



## The impact of crude oil prices on economic growth of India: An analytical view

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### Abstract

The present paper aims at exploring the impact of international crude oil prices on the economic growth rate of India based on monthly observations spanning January 2000 to December 2022 using ordinary least-square (OLS) regression mechanism. The findings unveil that an increase in crude oil prices exert significant negative impact on the Indian economic growth implying that if the international crude oil prices increase by one unit holding other things constant, the Indian economic growth decreases by 0.13 units. The study signifies that Indian government should attempt to minimise the country dependence on oil imports and other petroleum products for maintaining the stability in the economy.

**Jel Codes:** E31, F18, F31, F43

**Keywords:** Crude oil prices, inflation, economic growth, oil imports

### Introduction

Crude oil is the basic requirement for the industrial base and fulfils its consumption requirements. An economy may respond differently to an oil price shock based on its relative positioning as a net oil importer or exporter and also due to varying taxation structure. Although an incessant rise in oil prices has a beneficial impact on the economies of oil exporting nations (Kuboniwa, 2014) <sup>[7]</sup> but it has an unfavourable impact on the net oil importing economies for instance, unmanageable levels of inflation, declining demand due to increasing prices and mounting current account deficit consequent to adverse impact on balance of payments account. All these factors have detrimental impact on the economic growth of a nation. India being the fourth-largest oil importer has experienced a massive hike in both its oil demand and consumption since the country's economic reforms in 1991. Therefore, it is indispensable to understand the interaction between the international crude oil prices and growth rate of an Indian economy.

In the fiscal year 2023-24, India's total consumption of crude oil and petroleum products has reached 233.3 million metric tons while it was 57 million tons in 1991-1992 and 12.6 million tons in 1965. However, in the current fiscal year (FY-24), the country domestically produced 29.4 million metric tons of crude oil which has remained unchanged almost from 29.2 million metric tons of production in the previous year. Thus, in the current study, an effort is being made to evaluate the link between international crude oil prices and economic growth in India.

### Literature Review

For making an assessment of the link between international crude oil prices and economic growth of India, it is essential to have a review of earlier studies. A few studies are being discussed chronologically as below:

Hamilton (1983) <sup>[6]</sup> analysed the influence of international oil prices on the US economy following World War II using annual dataset spanning 1948 to 1972. The study provided the evidence that the oil price shocks caused the recessions in the US prior to 1972.

Bhattacharya and Bhattacharya (2005) <sup>[1]</sup> conducted the study to examine the influence of hike in oil prices on inflation rate prevailing in India. The authors investigated the impact of rising petroleum product prices on the prices of other commodities as well as the output in India.

Blanchard and Gali (2007) <sup>[3]</sup> pointed out that the dynamic impact of oil shocks has significantly diminished over time because of an integration of monetary policy innovations, increasingly flexible labour markets and a declining share of oil in the manufacturing sector.

Al-mulali and Sab (2010) <sup>[2]</sup> examined the effect of oil price shocks on economic growth (GDP) of Qatar using annual data series over the period 1970-2007 that includes all oil shocks. The study found a long-run positive impact of oil prices on the economic growth of Qatar.

Ogundipe and Ogundipe (2013) <sup>[9]</sup> scrutinised the link between global oil price and exchange rate of Nigeria using Vector error correction mechanism. The study unveiled a negative relationship between the price of crude oil and the Nigerian exchange rate volatility.

Ogboru *et al.* (2017) <sup>[8]</sup> investigated the impact of fluctuations in crude oil prices on Nigeria's economic growth based on annual time-series data spanning 1986 to 2015. It has been discovered that the prices of crude oil positively affect the growth of the Nigerian economy.

Considering the above review of earlier studies, the current study attempts to examine the impact of international crude oil price on the domestic country's economy i.e., Indian economy.

### Objectives of the Study

1. To identify if the crude oil prices have an impact on economic growth of India.
2. To explore the linkage between crude oil prices and economic growth of Indian economy.

### Data Description

This study seeks to investigate the influence of international crude oil prices on economic growth of India based on the monthly observations spanning January 2001 to December

2022. The figures have been retrieved from reliable secondary sources such as official websites of Federal Reserve Bank of St. Louis and Reserve bank of India. The crude oil prices are the spot prices in real terms measured in US dollar per barrel and the monthly data on GDP is not available and economic growth is proxied by Index for Industrial Production symbolized as IIP. Whole analysis has been performed considering natural logarithms of the series.

**Research methodology**

**Unit root tests**

The verification regarding the stationary behaviour of considered datasets has been done using the ADF (Augmented Dickey and Fuller, 1979) [4] and PP (Phillips-Perron, 1988) [10] unit root tests. The analysis of stationarity of the series is based upon the following equations

$$\Delta Y_t = \alpha_1 Y_{t-1} + \sum_{m=1}^n \beta_m \Delta Y_{t-m} + \mu_t \dots \dots \dots (1)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \sum_{m=1}^n \beta_m \Delta Y_{t-m} + \mu_t \dots \dots \dots (2)$$

Where, Δ stands for first difference operator, α<sub>0</sub> is intercept or constant, Y<sub>t</sub> is a time series, n denotes optimum lag length for dependent variables and μ<sub>t</sub> is error term which is

pure white noise. Likewise, the following regression models have been used to explain the Phillips-Perron (PP) test

$$Y_t = \alpha + \beta Y_{t-1} + u_t \dots \dots \dots (3)$$

$$Y_t = \alpha + \beta Y_{t-1} + \gamma \left( t - \frac{n}{2} \right) + u_t \dots \dots \dots (4)$$

Where, α represents the constant term, Y<sub>t</sub> represents the response variable, n denotes the number of observations, γ denotes the trend component coefficient and μ<sub>t</sub> denotes the white noise error term.

**Ols Regression Model**

For evaluating the influence of global crude oil prices on growth of Indian economy, ordinary least squares (OLS) regression methodology has been applied. Following is the specification of the model as expressed in equation (5)

$$Y_t = \beta_0 - \beta_1 OILP + u_t \dots \dots \dots (5)$$

Where, Y<sub>t</sub> = India’s economic growth (IIP) i.e., dependent variable  
 OILP = International crude oil prices viz., explanatory variable.

β<sub>0</sub> = Intercept term  
 u<sub>t</sub> = Disturbance term.

**Analysis and Discussion**

**Table 1: Stationarity Tests through ADF unit Root Test**

Series	Model Used	Data Level	p-value	Conclusion
OILP	Only Intercept	Levels	0.983	Non-Stationary I(1)
	With Trend and Intercept	Levels	0.768	Non-Stationary I(1)
	Only Intercept	Ist Difference	0.000***	Stationary I(0)
	With Trend and Intercept	Ist Difference	0.000***	Stationary I(0)
IIP	Only Intercept	Levels	0.575	Non-Stationary I(1)
	With Trend and Intercept	Levels	0.407	Non-Stationary I(1)
	Only Intercept	Ist Difference	0.000***	Stationary I(0)
	With Trend and Intercept	Ist Difference	0.000***	Stationary I(0)

\*\*\* shows 1% level of significance

In an effort to explore the stationarity of both the series, that is, oil prices (OILP) and economic growth (IIP), the

analysis is being firstly performed using ADF and PP unit root tests.

**Table 2: Stationarity Tests through PP unit Root Test**

Series	Model Used	Data Level	p-value	Conclusion
OILP	Only Intercept	Levels	0.983	Non-Stationary I(1)
	With Trend and Intercept	Levels	0.768	Non-Stationary I(1)
	Only Intercept	Ist Difference	0.000***	Stationary I(0)
	With Trend and Intercept	Ist Difference	0.000***	Stationary I(0)
IIP	Only Intercept	Levels	0.575	Non-Stationary I(1)
	With Trend and Intercept	Levels	0.407	Non-Stationary I(1)
	Only Intercept	Ist Difference	0.000***	Stationary I(0)
	With Trend and Intercept	Ist Difference	0.000***	Stationary I(0)

\*\*\* shows 1% level of significance

The observations derived from both ADF and PP unit root tests are reported in Table 1 and 2 respectively, suggest that both the data series that is, crude oil prices (OILP) and economic growth of India (IIP) have a unit root problem at levels with intercept as well as with trend and intercept.

However, the variables have been found stationary after taking their first difference and both data series are Integrated at I [1]. Having confirmed the integration order, subsequently OLS approach has been applied.

**Table 3:** Estimated OLS parameters for Crude Oil Prices and Economic Growth of India

Variables	Coefficient	Std. Error	t-Statistic	P-value.
C	5.486	0.124	44.07	0.000
OILP	-0.139***	0.030	4.551	0.003
R-squared	0.612	AIC	1.132	
Adj. R-squared	0.605	SBC		1.175
F-statistic	15.02	HQC		1.149
Prob. (F-stats.)	0.000	Durbin-Watson (DW) value		1.855

\*\*\* shows 1% levels of significance

Thus, the estimated equation for the OLS model can be stated as follow:

$$IIP = 5.486 - 0.139 \cdot OILP + u_t \dots\dots\dots (6)$$

Table 3 exhibits the derived regression model which explain the impact of international crude oil prices on economic growth of India. The results bring out that crude oil prices exert a negative influence on Indian economic growth at 1% level of significance. It is observed that if the international crude oil prices increase by one unit holding the other things constant, the Indian economic growth decreases by 0.13 units. The reason being that India is an oil-dependent economy and all its major sectors such as manufacturing, automobile, mining, airline industry, transportation sector etc. are highly dependent on oil consumption. Thus, a hike in oil prices have resulted into sky rocketing inflation rates in the domestic nation. As a consequence, there is an adverse impact of any hike in crude oil prices on the growth and expansion of the Indian economy.

Besides, both R<sup>2</sup> and adjusted R<sup>2</sup> values indicate that the variations in Indian economic growth is nicely explained by the explanatory factor included in the model i.e., international crude oil prices. Additionally, the Durbin-Watson statistic is close to 2 which implies the absence of autocorrelation in model.

Further, robustness of the derived OLS model has been checked by means of few residual diagnostic tests namely, Breusch-Godfrey Serial Correlation LM test, Breusch-Pagan-Godfrey Heteroskedasticity test, Ramsey RESET test and Jarque-Bera test for normality as shown in Table 4.

**Table 4:** Diagnostic tests results

Diagnostic Test	F-statistics	p-value
Normality Test (Jarque-Bera)	2.723	0.256
Breusch-Godfrey Serial Correlation LM Test	0.131	0.271
Breusch-Pagan-Godfrey Heteroskedasticity Test	1.352	0.368
Ramsey RESET Test	0.113	0.641

The results highlight that the selection of OLS model is quite robust and is good fit since the p-value is above 0.05 in each of the four cases.

**Conclusion**

The study focuses on scrutinising the impact of international crude oil prices on the growth of Indian economy based on monthly observations spanning January 2000 to December 2022 using ordinary least-square (OLS) regression mechanism. The explained variable taken into account is the economic growth of India which has been proxied using Index for Industrial Production (IIP). Likewise, the explanatory variable considered is spot crude oil price (OILP) which is measured in US dollar per barrel. To begin

with, both series have been transformed into natural logarithmic form. The stationarity features have been checked through ADF and PP unit root tests and the results bring out that both the series have unit root problem (non-stationary) at levels and are stationary at first difference i.e., I(1). Having confirmed the integration order, subsequently OLS approach has been employed.

In line with the objectives of the study, it is evident from the findings that crude oil prices exert significant negative influence on the economic growth of India and this relationship is significant at 1% level of significance. The results unveil that if the international crude oil prices increase by one unit holding other things constant, the Indian economic growth decreases by 0.13 units. The reason being that India is an oil-dependent economy and all its major sectors such as manufacturing, automobile, mining, airline industry, transportation sector etc. are highly dependent on oil consumption. Thus, a hike in oil prices have caused significant hike in inflation rates in the domestic nation. As a consequence, there is an adverse impact of a rise in crude oil prices on the growth and expansion of the Indian economy.

In addition, both R<sup>2</sup> and adjusted R<sup>2</sup> values indicate that the variations in Indian economic growth is nicely determined by the explanatory factor included in the model i.e., international crude oil prices and the model stands a good fit. Further, robustness of the underlying OLS model has been checked by means of some residual diagnostic tests namely, Breusch-Godfrey Serial Correlation LM test, Breusch-Pagan-Godfrey Heteroskedasticity test, Ramsey RESET test and Jarque-Bera test for normality, the results for which confirmed the model’s robustness as the p-value is above 0.05 in each of the four tests. In nutshell, the findings bring out that increasing crude oil prices lead to fuelling of the inflation rates and diminishing the purchasing power of people in domestic nation which eventually limits the potential of economic growth in India. Thus, it is suggested that Indian government should intensify efforts to minimise the country dependence on oil imports in order to ensure the expansion as well as stability in the Indian economy. Additionally, it is recommended that attempts should be made to switch to other means of energy.

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