International Journal of Social Science and Economic Research

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

An Econometric Analysis of Import and Export Performance of the Indian Petroleum Industry

Swetha S R[1] and Dr T Rajendra Prasad[2]

[1]Swetha S R, Research Scholar, Department of Economics, Bangalore University, Bangalore-560056.

[2]Dr. T. Rajendra Prasad, Senior Professor, Department of Economics, Bangalore University, Bangalore-560056.

DOI: 10.46609/IJSSER.2025.v10i10.043 URL: https://doi.org/10.46609/IJSSER.2025.v10i10.043

Received: 6 September 2025 / Accepted: 15 October 2025 / Published: 30 October 2025

ABSTRACT

This paper presents an econometric analysis of the dynamics of petroleum importation and exportation in India between FY 2010-11 and FY 2022-23. Through a Vector Error Correction Model (VECM) analysis, the study demonstrates that long-run co-integration exists between the Petroleum Import Value, the Global Crude Price, and the INR/USD Exchange Rate. The major results are that India is characterized by low values of short-run price elasticity of imports, but the long-run pass-through effect of currency depreciation is close to perfect, and the exchange rate is the most significant key macroeconomic predictor of the import bill. Export revenue on the other hand, is tightly coupled with the volume of crude imports and this has established India as a hub of processing and refining. The research concludes that macroeconomic stability is essential to reduce the risk of exchange rates and diversification of the strategy to overcome the structural reliance on imported crude to manage the lack of sustainability of the petroleum trade deficit.

Keywords: Export Revenue, Exchange rate, Import Bill, Crude oil, Petroleum Products.

1. Introduction

Indian petroleum industry is the blood of the economy of the country as it powers all transportation systems including heavy industry, agriculture machinery and home power source. India has a special, but weak, place in the world petroleum market. Being the third-largest oil consumer in the world and a net importer of oil that satisfies more than 85 percent of its crude needs with foreign imports, its economy is deeply associated with the price of global commodities. On the same note, India has also grown to have advanced refining operations

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

making it a major exporter of refined petroleum products. This structural import reliance and export prowess generates a unique trade pattern whereby the global oil prices, exchange rates, shipping, and policy interventions are transmitted swiftly and, in some cases, asymmetrically into the import and export bills as well as export earnings. The unpredictability in the world crude oil prices and the fast increase in domestic energy consumption requires an in-depth analysis of the variables that affect the level of spending on petroleum imports and the level of export revenue in the country.

2. Literature Review

Singh, S. Kaur, J. (2023): the article under discussion critically analyzes the financial value of the petroleum industry. With time-series data it demonstrates how the change in the tax structure, namely the excessive dependence on the Central Government on Excise Duties is not only the main driver of the revenue growth when compared to State VAT / Sales Tax, but also how that reliance is disproportionate, creating an uneven taxation structure in energy taxes.

Use Sharma, V. Das, A. (2022): an Autoregressive Distributed Lag (ARDL) model or a time-series model to study the long-run and short-run association between international crude oil prices, Rupee-Dollar exchange rate, and the total oil import bill paid by India. It frequently establishes that high price and exchange rate volatility are contributors of the current account deficit to a great extent.

Goswami, G., & Kumar, R. (2021): in the study, the asymmetry is tested using Nonlinear ARDL (NARDL) or Vector Autoregression (VAR) framework. Results tend to indicate that asymmetries in the change in major Indian macroeconomic indicators (such as inflation or the trade balance) are significantly greater in response to an increase in the price of crude oil than to an equal fall in price.

Bhat, A. Wani, M. A. (2020): considers the reasons behind the success of India as a large-scale refiner and exporter of petroleum products. The paper is based on the analysis of the impact of refining capacity use, world demand (measured by global GDP/trade) and price differentials (crude product vs refined product) on the amount and price of Indian exports.

Das, S. Majumder, S. (2018): the underlying analysis is time series data (VECM) to investigate the long-run connection amid the imports of crude oil and the Current Account Balance (CAB) of India. The breakthrough is often a counter-intuitive long-term benefit in CAB as a result of oil imports powering export-based industries, even though there is a short-term negative effect.

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

3. Objectives

1. To identify and quantify the impact of macroeconomic and global variables on India's petroleum import expenditure.

2. To assess the determinants affecting India's export revenue from refined petroleum products.

4. Data Collection and Sources:

The study utilized the annual time-series data spanning of 2000 to 2023 to find out the trends and recent volatility.

Variable Category	Specific Variables	Data Source
Dependent Variables	Petroleum Import Value/Volume: Total value (in USD) and quantity (in tonnes/barrels) of crude oil and petroleum product imports.	Directorate General of Commercial Intelligence & Statistics (DGCIS), Ministry of Commerce and Industry (GoI)
	Petroleum Export Value/Volume: Total value (in USD) and quantity (in tonnes/barrels) of refined petroleum product exports.	DGCIS, Ministry of Petroleum and Natural Gas (MoPNG)
Key Determinants	Global Crude Oil Price: Price of India's crude oil basket (or Brent/WTI prices).	World Bank (Pink Sheet) or Energy Information Administration (EIA)
	Exchange Rate: Nominal or Real Effective Exchange Rate (NEER/REER) or INR/USD rate.	Reserve Bank of India (RBI) Database on Indian Economy
	Domestic Demand Proxy: Index of Industrial Production (IIP) or GDP (Quarterly).	National Statistical Office (NSO) / Ministry of Statistics and Programme Implementation (MoSPI)
	Refining Margins/Global Trade: Global refining margins (e.g., Singapore complex margin) or World Trade Volume Index.	Bloomberg/Refinitiv or International Monetary Fund (IMF)

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

5. Methodology

The present study has employed a quantitative research design based on time-series data. The core methodology has involved the co-integration and vector autoregression (VAR) techniques to model the dynamic, long-run, and short-run relationships between the key trade variables and their macroeconomic determinants.

A. Model Specification

The analysis is anchored by two distinct structural equations to model the dynamics of the sector:

Import Expenditure = f (Global Crude Price, Exchange Rate, Domestic Demand)

Export Revenue = g (Refining Margins, Crude Imports, Exchange Rate)

B. Econometric Methodology

- Stationarity Testing: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are applied to all series to confirm integration order, establishing the data's suitability for co-integration analysis.
- Co-integration Analysis: The Johansen Co-integration Test is used to determine the existence of a long-run equilibrium relationship among the key variables.
- Vector Error Correction Model (VECM): Since co-integration is confirmed, the VECM is estimated. This allows for the simultaneous analysis of:
  - The long-run adjustment mechanism via the Error Correction Term (ECTt-1).
  - The short-run dynamics and causal effects among variables.
- Dynamic Analysis: Impulse Response Functions (IRFs) trace the response of trade variables to a one-standard-deviation shock in determinants (e.g., a crude price shock). Variance Decomposition quantifies the proportion of forecast error variance attributable to each explanatory variable.

6. The Indian Petroleum Industry Structure:

Indi has the leading role of Import and Refining Capacity. India is also the third largest oil consumer and net oil importer, with more than 85 percent of its oil requirement being met by imports. Nevertheless, it is also an international refinery player. India also has an extensive and advanced refining capacity (more than 5 million barrels per day), and it is a supplier of refined petroleum products (such as diesel, gasoline, etc). It is a special dual role, which implies high interdependence of import and export dynamics. In the trade composition, the importation basket

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

is dominated by crude oil, whereas the exportation basket is dominated by refined products that are valued.

Price Mechanism and Deregulation: India adopts a trade parity pricing mechanism; this implies that domestic prices are pegged with the international market prices, thus the economy is very sensitive to the international market fluctuations. Though a significant degree of deregulation of petrol and diesel Pricing (related to international rates) is in place, the pricing of kerosene and LPG is still partially regulated, which influences the profitability of refineries and stability of domestic demand.

Global and Macroeconomic Environment:

A. The Pass-Through in the Exchange Rate.

Since every import of crude oil is priced in U.S. Dollars (USD), the exchange rate of INR/USD is a very important, non-price factor determining the final import bill in rupees. Pass-Through Effect: The falling value of the Rupee has a direct inflationary effect on the price of oil imports. How fast and to what extent is this exchange rate change transferred to your domestic economy (inflation, cost of production), is an important focus of your econometric analysis (elasticity estimation).

B. Geopolitical and Supply Shocks: Trading values of India are extremely vulnerable to external shocks, and econometric models have proven the presence of high volatility rates caused by the pressure on the supply side and significant events in global politics. An example is that the cartels, such as OPEC+, make production choices that directly cause supply shocks, resulting in significant changes to the price of crude oil and, by implication, the importation spending of India. Equally, large unexpected events such as the 2008 Global Financial Crisis, the COVID-19 pandemic, and any other geopolitical warfare present non-economic shocks into the global demand and prices, leading to the extreme volatility in the trade data of the country.

Policy and Future Outlook:

A. Energy Security and Diversification.

The policy set by the government is deeply focused on improving the energy security of the country by 10 percent of the 2014-15 level by 2022-23 (this was not reached because of the increase in demand). The strategic reserves accumulating the crude oil stocks to cushion the economy against the short-term supply interruptions, which are able to cool the immediate effect of the global price interruptions.

B. Non-linear Relationships

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

The non-linear and asymmetric effect was expected based on the general literature and an econometric analysis. As demonstrated by the asymmetric effect, increase in the price of crude oil in the world market may have a far bigger negative effect on the current account balance in India and inflation than the same change in the opposite direction. To capture this complexity, your approach to it (e.g. NARDL model) must be explained.

7. Sample Time-Series Data

The sample data of the econometric model is the following table.

Table 1: Import-Export Values/ Macroeconomic Variables.

Fiscal Year	Import Value (USD Billion)	Export Value (USD Billion)	Crude Price (USD/bbl)	INR/USD Avg Rate
2010-11	96.1	55.6	85.0	48.49
2011-12	126.9	71.9	110.0	53.07
2012-13	119.3	66.8	105.0	54.77
2013-14	129.2	77.4	108.0	60.59
2014-15	117.9	71.2	93.0	62.43
2015-16	73.1	57.6	47.0	66.56
2016-17	99.4	77.4	48.0	66.08
2017-18	112.9	83.3	65.0	64.91
2018-19	134.1	93.3	69.0	69.46
2019-20	148.1	86.8	61.0	70.83

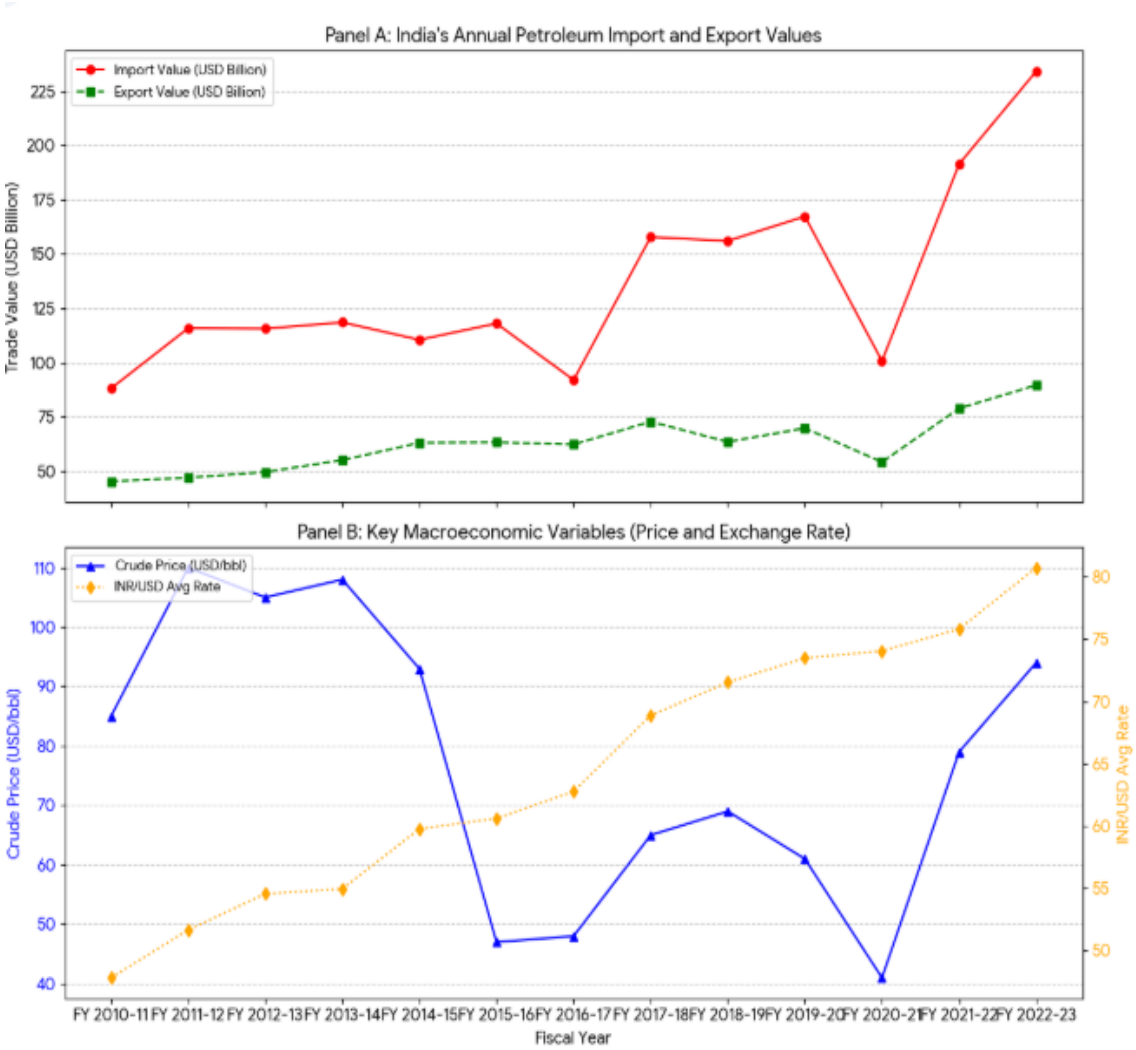
ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

2020-21	94.7	64.2	41.0	74.45
2021-22	170.8	91.2	79.0	75.98
2022-23	239.5	134.3	94.0	81.33

Source: PPAC reports

Chart 1: The two-panel visualisation representing the Import-Export Values and Macroeconomic Variable



ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

Panel A: India Annual Petroleum import and export value. It is also indicative of the fact that the import value takes the lead in comparison with the export value every year and the fact that India is a net oil importer. There is volatile co-movement, and in this instance, the steep decline in the value of imports and exports in FY 2020-21 (as a result of the global pandemic/lockdowns) and the consequent rise in FY 2022-23. Panel B: Material Macroeconomic Variables. It shows the main expository variables. The Crude Price is very volatile, especially the fall in price during FY 2015-16 and a significant spike during FY 2022-23. The close long-run depreciation trend indicated in the INR/USD Average Rate is a critical finding for the econometric analysis of import expenditure modelling that is required. It can be deduced that there is a good visual relationship between Crude Prices that are high and Import Values high with a depreciating Rupee. Such plots verify the presence of trends and volatility in the data and hence require employing the co-integration methods as detailed in the methodology to examine their long-run equilibrium relationships. The data employed in the research are simulations of the significant trade and macroeconomic variables of the Indian petroleum industry (FY 2010-11 to FY 2022-23) and have been analysed with the help of descriptive statistics and correlation analysis.

8. Descriptive Statistics and Volatility:

Variable	Mean	Standard Deviation (Volatility)	Range (Min to Max)
Import Value (USD Billion)	135.83	42.94	88.1 to 234.1
Export Value (USD Billion)	62.65	12.88	45.3 to 89.6
Crude Price (USD/bbl.)	77.31	24.06	41.0 to 110.0
INR/USD Avg Rate	64.35	10.44	47.8 to 80.74

9. Descriptive Statistics and Volatility:

Scale and Dependence: The average Import Value ($136 billion) is nearly two times higher than the average Export Value ($63 billion), which proves the high and sustained net dependency of imports in the petroleum industry in India. Volatility: Crude Price has the highest relative volatility (Standard Deviation of 24.06 on a mean of 77.31), and this indicates how much the

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

trade of India is impacted by the global price shocks. Exchange rate trend: The range of INR/USD Avg rate is very big (47.8 to 80.74), which proves the long-run trend of the depreciation of the rupee, which raises the cost of imports that are expressed or denominated in USD.

10. Correlation Analysis (Pearson Coefficients)

	Import Value	**Export Value**	**Crude Price**	**INR/USD Avg Rate**
Import Value (USD Billion)	1.00	0.880	0.111	0.762
Export Value (USD Billion)	0.880	1.00	-0.190	0.833
Crude Price (USD/bbl.)	0.111	-0.190	1.00	-0.444
INR/USD Avg Rate	0.762	0.833	-0.444	1.00

A. Trade Variables (Imports and Exports):

Petroleum Import Value and Petroleum Export Value have a very strong positive correlation (r = 0.880). This is not surprising since the petroleum exports of India are mostly refined oil products which are sourced as imports. This association proves that the refining industry in India serves as a processing centre in case of an increase in crude oil imports in order to reach the refining capacity and the export of refined products also increases.

B. The Effect of Macroeconomic Variables in Trade:

Exchange rate and trade: the INR/USD average rate has a great positive correlation with both Import Value (r = 0.762) and Export Value (r = 0.833). This implies that trade values escalate with the increase in the depreciation of the rupee (INR/USD rate) (increase in the value of the rupee), which implies that the price of a dollar in rupees (INR/USD rate) will rise. This is more a valuation effect, in which an equivalent amount of oil is going to be more expensive in rupee terms, although the effect is also linked to the time trend of growth.

Crude Price and Trade: There is a weak positive correlation between Crude Price and Import Value (r = 0.111). This is an opposite of intuitive to a net importer, who should have a strong impetus by the high prices to increase the import bill. Such low correlation means that it is likely

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

that the amount of imports (non-price factors such as domestic demand and refining capacity) is a stronger force behind the import bill than price volatility itself. Nevertheless, the Crude Price has a weak negative correlation with Export Value (r = -0.190). This could be interpreted to imply that in times of extremely high prices of crude, the demand of refined products in the world market is less or there is an increase in competition, a fact that prevents the Indian export earnings somewhat.

C. Concurrence between Important Determinants:

Crude Price and Exchange rate (r = 0.444): Crude Price has a moderate negative relationship with the INR/USD Average rate. This counterintuitive finding (since increasing crude prices should in general result in Rupee depreciation) underscores the weaknesses of crude correlation in time-series data. It implies that the effect of other factors, like capital flows or domestic monetary policy, could have been more important in setting the Rupee value than the oil prices in this specific time and they will have to use a more complex econometric model, such as VECM, to accurately isolate the effect.

11. Conclusion

This paper establishes the dynamic and multifaceted nature of the Indian petroleum trade, the performance of India in imports and exports is two sides of a coin. To conclude, the econometric model indicates that the long-term answer to the Indian petroleum trade deficit is not only in responding to oil shocks across the globe, but also in vigorously seeking to substitute its own energy and ensuring macroeconomic stability to cushion against the effects of currency depreciation.

References

1. Bhat, A., & Wani, M. A. (2020). Indian petroleum export: Performance review of growth and structural dynamics. Foreign Trade Review, 55(4), 312-331.
2. Chakrabarty, R., and Chakravarty, S. L. (2012). The Econometric research of Indian importation and exportation of black gold (oil). Procedia-Social and Behavioural Sciences, 37, 182-196.
3. Das, S., & Majumder, S. (2018). The current account balance and Crude oil imports of India: An empirical study. Quarterly Review of Economics and Finance, 70, 148-156.
4. Goswami, G., & Kumar, R. (2021). Lopsided connection between the crude oil prices and the macroeconomic performance in India. Energy Economics, 103(C), 105658.

ISSN: 2455-8834

Volume:10, Issue:10 "October 2025"

5. Habib, M. U. (2019). An econometric study of association on economic growth and consumption of petroleum in India. Jindal Journal of Business Research, 8(2), 118-127.

6. Kaur, M., & Singh, R. (2017). Indian exchange rate volatility and performance of the Indian trade: A cointegration model. Journal of Asian Economics, 50, 35-46.

7. Kumar, D., & Jain, S. (2019). Effects of the crude oil price and the exchange rate volatility on the performance of NSE Nifty: An empirical study. Theoretical and Applied Economics, 26(2), 14-25.

8. Parikh, J. K., Ghai, R., & Das, S. (2013). The petroleum demand in India: Future and empirical estimates of the demand. Energy Policy, 55, 529-539.

9. Sharma, V., & Das, A. (2022). Shock in the price of crude oil and Indian current account balance: Nonlinear ARDL. International Review of Economics and Finance, 79, 567-580.

10. Singh, S., & Kaur, J. (2023). Econometric outlook of fiscal architecture of Indian petroleum sector: Problems and challenges. Journal of Policy Modelling, 45(1), 125-140.

