A Study on the Impact of Crude Oil Prices on the Indian Stock Market

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ABSTRACT: *The intention of this research study is to contribute to the literature on stock markets and energy prices by studying the impact of oil price changes on Indian stock market. This study has employed various statistical tools like regression analysis, ANOVA in order to try and establish a relationship between Crude Oil Prices and Indian Stock Market based on available past data. The span of this study includes data of Crude Oil Price (Brent Crude) and Indian Stock Market Index (BSE Sensex and NSE Sensex) for last 5 years (2013-17) in a 6-monthly Time Series format. The above mentioned period (i.e. 2013-17) has witnessed various turmoil and changes in both Indian and World economy. Consequently, the period experienced marked movement in global crude oil prices and thus, would prove to be significant for our study. The findings of the study indicate that oil prices generally follow market expectations in short run, however, it follows economic principles of supply and demand in the long run. Also there exists a weak but significant relationship between oil price changes and returns on Indian stock market (BSE Sensex and NSE Sensex).*

Key Words: : *Crude Oil, Indian Stock Market, BSE and NSE Sensex*

Introduction:

Oil is a common word that always makes the headlines frequently. It is an essential natural resource for any country. Every country, even the ones that have this natural resource in abundance, struggles to explore and extract more of it at almost any cost and measure. The layman in every country bears the burden of the cost of exploration of oil and the cost of its import, in spite of ignorance regarding the same.

There has been no agreement on the definition of Oil or Petroleum(also called as crude oil or rock oil). The two Latin words Petra (meaning rock) and oleum(meaning oil) having geological connotations in nature are more relevant. It covers a wide range of substances comprising hydrocarbons.

Crude Oil price is one of the most crucial and essentialmacroeconomic variables which affect the cost ofproduction directly or indirectly, thus, affecting the futurecash flows and profits of companies. In recent years after Libya Wars (2011), Paris Climate Agreement (2016), Sudan and Congo becoming OPEC (2018) have caused substantial volatility to the oil prices across the globe. This has majorly impacted the BRICS countries as they form part of major oil demands and imports.Despite the fact that, based on previous research,oil price changes seem to affect equity as well as other prices in a negativemanner, a deeper analysis should be done with respect to the different impacts on oil exporting and on oil importingcountries. In the OPEC countries and in other oil exportingcountries, the impact of increases in oil prices should bepositive, whereas for the oil importing countries like Indiathe impact should be negative.

Brent Crude Oil and Brent Crude Index

Brent Crude(also known as Brent Blend, London Brent and Brent petroleum) is a major trading classification of sweet light crude oil (Being relatively low in density it is described as light, and sweet because of its low Sulphur content.). It facilitates as a major benchmark price for purchases of oil worldwide. Brent Crude is extracted from the North Sea.

Brent Crude Index is a benchmark which serves as a reference price for buyers and sellers of crude oil. Investors in commodity consider Brent's prices while trading in the commodity markets and judge others' items prices based on this.

Crude Oil Industry in India

Crude oil Industry is considered to be the back bone of some economies. It plays a major role in the upliftment of under-developed countries.It is the main source of energy and for any economy to move forward and function,drive of crude oil industry is a must. Demand and supply mechanism around the globe determine the price of crude oil.Crude oil is not a domestic product and any kind of shortage in the same has serious implications on all possible industries along with the economies all over the world. Crude oil industry always needs to explore on finding new crude oil sites.

Technological advancements has given oil producers in India,an access in the methods of exploration and extraction of oil. This finding of more deposits has resulted in an increase in reserves. Refining, transporting

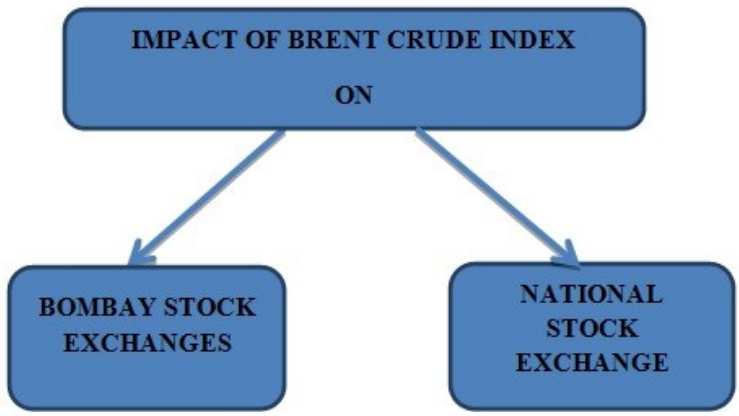
and marketing of oil and oil products has grown over the years. In addition to technological advancements, globalization and the changes in the way business is conducted has resulted in important changes & opportunities to the petroleum companies in India.

Review of Literature

Arezki et al. (2017) state in their study, a simple macroeconomic model, which explores the effects of a change in world GDP growth, a change in the efficiency of oil usage and a change in the supply of oil. This analytical framework integrates the four views of the drivers of the oil market into a model based on the fundamentals of demand and supply. Their analysis suggests that an era of prolonged low oil prices is likely to be followed by a period where oil prices overshoot their long-term upward trend.**Soundarapandiyan and Ganesh (2017)** in their study mention that there is an inter correlation between CPI and crude oil price and vice versa. There is a clear indication that whenever the CPI increases there is decrease in crude oil price and vice versa. It was also found that there was significant difference between crude oil price and GDP and no significant difference between CPI and GDP. **Punati and Raju (2017)** have found in their research through econometric technique that Brent crude oil prices, index of industrial production, exchange rate and inflation determine the crude oil prices.

Bhattacharjee (2013) has considered 124 data sets of crude oil and WPI and performed correlation which resulted that there is positive correlation between them. Further, the author considered Grangers' Cause Test to study whether crude oil prices changes inflation. It resulted that the variables selected are bidirectional ie., the crude oil price change Granger causes inflation and vice versa. The author also tested crude oil with capital and labor productivity, which ascertained that a rise in energy prices would result in decline in productivity of existing capital and labor.**Hamilton (2008)**in his study "Understanding Crude Oil Prices" has concluded that oils' future and spot prices differ in a minimum extent, however if such difference is caused by news, the future prices in every horizon move together in the same direction. The author has further studied that oil is price and income elastic and would become less price elastic over time, in which case the predicted price would increase. In order to increase oil from a field, methods such as drilling wells, pumping in water or carbon dioxide is used to maintain pressure. However, it becomes difficult to continue extraction at the same rate and hence new geographical areas are found for extraction. He also concluded that price speculation, OPEC monopoly pricing, strong world demands, geographical limitations are increasingly important contributions of the scarcity of oil. **Kumar & Shipra (2018)**have indicated that the causes of fall in oil prices are majorly due to the monopoly of OPEC countries. In short run, the price volatility is due to market expectations, however for long run, it is underlying demand and supply conditions. Further, the decline in oil prices are sometimes due to new technologies as cost of exploration and extraction reduce. Increase in dollar rates are also one of the reasons for fall in oil prices. Further, their study has determined that oil forms a major part of the Indian commodity basket and therefore its volatility will impact the Indian economy as a whole. However, decline in crude oil prices have helped the government to manage finances better as it reduces the subsidies provided towards petroleum products.

Figure 1: Theoretical Framework of the Impact of Brent Crude Index on Indian Stock Market



As mentioned earlier, this study focuses on the impact of Brent Crude Index on the volatility of Bombay Stock Exchange and National Stock Exchange. The variables involved are BSE index, NSE index and Brent Crude Index. The dependent variables are BSE 30 and NIFTY 50 and independent variable are Brent Crude Index.

Research Methodology:

Statement of the Problem

The desire of the study is to understand, how the increase/decrease in international crude oil prices impact the Indian Stock Market. This study attempts to analyze the short term and long-term relationship between oil prices and stock market indices of emerging markets. The essence of the study is to garnerthe understanding of the causal relationship with the historic facts in crude oil prices and its effectivity in the stock indices by considering both BSE and NSE indices. The study is essential for both – knowledge and to help insolving problems of businesses arising out due to inflation, predicting the futureprice signal in relation to the business environment.

Need for the Study

The main purpose of doing this project was to know about the volatility of crude oil towards the stock exchange indices. This helps to know in details about crude oil industry right from its inception stage, growth and future prospects. It also helps in understanding reasons for such volatility of crude oil prices.

Objectives:

1. To study the contribution of Crude Oil prices on the BSE index volatility.
2. To study the contribution of Crude Oil prices on the NSE index volatility.
3. To determine the impact of Crude Oil prices on the BSE index.
4. To determine the impact of Crude Oil prices on the NSE index.

Hypothesis:

Hypothesis 1

H_0: There is no significant impact of changes in oil prices on BSE Sensex returns.

H_1: There is a significant impact of changes in oil prices on BSE Sensex returns.

Hypothesis 2

H_0: There is no significant impact of changes in oil prices on NSE Sensex returns.

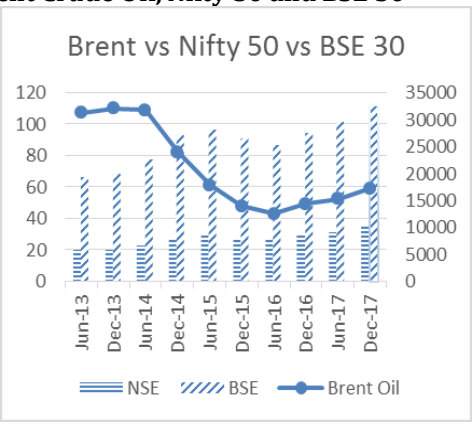
H_1: There is a significant impact of changes in oil prices on NSE Sensex returns.

Data Analysis and Interpretation

The data considered for the study is Brent Crude Index, Nifty 50 and BSE 30 for a period of 5 years i.e., from 2013 to 2017. In this study, various tools like linear regression, one tailed ANOVA were used to test the significance of Brent Crude Index and Stock Market Index.

Table 1 and Graph 1on 5-Year Analysis of Brent Crude Oil, Nifty 50 and BSE 30

Year	Brent Oil	NSE	BSE
Jun-13	106.98	5861.45	19375.4
Dec-13	109.9	5954.72	20078.7
Jun-14	108.85	6768.06	22678.2
Dec-14	82.24	8138.93	27203.8
Jun-15	61.1	8530.9	28187.1
Dec-15	47.7	8066.74	26578.8
Jun-16	42.97	7764.44	25414.8
Dec-16	49.03	8511.98	27596.6
Jun-17	52.35	9176.81	29667.6
Dec-17	59.06	10146.02	32658.1



- In the above table a 5 year halfyearly data of Brent Crude Index, NSE and BSE is being analyzed. There has been frequent fluctuations in all the three variables. However, substantial fluctuations were seen in the Brent Index.
- The volatility of the variables is dependent on internal and external factors, which are not controlled by any type of agency or country. All three variables are free from bias and therefore must be carefully observed.

Table 2 (a) & (b)on Multiple Linear Regression

Table 2(a)	**Table 2(b)**
Brent vs Nifty 50	Brent vs BSE 30

Multiple R	R Square	Adjusted R Square	Multiple R	R Square	Adjusted R Square
0.770928	0.59433	0.543622	0.686080972	0.4707071	0.395093828

- The **multiple R** in Table 2(a) represent an almost perfect positive correlation at 0.77. The multiple R between Table 2(b) also represents an almost perfect positive correlation at 0.686.
- Further, in Table 2(a) he **R-square** value or co-efficient of determination is seen at 0.594 or 59%, which suggests that there is 59% chance that the variation in NIFTY 50 index is explained by Brent Crude Index. This represents that there is above 50% chance that the NIFTY 50 is influenced by Brent Crude Index. Similarly, in table 2(b), R-square value or co-efficient of determination is seen at 0.470 or 47%, which suggests that there is 47% chance that the variation in BSE 30 index is explained by Brent Crude Index. This shows that there is less than 50% chance that the BSE 30 is influenced by Brent Crude Index. This indicates there is significant yet a moderate impact to the Bombay Stock Market by the Brent Crude Index.
- However, **adjusted R-square** must be focused on while interpreting the regression analysis as it focuses on only those variables which has significant impact on the regression model. It can be noted in Table 2(a) that the value ascertained is 0.543 or 54.3% which indicates that there could be a significant influence on the dependent variable (NIFTY 50). Therefore, based on the sufficient evidence obtained, Brent Crude Oil has a significant contribution to the volatility of NIFTY 50. Subsequently, in table 2(b) the value ascertained is 0.395 or 39.5% which represents a significant influence on the dependent variable. Therefore, based on the sufficient evidence obtained, Brent Crude Oil has a significant yet weak contribution to the volatility of BSE 30.

Objective: To determine the impact of Crude Oil prices on the BSE index.
Hypothesis 1:
$\boldsymbol{H_0}$: There is no significant impact of changes in oil prices on BSE Sensex returns.
$\boldsymbol{H_1}$: There is a significant impact of changes in oil prices on BSE Sensex returns.
Test: One – Tailed ANOVA
Result:

Table 3(a) on One - Tailed ANOVA of Brent Crude Index and BSE 30

Brent vs BSE 30

	df	Sum of Square	Mean of Square	Sig F
Regression	1	2540.81	2540.81	
Residual	7	2857.048	408.1497	0.041291
Total	8	5397.858		

$$f = \frac{Mean\ of\ Square\ between\ groups}{Mean\ of\ Square\ within\ groups}$$
$$f = \frac{2540.810083}{408.1497024}$$
$$f = 6.225191560987403$$

- From the above, table the results obtained indicate that there is no significant difference between the sample means, i.e., the sum of squares and mean of squares. This determines that there is a dependency of the variable BSE 30 onto the Brent Crude Index.
- 'f value' represents the ratio Between-Groups and Within-Groups. The null hypothesis is said to be true when the 'f value' is close to 1. However, it can be observed that the value (f = 6.22) way farther to 1, and therefore, null shall be rejected and alternate shall be accepted. There is significant impact of Brent crude index on BSE 30 index.
- The 'Sig F' value or **Significance Level of 'f'** measures the degree of diversity between the data sets. This is calculated by taking into consideration the degree of freedom and the 'f' value. This helps in testing the hypothesis. In the given table the 'Sig f' value is 0.04.
- It is seen that the Sig F value < 'alpha value' i.e., 0.04 < 0.05. Therefore, the null hypothesis (H_0) is rejected and the alternate hypothesis (H_1) is accepted.
- Therefore, it can be concluded that there is significant impact of Brent Crude Index on the Bombay Stock Market or the BSE 30 index.
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Objective: To determine the impact of Crude Oil prices on the NSE index.
Hypothesis 2:
$\boldsymbol{H_0}$: There is no significant impact of changes in oil prices on NSE Sensex returns.
$\boldsymbol{H_1}$: There is a significant impact of changes in oil prices on NSE Sensex returns.
Test: One – Tailed ANOVA

Result:

Table 3(b) on One - Tailed ANOVA of Brent Crude Index and NIFTY 50

Brent vs Nifty 50

	df	Sum of Square	Mean of Square	Sig F
Regression	1	4015.306	4015.306	
Residual	8	2740.709	342.5887	0.009041
Total	9	6756.015		

$$f = \frac{Mean\ of\ Square\ between\ groups}{Mean\ of\ Square\ within\ groups}$$
$$f = \frac{4015.306}{342.5887}$$
$$f = 11.72049$$

- From the above, table the results obtained indicate that there is no significant difference between the sample means, i.e., the sum of squares and mean of squares. This determines that there is a dependency of the variable NIFTY 50 onto the Brent Crude Index.
- 'f value' represents the ratio Between-Groups and Within-Groups. f value = 11.72 is way farther to 1, and therefore, null shall be rejected and alternate shall be accepted. There is significant impact of Brent crude index on NIFTY 50 index.
- The 'Sig F' value or **Significance Level of 'f'** measures the degree of diversity between the data sets. This is calculated by taking into consideration the degree of freedom and the 'f' value. This helps in testing the hypothesis. In the given table the 'Sig F' value is 0.009.
- It is seen that the Sig F value < 'alpha value' i.e., 0.009 < 0.05. Therefore, the null hypothesis (H_0) is rejected and the alternate hypothesis (H_1) is accepted. Therefore, it can be concluded that there is significant impact of Brent Crude Index on the National Stock Market or the NIFTY 50 index.

FINDINGS AND SUGGESTIONS

Findings:

- The major variables considered for the study were Brent Crude Index; NIFTY 50; BSE 30. It was observed that all the three variables saw both growth and decline in the period of 5 years. Only in the year 2014 both the stock markets rose and climbed an all-time high, however there was a downfall in the crude index. Only in the year 2017, both the markets saw an all-time high in their points.
- It was observed that one of the major reasons for the fluctuations in the stock market was due to internal factors such as: Demonetization, implementation of GST, change in Govt and their reforms, influence of Foreign countries, Gold rates, Start-up business influences, Diamond rates, derivatives market etc. The study showed that the oil fluctuations tend to follow the basic economic principle of law of demand and law of supply.
- Brent crude index, being an international index traded in the Futures Exchange, influences the entire world's economy. Therefore, it was noted that the fluctuations in the Brent index was due to various influences of the world economy.
- The study was concluded using statistical tools: Linear Regression and ANOVA, which helped in providing a basis as well as a structure in performing and concluding the study.

The linear regression helped in figuring the impact between the independent and dependent variables. Finally, ANOVA technique helped in testing the overall hypothesis.

- After performing various statistical tests, it was found that there is significant impact of crude oil in the Indian Stock Market, however, such impact is weak or lower than other factors. However, crude oil shall not be ignored while studying the volatility of stock market.
- Ultimately, the alternate hypothesis (H_1) were accepted under both objectives, which indicates that there is a significant relationship between the Brent Crude Index and the Indian Stock Market.

Suggestions:

- It was noticed that the Indian economy substantially depends upon crude oil for its functioning. From running a small vehicle to running a large-scale equipment, crude oil is used everywhere. This is costing the Indian economy a large amount of money, and therefore it is suggested to adopt alternate sources of energy like solar power, electric lithium, biogas etc.The study showed that there is significant yet weak impact of Crude oil prices on the Indian Stock Market. This shows that though there is weak impact, the entire Indian economy runs on Crude oil and its products. Therefore, it is necessary for us to develop various methods to adopt alternate fuels, which can pump in some fluctuations to the Indian Stock Market. This could bring in both good and worse changes in the Indian economy, but on the whole would create a sustainable livelihood.
- The Indian economy has a lot of debts to recover from a lot of fugitives, which has increased its fiscal deficit. Further, due to excess import over export of oil, the deficit seems to be increasing substantially. This could be a cause a major chaos in Indian economy if not looked into. India's 80% imports go only in importing oil and oil products. Therefore, it is highly necessary to adopt alternate source of energy.
- The study concluded that there is a significant yet weak impact of crude oil on Indian stock market. Though the Indian economy took major reforms such as Demonetization, it was noticed that this event did a very minute impact to the Indian scenario. This shows that the Indian market can fight against major economic changes and therefore it should not let external factors ruin its fluency.

Conclusion:

The present study analyzed the relationship between crude oil future prices, nifty and BSE Energy Index. On performing the Multi Linear Regression, it was found that the volatility of NSE and BSE indices are dependent on the fluctuations of Brent Crude index.

The ANOVA test finally concluded the analysis suggesting that there is significant relationship between Crude Oil prices and the Indian Stock Market. Therefore, its affect in the Indian household is essential and necessary. Further, the governmentt must incorporate innovative and modern methods of utilizing the resources in order to develop alternate sources of energy. Therefore, this study has scope for further research.

Scope for Future Research:

Though this study has considered a major economic indicator viz., Indian stock market, however, there are other economic indicators such as GDP, Inflation, Interest rates, Dollar and other currency rates, etc. Therefore, this study has scope in analyzing the impact of individual as well as collective impact of other macro-economic factors affecting the oil prices.

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