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Relationship between equity returns, Exchange rate and crude oil price: Evidence from India

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ABSTRACT

The present study examines the linkages between International crude oil prices (WTI), exchange rate (INR/USD) and Indian equity index (BSE-Sensex). Cointegration analysis of Johansen-Juselius with daily data from January 2010 to October 2018 suggests that there is no cointegrating vector as per the Trace statistic and Max- Eigen tests. Also, results of pairwise cointegration test indicate that BSE is not cointegrated with USD and WTI. Results of Granger causality reveal that past returns of exchange rate and Oil Prices influence future returns of Stock index. In addition, results of Granger causality on conditional variance series show there is two-way volatility spillovers between the exchange rate (USD) and returns on Stock market of India (BSE). Also, there is unidirectional volatility spillover from India stock market (BSE) to Crude oil index (WTI). Thus, we conclude that future equity index returns in India are influenced by changes in exchange rate and oil prices.

Keywords: Cointegration, Volatility spillover, Granger Causality, Correlation.

Introduction

India is one of the fastest growing economies of the world. It is heavily dependent on import of petroleum and petroleum related products. India's demand of crude oil has been increasing every year. As on March 2018, India's imports were 82% of its crude oil needs. Since, most of the oil imports are made in US dollars, oil price and exchange rate both have a bearing on the import bill of the economy. Numerous studies have examined the relationship between oil prices and exchange rate. For example, Amano and Van Norden (1998); Benasy-Quere et al. (2007); and Ghosh (2011) find increase in Crude Oil price causes U.S. dollar appreciation against other currencies. On the contrary, some other studies show that an increase in oil prices leads to U.S. dollar depreciation (Narayan et al., 2008; Akram, 2009; Wu et al., 2012; Turhan et al., 2013).

Since, oil is used as one of the primary inputs in several industries, the performance and prospects of these Industries is affected by movements in oil prices. Moreover, as most of oil is imported and paid in US dollars, the crude oil and exchange rate dynamics directly or indirectly influence the fortunes of any oil importing economy like India. As stock market is regarded the barometer of an economy, therefore, stock market performance is also influence by variability in crude oil price (Miller and Ratti, 2009). Also, there are various factors influence by oil prices which impact stock markets i.e. type of economy (oil-importing, oil-exporting, developed, emerging), percentage change in oil price etc. (Degiannakis et al; 2017).

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The present study is an attempt to examine the linkages between International crude oil prices (WTI) with exchange rate (INR/USD) and Indian equity index (BSE-Sensex). Analysing the daily data in the framework of Johansen cointegration procedure, we find no long-run relationship between WTI, USD and BSE Sensex. However, as far as short-run relationships are concerned, results of granger causality reveal that past changes in exchange rate and Oil Prices influence future returns of Stock index. In addition, results of Granger causality on conditional variance series show that there is two-way volatility spillovers between the changes in exchange rate and Stock market returns. Thus, we conclude that future equity index returns in India are influenced by changes in exchange rate and oil prices. Moreover, we conclude that there is stronger relationship between equity returns and exchange rate movements than between equity returns and oil price changes. Given the importance of foreign investors in Indian markets, these findings are quite plausible. The finding of our study that returns on BSE Sensex are influenced by changes in oil price and exchange rate have important implications for investors and money managers. Investors who wish to invest in Indian equity market can make better investment decisions by considering movements in oil prices and exchange rate rather than by watching the equity market alone.

The remainder of the article is arranged as follows. Section 2 demonstrate review of literature; section 3 details data and methodology, section 4 discusses empirical results and section 5 concludes.

2. Review of Literature

Singhal et al. (2019) analyse the interrelationship between WTI oil price, gold price, exchange rate and Mexican stock market Index over period of 2006 to 2018. By using ARDL cointegration method they suggest that stock price of Mexico is positively affected by international gold prices while negatively affected by oil price.

Mollick and Sakaki (2018) examine the interlinkages between WTI oil price, exchange rate of 14 countries and stock market of FTSE using VAR and GARCH methods over the period from 1999 to 2017. They find that currencies strongly appreciate due to positive oil price shocks and depreciate following positive global equity shocks.

Delgado et al. (2018) explore the relation between oil price, exchange rate and stock market of Mexico over the period from 1992 to 2017 by using autoregressive (VAR) model. They find that stock market is negatively affected by exchange rate and exchange rate is positively affected by oil prices.

Seyyedi (2017) examines the interlinkage between oil price, gold price and INR-US exchange rate over the period of 2004 to 2015 by applying Johansen's cointegration test, VAR technique, Granger Causality test. They find that all three variables are independent from each other.

Mensah et al. (2017) explore the dynamic relationship among oil prices and the US dollar exchange rate of various countries, before and after the global crisis of 2008-2009. They find an equilibrium linkage between oil price and exchange rate. Also, after the crisis period, they find a significant increase in both the exchange rate volatility and negative interlinkage among oil price and exchange rate.

Aloui and Aissa (2016) examine the dynamic linkages among WTI crude oil, exchange rate and stock market (DJIA) by applying a vine copula-based GARCH technique and find significant and symmetric relationship among these variables.

Jain and Biswal (2016) investigate the interlinkages among international prices of crude oil and gold, exchange rate and stock market in India, by using DCC-GARCH method and non-linear causality tests. They find that the decrease in prices of crude oil and gold cause a decrease in the value of Indian Rupee and stock market index.

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Jain and Ghosh (2013) investigate the relation between oil prices, exchange rate (INR-US) and precious metal prices over the period from 2009 to 2011 by using ARDL bound tests and Granger Causality test. They find that series are cointegrated in the long run and causation exists among the variables.
Chang et al. (2013) explore the conditional correlations and volatility spillovers among crude oil prices of Brent and WTI markets and Financial markets returns from 1998 to 2009 by using CCC model, VARMA-GARCH, VARMA-AGARCH and DCC model. They find that conditional correlations for returns across markets are not statistically significant, but for the same market, it is significant, while the DCC estimates are always significant. However, the results from VARMA-GARCH and VARMA-AGARCH estimates indicate volatility spillover among the two markets.
Al-Mulali and Sab (2012) investigate the impact of oil price shocks on the real exchange rate over the period between 2000 to 2010 in 12 oil-exporting economies and found that real exchange rate appreciates due to increase in oil price.

3. Data and Methodology

In the present paper, we investigate the long-run relationships among international oil prices, exchange rate and stock markets in India. We chose West Texas Intermediate (WTI) crude spot price which is benchmark of oil price in US. It has measured in USD/barrel and denoted by WTI in our study. The majority of export and import has done from India in US Dollars; therefore, Indian Rupee and US dollar currency is used for exchange rate movements. They are measured as INR/USD and represented by USD. Among various stock exchange in India, Bombay stock exchange (BSE) is the oldest one. So, we chose BSE for benchmark index of Indian stock markets. We used daily price data on levels for all the series in the present study. The data is downloaded from Investing.com. The study period ranges from January 2010 to October 2018.
For analysis of the data various models have been used to perform econometric analysis such as Augmented Dickey- Fuller (ADF) test for Stationarity i.e. series are I(1) or I(0). If series are I(1), then we can proceeds further for long run test. We used Pearson's correlation test for short-term relationship. Then we apply Granger causality for cause and effect relationship, which shows that if there are two variables X and Y, and change in X variable cause change in Y variable then we can say X granger causes Y. To test for long-run relationship Johansen cointegration is used. At last, we used GARCH model for estimation of individual index volatility.

4. Empirical Results and discussion

Fig. 1 shows daily price movements of the variables under study. It is evident from Fig. 1 that oil prices are stagnant between 2010 to 2014 and after that, there is steep fall in oil prices between 2014 to 2016 and after 2016 its increases again. While exchange rate and BSE Sensex rise continuously during period of study except on some occasions when downward trend is also observed. It seems that most of the time series have a unit root, i.e. I(1).

The descriptive statistics of all the variables are reported in Table 1. From Table 1 it can be seen that mean returns for BSE and USD are positive and for WTI mean is negative. Among all the variables oil prices shows the highest volatility followed by stock and exchange rate. All the return series except BSE are positively skewed.

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Table 1. Summary Statistics of the price series.

	BSE	USD	WTI
Mean	0.03488	0.021638	-0.003553
Median	0.049234	-0.002218	0.018399
Maximum	3.703462	3.69357	11.71551
Minimum	-6.119711	-3.324774	-10.64651
Std. Dev.	0.968972	0.485423	2.029867
Skewness	-0.157235	0.266281	0.047218
Kurtosis	4.703526	9.2478	5.698909
Jarque-Bera	262.5782	3440.38	638.14
Probability	0	0	0
Observations	2100	2100	2100

Source: *Authors' Calculation.*

Table 2 presents the estimates of Karl Pearson's coefficient of correlation between the pairs of variables. Change in oil price is found to be positively correlated with stock price change and negatively correlated with exchange rate movement.

Among all the variables, WTI is the only variable which is weakly correlated with the Indian equity benchmark index (almost 14%). WTI is negatively correlated i.e. -42% with exchange rate.

Table 2: Karl Pearson's correlation

	BSE	USD	WTI
BSE	1	-0.42155	0.144359
USD	-0.42155	1	-0.16939
WTI	0.144359	-0.16939	1

Source: *Author's Calculation*

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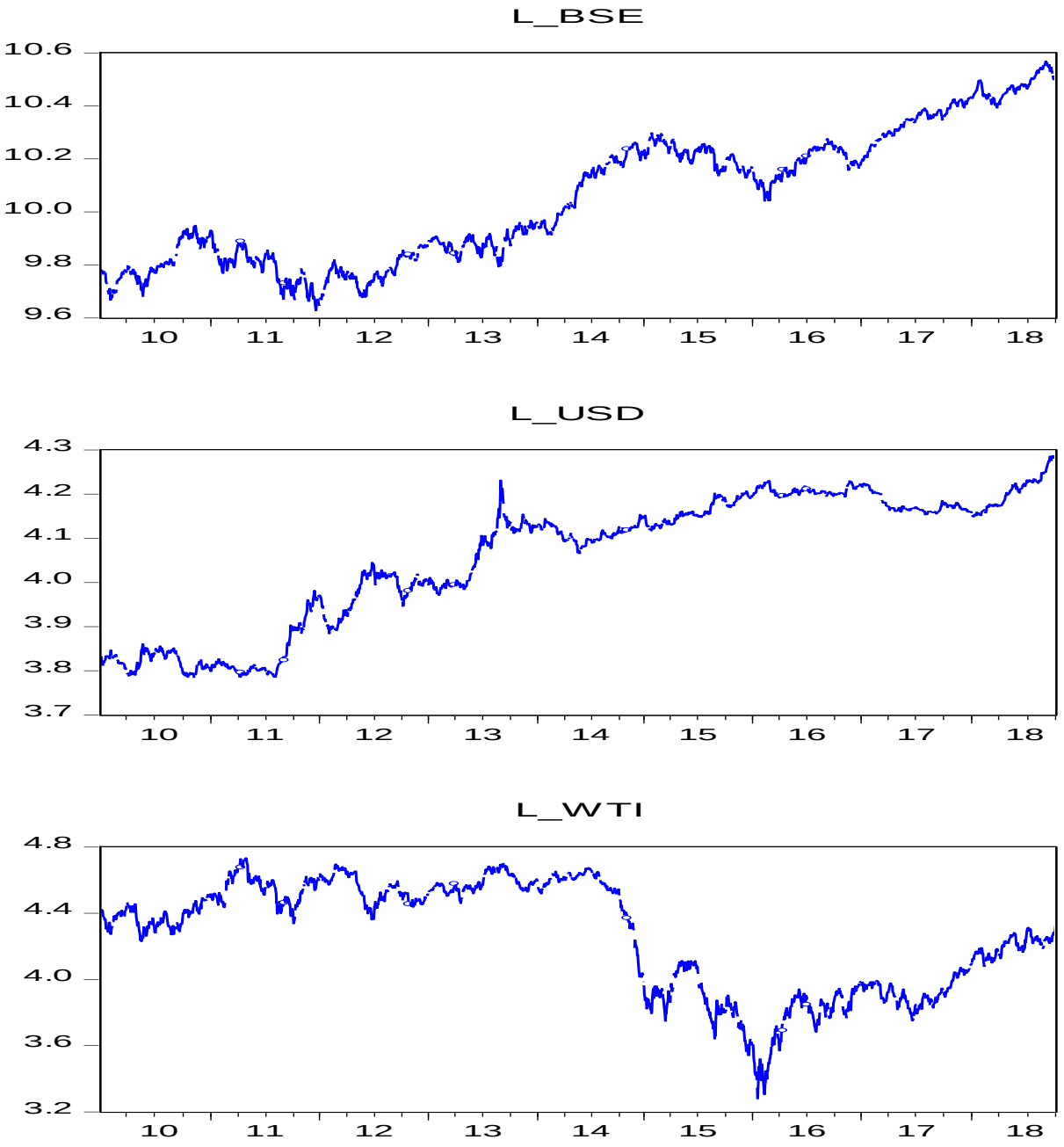

Figure 1. Daily price movement of variables.

Fig. 1 suggests that all the variables series have unit root. So, to test this formally, the Augmented Dickey-Fuller (ADF) test has been used. The results of unit root test at level and at first difference are presented in table 3.

Table 3: Results of Unit Root tests

	At level		At 1st Difference	
Variables	t-Statistic	Prob	t-Statistic	Prob
BSE	-0.4071	0.9056	-42.5026	0.0000
USD	-0.7242	0.8388	-34.8469	0.0000
WTI	-1.4257	0.5711	-47.6916	0.0001

Source: *Authors' Calculation.*

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At the significance level of 5%, the result of ADF tests reveals that series of all variables have a unit root, i.e. I(1). Looking at the ADF test results on the first difference, it is concluded that the returns (first difference) of all the series are stationary.
For examining causal relationship, we used Granger Causality test based on VAR. Results are shown in table 4.

Table 4: Results of Granger Causality Test

Null Hypothesis:	Obs.	F-Statistic	Prob.
USD → BSE	2095	2.3104	0.0419*
BSE → USD		1.5278	0.1778
WTI → BSE	2095	4.37518	0.0006*
BSE → WTI		0.7208	0.6078
WTI → USD	2095	1.11773	0.3487
USD → WTI		0.85231	0.5126

Source: *Authors' Calculation.*
[Note: → implies "does not Granger cause". * denotes significance at 5% level.]
From Table4, it can be seen that at 5% significance level, there is unidirectional causality from USD to BSE and from WTI to BSE.

Results of Cointegration Test
(Johansen, 1990) test for Cointegration is employed to examine long-run linkages between selected variables. Following table 5 shows the cointegration results among all selected variables. Trace statistic and max-eigen tests show that there is no cointegrating vector at 5% level of significance.

Table 5: Johansen Cointegration Test

Hypothesised No. of CE(s)	Trace Statistic	prob	Max-Eigen Statistic	prob
None	16.04407	0.7092	10.21945	0.7238
At most 1	5.824616	0.7161	5.763817	0.6437
At most 2	0.060799	0.8052	0.060799	0.8052

Source: *Authors' Calculation.*
Results of pairwise cointegration test is presented in table 6 which indicates that there is no long run relationship among selected pairs of variables at 5% significance level. So, by combining all results we can conclude that there is no cointegration between selected crude oil price (WTI), exchange rate (USD/INR) and stock price index (BSE).

Table 6: Pairwise Cointegration Test

Indices	Hypothesised No. of CE(s)	Trace Statistic	prob	Max-Eigen Statistic	prob
BSE & USD	None	7.832366	0.4835	7.809359	0.3984
	At most 1	0.023006	0.8794	0.023006	0.8794
BSE & WTI	None	4.641973	0.8456	4.521384	0.8006
	At most 1	0.120588	0.7284	0.120588	0.7284
USD & WTI	None	3.747591	0.9228	3.030801	0.9447
	At most 1	0.716791	0.3972	0.716791	0.3972

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Source: *Authors' Calculation.*

Volatility Spillovers

For studying volatility linkages, the present study estimated univariate GARCH models for each variable and generated variance series for the respective variables. Then Granger causality is performed between pairs of variables. The results are presented in Table 7.

The results in Table 7 demonstrate that there are bidirectional volatility spillovers between the markets of India (BSE) and exchange rate (USD). Also, there is unidirectional causality from volatility of Indian stock market (BSE) to crude oil (WTI).

Table 7. Granger Causality Test between volatility of indices.

Null Hypothesis:	Obs.	F-Statistic	Prob.
USDGARCH → BSEGARCH	2095	2.87975	0.0135*
BSEGARCH → USDGARCH		2.46023	0.0312*
WTIGARCH → BSEGARCH	2095	0.81983	0.5354
BSEGARCH → WTIGARCH		7.46396	0.0000*
WTIGARCH → USDGARCH	2095	0.75478	0.5825
USDGARCH → WTIGARCH		0.4896	0.7843

Source: *Authors' Calculation.*

[Note: → implies "does not Granger cause". * denotes significance at 5% level.]

5. Conclusions

The present study examines the linkages between International crude oil prices (WTI), exchange rate (INR/USD) and Indian equity index (BSE-Sensex). Cointegration analysis of Johansen-Juselius with daily data from January 2010 to October 2018 suggests that there is no cointegrating vector as per the Trace statistic and Max- Eigen tests. Also, results of pairwise cointegration test indicate that BSE is not cointegrated with USD and WTI. Results of Granger causality reveal that past returns of exchange rate and Oil Prices influence future returns of Stock index. In addition, results of Granger causality on conditional variance series show there is two-way volatility spillovers between the exchange rate (USD) and returns on Stock market of India (BSE). Also, there is unidirectional volatility spillover from India stock market (BSE) to Crude oil index (WTI). Thus, we conclude that future equity index returns in India are influenced by changes in exchange rate and oil prices. However, the relationship between equity returns and changes in exchange rate is stronger than the relationship between equity returns and changes in oil price. Given the importance of foreign investors in Indian markets, these findings are quite plausible. The finding of our study that returns on BSE Sensex are influenced by changes in oil price and exchange rate have important implications for investors and money managers. Investors who wish to invest in Indian equity market can make better investment decisions by considering movements in oil prices and exchange rate rather than by watching the equity market alone.

References

Akram, Q. F. (2009). Commodity prices, interest rates and the dollar. *Energy economics*, *31*(6), 838-851.

Al- mulali, U., & Che Sab, C. N. B. (2012). Oil prices and the real exchange rate in oil-exporting countries. *OPEC Energy Review*, *36*(4), 375-382.

Aloui, R., & Aïssa, M. S. B. (2016). Relationship between oil, stock prices and exchange rates: A vine copula based GARCH method. *The North American Journal of Economics and Finance*, *37*, 458-471.

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Bénassy-Quéré, A., Mignon, V., & Penot, A. (2007). China and the relationship between the oil price and the dollar. *Energy policy*, *35*(11), 5795-5805.
Chang, C. L., McAleer, M., & Tansuchat, R. (2013). Conditional correlations and volatility spillovers between crude oil and stock index returns. *The North American Journal of Economics and Finance*, *25*, 116-138.
Degiannakis, S., Filis, G., & Arora, V. (2017). Oil prices and stock markets. *Washington, US: Energy Information Administration*.
Delgado, N. A. B., Delgado, E. B., & Saucedo, E. (2018). The relationship between oil prices, the stock market and the exchange rate: Evidence from Mexico. *The North American Journal of Economics and Finance*, *45*, 266-275.
Ghosh, S. (2011). Examining crude oil price–Exchange rate nexus for India during the period of extreme oil price volatility. *Applied Energy*, *88*(5), 1886-1889.
Jain, A., & Biswal, P. C. (2016). Dynamic linkages among oil price, gold price, exchange rate, and stock market in India. *Resources Policy*, *49*, 179-185.
Jain, A., & Ghosh, S. (2013). Dynamics of global oil prices, exchange rate and precious metal prices in India. *Resources Policy*, *38*(1), 88-93.
Mensah, L., Obi, P., & Bokpin, G. (2017). Cointegration test of oil price and us dollar exchange rates for some oil dependent economies. *Research in International Business and Finance*, *42*, 304-311.
Miller, J. I., & Ratti, R. A. (2009). Crude oil and stock markets: Stability, instability, and bubbles. *Energy Economics*, *31*(4), 559-568.
Mollick, A. V., & Sakaki, H. (2019). Exchange rates, oil prices and world stock returns. *Resources Policy*, *61*, 585-602.
Narayan, P. K., Narayan, S., & Prasad, A. (2008). Understanding the oil price-exchange rate nexus for the Fiji islands. *Energy Economics*, *30*(5), 2686-2696.
Sari, R., Hammoudeh, S., & Soytas, U. (2010). Dynamics of oil price, precious metal prices, and exchange rate. *Energy Economics*, *32*(2), 351-362.
Seyyedi, S. (2017). Analysis of the interactive linkages between gold prices, oil prices, and exchange rate in India. *Global Economic Review*, *46*(1), 65-79.
Singhal, S., Choudhary, S., & Biswal, P. C. (2019). Return and volatility linkages among International crude oil price, gold price, exchange rate and stock markets: Evidence from Mexico. *Resources Policy*, *60*, 255-261.
Turhan, I., Hacihasanoglu, E., & Soytas, U. (2013). Oil prices and emerging market exchange rates. *Emerging Markets Finance and Trade*, *49*(sup1), 21-36.
Wu, C. C., Chung, H., & Chang, Y. H. (2012). The economic value of co-movement between oil price and exchange rate using copula-based GARCH models. *Energy Economics*, *34*(1), 270-282.