An Investigation of Cause and Effect Relationship between Crude Oil Prices and Inflation

Ekta
SRF, Institute of Management Studies and Research (IMSAR), Maharshi Dayanand University, Rohtak[1]

Dr. Rajkumar
Professor, Institute of Management Studies and Research (IMSAR), Maharshi Dayanand University, Rohtak[2]

Chetna Verma
Research Scholar, Institute of Management Studies and Research (IMSAR), Maharshi Dayanand University, Rohtak

Abstract

According to conventional wisdom, there can't be a significant rise in inflation without a corresponding and preceding jump in energy prices. The prices of crude oil and inflation are often seen as being connected in a cause and effect relationship. If price of crude oil goes up or down, inflation moves in the same direction. The reason of this relation is that crude oil is a major input in the economy and used in essential activities such as fueling transportation and heating homes. If input costs increase, cost of end products also increase which raises prices and thus inflation. This paper also examines cause and effect relationship between crude oil prices and Inflation in the context of India for a time period from January 2004 to December 2012. Monthly data is taken on crude oil prices and inflation (Consumer Price Index). This time series data is analyzed by using unit root test and Granger causality test. Unit root test is employed to test the stationarity of data. Granger causality within the error correction framework is used to investigate the direction of causality between crude oil price and inflation. Evidence from the causality test indicates unidirectional causality running from crude oil price to Consumer Price Index.

Keywords: Inflation, Consumer Price Index, Granger Causality

Introduction

With economy developing rapidly throughout the world, it has become a great challenge for the policy makers to cope up with the ever fluctuating oil prices. Oil price shocks impact economic activities such as inflation rate, growth, trade balance and others. It is commonly accepted that increase in oil price lead to slow economic growth. Figure No.1 shows oil prices from January 2012 to September 2013.

Fluctuations in Oil prices from May 2013 to September 2013 were much higher than fluctuations from January 2012 to May 2013. Higher oil prices impact the world economy through many ways. Due to the increment in oil prices, income is shifted from oil consumers to oil producers or from oil importer countries to oil exporting countries. This income redistribution forced economies in the world to observe inflation. Increased oil prices also increase production cost as a consequence of high energy input prices. High oil prices has also influence on demand of many products. Consumers normally postpone purchasing durables such as automobiles when oil prices go up. Due to this demand side effect inventories for sales are accumulated, which forces industry to produce less. High oil prices leads to decline in foreign exchange reserves of oil importing countries. Foreign exchange become scarce in supply so its value would increase while on the other hand local currency depreciates that further increase the import bills. This impact deteriorates the position of trade balance of the oil importing country. This entire not only increase the private expenditures but also public expenditure, which increases the inflation (rapidly rising prices of goods and services) that pushed the country in the poverty trap.

Figure No. 1

Source: Economic times

Table No. 1: Producers of Crude Oil in 2012

Producers	Mt	% of World Total
Saudi Arabia	544	13.1
Russian Federation	520	12.6
United states	387	9.3
People's Rep. of China	206	5.0

Islamic Rep. of Iran	186	4.5
Canada	182	4.4
United Arab Emirates	163	3.9
Venezuela	162	3.9
Kuwait	152	3.7
Iraq	148	3.6
Rest of the World	1492	36.0
World	4142	100.0

Source: Key world Energy Statics 2013 (International Energy Agency)

Table No. 2: Exporters & Importers of Crude Oil in 2011

Net Exporters	Mt	Net Importers	Mt
Saudi Arabia	353	United States	500
Russian Federation	247	People's Rep. of China	251
Islamic Rep. of Iran	122	Japan	177
Nigeria	121	India	172
United Arab Emirates	114	Korea	125
Iraq	108	Germany	90
Venezuela	93	Italy	77
Kuwait	89	France	64
Canada	82	Singapore	58
Angola	79	Netherlands	57
Others	574	Others	508
Total	1982	Total	2079

Source: Key world Energy Statics 2013 (International Energy Agency)

Table No.1 shows the main producers of Crude oil in world. Only 10 countries in world produce 64% of total crude oil production in world. Saudi Arabia and Russian Federation, both produce more than 10% of total crude oil production in world. Other 8 countries production lies in the range of 3% to 10%. Table No. 2 depicts that Saudi Arabia is the top most exporter of crude oil in the world. Out of total exports of crude oil i.e. 1982 metric tons, 1408 metric tons is exported by Saudi Arabia, Russian

Federation, United states, Islamic Rep. of Iran, Nigeria, United Arab Emirates, Iraq, Venezuela, Kuwait, Canada and Angola. United States is the top most importer of crude oil followed by People's Rep. of China and Japan. India comes at fourth place in oil importing countries list. From these figures, it is evident that change in oil prices has crucial impact on Indian economy. So this paper examines the empirical relationship between changes in crude oil price and inflation. The remaining paper is organized as follows. The next section provides a brief review of the related literature. Section 3 documents the sources of data and methodologies that we have employed. Section 4 discusses and evaluates the empirical results. The last section offers the conclusion.

Literature Review

A lot of empirical research has confirmed that increase in oil price have strong and negative impact on the economy. Most of these researches have checked the impact of oil price shocks on the real output; only a few emphasize the effect on inflation like Cunado and Perezde (2003), Michael and David (2004), Cunado and Gracia (2005), Olomola and Akintoye (2006) and Chou and Tseng (2011) etc. Mostly all of these studies are done in developed countries. Firstly relationship between oil prices and inflation was evident in the 1970s, when the cost of oil rose from a nominal price of $3 (before the 1973 oil crisis) to $40 (during the 1979 oil crisis) and consumer price index (CPI), a key measure of inflation, also becomes more than double i.e. from 41.10 (in 1972) to 86.30 (in 1980). However, this relationship between oil and inflation started to deteriorate after the 1980s. In 2003 Cunado and Perezde studied the effect of oil prices on inflation and industrial production for several European countries from 1960 to1999. The research results show that there is asymmetric effect of oil price on production growth rate and significant impact on inflation. Moreover, there are significant differences among the countries response to oil shocks. In 2004, McKillop in his paper suggested that higher oil prices reduce economic growth, generate stock exchange panics and produce inflation, which eventually lead to monetary and fiscal instability. Michael and David (2004) also found modest impact of oil price fluctuations on the inflation in United States, Japan, United Kingdom, Germany and France by using augmented Phillips curve framework. Result shows that 10 percentage rise in oil prices lead to about 0.1 to 0.8 % direct inflationary increases in the U.S.A. The European inflation usually considered highly responsive to oil prices than U.S. inflation throughout Europe is not likely to demonstrate major variation in sensitivity as compared to United States of America and it is less in some countries of the continent. In 2005, Cunado and Gracia studied the relationship between macro-economic indicators (economic growth rates and

inflation) and oil prices for six Asian countries from 1975 to 2002. In long run oil prices and economic activities does not have any co-integrating relationship between them. But in the short run, oil price fluctuations Granger cause the economic expansion in all studied countries. They also found proof of asymmetric relationship in oil price shocks and inflation for Thailand, Japan, Malaysia, and South Korea. Olomola and Akintoye (2006) study shows change in oil prices have not any impact on inflation and growth in Nigeria. However, Shocks in crude oil prices have significantly effect on real exchange rates in Nigeria. In 2008, Kilian again examines the different causes of the oil price shocks and estimated that they cause a sharp drop in U.S. real gross domestic product (GDP) growth after five quarters rather than an immediate and sustained reduction in economic growth and a spike in consumer price index (CPI) inflation after three to four quarters. Kiptui (2009) using conventional Phillips curve estimate the impact of oil price, exchange rate on inflation in Kenya. The result showed that oil price fluctuations, exchange rate and aggregate demand had significant impact on inflation. The measure of oil price pass-through is 0.10 in the long-run and 0.05 in the short-run to inflation, much lower comparing to exchange rate pass-through which is 0.64 in the long-run and 0.32 in the short-run. It means that 10% rise in prices of oil leads to 1% increase in inflation in the long-term and 0.5% in the short-term. Therefore Oil price pass-through is incomplete and low in both cases. Chou and Tseng (2011) studies the short-run and long-run pass through impact of crude oil price on Taiwan's inflation from 1982 to 2010, using the CPI index, core index, and different necessary sub-indices for estimation. The findings expressed that there is a significant long run pass through impact of crude oil prices on Taiwan's inflation, although the short run pass through impact is not significant.

Methodology and Data Description

Main objective of this paper is to examine the cause and effect Relationship between crude oil price and inflation. There are two measures of inflation: Wholesale Price Index, Consumer price index. Consumer price index is a more advanced instrument for the measurement of inflation. Consumer Price Index is calculated on a monthly basis while the Wholesale Price Index is calculated on a weekly basis. In this paper, we use Consumer price index (CPI) for inflation. Monthly data on crude oil and CPI has been taken from January 2004 to December 2012. Crude oil price and Consumer price index data has been taken from websites mcxindia.com and inflation.com respectively. Time series data has been analyzed by using Unit Root, Granger Causality Test.

Empirical Results

For checking the cause and effect relationship between crude oil prices and inflation, granger causality test is employed. There is condition in the granger causality test that data must be stationary on which this test is employed. Stationarity of data is checked by using Augmented Dickey Fuller Unit Root test. Prior to checking stationarity of data, it is necessary that we must aware about the nature of data by using descriptive statistics.

Table No.3: Descriptive Statistics

Descriptive Statistics	Consumer Price Index	Crude Oil Price
Mean	210.6152	66.62125
Median	212.5670	66.10500
Maximum	231.4070	126.3300
Minimum	185.2000	30.87000
Standard Deviation	12.95083	21.56199
Skewness	-0.231605	.0414725
Kurtosis	1.975801	2.789632
Jarque Bera	5.685962	3.295084
Probability	0.058252	0.192523

Table No.3 shows the descriptive statistics of Crude oil prices and Consumer price index. Mean value of Consumer Price Index is 210.6152 and Crude Oil Price is US$ 66.62125/BBL. Standard deviation of Crude oil prices is 12.95083 and of Crude Oil Price is 21.56199. It means crude oil prices are more volatile in comparison to consumer price index (inflation). Skewness measure of Crude Oil Price is -0.231605 and of consumer price index is .0414725. Kurtosis measure of Crude Oil Price and consumer price index are 1.975801 and 2.789632 respectively. Both of variable skewness and kurtosis measure are significantly different from 0 and 3. Jarque Bera test statistics did not reject the null hypothesis of normality in both the cases. As probability value is 0.058252 in case of crude oil price and 0.192523 in case of consumer price index, which is more than 5%.

Table No. 5: Result of Unit Root Test

Variable name	Augmented Dickey Fuller Unit Root Test At Level (Probability Value)	Augmented Dickey Fuller Unit Root Test At First Difference(Probability Value)
Crude Oil Prices	.0630	.0000
Consumer Price Index	.6948	.0000

Table No.5 shows the result of Augmented Dickey Fuller Unit Root Test. Results indicate that probability value of crude oil prices at level is .0630 which is more than 5% so the null hypothesis can't rejected which assumes that Crude oil price series has a unit root or this series is not stationary at level. Consumer Price Index probability value at level is also more than 5% i.e. .6948, thus null hypothesis can't be rejected. Both Crude Oil Prices and Consumer Price Index are non stationary at level. Therefore we move to the first difference. At first difference, both Crude Oil Prices and Consumer Price Index series probability value is 0, which is less than 5%. Therefore null hypothesis of unit root is rejected. Both crude oil Prices and Consumer Price Index series become stationary at first difference. After it Crude Oil Prices and Consumer Price Index series are converted into first difference series and then granger causality test is employed on these new series. The results of granger causality test are given in Table no. 6.

Table No. 6: Result of Granger Causality Test

Null Hypothesis	Observations	F-Statistics	Probability Value
Consumer Price Index does not granger cause Crude Oil Prices	106	1.47390	0.2339
Crude Oil Prices does not granger cause Consumer Price Index		7.07365	0.0013

Table No. 6 discloses that the null hypothesis that Consumer Price Index does not granger cause Crude Oil Prices can't be rejected as their probability value (0.2339) is more than 5% but the null hypothesis that Crude Oil Prices does not granger cause Consumer Price Index is rejected at 1% level of significance because its probability value is 0.0013 which is less than 1%. So uni directional causality is

found between Crude Oil Prices and Consumer Price Index. Consumer Price Index (inflation) has not any impact on Crude Oil Prices. But Crude Oil Prices significantly affected the Consumer Price Index.

Conclusion

Inflation is a persistent increase in the general price level of goods and services in an economy over a period of time. When the general price level rises, each unit of currency buys fewer goods and services. Consequently, inflation reflects a reduction in the purchasing power per unit of money – a loss of real value in the medium of exchange and unit of account within the economy. Indian central Bank RBI (Reserve Bank of India) has been fighting against inflation for a long time. Higher interest rate is an important tool, to which RBI used to control inflation. But inflation cannot be controlled by only monetary policy measures. Government should consider other issues also such as supply side constraints; fiscal policy measures, increased value of imports and global economic environment are not conducive for it. In this paper, we have explored the relationship between crude oil price and consumer price index (Inflation) as India is a major importer of crude oil and 75% of the nation's demand of crude oil is met from imports. Unit root test and granger causality test are used for analysis of 9 years monthly data on crude oil prices and consumer price index collected from websites publically available. The traditional unit root tests determine that both variables are found to be stationary at first difference. Granger causality tests indicate that it is the crude oil price that Granger causes inflation. The policy implication of this paper is that government should consider oil price shocks in formulating the inflation conquering policies.

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