

Review Paper

Impact of Crude Oil Price Fluctuation on Inflation in India

Hera Asif Khan, Amina Irshad, Saleemur Rahman

M.A., Dept. of Economics, Aligarh Muslim University, Aligarh, Uttar Pradesh, India

Hera Asif Khan, herasif05@gmail.com.

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Crude oil has many important roles to play in the Indian Economy. Its requirement is increasing rapidly in India because it is not only used for fuel but also for making plastics, fiber clothes, medicines etc. India is the third-largest country of Crude oil imports. Whenever the import of crude oil gets disturbed because of oil price fluctuation it harms the balance of payment. So, the main aim of this paper is to show the impact of crude oil price fluctuation on inflation. Whenever the price of crude oil fluctuates it has many indirect effects on Indian Economy but its direct effect is on inflation which plays an important role in economic development. This study has been conducted using time series data from 1995 to 2018. The analysis shows that there is a positive relationship between crude oil price fluctuation and inflation for which I have used the ARDL model.

Keywords: Crude Oil, ARDL Model

INTRODUCTION

With rapid economic growth, energy demand in India has been rising rapidly, and India is now the fourth largest consumer of crude oil in the world. Unfortunately, India has to import most of its oil requirement which leads to severe pressure on the economy when the oil prices rise. Thus, estimations of crude oil demand and projections for the future should be useful to policymakers in making appropriate supply arrangements for the future. The oil and gas industry in India dates back to 1889 when the first oil deposits in the country were discovered near the town of Digboi in the state of Assam. India imports 82% of its oil needs and aims to bring that down to 67% by 2022 by replacing it with local exploration, renewable energy and indigenous ethanol fuel. India was the third top net crude oil importer in 2018. The import bill is estimated to grow by 27% from \$88 billion in 2017-18 to touch \$112 billion in 2018-19, says the Petroleum Planning and Analysis Cell (PPAC). It's no wonder that for the past five years the government has been working out various strategies to boost domestic production of oil and gas. India produced 35.68 MTs of crude petroleum in 2017-18. India accounted for 0.92% of world oil production in 2016-18. India has deployed 159 rigs and drilled 545 production wells during 2017-18 which stands globally fifth but the oil and gas production is not commensurate with the wells drilled. Inflation plays an important role in economic development. There is an interdependence between inflation and GDP. If GDP does not grow fast, monetary authority increases the money supply and reduces the interest rate. If interest rate declines, investment increases which improve GDP. But with this inflation also increases. Higher GDP shows the performance and prosperity of the country.

But on the other hand, a rise in inflation affects social welfare adversely. It affects social welfare in such a way that when inflation increases, it leads to an increase in inequality in the economy which is considered to be a bad sign for the economy. Inflation is very much linked with crude oil price fluctuation and exchange rate depreciation. Increase in oil price leads to slow economic growth which, in turn, leads to increase in inflation and vice versa.

This study has also been reviewed by many other researchers. Hamilton (1983) did his empirical research on US economy and later on in 2000 Hamilton restarted his research on impacts of Oil Prices on US Economy. Kaushik Bhattacharya also analyzed the impact of Oil Prices on Inflation in US Economy.

1.1 Crude oil in India

Crude oil is one the most important commodity which is used as a raw material in almost every product. Therefore, it is a very important form of energy. It plays a significant role in economic development. India's import of crude oil has reached around 100 million tons. As India is among the largest importers of crude oil, its prices affect India a lot. A rise in oil prices increases the cost of its imports. Similarly, a fall in oil prices helps to narrow India's current account deficit. During the last few decades, world economies have faced several big oil shocks. The first oil shock took place in 1973 when OPEC countries reduced oil export due to Arab Israel war. This resulted in an increase in oil price from \$4.15 in 1973 to \$9.07 in 1974. The second oil shock took place in 1979 when Iran faced severe political instability. As a consequence of this, oil production in Iran reduced in a very large amount. As a result, oil price increased \$12.46 per barrel in 1978 to \$35.24/barrel in 1981. From 2000 to 2008 oil price has made a new record which affected the economy of the entire

world severely in 2007-08, the oil price has reached to its highest peak to \$145 per barrel. But in the second quarter of 2014-15, oil price came down to \$44 per barrel. It was the lowest one in 10 years. These oil price shocks have adversely affected economic growth, foreign trade, Balance of Payment, inflation and other economic variables of almost all the economies.

1.2 RELATION BETWEEN CRUDE OIL AND INFLATION

Inflation may be affected by the crude oil price fluctuation in both ways direct or indirect. Since crude oil is used in the production of a number of goods as an input. So, when its price increases, the price of the product also increases. Because the law says that the price of the output increases when its factor price goes up and when factor price increases, cost of production increases. When cost of production increases, price of output increases. Thus, in this way inflation arises in the economy. By the oil prices and inflation have a cause-and-effect relationship because as price moves up inflation also rises and if prices fall inflation also falls. Therefore, inflation goes in the same direction As, India is the 2nd largest populated country in the world, its demand for crude oil is much higher which, in turn, leads to increase inflation. And on the other hand, because of increase in crude oil price and deficit in its Balance of Payment, Rupee is being depreciated from time to time. As a result of depreciation, exports have become cheaper which led to raising inflation.

1.3 INDIA'S CRUDE OIL IMPORT FROM DIFFERENT COUNTRIES

Since India is one of the largest populated countries in the world, demand for crude oil is much higher. After China and the USA, India is the 3rd largest importer of crude oil. 80% of energy is imported by India from other countries. While 20% is produced by the country itself. In 2016, import of crude oil by India amounted to 60869 million dollars. While country's domestic production of energy was 37.788 million metric tons in 2013-14 which was 37.862 million metric tons in 2012-13. So, there was a marginal decrease of 0.20%. Therefore, to maintain balance in consumption and production, India had to import 190.5 million tons of crude oil and had to export domestic crude oil of less than 0.5%.

Table.1 Shows countries from where India imports crude oil in the largest amount Saudi Arabia has been on the top for 15 years followed by Iran, Iraq, and Nigeria.

Saudi Arabia	19.9%
Iraq	16.2%
Iran	11%
Nigeria	10.9%
United Arab Emirates	9.3%
Venezuela	8.3%
Kuwait	4.5%
Qatar	2.8%
Malaysia	2.8%
Angola	2.6%
Mexico	2.4%

2. LITERATURE REVIEW

1. **Hamilton (1983)**: He investigated the impact on the US economy. His evidence suggests that crude oil prices have a strong relationship with the US business cycle and tends to highlight cost-push inflationary effects.

2. **B.C. Ummat**: he analyses the problem of inflation and factors responsible for this around 1991-92. According to him, inflation is affected by the money supply, gulf crisis due to which price of petroleum products increased, devaluation of rupee due to which import costs increased, significant increases affected price of fertilizers, coal, food grains, supplied through PDS stepping up of power rates and tariff increases in telephone and other service sectors.

2. **Later Hamilton (2000)**: He reported clear evidence of non-linearity-oil price increases is much more important than oil price decreases. An alternative interpretation was proposed based on the estimation of a linear functional form using exogenous disruptions in petroleum supplies as an instrument. His study shows that oil shocks play a crucial role in determining macroeconomic behavior because they disrupt spending by consumers and firms.

3. **Kaushik Bhattacharya (2005)**: He analyzed the impact of increase in oil price on inflation. They studied the mechanism of increase in the prices of petroleum products on the prices of other commodities and the output in India. In February 1999, from an all-time low of 11 U.S Dollars per barrel, it increased to a peak of 35 dollars in the first week of September 2000. Due to this, all oil-importing countries faced the threat of oil shock; India, being a major oil importer, was particularly affected. Historically, there have been four oil

shocks in the past thirty years. In spite of this, low inflationary pressure has been assisting the developed countries in mitigating the risk associated with oil shocks. Contrary to this, developing countries are affected more because of the absence of advanced technology to conserve oil. Literature reveals that most researchers agree with the fact that inflation has a recessionary effect on oil prices.

4. **RBI Report (2005)**: It says for every unit of Dollar increases in crude oil price; wholesale price (WPI) inflation rises by 30 basis points. The impact of increase in oil price of inflation. They studied the mechanism of increase in the prices of petroleum products on the prices of other commodities and the output in India. In February 1999, from an all-time low of 11 US\$ per Barrel. The price increased to a peak of \$35per barrel in the first week of September 2000. Due to this all importing countries faced the threat of oil shock. India, being a major oil importer was directly affected by the price rise. According to Bruno (1982), oil price shocks lead to increases in wages and prices and decrease in real output.

5. **Khoedir (2012)**: According to him both exchange rate depreciation and inflation are interdependent. If exchange rate is depreciated, inflation increases. This, in turn, causes exchange rate depreciation. He has conducted the study of relationship between exchange rate and inflation in Egypt using data from 1990 to 2008.

6. **Lamazoshvili (2014)**: The effects of oil price shocks can be viewed from three factors, i.e., the source of shocks, the transmission mechanism of oil shocks and the structure of energy flows. Some studies distinguish the effect of oil shocks between oil supply and oil demand shocks.

7. **Kilian (2014)**: He provided a broad discussion on the need to understand the

origins of the sources of oil shock. The effects of oil price can transmit into various channels. One of the channels is inflationary or supply channel. Higher oil price creates inflationary pressures and leads to higher price of final goods. Higher oil price can also transmit through cost channel in which higher oil price induces higher cost of production and this leads to time-varying mark-ups and variable capital utilization and also reallocation effects. The structures of energy flows which vary over time and across countries can be another factor to be concerned with in analyzing the impact of oil shocks on the macro economy.

OBJECTIVES OF THE STUDY

- 1) to explore the impact of crude oil prices on the Indian Economy
- 2) to find out the linkage between inflation and crude oil prices
- 3) To find out if crude oil has an impact on GDP

3. RESEARCH METHODOLOGY

This study shows that fluctuation in oil prices causes a change in inflation in India. And the relationship between crude oil prices and inflation is proportional. The methodology of this study is based on quantitative and analytical research in which the data is time-series in nature. Data is collected from the year 1995 to 2018 which is purely from secondary sources. The whole data is converted in log form for the purpose of analysis and relationship is shown through ARDL Model through e-views.

SOURCES

Study is mainly based on secondary data which are collected from different sources such as the RBI Bulletin, A handbook of Statistics on Indian Economy and Index Mundi.

Statement of Hypothesis:

Null Hypothesis (H0): there is no impact of crude oil price fluctuation on inflation in India

Alternative Hypothesis (H1): there is impact of crude oil price fluctuation on inflation and in India.

TOOLS AND TECHNIQUES

Various tools and techniques have been used to analyze the study as per requirement, which includes:

UNIT ROOT TEST

Data may be both, stationary and non-stationary. If the basic properties of a series, for example, its mean and its variance do not change over time, that is to be known as stationary data. On the other hand, if shape of distribution is changed with the change of time, that would be non-stationary data. The major consequence of non-stationary data is that it creates spurious regression which inflates R² and t-scores that leads to incorrect specification of model.

Autoregressive equation

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

Where V_t is classical error term

If $\alpha < 1$, the series will be stationary. Because the expected value of Y_t will eventually approach 0 as the sample size gets bigger and bigger. (expected value of

$V_t = 0$). If $\rho > 1$, then the expected value of Y_t will continuously increase making series non-stationary. This non-stationary is due to a trend. If $\rho = 1$, the expected value of Y_t does not converge on any value, meaning it is non-stationary.

This circumstance where $\rho = 1$, is called a unit root. A unit root test includes different tests to check stationarity in a series. But we have to discuss only ADF test.

ADF Test

Augmented Dickey-Fuller Test is one of the unit root tests that were developed by Dicky and Fuller. This test is conducted by augmenting three equations by adding lagged values of dependent variable.

ARDL BOUND TEST

ARDL (Autoregressive Distributed Lag) bounds testing approach is a cointegration method to test the presence of long-run relationship between the variables. This procedure has many advantages over classical co-integration tests. Firstly, the approach is used irrespective of whether the series are $I(0)$ or $I(1)$. Secondly, unrestricted error corrections model can be derived from the ARDL bounds testing through a single linear transformation. This model has both short and long-run dynamics. Thirdly, the empirical results show that the approach is superior and provides consistent result for a small sample.

ECONOMETRIC MODEL

Symbolically:

$$INF = f(COP, EXC)$$

Mathematically:

$$INF = \beta_0 + \beta_1 COP + U_i$$

Rewriting in the log form:

$$\ln INF = \beta_0 + \beta_1 \ln COP + U_i$$

Where, β_0 and β_1 are the parameters

$\ln INF$ is the log value of Inflation

$\ln COP$ is the log value of crude oil price

The ARDL model can be stated as:

DATA

Table 1.2: Values of inflation and exchange rate.

YEAR	INFLATION(avg)	CRUDE OIL PRICE (barrel)	LNINFLATION	LNCRUDE OIL PRICE
1995	10.22	18.42	2.324347	2.913437
1996	8.98	21.73	2.195	3.078694
1997	7.25	20.38	1.981001	3.014554
1998	13.17	14.53	2.577942	2.676215
1999	4.84	19.64	1.576915	2.977568
2000	4.02	29.74	1.391282	3.392493
2001	3.77	25.24	1.327075	3.22843
2002	4.31	26.56	1.460938	3.279406
2003	3.81	30.84	1.337629	3.428813
2004	3.77	41.6	1.327075	3.7281
2005	4.25	57.28	1.446919	4.047952
2006	5.79	66.96	1.756132	4.202095
2007	6.39	74.94	1.8547342	4.316688
2008	8.32	98.58	2.118662	4.590868
2009	10.83	63.92	2.38232	4.157632
2010	12.11	79.98	2.494032	4.381777
2011	8.87	97	2.182675	4.574711
2012	9.3	94.05	2.230014	4.543827
2013	10.92	97.61	2.390596	4.58098
2014	6.37	91.23	1.851599	4.513384
2015	5.88	49.31	1.771557	3.898127
2016	4.97	44.47	1.60342	3.794815
2017	2.49	51.86	0.912283	3.948548
2018	4.66	67.91	1.539015	4.218183

Sources: RBI Bulletin, A Handbook of statistics on Indian Economy and Index Mundi.

ANALYSIS

Table shows the unit root test on inflation and crude oil price. The result is that the variables are non-stationary in ADF test on the level form of variables. The calculated

statistics are showing significance at 5% and 1% in most cases and hypothesis of non-stationary is rejected. Therefore, order of integration is one for all variables as application of unit root tests requires assurance on part of variables to be integrated at 1(0) or 1(1) to apply ARDL cointegration test.

VARIABLES	LEVEL		1 ST DIFFERENCE	
	t-statistics	P-value	T-statistics	P-value
INFLATION	-2.183	0.2169	-5.55	0.0002**
CRUDE OIL PRICE	-1.438	0.5455	-4.11	0.0046**

Note: ***, **, * shows the statistical significance at 10%, 5%, 1% respectively.

ARDL BOUND TEST

Levels Equation Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG_PRICE	0.565784	0.237363	2.383627	0.0363
C	-0.553345	0.998999	-0.553900	0.5907
EC = LOG_INFLATION - (0.5658*LOG_PRICE -0.5533)				
F-Bounds Test Null Hypothesis: No levels relationship				
Test Statistic	Value	Signif.	I(0)	I(1)
Asymptotic: n=1000				
F-statistic	8.165037	10%	3.02	3.51
k	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58
Finite Sample: n=30				
Actual Sample Size	20	10%	3.303	3.797
		5%	4.09	4.663
		1%	6.027	6.76

This table shows the calculated F-statistics by bound testing procedure based on selected ARDL model. The result shows that the *F-statistic* = 8.165037 which is a

higher value than critical F-statistics at 1% level of significance. The other results are given as:

$$\beta_0 = -0.553345$$

$$\beta_1 = 0.565784$$

Thus, the results of the ARDL model can be given a

$$\text{LnINF} = -0.553345 + 0.565784 \text{LnCOP} + u_i$$

TESTING OF HYPOTHESIS

We know that the F-statistics from ARDL bound test is a higher value than critical F-statistics at 1% of significance. Therefore, we can reject Null Hypothesis that there is no impact of crude oil price fluctuation on inflation. Rather there is a sufficient long-run relationship between inflation and crude oil price in India.

EQUATION

$$\text{INF} = \beta_0 + \beta_1 \text{COP} + u_i$$

From ARDL

$$\text{LnINF} = -0.553345 + 0.565784 \text{LnCOP} + u_i$$

>If there is 1% increase in crude oil price, inflation will increase by 0.565784%

4.SUGGESTION

Findings of the study show that both the variables oil price and inflation are interrelated with each other. It shows that

the demand for oil in India increases price which leads to inflation. Keeping in view this empirical analysis, it is suggested that the government should formulate policies that may help to maintain consistency in oil prices and try to reduce the adverse effect of severe fluctuations of crude oil prices on the Indian economy. Furthermore, instead of being sanctions on Iran, India should have relations with it to maintain exchange rate instability because Iran gives us oil at Indian Rupee.

5.CONCLUSION

The empirical analysis of relationship between crude oil price fluctuation and inflation has received a lot of attention from researchers and policymakers. The results of most of the studies in developing and developed countries conducted in different time periods show that oil price and inflation have an adverse effect on economic development. Being an oil-importing country, India has been spending a lot of amount of foreign exchange on oil imports which is a significant part of total imports and the ratio of imports to total import has been increasing over time. Furthermore, India has experienced higher inflation during the last few decades and measures taken by the government to reduce it have failed to achieve its objectives. This brings up the need to take into consideration the impact of oil prices on inflation in India using appropriate measures.

This study examines the adverse impact of crude oil price fluctuation and exchange rate depreciation on inflation in India. The study has been conducted using yearly average time-series data from 1995 to 2018. ADF Test and PP Test have been used to check the unit root in series while ARDL test has been applied for finding long run relationship between oil price changes, exchange rate and inflation. From the above analysis it can be concluded that in the long-

run, oil prices and exchange rate affect inflation in India. The oil price fluctuation has positive impact on inflation while exchange rate has negative effect.

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