DYNAMIC CORRELATION BETWEEN OIL PRICES AND MACRO ECONOMIC CHANNELS: THE CASE OF US ECONOMY

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ABSTRACT

In the modern era the demand for crude oil is increasing due to technology enhancement which, in turn, exerts pressure on oil exploration throughout the world. The United States of America is the world's largest economy and the number one oil consumer in the world. It has a well-developed infrastructure and high productivity. World crude oil prices are fairly volatile due to various factors like inelasticity in supply, market condition political situations etc. The study is aimed at measuring the relationship between volatility in Crude Oil price and Stock Market, Gross Domestic Product and Inflation. It also studies the impact of Crude Oil price changes on Gross Domestic Product, US Stock Market and Inflation Rate. For this purpose the oil prices of a barrel from January 2013 to December 2015 were taken and statistical analysis was made. It is found that there exists a strong negative correlation between Gross Domestic Product (GDP) and crude oil price and the volatility of oil price has a negative impact on the GDP. There exists a positive relationship between inflation and crude oil price but the volatility of COP does not explain the volatility CPI. The correlation between S&P 500 index and crude oil price is negative and the volatility of oil price has a negative impact on the index.

KEYWORDS: Gross Domestic Product, Inflation, S&P500, Inelasticity, Consumer Price Index.

INTRODUCTION:

Crude oil and natural gas play a vital role in the international trade and commerce markets and among the various key commodities. In the modern era the demand for crude oil is increasing due to technology enhancement which, in turn, exerts pressure on oil exploration throughout the world. The United States of America is the world's largest economy and the top one oil consumer in the world which has a well-developed infrastructure and high productivity. Crude oil is an important natural resource for industrialized nations. The industrial output of US was $2.4 trillion in the year 2013.Its manufacturing output is greater than that of Germany, France and Brazil. The industries include steel, automobiles, construction machinery, Aerospace, Agricultural machinery, telecommunications, food processing and mining. Therefore with limited domestic crude resource it is impossible for the US economy to perform any industrial function. Crude oil is extensively used as raw material for processing major products. On the other hand world crude oil prices are fairly volatile due to various factors like

inelasticity in supply, market condition and political situations etc. This would cause potential shortage for fuel in coming years. If it continues, there will surely be a surge in the crude oil prices worldwide, which will, in turn, hike the prices of the other essential commodities including food. To overcome this problem, countries started exploring their own oil resources so that they can decrease the dependency on oil exporting countries to meet their needs.

In US, domestic oil production has been increasing continuously since 2008. But it is far less when compared to its domestic consumption. According to the EIA, 96% of transportation, 43% of industrial product, 21% of residential and commercial, and (only) 3% of electric power rely on oil.

On an average, to meet the daily needs, twenty million barrels are required, but the daily production of oil averages just six million barrels and for the deficit it has to import from OPEC nations. In the year 2013 US daily consumption was 18.96 Million barrels whereas in the year 2015. 19.40 Million barrels oil was consumed by them per day.2.321% consumption was increased in 2015 when compare to 2013.

ECONOMIC GROWTH AND OIL PRICE TREND:

In this study oil price from Ja nuary 2013 to December 2015 was taken and trend analysis was made. There is an increasing trend in GDP and oil price during the study period except in a few months. Real exports of goods and services increased to 2121.1 Billion dollars in the third quarter of 2015, compared with 2021.1 Billion dollars in the third quarter of 2013 which has 4.95% upward trend[1]. Real imports of goods and services increased to 2667.2 Billion dollars in the third quarter of 2015, compared with 2449.4 Billion dollars in the third quarter of 2013 which has 8.89% upward trend[2]. In the year 2013 the highest GDP registered was $17.01 trillion during the month of December. The lowest was $ 16.46 trillion during February. In the year 2013, there was an increase in GDP at $15.97 trillion in the month of November but there was a decline in GDP to $15.47 trillion in the month of February. As per the 2014 statistic there was an increase in GDP at $17.66 trillion during November, the lowest was $16.91 trillion in the month of January. The highest GDP in 2015 was $18.14 trillion in December and lowest was $17.52 trillion in February.[3]

In the study period, the highest oil price in 2013 was $107.65 during August and the month of May the highest decrease was $91.97 a barrel. The year 2014 began with an upward trend till June ended with a downward trend. The highest oil price was $105.37 per barrel in June. The lowest price at the end was $53.27 a barrel in December. There was a tremendous hike in the year 2015; the statistical data revealed that the highest price during the year was $60.3 per barrel. The lowest price at the end was $37.04 per barrel during the month of December.[4] Due to the upward trend in oil price, many energy companies began to extract oil to a larger extent. In the United States, companies began to use various techniques to extract oil from shale formation.

1.https://research.stlouisfed.org/fred2/series/EXPGSC1
2.https://research.stlouisfed.org/fred2/series/IMPGSC1
3.https://ycharts.com/indicators/us_monthly_gdp
4.http://in.investing.com/commodities/crude-oil-historical-data

LITERATURE REVIEW:

A large body of literature is an the impact of oil price changes on macroeconomic variables like employment, external debt, gross domestic product, consumer price index and stock market. However, the evidence is mixed.

Hawati Janor et.al(2013) have made a study in Oil Price Fluctuations and Firm Performance in an Emerging Market: Assessing Volatility and Asymmetric Effect. The result of the study reveals that in the existence of asymmetric effects on the impact of oil prices on stock returns has a greater impact on price declines.

A study made by **Michael Ratner(2014)** related to Oil price volatility and US macro economic activity proves that crude oil price has had a negative and significant effect on GDP over the period 1984-2004. An increase in the relative price of crude oil tends to have a negative effect on output and employment. The increase in oil price tends to increase inflation. The sharp oil price changes- either increases or decreases-may reduce the aggregate output tentatively.

"Macroeconomic Impacts of Oil Price Volatility: Mitigation and Resilience" by **Zoheir Ebrahim et.al(2014),** indicates the link between OPV and economic activity. OPV negatively affects economic output in the short to medium term. The study reveals that industrial production is found to decline subsequently it responses to the downward trend in an aggregate demand than to production cost uncertainty.

Geroge Filis et,al(2011) have done executed their research on the Dynamic correlation between stock market and oil prices: The case of oil importing and exporting countries. The contemporaneous correlation results show that the correlation increases positively in respond to important aggregate demand-side oil price shocks, which are caused due to global business cycle fluctuations.

Another study by **M.Anandan et.al(2013)** "Crude oil price behavior and its impact on macro-economic variables in India: A case of Inflation shows that for the oil importing countries, oil price increase and economic growth are negatively correlated as far as exporting countries are concerned ,it is positively correlated. As oil prices move up and down, inflation follows in the same direction.

Abdullah et.al(2012) found that there is a theoretical relationship between selected macro economic variables and Crude oil.

The research result of **Muhammed Akram(2011)** reveals that oil price increase doesn't granger cause the economic growth whereas decrease causes it.

K Roach et.al(2008) research result reveals that Asymmetric co-integration found between oil prices and GDP in the US and European Countries. There exists a strong causality running from oil to stock prices.

Muritala Taiwo et.al (2012) found that Crude oil prices have significant influence on the growth of the Nigeria economy.

Kapil Jain(2013) made a study " Oil price volatility and its impact on the selected economic indicators in India". As per the study concept, slight fluctuation in crude oil price can have both direct and indirect influence on the economy of the countries. The study was aimed to measure the relationship between crude oil price and selected macro economic variables i.e. inflation and stock market (NSE). The study found that there is significant positive relationship between crude oil price and inflation India on the other hand stock market of India also affected by the changes in crude oil price.

The impact of oil price fluctuations on macro-economic variables of Demanding and Supplying countries by **Zeinab Kazemi(2013)** indicated that in the groups of oil importing countries, the effects of negative shock has been more significant on the GDP and inflation. In increase in oil price has two negative impacts. For exporting countries , the fluctuations in oil price, whether in form of decrease or increase, improve the growth rate of prices.

The study by **Ruhul Salim et.al** empirically investigates the impact of crude oil price volatility on six major emerging economies of Asia, namely China, India, Indonesia, Malaysia, Philippines and

Thailand. For India and Indonesia, volatility impacts both GDP growth and inflation whilst Thailand and Malaysia oil price fluctuations impact output. As for as Philippines concerns, volatility of oil price impacts inflation. For China, oil price volatility impacts output growth in the short run.

According to **Mahmud Suleiman (2013)** research, oil prices have a strong influence on economic output of net oil exporting countries with little influence on the economic output of net oil importing countries. Oil as a resource cannot be attributed to the poor economic performance of most oil rich nations. It has an adverse effect on long-term economic performance.

Oil price shocks and Nigerian economic growth by **Alley Ibrahim (2014),** found that the significant positive effect of oil price on economic growth confirms that conventional wisdom that oil price increase is beneficial to oil exporting nation like, Nigeria. Shocks however create uncertainty and undermine effective fiscal management of crude oil revenue; hence the negative effect of oil price shocks.

As per the report on analysis of the impact of high oil prices on the Global Economy of **International Energy Agency (2004),** reveals that the results of the sustained higher price simulation for both OECD and non-OECD countries produce that, the net effect on the global economy would be adverse and cause substantial damage to the output of oil importing countries.

Jung Wook Park et.al (2007) found that oil price shocks have a statistically significant impact on real stock returns of US and 13 European countries. For many European countries but not for the US, increased volatility of oil prices significantly depressed real stock returns. The study reveals that for the U.S., there is no evidence of asymmetric effects on real stock returns of positive and negative oil price shocks for any of the European countries.

OBJECTIVES:

The study is aimed at

- measuring the relationship between Crude Oil price and US Stock Market, Gross Domestic Product and Inflation.

-analyzing the impact of Crude Oil price changes on Gross Domestic Product, US Stock Market and Inflation Rate.

RESEARCH HYPOTHESIS

a. Null hypothesis:

H0= There is no significant relationship between Crude oil Price and Gross Domestic Product.

Alternative Hypothesis:

Ha= There is a significant relationship between Crude oil Price and Gross Domestic Product.

b. Null hypothesis:

H0= There is no significant relationship between Crude oil Price and Indian Stock market

Alternative Hypothesis:

Ha= There is a significant relationship between Crude oil Price and Indian Stock market.

c. Null hypothesis:

H0= There is no significant relationship between Crude oil Price and Inflation.

Alternative Hypothesis:

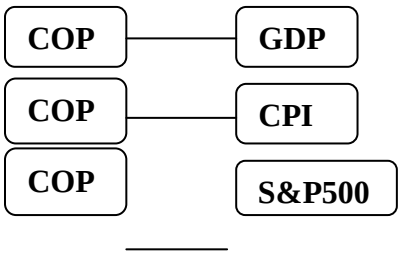
Ha= There is a significant relationship between Crude oil Price and Inflation.

METHODOLOGY

Data Collection:

The primary purpose of this paper is to empirically analyze the impact of crude oil price on US GDP, stock market and Inflation. The study period covers January 2013 to December 2015. The secondary data were used for the empirical analyses which were derived from US Energy Information Administration. To examine the impact of oil price volatility on GDP, S&P 500 and Inflation individually, theoretical models have been framed.

Theoretical Framework:



GDP = α + COPβ + μ ----------(1)
CPI = α + COPβ + μ ----------(2)
S&P500 = α + COPβ + μ ----------(3)

EMPIRICAL RESULTS:

Impact of oil price volatility on GDP:

The impact of oil price on GDP is measured with the help of simple regression analysis. The fixed regression model is as follows,

Y= a+bx+μ

Y= Gross domestic product a= intercept b= regression coefficient
x= crude oil price μ= error term

As per Table 1, there exists a strong negative correlation between gross domestic product and crude oil price, which means that crude oil price and gross domestic product move in the opposite direction to the extent of 81.9%. The correlation between the variables is statistically significant since its p value is less than 0.05(0.000).66.1% of the variation in GDP can be explained by volatility of crude oil price. In order to ascertain the extent of the impact of oil price on GDP, the following null hypothesis was framed "There is no significant relationship between crude oil price and GDP". To test the above hypothesis regression analysis was used.

The test statistics is 69.227 which are much larger than the critical value (16.000). The slope coefficient of the input (oil price) in the regression analysis has negative impact on GDP. Every 1% change in crude oil price makes 0.019 % changes in the GDP of US economy negatively. p value for the F stat is 0.000. Hence the null hypothesis is rejected. It can be concluded that volatility of oil price has a negative impact on the Gross Domestic Product.

The regression equation is as follows:

GDP=18.803-.019COP+μ

Impact of oil price volatility on CPI:

The impact of oil price on CPI is measured with the help of simple regression analysis. The fixed regression model is as follows,

Y= a+bx+μ

Y= Consumer Price Index a= intercept b= regression coefficient
x= crude oil price μ= error term

Table 2 shows that R^2 value is less than 50% therefore the volatility of Crude oil price in US does not explain changes of CPI.

Impact of oil price volatility on S&P500:

The impact of oil price on S&P500 is measured with the help of simple regression analysis. The fixed regression model is as follows,

Y= a+bx+μ

Y= S&P Index a= intercept b= regression coefficient
x= crude oil price μ= error term

Table 3 shows that there exists a negative correlation between S&P 500 index and crude oil price, which mean that crude oil price and S&P 500 index move in opposite directions to the extent of 72.3%. The correlation between the variables is statistically significant since its p value is less than 0.05(0.000). 52.2% of the variation in S&P 500 can be explained by volatility of crude oil price. In order to ascertain the extent of the impact of oil price on stock indices, the following null hypothesis was framed: "There is no significant relationship between crude oil price and S&P 500". To test this hypothesis, regression analysis was used.

The test statistics is 37.131 which are higher than the critical value (16.000). The slope coefficient of the input (oil price) in the regression analysis has a negative impact on Index value. Every 1% change in crude oil price makes 5.801% in the changes of S&P Index of US, negatively. p value for the F stat is 0.000. Hence the null hypothesis is rejected. It can be concluded that the volatility of oil price has a negative impact on the S&P 500.

The regression equation is as follows:

S&P 500=2564.936-0.002 COP+μ

RESULTS AND DISCUSSIONS:

According to the study results, there exists a strong negative correlation between Gross Domestic Product (GDP) and crude oil price and hence the volatility of oil price has a negative impact on the GDP. Similarly a negative correlation exists between S&P 500 index and crude oil price and hence the volatility of oil price has a negative impact on the index. There is meager relationship between Inflation and crude oil price but contrary to the above an independent variable does not explain the change in dependent variable. The present study result was supported by the previous research which reveals that the effect of oil price volatility strongly influence the level of inflation and the level of unemployment. The oil price fluctuation increases unemployment and inflation and decreases economic growth. The result of another study also support the present analysis, the findings of which demonstrate that oil price shocks, especially negative shocks, strengthen the volatility of stock indices. The study reveals that in the existence of asymmetric effects on the impact of oil prices on stock returns has a greater impact on price declines. . OPV negatively affects economic output in the short to medium term. The results of the previous study also reveal that industrial production is found to decline subsequently it responses to the downward trend in an aggregate demand than to production cost uncertainty. The contemporaneous correlation results show that the correlation increases positively in respond to important aggregate demand-side oil price shocks, which are caused due to global business cycle fluctuations. For the oil importing countries, oil price increase and economic growth are negatively correlated as far as exporting countries are concerned, it is positively correlated. As oil prices move up and down, inflation follows in the same direction. A theoretical relationship exists between selected macro economic variables and Crude oil. Oil price increase doesn't granger cause the economic growth whereas decrease causes it. Asymmetric co-integration found between oil prices and GDP in the US and European Countries. There exists a strong causality running from oil to stock prices. The rising oil prices tend to have a greater impact on economic growth of a nation.

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Table - 1

Variable	Un-standardised co-eff beta	t value	p value	F stat	r	R^2
Oil price	-0.019	-8.320	0.00	69.227	-0.819	0.661

Table-2

Variable	Un-standardised co-eff beta	t value	p value	F stat	r	R^2
Oil price	-0.041	-2.715	0.010	7.370	-0.422	0.178

Table-3

Variable	Un-standardised co-eff beta	t value	p value	F stat	r	R^2
Oil price	-5.801	-6.094	0.00	37.131	-0.723	0.522