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A Study on Impact of Oil Prices on Emerging Market Stock Indices

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Abstract: *Stock indices are influenced by several economic and political factors. Some of the most influencing parameters affecting indices are inflation, interest rates, world events, currency exchange rates and commodity prices. One of the most volatile commodities in recent times in terms of its price fluctuation is crude oil price. Impact of crude oil price fluctuations on stock indices has been observed by many researchers in recent times. This paper attempts to analyze the short term and long term relationship between oil prices and stock market indices of emerging markets for the period July 2005 to June 2015 by using Vector Auto Regression (VAR) model. The research paper used Granger Causality test and Variance Decomposition under VAR environment to understand whether stock indices influence oil prices in India and China or not. Among the emerging economies Sensex and SSE Composite Index were chosen as indices for study. The results obtained suggest that Sensex does granger cause oil prices in India whereas oil prices in India do not granger cause Sensex. In China also SSE Composite index does granger cause oil prices, whereas oil prices does not granger cause SSE Composite Index. Our results for variance decomposition show that in the short run shock to oil prices in India and China can cause 0.97% & 3.21% variation fluctuation in Sensex and SSE Composite index respectively in the future. In the long run shock to oil prices in India and China can cause 1.09% & 3.86% variation fluctuation in Sensex and SSE Composite index respectively in the future. Variance decomposition shows that in the short run shock to stock Indices can cause 8.16% & 7.73% variation fluctuation in oil prices in both countries. Whereas, in long run shock to stock indices can cause 8.35% & 10.21% variation fluctuation in oil prices in both countries. The study revealed that in the short run or long run volatility of stock prices in India and China have marginal impacts on the volatility of oil prices. But volatility in oil prices does not have impact on stock prices of both India and China.*

Keywords: *Oil price, Sensex, Interest rates, SSE composite index*
JEL Codes: *C22, E44, G14*

I. Introduction

The relationship of oil price changes with other parameters like employment, economic activity is a significant study that has been researched by many in most of the developing countries (Darby, 1982; Hamilton, 1983). In a remarkable research work conducted by Hamilton (1983) showed that oil price increases lead to post world war in US recession. Other researchers continued the basic research conducted by Hamilton and conducted research by using alternative data and prediction methods (Gissar and Goodwin, 19386).

Some of the most influencing parameters affecting indices are inflation and interest rates, world events, currency exchange rates and commodity prices. One of the most volatile commodities in recent times in terms of its price fluctuation is crude oil price. Impact of crude oil price fluctuations on stock indices has been observed by many researchers in recent times. This paper attempts to analyze the short term and long term relationship between oil prices and stock market indices of emerging markets for the period July 2005 to June 2015 by using Vector Auto Regression (VAR) model. The research paper used Granger Causality test and Variance Decomposition under VAR environment to understand whether stock indices influence oil prices in India and China or not. Among the emerging economies Sensex and SSE Composite Index were chosen as indices for study. The results obtained suggest that Sensex does granger cause oil prices in India whereas oil prices in India do not granger cause Sensex. In China also SSE Composite index does granger cause oil prices, whereas oil prices does not granger cause SSE Composite Index. Our results for variance decomposition of oil prices show that in the short run shock to oil prices in India and China can cause 1.17% & 8.23% variation fluctuation in Sensex and SSE Composite index respectively in the future. In the long run shock to oil prices in India and China can cause 1.21% & 3.69% variation fluctuation in Sensex and SSE Composite index respectively in the future

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II. Literature Review

Several studies have been conducted on interaction between stock market and crude oil prices. Rong-Gang Cong, Yi-Ming Wei, Jian-Lin Jiao & Ying Fan (2008) investigated relationship between oil price shock and Chinese stock market by using VAR model, in which it was found that oil price shocks do not show significant impact on the real stock return of most Chinese stock market indices. Irene H & Perry S (2007) found relationship between energy stock prices, technology stock prices, oil prices and interest rates using VAR model. Results concluded that technology stock prices and oil prices individually granger cause the stock prices of alternative energy companies. Whereas simulation results shows that impulse to technology stock prices has a greater impact on energy stock prices. Evangelia P (2001) conducted study to find out relationship between oil prices, stock prices, interest rates, economic activity and employment for Greece, which suggests that economic activity and employment affected by changes in oil prices. The study also concluded that oil price movement is important in explaining stock price movement and a change in real activity and employment is not caused by stock return. Jungwook P. & Ronald R. (2008) studied oil prices shocks and stock markets in the U.S. and 13 European countries and concluded that oil prices shocks account for 6% volatility in stock return. Maghyereh & Akttam (2004) studied the linkages between crude oil prices shocks and stock market in 22 emerging economies using VAR models and concluded that oil shocks have no significant impact on stock index returns. Jones and Gautam (1996) applied valuation model on the stock market of US, Canada, Japan and England and found that change in oil prices had effect on the four countries real stock returns. Ciner (2001) concluded that non-liner relationship existed between stock return and oil prices. Huang and Masulis (1996) applied VAR model and found that crude oil future returns had ability to explain oil companies stock returns, had little impact on the total market research which was based on S&P 500 index, 12 US industries price indices and oil companies stock prices.

Sadorsky (2001) conducted research on Canadian companies by using stock market index, energy price, interest rates and exchange rates as a variable and found that oil companies' returns positively impacted by stock market index and oil price whereas the rise of interest rate and exchange rates had a negative impact. Hamilton (1983) applied Granger Causality test and studied the influence of oil price shocks on the US economy and concluded that oil prices Granger Cause changes in unemployment and GNP.

In summary, it can be stated that relationship between oil prices and the stock market, which have been tested in several developed countries. Whether these relationships exist in Indian and China is the focus of this paper. This study estimates the effect of oil prices on the stock market of India and China over 2005:7 – 2015:7 under VAR environment.

III. Data and Methodology

3.1 Data Description

This study examines the effect of crude oil prices on stock market indices. Data from June 2005 to July 2015 is taken for the current research work. Sensex was chosen as representative market index for India and for China Shanghai stock market index SSE composite index was taken. As the research is of secondary in nature the data for all the variables are taken from Investexcel.net.

3.2 Unit Root Test

For testing whether series is stationery or non-stationery, study used unit root test in the natural logarithms of selected variables. A test was conducted for null hypothesis of non-stationary variables versus the alternative hypothesis of non-stationary variables using the Augmented Dickey-Fuller (ADF) test. Researchers applied the Akaike Information Criteria (AIC) which suggests lag 2 for ADF test. The results of ADF test is shown in Table 1.

3.3 Granger Causality Test

This test was applied on data for determining whether one time series is useful in forecasting another time series. The result of Granger Causality test along with null hypothesis is shown in Table 4.

3.4 Variance Decomposition

In order to understand the short run and long run relationship between variables, variance decomposition analysis was used. The variance decomposition indicates the amount of information each variable contributes to the other variables in the autoregression. It determines how much of the forecast error

variance of each of the variables can be explained by exogenous shocks to the other variables. The results of variance decomposition are shown in Table 5 and 6.

3.5 Variables for the Study

a. BSE Sensex (Sensex)
b. Crude oil prices in India (Oilindia)
c. Shanghai Stock Exchange Composite Index (SSE)
d. Crude oil prices in China (Oilchina)

IV. Findings & Discussions

In order to check that time series are stationary or non-stationery ADF test is used. The results of Augmented Dickey-Fuller (ADF test) is shown in Table 1

H_0: Variables got unit root i.e. variables are non-stationery
H_1: Variables are stationery

Table 1: Augmented Dickey-Fuller Test

Variables	P- value	Reject/ Accept H_0	Decision
Sensex	0.000	Reject	Stationery
SSE Composite Index (SSE)	0.000	Reject	Stationery
Oil Price in China (Oilchina)	0.000	Reject	Stationery
Oil Price in India (Oilindia)	0.000	Reject	Stationery

It is found that all series are stationery as P-values are less than 5% and we reject null hypothesis. For estimating Vector Autoregression (VAR) model it is essential that all series need to be stationery. In order to find out significance of one variable to explain other variable VAR equation and coefficients are shown in Table 2.

Hypothesis 1
H_0: Oilindia (Lag 1 & Lag 2) is not significant to explain Sensex
H_1: Oilindia (Lag 1 and Lag 2) is significant to explain Sensex
Hypothesis 2
H_0: Sensex (Lag 1 & Lag 2) is not significant to explain Oilindia
H_1: Sensex (Lag 1 and Lag 2) is significant to explain Oilindia

SENSEX = C(1)*SENSEX(-1) + C(2)*SENSEX(-2) + C(3)*OILINDIA(-1) + C(4)*OILINDIA(-2) + C(5) Equation 1

OILINDIA = C(6)*SENSEX(-1) + C(7)*SENSEX(-2) + C(8)*OILINDIA(-1) + C(9)*OILINDIA(-2) + C(10) Equation 2

Table 2: VAR Coefficients and Probabilities (Sensex & Oil Prices in India)

	Prob.
C(1)	0.4385
C(2)	0.6151
C(3)	0.4450
C(4)	0.6447
C(5)	0.1362
C(6)	0.0029
C(7)	0.8365
C(8)	0.0011
C(9)	0.2412
C(10)	0.8308

In equation 1 coefficient associated with oilindia lag 1 and 2 is C (3) and C (4) for which probability values are 0.4450 & 0.6447 respectively. Both of these values are less than 0.05 hence null hypothesis is accepted, that is oil prices in India is not significant to explain Sensex.

In equation 2 coefficient associated with Sensex lag 1 and 2 is C (6) and C (7) for which probability values are 0.0029 and 0.8365 respectively. In case of Sensex lag 1 null hypotheses got rejected and for lag 2 null

hypothesis got accepted. Hence, at lag 1 Sensex is significant to explain oil prices in India whereas at lag 2 Sensex is not significant to explain oil prices in India

In order to do the same analysis from the context of Chinese economy VAR equation and coefficients are presented in Table 3:

Hypothesis 3

H_0: Oilchina (Lag 1 & Lag 2) is not significant to explain SSE

H_1: Oilchina (Lag 1 and Lag 2) is significant to explain SSE

Hypothesis 4

H_0: SSE (Lag 1 & Lag 2) is not significant to explain Oilchina

H_1: SSE (Lag 1 and Lag 2) is significant to explain Oilchina

SSE = C(1)*SSE(-1) + C(2)*SSE(-2) + C(3)*OILCHINA(-1) + C(4)*OILCHINA(-2) + C(5)

Equation 3

OILCHINA = C(6)*SSE(-1) + C(7)*SSE(-2) + C(8)*OILCHINA(-1) + C(9)*OILCHINA(-2) + C(10)

Equation 4

Table 3: VAR Coefficients and Probabilities (SSE & Oil Prices in China)

	Prob.
C(1)	0.3095
C(2)	0.0407
C(3)	0.3040
C(4)	0.0289
C(5)	0.3438
C(6)	0.5254
C(7)	0.0113
C(8)	0.0009
C(9)	0.2286
C(10)	0.6906

In equation 3 coefficient associated with oilchina lag 1 and 2 is C (3) and C (4) for which probability values are 0.3040 & 0.0289 respectively. So, oil prices in China at lag 1 are not significant to explain SSE whereas oil prices in China at lag 2 is significant to explain SSE.

In equation 4 coefficient associated with SSE lag 1 and 2 is C (6) and C (7) for which probability values are 0.5254 and 0.0113 respectively. In case of SSE lag 1 null hypothesis got accepted and for lag 2 null hypothesis got rejected. Hence, at lag 1 SSE is not significant to explain oil prices in China whereas at lag 2 SSE is significant to explain oil prices in China.

To find out causal relationship between variables Granger Causality test under VAR environment is conducted finding of which are as follows:

Table 4: Granger Causality Test

Null Hypothesis	**P- Value**	**Accept/ Reject H_0**
Oil Prices in India (Lag 1 & Lag 2) cannot cause Sensex	0.5452	Accept
Sensex (Lag 1 & Lag 2) cannot cause Oil Prices in India	0.0107	Reject
Oil Prices in China (Lag 1 & Lag 2) cannot cause SSE	0.0870	Accept
SSE (Lag 1 & Lag 2) cannot cause Oil Prices in China	0.0257	Reject

From above analysis it is clear that oil prices in both countries cannot influence market indices. Whereas, market indices can cause oil prices in both countries in short run.

Variance Decomposition analysis is conducted on the above series in order to find out any shock or impulse in short term and long term in one variable account for how much percentage variation in other variable. Table 5 shows forecast of 12 months ahead of Sensex and Oil prices in India (OILINDIA). For short run relationship we check probability value of 3rd month and for long term relationship we check 12th month value.

Table 5: Variance Decomposition of Sensex and Oil Prices in India

Variance Decomposition of SENSEX:			Variance Decomposition of OILINDIA:		
Period	SENSEX	OILINDIA	Period	SENSEX	OILINDIA
1	100.0000	0.000000	1	0.247478	99.75252
2	99.49378	0.506222	2	7.741411	92.25859
3	99.02844	0.971558	3	8.163783	91.83622
4	98.93961	1.060393	4	8.292361	91.70764
5	98.91295	1.087053	5	8.336537	91.66346
6	98.90414	1.095859	6	8.351424	91.64858
7	98.90133	1.098672	7	8.355918	91.64408
8	98.90045	1.099548	8	8.357327	91.64267
9	98.90018	1.099823	9	8.357772	91.64223
10	98.90009	1.099910	10	8.357912	91.64209
11	98.90006	1.099937	11	8.357956	91.64204
12	98.90005	1.099946	12	8.357969	91.64203

It is observed from the table of variance decomposition of Sensex in the short run i.e. in third month, impulse or innovation or shock to Sensex account for 99.03% fluctuation in Sensex (Own shock) whereas in the long run i.e. in 12th month it is 98.90%. In the same table in short run shock to oil prices in India can cause 0.97% fluctuation in Sensex, in long run shock to oil prices in India can cause 1.09% fluctuation in Sensex.
In table variance decomposition of Oil Prices in India (OILINDIA) in short run shock to Sensex account for 8.16% fluctuation in oil prices in India, whereas in the long run it increase vary marginally to 8.36%. So, in Indian context we found that shock in market index cause fluctuation in oil prices.
Finding of variance decomposition analysis in Chinese context is shown in table 6

Table 6: Variance Decomposition of SSE and Oil Prices in China

Variance Decomposition of SSE:			Variance Decomposition of OILCHINA:		
Period	SSE	OILCHINA	Period	SSE	OILCHINA
1	100.0000	0.000000	1	0.931313	99.06869
2	99.14300	0.857000	2	1.546993	98.45301
3	96.78192	3.218077	3	7.726517	92.27348
4	96.65415	3.345851	4	8.895314	91.10469
5	96.27490	3.725104	5	9.878718	90.12128
6	96.17417	3.825827	6	10.13877	89.86123
7	96.14565	3.854352	7	10.20138	89.79862
8	96.13689	3.863108	8	10.21235	89.78765
9	96.13652	3.863478	9	10.21181	89.78819
10	96.13660	3.863398	10	10.21152	89.78848
11	96.13657	3.863428	11	10.21191	89.78809
12	96.13649	3.863513	12	10.21231	89.78769

It is observed from the table of variance decomposition of SSE in the short run i.e. in third month, impulse or innovation or shock to SSE account for 96.78% fluctuation in SSE (Own shock) whereas in the long run i.e. in 12th month it is 96.13%. In the same table in short run shock to oil prices in China can cause 3.21% fluctuation in SSE, in long run shock to oil prices in China can cause 3.86% fluctuation in Sensex.

In table variance decomposition of Oil Prices in China (OILCHINA) in short run shock to SSE account for 7.73% fluctuation in oil prices in China, whereas in the long run it increase vary marginally to 10.21%. So, in Chinese context as well we found that shock in market index cause fluctuation in oil prices.

So, as per variance decomposition analysis in both the countries market indices impact oil prices but at a very marginal rate.

When market is in bullish nature demand for goods and services increases which leads to increase in Production, Transportation and shipping activities. Thereby demand for oil increases, which lead to increase in oil prices. When market is in bearish nature above parameters influence vice versa. The following table explains the relationship between of stock indices on oil prices

Stock Market	Economy	DD for Goods & Services	Prod.	Transport & Shipping	DD for Oil	Oil Prices
Bull	↑	↑	↑	↑	↑	↑
Bear	↓	↓	↓	↓	↓	↓

V. Conclusion

Stock market is often said to be the barometer of one's macro economy, which means that they have a close relationship. In this paper the relationship between stock market indices in emerging economies and crude oil is analysed. Over the period researchers examined, all the variables are I(1) and by analysing VAR, variance decomposition and granger causality test researchers found evidence for unidirectional causality from Sensex & SSE to crude oil price in both economies. In other words Sensex and SSE composite index contains some useful information for predicting crude oil prices (in the linear least square sense). Based on the analysis, it was found that market indices influence crude oil prices at a very lower degree. The paper concludes that bullish market influences demand for goods and services marginally, which leads to increase in Production, Transportation and shipping activities. Thereby demand for oil increases which lead to increase in oil prices. Bearish market influences nature of above parameters in opposite direction.

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