780***	0.9189***	0.8228***
C(11)	0.0000*	0.0000	0.0000***	0.0000	0.0000	0.0000
C(12)	0.0275***	0.0299***	0.0347***	0.0466***	0.0256***	0.0467***
C(13)	0.9591***	0.9515***	0.9394***	0.8723***	0.9516***	0.8968***

Note: *** indicates significant at 1% level

Table 3 Results of MGARCH-BEKK – Oil Importing Countries

	Mean equation					
Parameter	Estimated value					
	China	India	Italy	Netherlands	Singapore	South Korea
C(1)	0.0004	0.0004	0.0004	0.0004	0.0003	0.0004
C(2)	-0.0145	-0.0140	0.0098	0.0034	-0.0362*	-0.0349*
C(3)	0.0000	0.0004*	0.0002	0.0004*	0.0003*	0.0003*
C(4)	-0.0491**	0.0006	0.0050	0.0393*	-0.0080	-0.0032
	Variance-covariance equation					
C(5)	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
C(6)	0.0408***	0.0190***	0.0178***	0.0183***	0.0186***	0.0147***
C(7)	0.9502***	0.9734***	0.9737***	0.9727***	0.9735***	0.9783***
C(8)	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
C(9)	0.0000	0.0351***	0.0465***	0.0458***	0.0430***	0.0376***
C(10)	0.9971***	0.9591***	0.9382***	0.9425***	0.9482***	0.9549***
C(11)	0.0000***	0.0000**	0.0000***	0.0000***	0.0000**	0.0000**
C(12)	0.0016	0.0258***	0.0288***	0.0290***	0.0283***	0.0235***
C(13)	0.9734***	0.9662***	0.9558***	0.9575***	0.9608***	0.9665***

Note: *** indicates significant at 1% level

Table 4 Results of Ljung-Box Q Statistics – Oil Exporting Countries

Lag	Q-statistics					
	Qatar	Kuwait	Saudi Arabia	UAE	Venezuela	Nigeria
1	0.4376	0.1449	0.1032	0.5754	0.0432	0.3411
2	0.4844	0.1450	0.1137	0.5884	0.0445	0.3560
3	0.5262	0.1836	0.1555	0.6121	0.0486	0.4258
4	0.5915	0.2153	0.2589	0.6661	0.0660	0.4669
5	0.8410	0.3512	0.3707	0.8455	0.2634	0.7118
10	2.3327	1.7947	1.7257	2.3684	1.4980	2.1530
20	13.471	12.583	14.319	12.096	11.925	12.282

Table 5 Results of Ljung-Box Q Statistics – Oil Importing Countries

Lag	Q-statistics					
	China	Netherlands	Singapore	India	Italy	South Korea
1	0.4360	0.0434	1.6911	0.1779	0.0111	1.3388
2	0.4673	0.0585	1.7128	0.2335	0.0133	1.3388
3	0.5087	0.0803	1.7862	0.2942	0.0596	1.3807
4	0.5709	0.0807	1.9158	0.3381	0.0609	1.5586
5	0.7430	0.0879	2.1105	0.4281	0.0776	1.8635
10	1.8799	2.6292	4.1875	1.7090	2.3646	3.7870
20	14.660	15.292	16.192	13.439	16.234	15.239

7.0 CONCLUSION

We conduct empirical analyses on investigating the spillover effect from oil price shock into stock market. The results are compared between oil importing and oil exporting countries. Using the multivariate GARCH-BEKK(1,1) specification, our results reveal spillover effect in all countries. The spillover effect of oil price shock on stock performance is higher in the oil importing group. The effect of long run shock is much larger compared to the short run shock. The result holds for the oil volatility, stock returns volatility and the interaction of both equations respectively.

The results are expected as oil importing countries are more dependent on using oil as the main commodity in their productions especially the manufacturing/ industrialized countries. Therefore, changes in oil prices may have large impact in influencing their expected cash flow and discount rate as explained in the discount cash flow theory. The results confirm that oil dependency factor is matter in determining the impacts of oil price shocks on stock market performances. The results also imply the significance impacts of oil price shocks on determining the stock market performances are of globally nature through spillover effects due to trade integration and networking.

References

[1] Hamilton, J. D., 1983. Oil and the Macroeconomy Since World War II. *Journal of Political Economy*. 91: 228-248.

[2] Tang, W., Wu, L. and Zhang, Z. X. 2010. Oil Price Shocks and Their Short-and Long-Term Effects on the Chinese Economy. *Energy Economics.* 32(supplement 1): s3-s14.

[3] Zhao, L., Zhang, X., Wang, S. and Xu, S. The Effects of Oil Price Shocks on Output and Inflation in China. *Energy Economics.* In press.

[4] Hasan, M. Z. and Ratti, R. A. 2013. Oil Price Shocks and Volatility in Australian Stock returns. *Economic Record.* 89. 67-83.

[5] Jones, C.M. and Kaul, G. 1996. Oil and the Stock Markets. *Journal of Finance.* 51: 463-491.

[6] Sadorsky, P. 1999. Oil Price Shocks and Stock Market Activity. *Energy Economics.* 21: 449-469.

[7] Arouri, M. E. H., Jouini, J. and Nguyen, D. K. 2011. Volatility Spillovers Between Oil Prices and Stock Sector Returns: Implications for Portfolio Management. *Journal of International Money and Finance*. 30: 1387-1405.

[8] Huang, R. D., Masulis, R. W. and Stoll, H. R. 1996. Energy Shocks and Financial Markets. *Journal of Futures Markets.* 16: 1-27.

[9] Baumeister, C. and Peersman, G. 2012. Time-Varying Effects of Oil Supply Shocks on the U.S. Economy, Bank of Canada. Working Paper.

[10] Lippi, F. and Nobili, A. 2009. Oil and the Macroeconomy: A Quantitative Structural Analysis. *Temi di discussione (Economic Working Papers)* 704. Bank of Italy.

[11] Sadorsky, P. 2008. Assessing the impact of Oil Prices on Firms of Different Sizes: Its Tough Being in the Middle. *Energy Policy.* 36: 3854-3861.

[12] Miller, J. I. and Ratti, R. A. 2009. Crude Oil and Stock Markets: Stability Instability and Bubbles. *Energy Economics.* 31: 559-568.

[13] Ciner, C. 2013. Oil and Stock Returns: Frequency Domain Evidence. *Journal of International Financial Markets, Institutions and Money*. 23: 1-11.

[14] Filis, G. and Chatziantoniou, I. 2014. Financial and Monetary Policy Responses to Oil Price Shocks: Evidence From Oil-Importing and Oil-Exporting Countries. *Review of Quantitative Finance and Accounting.* 42: 709-729.

[15] Uwubanmwen, A. E. and Omorokunwa, O. G. 2015. Oil Price Volatility and Stock Price Volatility: Evidence from Nigeria. *Academic Journal of Interdisciplinary Studies*. 4: 253-260.

[16] Mohanty, S. K., Nandha, M., Turkistani, A. Q. and Alaitani, M. Y. 2011. Oil Price Movements and Stock Market Returns: Evidence from Gulf Cooperation Council (GCC) Countries. *Global Finance Journal.* 22: 42-55.

[17] Narayan, P. K. and Sharma, S. S. 2011. New Evidence on Oil Price and Firm Returns. *Journal of Banking and Finance.* 35: 3253-3262.

[18] Hammoudeh, S. and Li, H. 2005. Oil Sensitivity and Systematic Risk in Oil-Sensitive Stock Indices. *Journal of Economics and Business.* 57: 1-21.

[19] Kilian, L. and Park, C. 2009. The Impact of Oil Price Shocks on the US Stock Market. *International Economic. Review*. 50: 1267-1287.

[20] Degiannakis, S., Filis, G. and Floros, C. 2013. Oil and Stock Returns: Evidence from European Industrial Sector Indices in Time-Varying Environment. *Journal of International Financial Market, Institutions and Money*. 26: 175-191.

[21] Arouri, M. E. H. and Nguyen, D. K. 2010. Oil Prices: Stock Markets and Portfolio Investment: Evidence from Sector

Analysis in Europe over the Last Decade. *Energy Policy.* 38: 4528-4539.

[22] Broadstock, D. C. and Filis, G. 2014. Oil Price Shocks and Stock Market Returns: New Evidence from United States and China. *Journal of International Financial Markets, Institutions and Money*. 33: 417-433.

[23] Kilian, L. 2009. Not All Oil Shocks Are Alike: Disentangling Demand and Supply shocks in the Crude Oil Market. *American Economic Review.* 99: 1053-1069.

[24] Degiannakis, S., Angelidis, T. and Filis, G. 2013. Oil Price Shocks and volatility Do Predict Stock Market Regimes. Working Paper 170. Bank of Greece.

[25] Effiong, E. L. 2014. Oil Price Shocks and Nigeria's Stock Market: What Have We Learned from Oil Market Shocks? *OPEC Energy Review*. 38: 36-58.

[26] Kang, W., Ratti, R. A. and Yoon, K. H. 2015. The Impact of Oil Price on the Stock Market Return and Volatility Relationship. *Journal of International Financial Markets, Institutions and Money.* 34: 41-54.

[27] Engle, R. F. and Kroner K. 1995. Multivariate Simultaneous Generalised ARCH. *Econometric Theory.* 11: 122-150.

[28] Bollerslev, T., Engle, R. F. and Wooldridge, J. M. 1988. A capital Asset Pricing Model with Time-Varying Covariances. *Journal of Political Economy.* 96: 116-131.

[29] Worthington, A. and Higgs, H. 2004. Transmission of Equity Returns and Volatility in Asian Developed and Emerging Markets: A Multivariate GARCH Analysis. *International Journal of Finance and Economics.* 9: 71-80.

[30] Lin, C. C., Fang, C. R. and Cheng, H. P. 2010. Relationships Between Oil Price Shocks And Stock Market: An Empirical Analysis from Greater China. *China Economic Journal.* 3(3): 241-254.

[31] Worthington, A., and Higgs, H. 2001. *A multivariate GARCH Analysis of Equity Returns and Volatility in Asian Equity Markets*. Queensland University of Technology, School of Economics and Finance.