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THE EFFECT OF CRUDE OIL PRICE VOLATILITY ON INFLATION IN INDIA: EVIDENCE FROM ARDL APPROACH

Shalini Jaiswal[1], Nagendra Kumar Maurya[2*],

[1]Research Scholar, Department of Applied Economics, University of Lucknow, Lucknow, Uttar Pradesh, India

[2]Assistant Professor, Department of Applied Economics, University of Lucknow, Lucknow, Uttar Pradesh, India

[*]Corresponding Author

ABSTRACT **DOI No: 10.36713/epra16290** **Article DOI: https://doi.org/10.36713/epra16290**

India has been experiencing the issue of rising crude oil prices since 2017, after a low-price regime from 2014 to 2017. Inflation was also moderate during the low-crude oil price regime. It has been empirically seen that a rise in crude oil prices exerts a significant impact on the inflationary situation of the nation. Rising oil prices and their spillover into higher general price levels might exacerbate the crisis in a nation that is already struggling with the declining demand for investment and consumption. The domestic oil price needs to be controlled by the government to boost demand while controlling inflation without putting further stress on the populace. Against this background, the present research aims to investigate the relationship between the crude oil price and the inflation rate in the nation using the data from 1991 to 2020 (before Covid years). This paper also aims to investigate the effect of crude oil prices and inflation on economic growth in India. The paper has used an Autoregressive Distributed lag model to investigate the long-run and short-run association between them. Our analysis shows that the prices of crude oil have a statistically significant impact on India's inflation rate over the long and short terms.

KEYWORDS: ***Inflation, Crude oil price, India, Spillover, ARDL, Granger Causality, GDP***

INTRODUCTION

Crude oil price fluctuations have been the subject of extensive discussion in both academic and government circles due to their significant economic consequences. An increase in oil prices is considered good news for oil-exporting countries but bad news for imported ones.

Crude oil is undeniably the most crucial and significant commodity in the world, as it serves as the primary and foremost source of energy production. (Energy Information Administration EIA). During the early 20th century, crude oil prices were relatively stable, hovering around $20 per barrel until the 1970s. In 1973, the price of crude oil rose dramatically, reaching a peak of $40 per barrel due to a variety of factors, such as the Arab-Israeli War, the OPEC oil embargo, and the Iran-Iraq War. (Alhajji, A. F. ,2004). During the 1980s, prices declined to as low as $10 per barrel due to oversupply and decreased demand. The late 1990s saw crude oil prices rise significantly, reaching a peak of $145 per barrel in 2008. (J. Hamilton, 2009). This was due to increasing demand from developing economies such as India, as well as geopolitical tensions in the Middle East. In response to the 2008 financial crisis, prices dropped to a low of $34 per barrel in early 2009. In 2015, the global oil market saw a dramatic drop in prices due to oversupply, reaching a low of $30 per barrel in February 2016. Prices then began to recover, reaching $60 per barrel by the end of 2016, and continued to rise until mid-2018, when they peaked at $85 per barrel. Since then, the price of oil has fluctuated between $50 and $70 a barrel, with the current price hovering around $60 a barrel. This is

largely due to the emergence of US shale oil production, which has increased the global supply of oil and kept prices relatively low. The future of oil prices is uncertain, as the market is influenced by many factors, including global demand, political and economic instability, and changing environmental policies. In recent years, prices have been affected by the US-China trade war and the COVID-19 pandemic, with prices dropping to a low of $20 per barrel in April 2020.

Oil is a crucial and life-blood commodity for all industrialised nations and has also become an essential raw material for economic growth. India is the third largest oil consumer after the USA and China, and simultaneously, its oil demand is increasing drastically year-on-year.

Further, India's consumption of oil increased to 193.4 million tons in Dec 2020 from 57 million tons in 1991–1992 (Petroleum Planning & Analysis Cell, 2021). According to the IEA's main scenario, India's oil consumption is expected to increase from 4.8 million barrels per day in 2019 to 7.2 million barrels per day in 2030 and 9.2 million barrels per day in 2050. (International Energy Agency, 2019). It is also projected that India's oil demand in 2030 will be about 7.4 million per day, which is double the oil demand in 2013 at some 3.7 million per day. Domestic crude oil production also fell 7.1% in May 2020 compared to May 2019, which was quite low due to covid-19 pandemic. However, the PPAC data showed that domestic production has been falling every year since FY 2012.

According to PPAC, India imported 227 million tons in 2019-2020. The spending on oil imports in 2019-20 was USD 101.4 billion, whereas India imported an average of 17.66 million tonnes of crude oil from 2014 to 2019. The highest recorded import was 21.10 million tonnes in October 2018, and the lowest import was 12.99 million tonnes in February 2015. India's oil import dependence rose to 85 per cent in 2019-2020 from 83.7 per cent in 2018-2019 and 82.9 per cent in 2017-2018. Higher import dependence shows a negative impact on macroeconomic parameters.

Similarly, Inflation is a key macroeconomic variable. The cost of oil essentially drives inflation in India. (Kumar, S., 2011). India is the world's third-largest consumer of oil and is heavily dependent on imports to meet its energy needs. Fluctuations in global oil prices cause changes in the country's inflation rate. When oil prices rise, it can lead to increased costs for businesses and consumers, which can lead to higher prices for goods and services. This can lead to a general rise in prices, resulting in higher inflation. In addition, when oil prices rise, the cost of production for businesses also increases. This can lead to a decrease in demand for goods and services, resulting in job losses and a decrease in economic activity. This can further contribute to higher inflation. On the other hand, when oil prices fall, it can lead to a decrease in inflation. This is because businesses may be able to reduce their production costs, leading to cheaper goods and services. This can stimulate economic activity, creating jobs and boosting demand.

Overall, oil price fluctuations can have a significant impact on inflation, both positive and negative. Therefore, governments should monitor oil prices closely and take appropriate steps to mitigate the impact of price fluctuations.

Many economists have shown the correlation between oil price fluctuations, inflation rate, and economic growth (e.g., Bhattacharya and Bhattacharya,2001; Zhang et al., 2018; Gómez Loscos et al., 2012; Hamilton,1996; Jones et al., 2004; Hooker,1996; Mork,1989, 1994; Mork et al., 1994; Lee et al., 1995; Davis & Haltiwanger,2001; and Cunado and Gracia,2003).

Similarly, large literature finds that oil price shocks have an impact on the inflation rate. According to Cashin et al studies from 2000 on the effects of increasing oil prices on the world economy, a US$5 per barrel increase in oil prices causes a 0.3% decline in the industrial countries' gross domestic product (GDP), which in turn drives up inflation in the short term. The same analysis also showed that, in the case of India, a sustained increase in oil prices of $5 per barrel would result in an increase in inflation of 1.3% and a 0.1% yearly decline in GDP growth.

In their study on the Indian economy, Bhattacharya, and Bhattacharya (2001) showed that a 20% shock to oil prices causes a 1.3% increase in inflation of other commodities and a decrease in output expansion of 2.1%. Even if the size of such a shock progressively decreases, its effects last for approximately two years. Furthermore, they have also warned that the short-run inflationary pressure shock generated by a jump in oil prices may be delayed. However, eventually, the shock would change itself into a much bigger shock. As the oil shock of the 1970s made clear, rising oil prices will result in a wage-price spiral, which will ultimately have an indirect impact on the prices of all other commodities that require oil as inputs. The prices of other commodities would rise in two ways because of a general increase in oil prices. As a result of widespread commodity hoarding in the first place, prices will immediately increase in the prospect of future prices.

Second, once an economy's typical production cycle is through, a cost-push effect starts to take hold, with its consequences becoming more noticeable. Inflation will cause disruptions in the nation's economic growth, leading to a situation of uncertainty, a depreciation in

the exchange rate, a decline in aggregate demand, and ultimately manifesting as hyperinflation at the domestic levels in a developing nation like India with mounting poverty and people living below the poverty line (29.5% of the population, according to the Rangarajan Committee Report of 2014). As a result, since 1974, the price of oil has experienced significant volatility.

The significance of the study will be helpful for the government for decision-making and policymaking, it will also serve as a contribution to the existing literature as well as methodology and academia.

Accordingly, this research is done to empirically test the impact of crude oil price fluctuation on Inflation rate and economic growth in the context of the Indian economy using the Autoregressive Distributed lag model (ARDL) advanced by Pesaran, Shin, and Smith (2001).

This paper is organized into five sections: The first section contains an introduction, research problem, significance of the study, objective of the study, and organization of the paper. The second section is a literature review, which gives some snapshots of existing literature. The third section presents the methodology and data. The fourth section presents results and discussions. Finally, the fifth section is about the conclusions and policy recommendations.

REVIEW OF LITERATURE

Many research studies have been conducted related to this. However, a major part of the research conducted was on crude oil price and economic growth, exchange rate economic growth nexus. Though a bundle of literature that investigated the relationship between crude oil prices and economic growth with different macroeconomic indicators in the Indian economy, due to the high dependence on crude oil imports, any volatility in crude oil prices has a major impact on the Indian economy. The study conducted by Pal and Mittal established a long-run relationship between Indian stock indices and macroeconomic variables such as interest rate, inflation rate, exchange rate and GDP. In addition, Giri and Joshi found that economic growth, inflation, and exchange rate have a positive impact, while crude oil prices share a negative impact on Indian stock prices. This implies that high crude oil prices can lead to lower stock market returns in India. It is worth noting that fluctuations in crude oil prices can also affect other sectors of the Indian economy. The responses of the purchasing power of the USD were asymmetric to crude oil price fluctuations, which was studied by Pal and Mitra (2019). They have applied a multiple threshold nonlinear autoregressive distributed lag (MTNARDL) approach to this study, and the findings were that the purchasing power of the USD experienced a sharp reduction with the rise in oil price.

Furthermore, Peersman and Van Robays (2012) suggest considering world oil production and refiner acquisition cost of imported crude oil along with standard macroeconomic variables like money stocks for both demand-and-supply-sides of global markets while determining actual conditions of shifts in price levels through variations occurring from different sources. Such evaluations provide an enhanced understanding for determining fluctuations in international markets which have far-reaching consequences for individual countries including India. Fluctuations in crude oil prices can also severely impact both net importing countries' economies by accelerating inflationary trends while impeding economic growth through budget deficits faced by net exporting nations as proposed independently by Abosedra and Baghestani.

The study by Sahoo and Dash found that crude oil prices have a significant impact on inflation in India, with an increase in crude oil prices leading to an increase in inflation. This impact of crude oil prices on inflation is particularly relevant to India, considering the country's heavy dependence on imported oil. Moreover, as highlighted by the Reserve Bank of India, crude oil price is a key driver of inflation in India because it affects the cost of transportation, which in turn affects the prices of other goods and services. Additionally, the high volatility in crude oil prices can lead to fluctuations in inflation rates and exchange rates.

However, there are opposing arguments to the idea that crude oil prices directly impact inflation in the Indian economy. Gupta et al. found that while crude oil prices do influence inflation rates, it is relatively small and short-lived. Other macroeconomic variables such as interest rates, exchange rates, and money supply have a stronger influence on long-term levels of inflation. Furthermore, some argue that the relationship between crude oil prices and inflation may not be direct or linear but rather indirect through their impact on other factors such as food production costs. As highlighted by Mullen et al, global food supply chains are highly dependent on fuel and logistics transport systems which can be impacted by changes in crude oil prices. Therefore, increased volatility in crude oil price can lead to higher food production costs with potential impacts on overall consumer pricing.

For instance, according to the study by Gangadharan and Valenzuela, while higher fuel prices can lead to an uptick in transportation costs and energy-intensive goods' prices, these effects do not translate into substantive changes in India's Consumer Price Index. Although global crude oil price spikes have caused short-term inflationary pressures on occasions such as 2008-09 and 2012-13 financial crises; however, a long-term relationship between Indian CPI and crude oil prices could not be established.

Many studies have advocated the impact of oil prices on inflation rate including Mork (1989), Mory (1993), and Hamilton (1996), acknowledged that variations in oil prices have an inflationary impact on the inflation rate. Furthermore, there is strong evidence linking oil price shocks to GDP growth. Darby (1982); Hamilton (1983,1988, 1996, 2000), Tang et al. (2010), Varghese (2017) confirmed a linear relationship between the GDP, economic growth, inflation rate, and exchange rate and the price of crude oil. The existing literature conducted looked on overall economic growth and less studies found on inflation alone in Indian outlook. Therefore, this is the gap that the study intended to fill the literature.

OBJECTIVE

The objective of this study is to understand how fluctuations in crude oil prices globally affect the inflation rate in India. The paper aims to analyse the impact of crude oil price changes on inflation levels in India from 1991 to 2020, determine if there is a cointegration between the two variables (crude oil prices - Brent, and inflation rate - WPI), and study the long-term and short-term relationship between inflation rate and crude oil prices. The study also proposes to investigate the cause-and-effect relationship between dependent and independent variables, as well as the impulse response of crude oil price shocks to inflation.

DATA AND METHODOLOGY

Data Sources

The Indian's monthly data from 1991 to 2020 was employed in this study. In our analysis, we make use of some macroeconomic variables: wholesale price index. (WPI), crude oil prices (Brent), expressed in US$. The WPI index measures and tracks changes in prices of all fuel-related goods in the stages before the retail level, which makes this the correct measure as a proxy of the inflation rate in our study. Both the time series data have been transformed into a natural log form. The explanatory variable is crude oil price (COP), and the endogenous variable is WPI, as a proxy of the inflation rate. The data was retrieved from the World Bank, World Development Indicators, the Handbook of Statistics on the Indian economy and the Petroleum Planning and Analysis Cell (PPAC).

Methodology

This study uses econometric techniques to perform time series analysis. The data has been interpreted using MS Excel and E-Views 12.0. Additionally, R-studio will also be used as an analytical tool. The Autoregressive Distributed Lag (ARDL) model has been applied to check for long-term relationships among the variables. Also, the Granger causality test has been used to determine cause-and-effect relationships among the variables.

Model specification and estimation techniques

The benchmark regression model is set as:

$WPI = f(COP)$

where, WPI is wholesale price index as a proxy of inflation level and COP is crude oil price.

Econometrically, the above model can also be written in a simple log-linear form:

$$\ln WPI = \beta_\circ + \beta_1 \ln COP + \eta_t \quad (1)$$

Where: $\ln COP$ stand in for the natural log of crude oil prices, $\ln WPI$ is the natural log of inflation rate and $\eta_t$is a disturbance term.

The co-integration approach of the ARDL model has been employed to test for co-integration relationships between the variables of interest. Despite that there are other methods for achieving the same purpose, this approach has several advantages that include its applicability regardless of the order of the variables in the model (i.e., whether they are all I (0), I (1) or mixture of the two); with the ARDL, both the short-run and long-run coefficients can be simultaneously obtained.

This ARDL model specifically helps us to know whether the underlying variables are cointegrated or not. (Pesaran, Smith, and Shin, 2001).

Based on the ARDL model approach, the formulated equation is estimated as follows:

$$\Delta \ln WPI_t = \delta_0 + \sum_{i=1}^{k} \chi_i \, \Delta \ln WPI_{t-i} \sum_{i=0}^{k} \gamma_i \, \Delta \ln COP_{t-i} + \psi_1 \ln WPI_{t-1} + \psi_2 \ln COP_{t-1} + \mu_i \quad (2)$$

Equation (2) is estimated, the null hypothesis if no co-integration is defined as

H_0: $\psi_1 = \psi_2 = 0$ as against the alternative hypothesis which states that co-integration exists $H_1 = \psi_1 \neq \psi_2 \neq 0$. To decide the results, the calculated F- statistics should be greater than upper and lower bounds of critical values, then the null hypothesis is rejected, which states that there is no co-integration exists. If the F- statistics are between the upper and lower bounds of critical values the results may be inconclusive. However, if F-statistics is less than upper and lower bounds of critical values, we failed to reject the null hypothesis, which states that there is co-integration exists among the variables.

The long-run and short-run models of ARDL approach are estimated in equations (3) and (4) respectively.

$$\Delta \ln WPI_t = \delta_0 + \sum_{i=1}^{k} \chi_{1i} \, \Delta \ln WPI_{t-i} \sum_{i=0}^{k} \gamma_{1i} \, \Delta \ln COP_{t-i} + \varepsilon_{1i} \quad (3)$$

$$\Delta InWPI_t = \delta_1 + \sum_{i=1}^{k} \chi_{2i} \, \Delta InWPI_{t-i} + \sum_{i=0}^{k} \gamma_{2i} \, \Delta InCOP_{t-i} + \emptyset EC_{T-1} + \varepsilon_{2i} \quad (4)$$

Where the coefficients of the error correction term (ECT) are denoted by ∅ which shows the speed of adjustments of the variables towards the long run relationship.

Finally, the study analysed the model by conducting tests for serial correlation (using the Breusch-Pagan LM test), heteroscedasticity (using the ARCH test), and stability test using CUSUM and CUSUMSQ to be able to assess the stability of the model during the sampled period. Then, the cause-and-effect relationship is diagnosed through the Granger-Causality test.

EMPIRICAL FINDINGS AND DISCUSSION

The time series properties of the variables were first tested for stationarity using the ADF test, which denoted the variables as either I (0) or I (1), i.e., mixed order of integration. The results are presented in Table 1. The ADF test reveals that crude oil price (COP) is stationary at first difference I (1), and the Wholesale price index (WPI) is stationary at level I (0). Therefore, for mixed order of integration, the ARDL approach has been applied in our study.

Empirical studies that use time series data rely on the assumption that the underlying time series is stationary. If the data is not stationary, it may lead to spurious or false relationships between the variables, especially if it possesses a unit root. Therefore, it is necessary to ensure that the data series is stationary before performing any econometric analysis. In our study, we began by conducting some pre-tests using the augmented Dickey-Fuller test (ADF) to determine the order of integration of the variables. The results, shown in Table 1, indicate that the p-value is less than 5% for both variables, confirming their stationarity at I (1) and I (0).

After testing the stationarity property, it is important to choose the optimum lag length through unrestricted vector autoregressive lag selection criteria. Using Sequential Modified LR test statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hannan-Quinn criteria (HC), and Schwarz Information criteria (SIC) revealed that lag 2 should be selected (Table 2). Therefore, the maximum lag to be used in the study is lag 2 based on Schwarz Information criteria (SIC). Hence, we lagged the variable 2 times in order not to lose the degree of freedom.

The next step was to estimate the long-run relationship among the variables using Long-run bound testing. The null hypothesis of bound cointegration test is no co-integration (H_0: $\psi_1 = \psi_2 = 0$) as against the alternative hypothesis which states that co-integration exists ($H_1 = \psi_1 \neq \psi_2 \neq 0$). The results of this test presented in Table 3, indicate that the null hypothesis get rejected for the study time period (1991-2020), at 5% level of significance. The F-statistics (27.790) exceeded the upper bound value (4.16) of the critical value at the 5% level of significance. The results presented, there exists a co-integration relationship between the variables. Therefore, we conclude that there exists a long-run relationship among the dependent and independent variables, that is supported by the result of ARDL bound test for co-integration.

Having established the cointegration relationship between the variables the long –run coefficients are estimated by using ARDL model, where the WPI is the dependent variable and COP is the independent variable. It is determined that log of WPI and log of COP, it is determined that the log of WPI and the log of COP are statistically significant at the level of 5%. The long-run relationship in Table 4, the coefficients of long-run cointegration presented the result which shows crude oil price is positively explaining the dependent variable inflation rate. Meaning that if there is 1% increase in crude oil price, there will be 0.41 % increase in inflation rate. Precisely, increase in crude oil price will increase in inflation rate, decrease in crude oil price will decrease in inflation rate. The short run results presented in Table 5, (estimation equation 4), which is showing the error correction term (-0.0053) satisfied the econometric requirement as it is negative, significant, and less than 1. The results estimate the finding that convergence rate to long-run equilibrium is 0.53%, which is low convergent. Precisely, error correction term also indicates that the long-run deviation from inflation rate is corrected by 0.53% annually.

Further, to ensure the robustness of the findings, the diagnostic tests of serial corelation, and heteroscedasticity were conducted and reported in Table 6 and Table 7, respectively. The results shows that the null hypothesis of all the tests could not be rejected in this model, that indicates the model is free from serial correlation, heteroscedasticity.

As suggested by Pesaran et al. (2001), cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ) tests for the model stability along the study time period were conducted. The results are shown in Figure 1 and Figure 2. Which illustrates the plots of the CUSUM and CUSUM squares test fall inside the critical bands of the 5% confidence interval, except that there is slight deviation in the cumulative sum of square (CUSUMSQ). The results show the model is strongly adequate fitted for the estimation, and model parameters are stable.

Next is the causal relationship between the variables and was studied through Granger causality test to test the direction of causality among the variables. In the granger causality test, there are two variables, dependent and independent and we see the cause-and-

effect relationship is unidirectional, bidirectional, or no causal relationship. The null hypothesis is that there exists no cause-and-effect relationship between the variables. If the value is less than 5%, we reject the null hypothesis and vice versa. From the Table 8, of Granger causality test, it is proven that crude oil price complies with Granger cause inflation rate for the given time period, the p-value is less than 5 %. Since the p-value for the other test is higher than 5%, we were unable to reject the null hypothesis. Hence, we can infer that inflation rate does not granger cause crude oil price. The Granger Causality Test results show that there is a unidirectional cause-and-effect relationship between the two variables. So, the results suggest that increase in oil price will increase in inflation rate.

Table 1. Unit root test using Augmented Dickey Fuller (ADF)

Variable	ADF t – statistics	Mackinnon's Critical Value			Prob*	Conclusion
		1%	5%	10%		
In WPI	-2.96923	-3.44841	-2.8694	-2.57102	0.0388	Stationary
In COP	-1.79109	-3.44841	-2.8694	-2.57102	0.3847	Non - Stationary
D.In COP	-14.8037	-3.44841	-2.8694	-2.57102	0.000	Stationary
Source: EViews 12; Note: Prob* stands for p-value at 5% level of significance.						

Table 2. VAR maximum lag selection result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-376.0252	NA	0.029367	2.147870	2.169823	2.156606
1	1626.910	3971.729	3.43e-07	-9.209713	-9.143856	-9.183505
2	1683.569	111.7083	2.54e-07	-9.508912	-9.399150*	-9.46232*
3	1687.387	7.484343	2.55e-07	-9.507879	-9.354211	-9.446726
4	1689.200	3.534110	2.58e-07	-9.495455	-9.297883	-9.416831
5	1696.274	13.70553	2.53e-07	-9.512920	-9.271443	-9.416824

Source: Authors' computation using EViews 12. Note: * indicates lag order selected by the criterion.

Table 3. Bound test result

Bound test critical values				
F-stat.	Lag	Level of significance	I (0)	I (1)
27.790	1	1%	3.02	3.51
		5%	3.62	4.16
		10%	4.94	5.58

Source: Authors' computation using EViews 12.

Table 4: Estimated long-run and short-run coefficients

Variable	Coefficient	T-stat. (P value)
In COP	0.4143	4.880(0.000)
Constant	3.2645	8.661(0.000)
EC = In WPI – (0.4144* In COP + 3.2645)		

Source: Authors' calculations using EViews 12.

Table 5: Error correction model.

Variable	**Coefficient**	**T-stat. (P value)**
D (In WPI (-1))	0.2666	5.742(0.000)
D (In COP)	0.0130	3.924(0.000)
D (In COP (-1))	0.0235	6.914(0.000)
ECM (-1)	-0.0053	-9.156(0.000)

Source: ECM = error correction model. Authors' calculations using EViews 12. Values in parentheses are the p-values.

Table 6: Autocorrelation test results

Obs *R-squared	**Prob. Chi-Square (2)**	**Results**	**Conclusion**
0.352555	0.8384	Accept H_0	There is no autocorrelation

Source: Authors' calculations using EViews 12.

Table 7: Heteroscedasticity test results

Obs *R-squared	Prob. Chi-Square (2)	Conclusion
0.689258	0.7085	Homoscedasticity

Source: Authors' calculations using EViews 12.

Figure 1: Plot of cumulative sum of residuals for the model

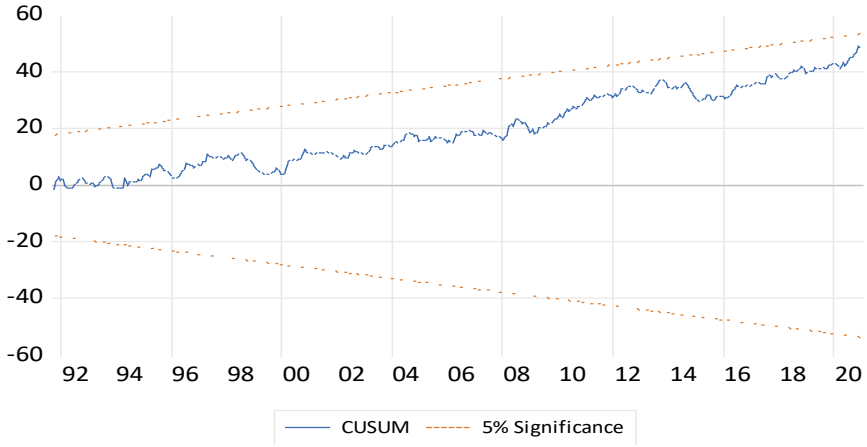

Figure 2: Plot of cumulative sum of square residuals for the model

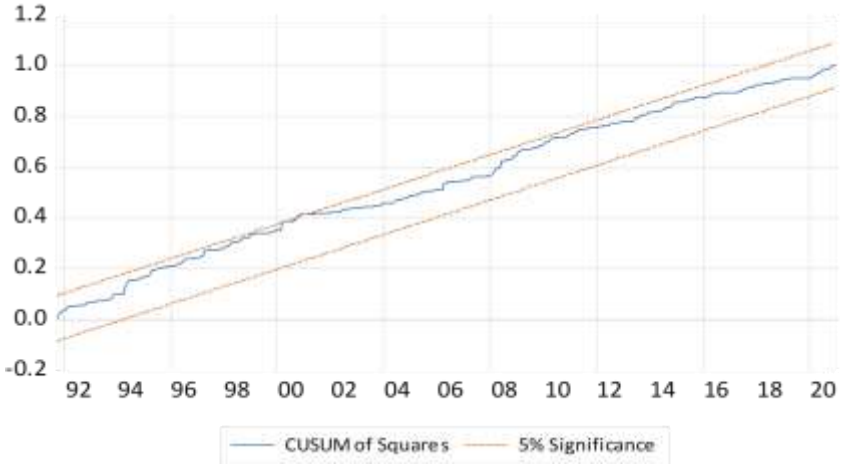

Table 8: Granger causality test result.

Null Hypothesis	Obs	F- stat (P value)	Direction of causality
In COP does not Granger cause In WPI	358	34.417(0.000) *	Unidirectional causality
In WPI does not Granger cause In COP		2.365(0.095)	No causality

Source: Values in parentheses are the p-values and * indicates statically significant at 5% significance level.

CONCLUSION

The study employed an Autoregressive distributed lag approach (ARDL) to co-integration to estimate the impact of crude oil price on inflation rate in Indian economy. The study further used Granger causality to test for the direction of causality among the variables.

At first, this study tested for the co-integration among the variables in the model after selecting the optimum lag criteria and found that all the variables in the model are cointegrated. The long-run model was estimated, and the result revealed that crude oil price impacted positively and significantly on inflation rate within the study time period. Besides, the long-run model estimations, short-run model were also estimated the model. The results also indicates that explanatory variable, that is, crude oil price was positive and significant in influencing inflation rate in the short-run. This suggested that crude oil price affect the inflation rate in both long-run and short-run periods.

The robustness of the model was checked through diagnostic tests and model stability were checked through CUSUM and CUSUMSQ tests which also indicated that the model is free from serial corelation, heteroscedasticity, fitted and stable. The causality was checked through Granger causality test which show that there is unidirectional causality between crude oil price and inflation rate, which is running from crude

oil price to inflation rate in the model. The main policy recommendation from this study is that crude oil price positively affect the inflation rate both in long-run and short-run periods, which means rise in crude oil price will increase the inflation rate and it will tend to reduce economic growth. Therefore, the government should focus on use of better alternative use in place of crude oil and should try to reduce the import dependence of crude oil. To reduce the heavy import dependence on crude oil and increased inflation rate from the fluctuation in crude oil price and to protect the country's economy, the policymakers should design and implement proper measures to reduce the impact of oil price shocks on the county's economy in the future and also ensure energy security for the sustainable development of the society.

While it is true that crude oil prices have a significant impact on the Indian economy, there are other factors that also play a role in determining inflation. For instance, monetary policy and fiscal policy decisions by the government can influence inflation rates. In addition, supply-side shocks such as droughts or floods affecting agriculture production can lead to increased food prices which drive up overall inflation in the economy. Therefore, while crude oil price may be an important factor contributing to inflation in India, it should not be viewed as the sole determinant of inflation. Other economic variables also need to be considered when analyzing changes in Indian macroeconomic indicators such as GDP growth rate, interest rate and exchange rates.

Overall, it is evident that there exists a strong causal relationship between crude oil price and inflation in the Indian economy. Therefore, understanding this connection is crucial for policymakers seeking to manage macroeconomic stability in India through appropriate policies such as reducing dependence on imported fossil fuels, improving efficiency of transportation systems among others. They must anticipate and plan for the potential fluctuations in crude oil prices by developing alternative energy sources, encouraging investment in renewable energy, and diversifying trade relations to reduce the country's dependency on a handful of countries for imports. The government also needs to implement prudent fiscal policies that take into account both short-term shocks and long-term goals. Such policies may include reducing subsidies or increasing taxes on fuel during periods of high crude oil prices but providing support for new industries as they emerge. Moreover, India should focus on boosting its domestic oil production capacity to increase self-reliance. Another strategy could be creating strategic petroleum reserves at various locations within the country so that there is little dependence on international suppliers. In conclusion, it is clear that fluctuations in crude oil prices can result in significant impacts not only in Indian economy but also globally if policymakers do not take proactive measures.

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