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Is the Influence of International Oil Price Changes on Economic Growth Significant in India?

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Abstract

The changes in the price of oil by creating supply-side shocks, inflation risks, and exchange rate risks, generate havoc in the development process of oil-importing countries like India. In this perspective, this study examined the degree and direction of connection among the price of oil and economic growth in India while controlling for the influences of exchange rate, real interest rate, rate of inflation, net inflows of foreign direct investment, and trade openness. The work uses the auto-regressive distributed lag bounds test approach and provides evidence in support of the negative effect of oil price changes on the long-run growth of the Indian economy when net inflows of foreign direct investment and foreign exchange rate exert statistically significant negative effects on this relationship. However, trade openness has a statistically significant positive effect. It is further observed that this long-run relationship has a convergence tendency towards the equilibrium value through short-run adjustments, thereby making the estimated relationship stable. The implication is that international oil price fluctuations can be used to predict the country's long-run economic growth. Besides, a policy effort is required to promote alternative energy consumption at home to keep oil demand under control. Furthermore, trade policies are required to be revisited to boost exports by the country to accommodate the negative effects of increases in the price of oil at the international level on economic growth.

Keywords: Economic Growth, Exchange Rate, India, Inflation, Oil Price.

Introduction

In the present era of liberalization, globalization, and industrialization, India has been facing problems with rupee value fluctuations in relation to the dollar, primarily because of the growing demand for crude oil for imports. Intermittent changes in global oil prices create a risk to the country's economic development through their multiplier effects on aggregate demand and supply, inflation, interest rates, and exchange rates. Crude Oil is critical for the development process as each and every sector in the economy requires huge quantities of oil inputs, both for production and consumption purposes. International oil price volatility leads to both economic expansions and contractions, but the most worrisome is the negative impacts of supply shocks due to a hike in the price of oil on the variables determining the growth of the macro-economy of a country (1, 2). Such shocks spread dreadful news among oil-importing countries and favorable news among oil-exporting countries (3), thereby influencing macroeconomic behavior. The literature has pointed out that the instability in the GDP growth, exchange rate, and interest rates is primarily due to oil price volatility (4).

Figure 1 depicts the volatility of the annual average OPEC reference basket measure of crude oil prices (in US $ per barrel) from 1960 to 2022. It is observed from Figure 1 that the crude oil price is almost stable during the periods 1960-1972 and 1987-1997. The hike in the price of crude oil was observed during 1973-1981, 1998-2008, and 2009-2012, when the crude oil price per barrel was at its maximum in the year 2012, i.e., $109.45 per barrel. The onset of the natural calamity "Hurricane Katrina" in the US in 2005, North Korea's missile launch in 2006, and the Iraq, Israel, and Lebanon war were the main factors leading to

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the rise in crude oil prices during 2004-07. The fall in crude oil prices has been observed during the periods 1982-1986, 1991-1994, and 2013-2016. The fall in the crude oil price during late 2008 and 2012 can be ascribed to the global recession and the Greek Depression, respectively. Again, the rising trend in the oil price has been observed after 2016, with an exceptional year in 2020 due to worldwide lockdowns amid the spread of the coronavirus-led pandemic. Thus, we can say that the international oil price has been highly volatile during 2008-2022.

Since crude oil, as an important source of energy, constitutes a crucial input in the production of goods and services, the supply-side mechanism reflects that a spike in the price of oil can elevate the production cost, fall the profit margin, and fall in the domestic investment, which results in lower output for oil-importing countries. A swell in the production cost raises the prices of goods and services, negatively impacting their demand and lowering the output. Therefore, an escalation in the oil price affects disposable income, household consumption, and private sector saving-investment decisions and puts larger unfavourable effects on economic growth. However, this negative impact of crude oil prices on output and economic growth seems to have weakened over time (5-16).

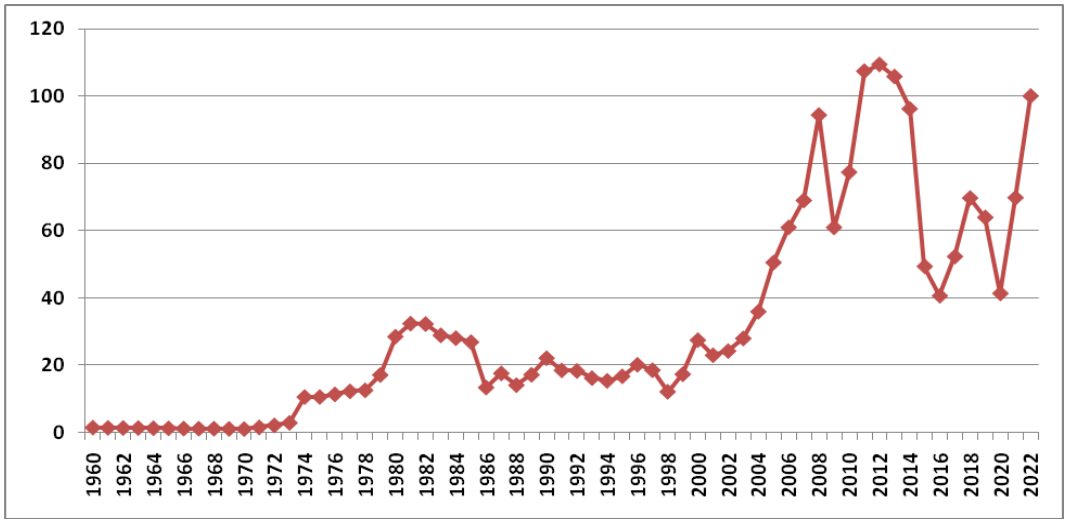

Figure 1: Annual Oil Price Trend in India, 1960-2022

The studies by Rasche and Tatom, Burbidge and Harrison, Mork, and Hamilton have provided evidence that a rise in oil price adversely affects output and contributes to inflation resulting in the fall in tax revenues of the Government and rising budget deficits (17-20). It has been observed that volatility in the price of oil is responsible for delaying the process of growth of an economy, particularly in the oil importing countries that experience inflation, rising input prices, fall in demand for non-oil products, investment slowdowns, reduction in tax revenues, and boosts in budget deficits thereby compromising with the welfare of the masses (21, 22). Rising oil prices have been observed to raise transportation costs and reduce the profit margin in transport businesses, ultimately escalating the cost of travel and transportation (23).

Oil price fluctuation is strategically significant for the economic growth of almost all oil-importing countries in the world. Its dynamics are that there is a rise in inflationary pressure in the economy. Because of the high import cost of oil, the cost of every unit of output produced rises. The domestic firms feel the burden of high prices, which they shift to the consumers by raising the market prices. Since the consumers are prudent in utilizing their income, demand for goods and services decreases. Higher price levels lead to a rise in people's cost of living. This rising cost of living compels the households to demand higher wages, and later, the firms pass on the increased factor prices to consumers by increasing the selling prices of goods and services. This wage-price spiral reinforces increased price rises in the economy (24-29).

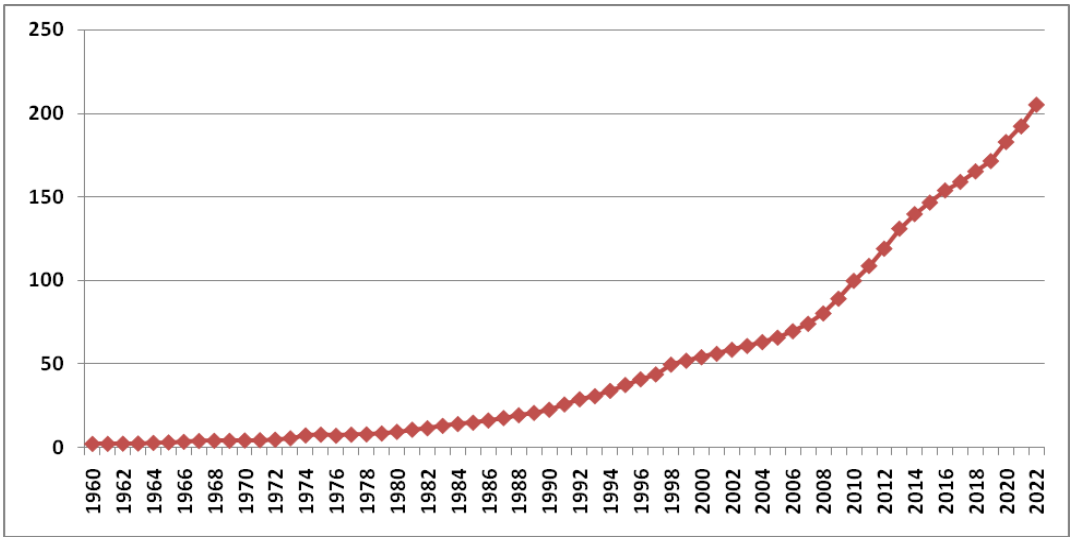

Figure 2: Annual CPI Trend in India, 1960-2022 (Base 2010=100)

It is observed from Figure 2 that the consumer price index in India depicts a rising trend during the period from 1960 to 2022. It implies the persistence of inflationary pressure in the economy. So, pressure has been created in terms of a decrease in disposable income and private savings, a rise in interest rates, and a fall in private investment. In the same scenario, the households will try to smooth their consumption by saving less or borrowing more, resulting in an upward rise in real interest rates. Olsen and Flo emphasize that inflation is mainly caused by oil price changes but not by growth in the domestic money supply (30). However, Sastry points out that a rise in price due to increased cost of production creates a temporary shock, but inflationary pressure is more in the domestic market. In this tough situation, foreign investors' choice plays a significant role in providing funds for getting lucrative returns on their investments (31). Higher interest rates attract foreigners to land more funds in oil-importing countries, which increases domestic infrastructure. This provides enormous scope for economic growth to accelerate at a rapid pace. Mukoka recently argued that inflation is crucial but can't be considered a pre-condition for economic growth (32).

So far as the exchange rate is concerned, for the last few decades, it has been observed that the Indian currency has experienced considerable depreciation in its value in comparison to the dollar. The main reason is the mismatch between demand and supply for dollar and Indian rupee. As India is treated as an oil-importing country and payments for oil are made in dollars, an escalation in the price of crude oil at the international level, along with an appreciation of the oil demand, increases the demand for the dollar. This results in the depreciation of the Indian rupee compared to the dollar (33). In this context, Figure 3 represents the trend pattern of the annual average exchange value of INR in US$ during the period 1960 to 2022. It indicates a continuous depreciation in the value of the rupee in the US dollar. The depreciation of the Indian rupee has multiplier effects on the country's gross domestic product through its impact on trade openness and foreign direct investment. Firstly, as the rupee value depreciates in terms of the dollar, imports become unfavorable and exports favorable. The trade openness in such a case helps in achieving economic growth through specialisation and full capacity utilisation. Thus, a high degree of positive association exists between trade openness and economic growth (34-35). Secondly, since trade openness is associated with an export friendly business climate, foreign direct investment increases, which, through the capital formation channel, raises the gross domestic product (36). Ullah and others point out that foreign direct investment is positively linked with the depreciation of the rupee and can be treated as a supplement to domestic capital formation (37). Nagubadi and Zhang argued in favor of the positive impact of host nations' currency depreciation and volatility in the exchange rates on the inflow of foreign direct investment (38).

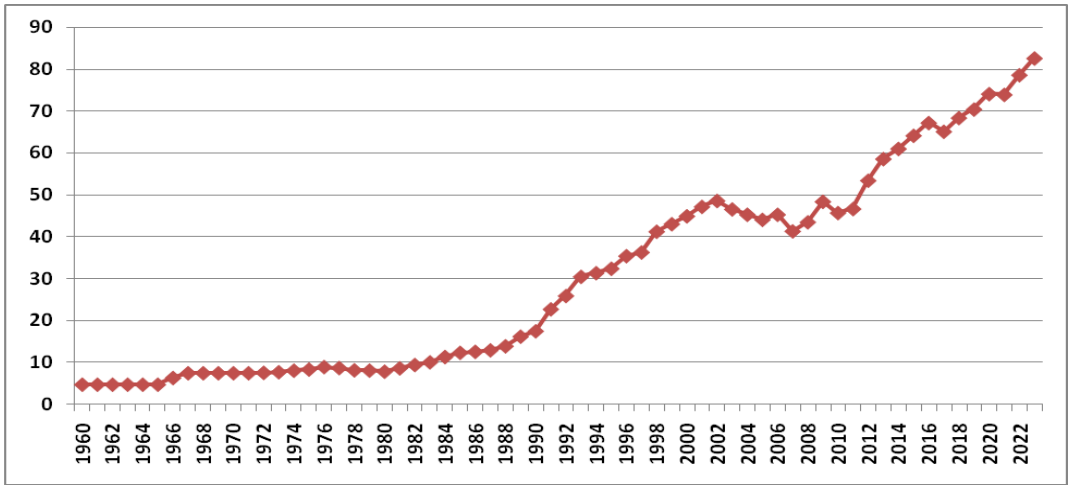

Figure 3: Annual Average Exchange Rate in India, 1960-2022 (Rupee vs. USD)

In the literature, it is well observed that the fluctuations in the price of crude oil at the international level affect the real gross domestic product in importing countries through different transmission channels (39). These channels are described as supply- and demand-side shocks in which situation output is mostly lower in the case of the former (40). However, the most common classification of the transmission channels of shocks due to oil price changes includes the supply side, inflation, and exchange rate channels. Based on the extant studies and contemporary observations, a theoretical construct explaining the abovementioned transmission mechanism is depicted in Figure 4. *First*, the supply side and inflation channels imply that the gross domestic product is likely to decrease in periods following these shocks. *Second*, the inflation and exchange rate channels imply that foreign direct investment is likely to increase in periods following these shocks. As a result, the nature of the consequence of changes in international oil prices on the national output is not very clear. The continuing debate among the researchers is how much supply-side and inflation shocks reduce gross domestic product and how much inflation and exchange rate shocks enhance gross domestic product. If the fall in gross domestic product due to supply-side shock is greater than the increase in gross domestic product due to inflation and exchange rate shocks, then the output of the country will fall. The reverse is the case when the fall in the gross domestic product due to supply-side shock is less than the increase in the gross domestic product due to inflation and exchange rate shocks.

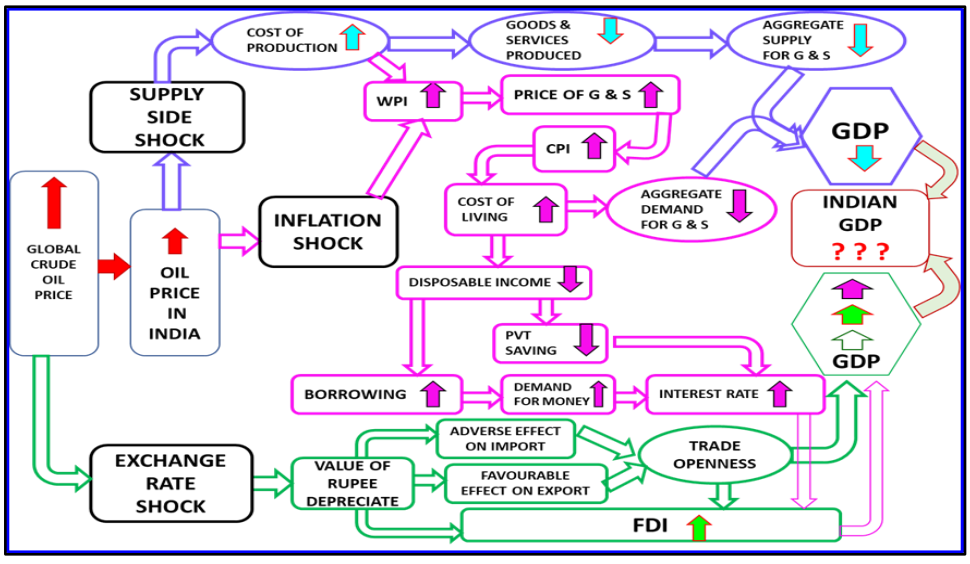

Figure 4: Theoretical Construct of the Transmission Mechanism of Oil Price Shocks

In this pre-text, the present work explores the consequence of international oil price changes on economic growth in India. Learning that supply-side, inflation, and exchange rate shocks transmit the consequences of changes in the international oil price to the real sector in a country; the work specifically examines the degree and direction of short- and long-run association among oil price and economic growth while controlling the macroeconomic parameters such as interest and exchange rates, inflation, trade openness, and foreign direct investment. The work used the auto-regressive distributed lag model for estimating the short- and long-run relationships among these variables. The main outcomes include the presence of a long-run equilibrium relationship among inflation, exchange rate, interest rate, oil price, gross domestic product, trade openness, and foreign direct investment. While this equilibrium has a tendency to deviate from the track in the short run, mainly due to oil price shocks, a long-run converging tendency is evidenced. Thus, the inference is that the long-run behaviour of gross domestic product can be predicted using international crude oil price changes while controlling other macroeconomic variables. The rest of the study is organised as follows: section-2 describes the data and methods of analyses, section-3 presents and discusses the results, and section-4 concludes.

Materials and Methodology

The study has been conducted in a time-frame of 45 years, from 1978 to 2022, to estimate the long-run relationship between economic growth and international crude oil price in India while macroeconomic variables such as foreign direct investment, trade openness, foreign exchange rate, inflation, and rate of interest are controlled. The reason for using this time frame is the availability of complete time-series data for the variables under consideration and to justify the long-run estimation requirements of time-series analyses. In this study, economic growth (EG) in India is measured by the annual growth of Gross Domestic Product at market prices; foreign direct investment (FDI) is taken as net inflows to India from rest of the world as a percentage of gross domestic product; trade openness (TRD) is taken as the sum total of exports and imports of goods and services of the country as a percentage of gross domestic product; foreign exchange rate (FRX) is taken as rupees per unit of US dollar; oil price (OLP) is taken as the OPEC reference basket value of crude oil in US dollar per barrel; rate of inflation (INF) is measured as annual changes in consumer price index (base 2010=100) in the country; and rate of interest (INT) is the lending rate adjusted for inflation in the country. The required time-series data for EG, FDI, TRD, INF, and INT have been compiled from the World Development Indicators database of the World Bank. The data on OLP has been compiled from the OPEC database on oil prices. The data on foreign exchange rates is taken from the International Financial Statistics (IFS) database of the International Monetary Fund (IMF).

The study uses both descriptive and inferential statistics to analyse the data. The descriptive statistics such as maximum, minimum, mean, and standard deviation have been calculated for the variables of interest to understand the basic data properties. In the second step, Pearson's pair-wise correlation coefficient was calculated to examine the degree and direction of the relationship between the variables of interest. Also, a t-test was conducted to determine the statistical significance of Pearson's correlation coefficients, as indicated by the two-tailed p-values. The study relied on regression analysis since correlation analysis fails to capture the long-run relationship between the variables. Thus, in the third step, the stationary properties of variables are examined using the Augmented Dickey-Fuller (ADF) unit root test. It tells the order of integration of each variable under consideration and helps in deciding an appropriate method of estimating the short- and long-run coefficients. This ADF unit root test requires estimating a regression of the variable Y against its first difference term, lagged difference terms, and a constant term along with a time trend. In econometric form, the ADF regression equation is as specified below:

$$\Delta y_t = \psi_0 + \psi_1 t + \psi_2 Y_{t-1} + \sum_{j=1}^{r} \psi_j \Delta y_{t-j} + u_t$$

…… [1]

In this ADF regression, non-stationarity of the underlying time-series (y_t) is the null hypothesis, which is rejected when the coefficient of yt-1 term is found significantly from zero, implying thereby the absence of unit root and level stationarity. Otherwise, the underlying series is considered to have a unit root and hence is non-stationary at the level and may be stable at the first difference. It will be seen in the next section that the underlying variables of the study are a mix of level stationary and first-difference stationary. This kind of variable structure indicates that the Autoregressive Distributed Lag (ARDL) model is appropriate for estimating the short- and long-run relationships among the variables. So, in the fourth step, the ARDL framework, as suggested by Pesaran and others, has been estimated (41). In this ARDL approach, a Bounds test has been performed to examine the long-run cointegrating or equilibrium relationship among the dependent and explanatory variables. The bounds test requires the estimation of the following conditional error-correction specification:

$$\Delta y_t = \psi_0 + \varphi_{yy} y_{t-1} + \varphi_{yx.x} x_{t-1} + \sum_{i=1}^{r} \upsilon_i \Delta y_{t-i} + \sum_{j=0}^{r} \kappa_j \Delta y_{t-j} + \tau_t$$

..... [2]

In this specification (2), the coefficients φ_{yy} and $\varphi_{yx.x}$ are long-run multipliers that are tested using the lower and upper-bound critical values given by Pesaran and others (41) for the null hypothesis that $\varphi_{yy} = \varphi_{yx.x} = 0$. If the F-stat is found to be greater than the upper bound, then the null is rejected, and the presence of an equilibrium relationship in the long run is concluded. The robustness of this test is checked using the Jarque-Bera test for normality, the Breusch-Godfrey LM test for serial correlation, the Breusch-Pagan-Godfrey test for heteroskedasticity, and Ramsey RESET model specification and stability. Then, the coefficients indicating the degree and direction of the long-run equilibrium relationship are obtained along with the estimated value of the error correction term. Finally, the short-run coefficients are estimated for interpretation. The Akaike Information Criterion (AIC) has been used in all these estimations to select the optimal lag length.

Results and Discussion

First, the statistics describing basic data characteristics of the variables under study are obtained and summarized in Table 1. The wide difference between the mean value and the maximum value indicates the occurrence of fluctuations in the price of oil and foreign exchange rates over the years. This finding also agrees with the larger values of standard deviation for these two variables. The fluctuation in the price of oil is more than that in the foreign exchange rate due to a larger standard deviation of the former. This observation is also confirmed through Figure 1.

Then, the pair-wise correlations between variables are calculated using Pearson's method, and the results are summarized in Table 2.

Table 1: Summary Statistics of Variables, 1978-2022

Statistics	EG	FDI	TRD	FRX	OLP	INF	INT
Maximum	9.63	3.62	55.79	78.6	109.45	13.87	10.77
Minimum	-5.83	0.0026	12.22	7.86	12.28	2.52	-1.98
Mean	5.66	0.94	30.19	38.47	42.38	7.51	5.59
Std. Dev.	3.06	0.89	14.75	21.44	29.87	3.06	2.81

Table 2: Pair-Wise Correlation between Variables, 1978-2022

Variables	FDI	TRD	FRX	OLP	INF	INT
EG	0.047	0.217	0.145	0.163	-0.013	0.125
	(0.75)	(0.15)	(0.34)	(0.28)	(0.93)	(0.41)
FDI	-	0.877*	0.762*	0.730*	-0.218	-0.367**
		(0.00)	(0.00)	(0.00)	(0.15)	(0.01)

TRD	-	-	0.828* (0.00)	0.901* (0.00)	-0.214 (0.16)	-0.514* (0.00)
FRX	-	-	-	0.624* (0.00)	-0.407 (0.00)	-0.314** (0.03)
OLP	-	-	-	-	-0.045 (0.77)	-0.552* (0.00)
INF	-	-	-	-	-	-0.249 (1.0)

*Note: * and ** significance at 1% and 5% levels, respectively; p-values in parentheses*

Referring to the two-tailed significance of correlation coefficients, no statistically significant direct correlation between oil price and economic growth in India is observed. However, the correlation between oil price, foreign direct investment, trade openness, foreign exchange rate, and real interest rate are found to be statistically significant. This observation supports the hypothesis that the economic growth in India is indirectly affected by changes in the oil price through the foreign exchange rate channel. In addition, no statistically significant correlation is observed between oil price and inflation rate, which does not *prima facie* validate the hypothesis that economic growth in the country is controlled by oil price changes indirectly through the inflation channel. However, simple correlation analysis is not robust enough to capture the dynamic relationship between economic growth and oil price being mediated by macroeconomic variables. For this purpose, advanced time-series econometric methods are available in the literature. However, the selection of the appropriate method of data analysis depends on the nature of the stationarity of variables. For this purpose, the ADF unit root test was performed over the study period, and its outcomes are summarized in Table 3.

Table 3: Stationary Properties of Variables, 1978-2022

Variables	ADF Statistic with trend and intercept (at level)	ADF Statistic with trend and intercept (at 1st Difference)	Decision
EG	-6.776* (0.00)	-	I(0)
FDI	-3.058 (0.13)	-7.691* (0.00)	I(1)
TRD	-1.651 (0.75)	-5.612* (0.00)	I(1)
FRX	-3.131 (0.11)	-5.634* (0.00)	I(1)
OLP	-2.640 (0.26)	-4.112** (0.01)	I(1)
INF	-3.461*** (0.06)	-	I(0)
INT	-4.588* (0.00)	-	I(0)

*Note: *,**, *** significant at 1%, 5% and 10% levels respectively; p-val. in parentheses*

Table 4: Results of ARDL Bounds Test for Cointegration

ARDL Model Specification	Dependent Variable	F-Statistic	Decision
ARDL(4,4,3,3,3,3,4)	EG	3.799	Cointegration
Lower bound I(0) = 2.04 and Upper bound I(1) = 3.24 at 5% level of significance			
Results of Model Diagnostic Tests			
Jarque-Bera Normality Test (p-val.)	**BG Serial Correlation LM Test (p-value)**	**BPG Heteroskedasticity Test (p-value)**	**Ramsey RESET Stability Test (p-value)**
0.479 (0.787)	0.217 (0.808)	2.037 (0.117)	1.943 (0.198)

It is observed from Table 3 that variables, namely economic growth (EG), rate of inflation (INF), and real interest rate (INT), are all level stationary. However, the variables, namely foreign direct investment (FDI), trade openness (TRD), foreign exchange rate (FRX), and oil price (OLP), are all level non-stationary, but the first difference is stationary. In other words, variables of interest have diverse orders of integration – a few are I(0), and a few others are I(1), as specified in Table 3. In such a case of mixed order of integration, Pesaran and others recommend the use of the ARDL framework for understanding and determining the short- and long-run relationships between the variables (41). In this framework, the analysis is conducted in two steps. In the first stage, the existence of a long-run relationship between the variables under investigation was tested through the Bound Test, and their F-statistics were computed to see the statistical significance. The second stage of the analysis is to estimate the coefficients of the long-run relationships and make inferences about their values. The results of the ARDL Bound test are summarized in Table 4. It is observed from Table 4 that the F-value of the ARDL Bounds test is greater than the upper bound critical value. This means that long-run equilibrium or a cointegrating relationship is evidenced between the variables of the study, in which the annual growth rate of gross domestic product measures economic growth (EG). The diagnostic tests support the robustness of this finding as error terms are normal, not serially correlated, not have heteroskedasticity, and the model specification is correct. Second, the ARDL framework requires the estimation of short- and long-run coefficients for drawing relevant inferences. Long-run coefficients are estimated in this connection, and the outcomes are summarized in Table 5. Based on the values of long-run coefficients, the cointegrating equation has been constructed and presented in (3). As revealed by the Bounds test, the cointegrating relationship between variables is confirmed by the error correction term's negative coefficient (-2.959), which is significant at 0.01 level.

$$ECT_t = GDP_t - \left(-4.5681FDI_t + 0.5784TRD_t - 0.0723FRX_t - 0.119OLP_t + 0.1064INF_t + 0.1133INT_t\right) \cdots [3]$$

Table 5: Estimated Long-Run Coefficients of ARDL Model

Regressor	Coefficient	Std. Error	t-statistic	p-value
ARDL (4,4,3,3,3,3,4**) selected based on AIC: 4.353 (optimum), Dependent Variable: EG**				
FDI	-4.568064**	1.494575	-3.056429	0.0109
TRD	0.578432*	0.123743	4.674453	0.0007
FRX	-0.072279***	0.033066	-2.185936	0.0513
OLP	-0.119005*	0.036314	-3.277144	0.0074
INF	0.106369	0.099492	1.069130	0.3079
INT	0.113327	0.142126	0.797366	0.4421
Error Correction Coefficient				
ECT	-2.959883*	0.715437	-4.137170	0.0017

*Note: *, **, **** Significant at 1%, 5% and 10% levels respectively*

Further, the results in Table 5 infer that net inflow of foreign direct investment, foreign exchange rate, and oil price changes have statistically significant negative impacts on the long-run economic growth in India. However, trade openness creates a statistically significant positive effect on the country's economic growth. Specifically, one percentage point increase in the net inflow of foreign direct investment as a proportion of the GDP of the country can reduce long-run economic growth by 4.57% (approx.). Also, one rupee increase in the US dollar price can lead to a 0.072% (approx.) decline in long-run economic growth in the country. Similarly, one US dollar increase in international oil price can reduce long-run economic growth in India by 0.119% (approx.). Furthermore, one percentage point increase in the total trade as a proportion of GDP can raise long-run economic growth in the country by 0.578% (approx.). From this interpretation, it can be

inferred that oil price shocks can influence the economic growth of a country in the long run through the negative effects on foreign exchange rates and net inflows of FDI and through the positive effects of trade openness. In addition, it is observed from the table that the control variables, viz., rate of inflation and real interest rate, are not statistically significant in explaining the impact of oil prices on economic growth in India. This observation undermines the importance of the inflation channel for transmitting international oil price shocks to disturb the growth path of output in the country in the long run.

Keeping in mind the possibility of divergence from the cointegrating relationship between economic growth and other economic variables, the short-run coefficients have been estimated from the specified ARDL model, the results of which are summarized in Table 6. The short-run impact is observed from the coefficients of variables in their first difference form. It is observed from Table 6 that changes in the price of oil have no statistically significant impact on the short-run growth of the economy. The changes in the net inflows of FDI in the current year and that of two years back have statistically significant negative and positive effects on economic growth, respectively. The changes in the total trade in the current year have a statistically significant negative impact on economic growth. The changes in the foreign exchange rate two years back had a statistically significant negative effect on economic growth. The changes in the rate of inflation have no statistically significant effect on economic growth in the short run. However, the changes in the real interest rate in the last two years have had a statistically significant negative effect on economic growth in India in the short run.

Table 6: Estimated Short-Run Coefficients of ARDL Model

Regressor	Coefficient	Std. Error	t-statistic	p-value
ARDL (4,4,3,3,3,3,4**) selected based on AIC: 4.353 (optimum), Dependent variable: EG**				
ΔEG_{t-1}	1.062508***	0.534168	1.989087	0.0721
ΔEG_{t-2}	0.451813	0.369639	1.222309	0.2471
ΔEG_{t-3}	0.240102	0.255068	0.941325	0.3668
ΔFDI	-4.211507**	1.546553	-2.723157	0.0198
ΔFDI_{t-1}	-1.885917	1.828940	-1.031153	0.3246
ΔFDI_{t-2}	2.144284	1.852510	1.157502	0.2716
ΔFDI_{t-3}	5.322888***	2.504378	2.125434	0.0570
ΔTRD	-0.758466***	0.403873	-1.877982	0.0871
ΔTRD_{t-1}	-1.150639	0.666424	-1.726588	0.1122
ΔTRD_{t-2}	-0.704837	0.654676	-1.076620	0.3047
ΔFRX	0.192588	0.277149	0.694890	0.5015
ΔFRX_{t-1}	0.636261	0.634900	1.002144	0.3378
ΔFRX_{t-2}	-0.975502***	0.477038	-2.044915	0.0655
ΔOLP	0.057579	0.066544	0.865273	0.4054
ΔOLP_{t-1}	0.192209	0.136114	1.412114	0.1856
ΔOLP_{t-2}	0.057523	0.108619	0.529588	0.6069
ΔINF	-0.403930	0.280113	-1.442027	0.1772
ΔINF_{t-1}	-0.357230	0.249344	-1.432682	0.1798
ΔINF_{t-2}	-0.396561	0.265896	-1.491415	0.1640
ΔINT	-0.223516	0.424921	-0.526016	0.6093
ΔINT_{t-1}	0.031241	0.424410	0.073610	0.9426
ΔINT_{t-2}	-0.798231***	0.380165	-2.099698	0.0596
ΔINT_{t-3}	-0.089436	0.244219	-0.366213	0.7212

*Note: *, **, **** Significant at 1%, 5% and 10% levels respectively*

From the aforesaid analysis, it is inferred that the cointegrating relationship, as explained in Table 5, can deviate in the short-run primarily due to the shocks created by inflows of foreign direct investment, total trade, foreign exchange rate, and real interest rate. However, the sign of the coefficient of the error correction term (ECT) in Table 5 indicates that there exists a convergence tendency towards the equilibrium relationship in the long run. The magnitude of this error correction term indicates that such a short-run deviation from the long-run cointegrating relationship will converge to the equilibrium level through an annual adjustment of 2.96% (approx.). This observation is significant at a 1% level, and the implication is that the growth of the Indian economy can be explained in terms of changes in the oil price in the international market in the long run.

Conclusion

This study seeks to examine the degree and direction of connection between the price of crude oil and economic growth in India, both in the short- and long-run, while controlling other macroeconomic variables such as exchange rate, real interest rate, inflation, net inflows of FDI, and trade openness. It is found that the real economic growth in the country is negatively influenced by net inflows of FDI, oil price changes, and foreign exchange rates, and it is positively influenced by trade openness in the long run. Other variables such as inflation and interest rate have not been found significant in influencing the growth of the country. Further, no statistically significant effect of changes in the price of crude oil on the growth of the Indian economy in the short run has been found. However, changes in net inflows of FDI, trade openness, foreign exchange rate, and real interest rate in the short run are found to be statistically significant in creating negative effects on the country's economic growth. The economic implication is that oil price changes need to be included in the growth equation used for the prediction of long-run economic growth in India. Second, the findings suggest the small reliance on crude oil as a source of energy to make India relatively immune to oil price fluctuations and justify the necessity of exploring and using alternative energy sources such as solar and wind power to reduce the consumption demand of crude oil at home. Such an action would not only keep the import bills of the country under control and safeguard the economy against inflationary shocks but also provide a shield to the stable growth process of the economy and aid in achieving sustainable environmental goals. In this respect, the Government of India is taking necessary steps to accomplish energy transition and has set a target to achieve 50 percent cumulative installed capacity from non-fossil fuel-based energy resources by 2030. To achieve these goals, several initiatives, such as the National Solar Mission, the National Mission for Enhanced Energy Efficiency, the National Bioenergy Programme, and the National Green Hydrogen Mission, have been undertaken by Govt. of India. It is expected that proper implementation of these existing programmes and the introduction of new programmes in these directions will help India to become less vulnerable to crude oil price shocks and attain sustained economic growth. Further, the negative impact of increased crude oil prices on economic growth suggests the necessity of formulating and implementing an energy conservation policy related to energy saving and efficiency policies. Third, the rise in crude oil price negatively influences the GDP growth rate through adverse foreign exchange rate. Emphasis on non-fossil fuel along with energy conservation will, no doubt, reduce the import of crude oil and make the exchange rate favorable. The government of India has taken several export promotion initiatives, viz., Trade Infrastructure for Export Scheme (TIES), Market Access Initiatives (MAI) Scheme, Remission of Duties and Taxes on Exported Products (RoDTEP), Common Digital Platform for Certificate of Origin to boost exports of the country. Further, under "Atmanirbhar Bharat," several reforms across sectors have been taken to make local products global and push India towards self-reliance. The emphasis on import substitution and export expansion will improve the exchange rate and help in boosting economic growth in India. Still, the trade policies need to be further reoriented to reduce imports and boost exports. This will contribute towards the appreciation of

the Indian rupee, prudent management of the negative effects of oil price hikes, and enhancement of openness in trade, which will ultimately speed up the growth process of the Indian economy. The influences of institutional, political, and financial factors on oil price changes have not been studied, which explains the limitations of this study, and the study can be extended in this direction.

Abbreviation

Consumer Price Index (CPI), Gross Domestic Product (GDP), Lagrange Multiplier test (LM test), Organization of the Petroleum Exporting Countries (OPEC), Regression Equation Specification Error Test (RESET), United States Dollar (USD).

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S. K. Mishra (literature review, problem formulation, theoretical construct, discussion, conclusion), P. K. Mishra (literature review, methodology, data analysis, interpretation, and conclusion), and M. K. Sarangi (literature review, theoretical construct, discussion, conclusion, and references).

Conflict of Interest

There is no conflict of interest.

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