Dynamic Relationships Among Crude Oil Price, Exchange Rate and Bse Sensex

Management Insight
13(2) 6 - 12
https://doi.org/10.21844/mijia.v13i02.11264

Roshan Kumar* Manisha Gupta**

roshan.singh79@gmail.com

ABSTRACT

The study examined Dynamic relationship among crude oil prices, exchange rates and stock prices in India for the duration January 2006 to December 2016 using daily data. The research work include the testing for a unit root test in time series data, then it testing the number of co-integrating vectors in the system. In the next step we use the johansen co integration test to examine the relationship among variables. At the last Granger causality test is used to estimating the direction of causality among the variables.

Keywords : Crude oil price; exchange rate; stock price, co-integration; granger causality test

INTRODUCTION

Crude oil price is important factor for the volatility in the stock prices. The effect of oil prices on any country is depend on whether the country is oil importer or oil exporter. The rise in price of oil improve the trade balance in oil exporting countries. It increase the current account surplus. But for an oil importing countries, an increase in price of oil negatively affected the trade balance, it create deficit in current account. The crude oil prices and exchange rates are also connected theoretically. The rise in crude oil prices may increase current account deficit which results in the rise in the foreign Exchange rate. This impulse for alteration in fiscal front which may affect the value of exchange rate. If price elasticity of crude oil in oil importing countries is far more than one, a rise in oil prices will decrease expenditure on oil and thus demand for dollar, which is cause to raises the exchange rate (Krugman 1983; Golub 1983).

There is an association ship among exchange rate and share prices. The rise in exchange rate may decrease the value of domestic currency; as such it may positive to attract FIIs which increase the demand of shares. Again, depreciation of domestic currency may affect the trade, it may be increased export and reduces import. If the country is export oriented, then depreciation may positively affect the country economy and the stock market is well performed.

Dornbusch and Fisher (1980) conclude that rise in the value of domestic currency changes the competitiveness of domestic firms due to reduce cost of goods in dollar terms which may change the turnover of the firm.

In the past two decades, there has been a positive relationship among international crude oil prices and the fluctuations in the benchmark of BSE Sensex. It started in 1991, every one per cent increase in Brent oil has meant a 0.93 per cent increase in the Sensex, on average. The high rise in crude oil prices also good result into better corporate profitability for India's top corporates. There is a 30 per cent positive correlation among crude oil prices and profitability (return on equity) of the Sensex 30 companies. BSE sensex is leading indicators of

***Research Scholar, IK Gujral Punjab Technical University, Jalandhar (Punjab)*

***Director, Punjab Institute of Management and Technology, Mandi Gobindgarh, Khanna (Punjab)*

the Indian economy. The fluctuations of crude oil price, exchange rate and sensex is important area of the research because these microeconomics variable affected the global trade. This empirical work tried to contribute to the study of relationship among crude oil price fluctuations, exchange rate and stock market performance of Indian oil-importing countries.

LITERATURE SURVEY

Kaul, G. and N. Seyhun (1990) investigated on exchange rate and oil price and they found negative effect of oil- price fluctuation on stock Prices.

Jones and Kaul (1996) conducted the research to investigate the linkage between crude oil prices, exchange rate and conclude the negative impact of crude oil price on stock market, which occurred due to oil price risk factor.

Amano and Nordan (1998) found a strong positive relationship among the real domestic price of crude oil and the foreign exchange rates for japan, Germany, and the U.S.A. in their study.

Sadorsky (1999) used the VAR and GARCH models and found that oil prices and stock market return. In their work, interest rate and industrial production output were also included.

Bashar (2006) applied VAR analyses for the research study to investigate the impact of oil price changes on GCC stock markets and shows that only the Arabic markets have predictive power of oil price rise.

Anoruo and Mustafa (2007) examined the association among stock market return and crude oil price in USA from the period 1996 to 2006. They used co-integration test and vector error correction Model for their study and they conclude that there was a long term association among stock market return and crude oil price and they observe a one way causality associationship from stock market return to crude oil price change.

Miller and Ratti (2009) investigated the long-run associationship among the world price of international stock market and crude oil, and conclude that stock markets have negative impact on increase in the crude oil price. Another group of researchers conduct the research and they found a positive association among oil price and stock indices.

Narayan and Narayan (2010) examined the relationship among oil prices and Vietnam's stock prices with daily data for the time period 2000 to 2008. They applied Johansen test, they conclude that oil price, and stock price and exchange rate have long run relationship. It have positive effect on Vietnam's stock price in the long run as well in short run period.

Samuel (2010) conducted the empirical research work to analyse the impact of crude oil price on stock prices of selected exporter and importer countries with exchange rate as important variable. The result of study show the variance decomposition and response test sure that oil price and exchange rate have strong impact on stock price.

Lizardo and Mollick (2010) found that increase in crude oil prices can lead to significant depreciation of dollar in relation to the exporting country like Russia, but, the oil importing country's currency may depreciate in relation to US dollar in the same situation.

Raheman et al. (2012) have conducted a research work to examine the associationship among oil price votality and stock returns in the selected countries of Asia Pacific. In VAR framework, they found a significant short run relationship between oil price fluctuations and stock returns in countries of asia Pacific. They applied Granger causality test and the result of the study reveals that oil price is a reason of stock returns for only Pakistan and Sri Lanka.

Kiran (2011) conducted the research work to study the long run associationship among oil prices and stock market prices of seven most powerful industrialized countries the US, Japan, Germany, the UK, France, Italy and Canada by applying Robinson tests for co-integration. Test results show that there is strong positive fractional co-integration among oil prices and FTSE 100, Dow jones DAX 30, and SP- TSX indices.

Ayhan (2011) investigated long term

association among Istanbul stock exchange and international oil price by applying Johansen Co-integration test and Granger Causality analysis. It was found that there was a co-integrated association among stock index and oil price and there was one way causality associationship from indices of the stock exchange to oil price, but oil price was not the causal of the stock exchange indices.

Krishna, Reddy Chittedi (2012) examined the long run association among stock prices and oil for India over a ten year period and concluded that fluctuations of stock prices in India have strongly positive effect on the fluctuations of oil prices. They applied Auto Regressive Distributed Lag (ARDL) model in this work.

Turhan et al. (2013), showed that an increase in price of oil results into positive appreciation of domestic currency against the US dollar between 2003 to 2010.

Alex, D and Varghese, R. (2015) investigate the long run association among oil prices, exchange rate and stock prices in India for the duration April 2005 to March 2013. They use monthly data and applied co integration test and found there is at most one co-integrating vector among the three variables. The granger Wald test suggest that causality run from sensex to crude oil price.

RESEARCH METHODOLOGY

The research work examined associationship among crude oil prices, exchange rates and stock prices in India for the duration of January 2006 to December 2016 using daily data. The crude oil price data is gathered from the official website of Ministry of petroleum, government of India whereas the BSE indices data are collected from the official website and exchange rate are collected from Reserve bank of India.

The research work uses the following statistical test:

- Testing for unit root in each variable
- Testing the number of co-integrating variable
- Testing the co integrating relationship among the variable
- Testing the causality among the variables by using granger causality test.

UNIT ROOT TEST

A unit root test whether a time series variable is non stationary and possesses a unit root. The present study utilizes the most popular test for unit roots known as Dickey Fuller tests. The test is available in different forms depending on whether the variable under consideration has no intercept, intercept and intercept and trend.The unit root test of stationarity is based on the following set up.

$Y_{t} = \alpha + \rho\ Y_{t-1} + \mu_t$

Where $\mu_t \sim$ I(0) and -1 1 ρ 1

If ρ =1 then the series became a random walk model and Y_t is non stationary.

$Y_t - Y_{t-1} = \alpha + \rho\ Y_{t-1} + \mu_t$

$= \alpha + (\rho-1)\ Y_{t-1} + \mu_t$

It can be rewritten as $\Delta\ Y_t = \alpha + \delta\ Y_{t-1} + \mu_t$

Where δ is the first difference and

$\delta = (\rho-1)$

The Dickey Fuller Unit Root Test has three alternative:

1. Y_t isa random walk $\Delta Y_t = \delta\ Y_{t-1} + \mu_t$
2. Y_t is a random with drift

$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \mu_t$

3. Y_t is a random walk with drift

$\Delta Y_t = \beta_1 + \beta_2 + \delta$

Where t is the time series or trend variable. In each case, the null hypothesis is that $\delta = 0$, that is, there is a unit root and the series is non stationary. The alternative hypothesis is that ä is less than zero so the time series is stationary.

THE AUGMENTED DICKEY-FULLER TESTS

The Augmented Dickey Fuller Unit Root test has three alternative specifications as follows depending on whether the random walk process may have no drift or it may have drift or it may have drift and deterministic and stochastic trends. The ADF estimate use the following equation:

$$\Delta Y_t = \alpha + \beta t + \delta\ Y_{t-1} + \theta_i \sum_{i=1}^{p} Y_{t-1} + \mu_t$$

Here P represent the number of lags and the

hypothesis $\delta = 0$ is tested

The basic condition of unit root are the following:

1. If t statistics is ADF computed value it represent the presence of unit root for the time series data.
2. If t statistics is ADF computed value it means the null hypothesis is rejected and it show that unit root does not exist.

JOHANSEN CO INTEGRATION TEST

Co-integration test is developed by Johansen in 1988. They used trace statistics and the maximum Eigen value test to determine the presence of co-integration among the variable. The equation used for co-integration test is following:

$$\Delta Y_t = \beta_0 + \beta_t + Y_{t-1} + \delta_i Y_{t-1} + \mu_t$$

GRANGER CAUSALITY TEST

The granger test is a statistical test which is widely used for determining whether one time series is important in predicting another series. The equation used for granger causality test is following.

$$Y_t = \alpha_j X_{t-j} \sum_{j=1}^{n} + \beta_j Y_{t-j} + \mu_1 t$$

$$X_t = \sum_{j=1}^{n} X_{t-j} + \delta_j Y_{t-j} + \mu_2 t$$

HYPOTHESIS

Hypothesis 1

H_0 : Crude oil price, BSE sensex and exchange rate are not non stationary

H_1 : Crude oil price, BSE sensex and exchange rate are non-stationary

Hypothesis 2

H_0: Crude oil price, BSE sensex and exchange rate are not associated in the long run period.

H_1: Crude oil price, BSE sensex and exchange rate are associated in the long run period.

Hypothesis 3

H0: Crude oil price, BSE sensex and exchange rate are not related pairwise.

H1: Crude oil price, BSE sensex and exchange rate are much related pairwise.

DATA ANALYSIS AND INTERPRETATION:

The analysis include the Unit root test, co-integration test and granger causality test. In the first step of analysis to checking the stationarity of the data, unit root test was conducted.

UNIT ROOT TEST

The present study uses the Augmented Dicker Fuller test and Philips-perron test, both at level and first difference (intercept without trend and intercept with trend) in hypothesis at 5% level. The lag value computed according to Schwartz information criterion. The result of test are given below:

Table 1. Unit root test at level variables

Unit Root Test results at levels, Series with constant and trend

Time period 2006 to 2016	Variable	No of observation	ADF test statistic	PP tests tatistic	Critical Value @ 5%
Level	Crude oil Price	2725	-1.827187	-1.801558	-3.411456
	BSE sensex	2725	-2.938468	-2.827517	-3.411456
	Exchange Rate	2725	-2.732111	-2.625801	-3.411456

Since computed value of the ADF and PP test statistic is less than its critical value (3.411456), the null hypothesis cannot rejected it means it is accepted , which show that all the series crude oil price, BSE sensex and Exchange rate, unit root exists and they are non- stationary at their levels.

Table 2. Unit root test at first difference

Unit Root Test results at first difference, for series with Constant and trend

Time period 2006 to 2016	Variable	No of observation	ADF test statistic	PP tests tatistic	Critical Value @ 5%
First Difference	Crude oil Price	2725	-55.09389	-55.16493	-2.862401
	BSE sensex	2725	-48.62711	-48.59560	-2.862401
	Exchange Rate	2725	-15.14950	-56.25301	-2.862401

At their first difference the computed |t| > the critical value 2.862401 andhence, the null hypothesis rejected at 5% significance level i.e., unit root does notexist.Accordingly, time series for Exchange Rate, BSE sensex and crude oil price stationary at their first difference.

JOHANSEN CO-INTEGRATION TEST

Johansen's Co-integration test is applied to determine if there is co integration relation among the variables. Two likelihood test are used, the trace test and the maximum Eigen value test, to find out whether the series are co integrating. The estimation for series assumed as linear deterministic trend. The lag selection for 1st difference is based on the Swartz information criterion.

Table No 3. Johansen's Co-integration Test Result

Exchange rate, Crude oil price and BSE sensex		Sample: 1/09/2006 to 12/30/2016		
Trend assumption:Linear deterministic trend (restricted) Observation: 2716 Unrestricted Co integration Rank Test (Trace)				
Hypothesized No. of CE(s)	**Eigen value**	**Trace Statistic (λtrace)**	**Critical Value @ 5%**	**Prob.****
None	0.005884	25.36123	29.79707	0.1489
At most 1	0.003372	9.333137	15.49471	0.3355
At most 2	5.91E-05	0.160482	3.841466	0.6887
Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigen value**	**Maximum Eigenvalue**	**Critical Value @ 5%**	**Prob.****
None	0.005884	16.02809	21.13162	0.2232
At most 1	0.003372	9.172655	14.26460	0.2721
At most 2	5.91E-05	0.160482	3.841466	0.6887

The results of the Johansen's Co-integration test as presented in Table 3 above, Maximal Eigen statistic (ëmax) of 16.02809 is less than the 5 % critical value of 21.131 and the trace test statistic (ëtrace) of 25.36123 is less than the critical value of 29.79707. In this manner the result of other variable value is also less than critical value so the null hypothesis of no co integration (ie. r = 0) is cannot rejected. These result establish the no co-integration among time series variable like exchange rate, crude oil price and BSE sensex so the null hypothesis is accepted.

GRANGER CAUSALITY TEST

The Granger causality test study the short run relationship among the variables. It was studied by testing the causality among them. Granger test was used for the same. Causality is lag- dependent. It may be classified as bi-directional, uni-directional and at some lags causality may be absent.

GRANGER CAUSALITY TESTS

Table No. 4 Pairwise Granger Causality Tests

Date: 02/10/17 Time: 13:52 Lags: 2
Sample: 1/02/2006 to 12/30/2016

Null Hypothesis	Observation	F-Statistic	Probability
Exchange rate does not Granger Cause BSE sensex	2722	5.41113	0.0045
BSE sensex does not Granger Cause exchange rate	2722	11.6180	9.E-06
Crude oil price does not Granger cause Exchange rate	2722	3.23174	0.0396
Exchange rate does not granger cause crude oil price	2722	2.81917	0.0598
Crude oil price does not granger cause BSE sensex	2722	1.09289	0.3354
BSE sensex does not granger cause crude oil price	2722	3.36303	0.0348

To estimate the causal relationship with fluctuation of causation among crude oil price, exchange rates and sensex, pairwise causal test has been applied in the present Research work. Table-4 depict the results of pairwise causal test and point up that there is no causal relationship exist among (i) Exchange rate and BSE sensex, (ii) BSE Sensex and exchange rate, (iii) Crude oil price and exchange rate, (iv) exchange rates and crude oil price, (v) Crude oil price and BSE sensex (vi) BSE sensex and Crude oil price because the probability is more than 0.05. Table-4 represent the bi-directional causal relationship exist between Crude oil price, BSE sensex and exchange rates because the probability is less than 0.05. Therefore, this research work may conclude that causal relationship is merely a trend of the selected data under the period of study.

CONCLUSION

This Research work was conducted to determine the Dynamic relationship among crude oil price, BSE sensex indices and exchange rate. In this regard, the ADF test was used which showed non- stationarity at level and stationarity at first difference. Then the co-integration test is used, which indicated no co-integration among the variable. Therefore granger causality test is applied which show the bi-directional causal relationship exist between Crude oil price, BSE sensex and exchange rates because the probability is less than 0.05. Hence, pairwise causal assertion linking Crude oil price, exchange rates and BSE sensex indicates that trend in one indicator is not the grounds for trend in other indicator under the study. Therefore, this research work may conclude that causal relationship is merely a trend of the selected data under the period of study.

REFERENCES

- Alex, D and Varghese, R. (2015). An Empirical Investigation into the Relationship of Crude Oil Price, Exchange Rate and BSE Sensex. Bulletin of Business and Economics, 4(3), 149-157.
- Amano, R. A., & van Norden, S. (1998). Exchange rates and oil prices. Review of International Economics, 6, 683-694.
- Anoruo, E., Mustafa, M. 2007. An Empirical Investigation Into The Relation Of Oil To Stock Market Prices. North American Journal of Finance and Banking Research 1:1, 22-36.
- Ayhan, Kapusuzoglu. (2011). Relationships between Oil Price and Stock Market: An Empirical Analysis from Istanbul Stock Exchange (ISE). International Journal of Economics and Finance, 3 (6), 99 – 106.
- Bashar, Z. 2006. Wild Oil Prices, but Brave Stock Markets! The Case of Gulf Cooperation Council (GCC) Stock Markets. Middle East Economic Association Conference, Dubai.
- B, Kiran. (2011). The Empirical Relationship between Oil Prices and Stock Market Prices in Turkey: Evidence from Sectoral Analysis, International Journal of Ecological Economics and Statistics, 20 (11).

- Dornbusch, R. & Fischer, S. 1980. Exchange rates and current account. American Economic Review 70(5): 960-971.
- Jones, C., & Kaul, G. (1996). Oil and the Stock Market, Journal of Finance, 51(2), 463-491.
- Kant's 2015. Crude and sensex move together. In business standard available online at http:// www.business-standard.com.
- Kaul, G. and N. Seyhun (1990), "Relative Price Variability, Real Shocks, and the Stock Market," Journal of Finance, 45, 479-496.
- Krugman, P. 1983. Oil shocks and exchange rate dynamics. In Exchange Rates and International Macroeconomic, edited by A.F. Jacob, 259-284. USA: University of Chicago Press.
- Krishna, Reddy, Chittedi., (2012). Do Oil Prices Matters for Indian Stock Markets? An Empirical Analysis? Journal of Applied Economics and Business Research, 2(1), 2-10.
- Lizardo, R.A., Mollick, A.V., 2010. Oil price fluctuations and US dollar exchange rates. Energy Economics 32, 399–408.
- Miller, J.I. & Ratti, R.A. 2009. Crude oil and stock markets: Stability, instability, and bubbles. Working Paper, University of Missouri.
- Narayan, K. P., Narayan, S. 2010. Modeling the impact of oil prices on Vietnam's stock prices. Applied Energy 87, 356-361.
- Sadorsky, P. (1999), "Oil Price Shocks and Stock Market Activity," Energy Economics 21, 449-469.
- Samuel, Imarhiagbe. (2010). Impact of oil prices on stock markets: empirical evidence from selected major oil exporter and importer countries, Global journal of Finance and Banking Issues. 4(4), 15-31.
- Turhan, M.I., Hacihasanoglu, E., Soytas, U., 2013. Oil prices and emerging market exchange rates. Emerging Markets Finance and Trade 49, 21–36.