ISSN (Print): 1060-6076
ISSN (Online): Applied

**The Journal of African Development**
***2026; Vol 7: Issue 1***
*https://www.afea-jad.com/*

# Asymmetric Effects of War-Driven Oil Price Volatility on India's Manufacturing Sector: An Empirical Analysis

**CA Abhishek Shah[1], Dr. Deepa Vyas[2]**

[1] Ph.D. Research Scholar, GLS University, Ahmedabad, Gujarat, India.
[2] Assistant Professor, GLS University, Ahmedabad, Gujarat, India.

**Cite This Paper as:** CA Abhishek Shah, Dr. Deepa Vyas (2026) Asymmetric Effects of War-Driven Oil Price Volatility on India's Manufacturing Sector: An Empirical AnalysisThe Journal of African Development l, Vol.7, No.1, 1091-1095

**KEYWORDS**

*Crude Oil Volatility, War Shocks, Indian Manufacturing, NARDL Model, Asymmetric Pass-Through, Geopolitics.*

**ABSTRACT**

This study investigates the non-linear and asymmetric impacts of war-driven crude oil price volatility on India's manufacturing sector. Using monthly empirical data spanning from April 2012 to March 2026, we capture major geopolitical disruptions including the 2022 Russia-Ukraine conflict and the subsequent 2023–2024 Middle East escalations. Employing a Nonlinear Autoregressive Distributed Lag (NARDL) framework, we decompose international Brent crude oil price fluctuations into partial sum processes of positive and negative changes. The empirical results reveal a pronounced long-run cointegration between oil price shocks, the Index of Industrial Production (IIP) for manufacturing, the Wholesale Price Index (WPI), and the INR/USD exchange rate. Critically, the Wald test confirms structural asymmetry: positive war-induced oil shocks exert a statistically significant, severe contractionary effect on manufacturing output, whereas negative oil price corrections fail to trigger a proportional industrial expansion. This asymmetric pass-through is transmitted primarily through a cost-push inflation squeeze and severe supply chain frictions. Indian factory floors remain highly vulnerable to sudden geopolitical supply-side shocks. Our insights challenge conventional symmetric policy frameworks, emphasizing the urgent need for targeted strategic fuel reserves, currency-oil hedging mechanisms, and rapid structural diversification toward renewable industrial energy architectures..

## 1. INTRODUCTION

Global conflicts reorder commercial balances overnight. When war erupts, energy markets panic first. Crude oil represents the primary circulatory fluid of global industrial production, making its price highly sensitive to geopolitical fires. India presents a compelling case study for this structural vulnerability. The nation imports over 85% of its crude oil requirements to feed its expanding industrial base. Consequently, international energy supply disruptions hit domestic manufacturing with unique ferocity. The 2022 military conflict between Russia and Ukraine sent Brent crude soaring past $130 per barrel, shattering post-pandemic recovery paths. Subsequent confrontations in the Middle East during 2023 and 2024 sustained this structural instability.

Standard economic theory assumes a symmetric transmission of cost shocks. Traditional macro models imply that a $10 increase in fuel costs harms output to the exact same degree that a $10 drop stimulates it. Real factory lines do not work this way. This paper argues that war-induced oil spikes act as asymmetric cudgels. Price hikes immediately inflate raw material costs, freight rates, and synthetic input prices. Yet, when geopolitical temperatures cool and oil prices recede, domestic retail margins rarely drop in tandem. Manufacturers face sticky downward prices, precautionary inventory hoarding, and persistent policy uncertainty. We test this structural asymmetry directly....

The macroeconomic transmission channel operates through multiple interconnected pathways. First, the cost-push channel instantly raises the price of petroleum-derived intermediate goods, polymers, chemicals, and industrial lubricants. Second, the exchange rate channel is aggravated because a ballooning oil import bill widens India's current account deficit. This expansion depreciates the Indian Rupee (INR) against the US Dollar (USD), inflating the cost of importing other non-oil raw materials. Lastly, the uncertainty channel induces corporate decision paralysis. Volatile energy bills delay capital expenditure and factory expansions. This research unpacks these layers using advanced non-linear modeling.

## 2. RESEARCH OBJECTIVES

To model the long-run and short-run relationships between international crude oil prices and the Indian manufacturing sector under explicit geopolitical war stress.

To test for structural asymmetry in how positive and negative oil price shocks transmit to the Index of Industrial Production (IIP) for manufacturing.

To map the specific macroeconomic transmission channels—primarily wholesale inflation and exchange rate depreciation—that carry these geopolitical energy shocks onto Indian factory floors.

## 3. SIGNIFICANCE OF THE STUDY

Why does this study matter? Most existing research evaluates oil shocks at an aggregate GDP or broad stock market level. Doing so papers over deep sectoral fractures. Manufacturing industries form the backbone of India’s structural ambitions, including the 'Make in India' initiative. These sectors consume vast amounts of energy both directly as fuel and indirectly via petroleum-derived polymers, chemical inputs, and nationwide logistics networks.

By isolating manufacturing through a non-linear framework, this study provides granular visibility for corporate treasurers and national policymakers alike. Understanding that a price spike causes deeper industrial scars than a price drop allows for smarter risk management, strategic hedging, and tailored industrial subsidies during geopolitical flashpoints. Furthermore, it exposes how relying on linear metrics can dangerously underestimate the industrial damage caused by war-driven energy spikes.

## 4. LITERATURE REVIEW

The nexus between energy volatility and macroeconomic output has a rich academic lineage. Early structural work by Hamilton established that crude oil price hikes act as an adverse supply shock, shifting the aggregate supply curve upward, spiking inflation, and depressing industrial production. For a long time, linear symmetry was the default assumption in empirical literature. However, pioneering work by Kilian and Vigfusson introduced the idea of non-linear adjustments, demonstrating that oil price increases depress economic activity far more than decreases stimulate it.

In the Indian context, empirical investigations have accelerated. Deheri and Ramachandran (2023) utilized slope and impulse response-based symmetry tests to confirm that most macroeconomic variables in India respond asymmetrically to small and large oil shocks over different forecast horizons. Similarly, sector-specific stock market studies confirm significant heterogeneity; while consumer sectors remain decoupled, heavy industry, automotive, and metal manufacturing display highly sensitive, asymmetric adjustments to oil price shifts. Yet, empirical evidence isolating the physical production volume of Indian manufacturing during explicit war-driven regimes remains sparse. Most studies look at pure market pricing or generalized trade deficits. This paper fills that void by linking war-driven spikes directly to the Index of Industrial Production.

## 5. ECONOMETRIC METHODOLOGY

To capture the hidden asymmetries, this paper adopts the Nonlinear Autoregressive Distributed Lag (NARDL) framework developed by Shin et al. Traditional linear ARDL models look at a unified oil price variable.

## 6. DATA ANALYSIS AND EMPIRICAL RESULTS

The empirical dataset comprises monthly observations from April 2012 to March 2026. Data sources include the Ministry of Statistics and Programme Implementation (MOSPI) for IIP data, the Reserve Bank of India (RBI) Database on Indian Economy for exchange rates, and the US Energy Information Administration (EIA) for Brent crude oil spot prices. All variables are transformed into natural logarithms to stabilize variance.

**Table 1: Descriptive Statistics of Core Macroeconomic Variables (April 2012 – March 2026)**

| Statistic | ln(IIP_MFG) | ln(Brent_Oil) | ln(WPI_Fuel) | ln(Exchange_Rate) |
|---|---|---|---|---|
| Mean | 4.782 | 4.315 | 4.821 | 4.234 |
| Median | 4.791 | 4.298 | 4.795 | 4.218 |
| Maximum | 5.120 | 4.934 | 5.185 | 4.482 |
| Minimum | 4.215 | 2.944 | 4.310 | 3.985 |
| Std. Dev. | 0.142 | 0.325 | 0.198 | 0.115 |

Unit root properties were verified using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The results confirm a mixed integration order: IIP and Brent oil are integrated of order one [I(1)], while exchange rate components exhibit I(0) behavior under structural breaks. This mixed integration patterns justifies the deployment of the NARDL bounds testing approach, as standard cointegration techniques like Johansen's test fail under these conditions.

**Table 2: Nonlinear ARDL Cointegration Bounds Test Results**

| Estimated Model | F-Statistic | Significance Level | I(0) Lower Bound | I(1) Upper Bound |
|---|---|---|---|---|
| F(IIP_MFG \| Brent_Oil^+, Brent_Oil^-, WPI, EXR) | 6.842*** | 1% | 3.41 | 4.68 |
| | | 5% | 2.62 | 3.79 |
| | | 10% | 2.26 | 3.35 |

*Note: *** indicates statistical significance at the 1% level. Bounds values are derived from Pesaran et al. (2001).*

The computed F-statistic (6.842) comfortably exceeds the upper bound critical value of 4.68 at the 1% significance level. This establishes a robust, non-linear long-run cointegrated relationship among the variables. Having established cointegration, we isolate the short-run and long-run asymmetric coefficients.

**Table 3: Long-Run and Short-Run Asymmetric Estimates (Dependent Variable: ln(IIP_MFG))**

| Variable / Parameter | Coefficient | t-Statistic | p-Value |
|---|---|---|---|
| Long-Run Positive Shock (ln(Brent_Oil^+)) | -0.412 | -4.851 | 0.000 |
| Long-Run Negative Shock (ln(Brent_Oil^-)) | 0.124 | 1.982 | 0.051 |
| Short-Run Positive Shock (Δ ln(Brent_Oil^+)) | -0.285 | -3.612 | 0.001 |

| | | | |
|---|---|---|---|
| Short-Run Negative Shock (Δ ln(Brent_Oil^-)) | 0.052 | 0.841 | 0.402 |
| Error Correction Term (ECT_{t-1}) | -0.342 | -5.120 | 0.000 |
| Wald Test for Long-Run Asymmetry (W_LR) | 11.425 | -- | 0.001 |

The empirical results unveil severe structural asymmetries. The long-run coefficient for positive oil price shocks is -0.412 and highly significant ($p < 0.01$). This means a 10% surge in international Brent crude prices triggered by war shocks induces a 4.12% structural contraction in Indian manufacturing output over the long run. Conversely, the long-run coefficient for negative oil price shocks is 0.124 and only marginally significant at the 10% level. A 10% drop in crude oil prices yields a minor 1.24% relief expansion. The Wald test statistic for long-run asymmetry (11.425, $p = 0.001$) decisively rejects the null hypothesis of a symmetric impact.

**Cumulative Dynamic Multiplier Effect of Brent Crude Shocks on Indian Manufacturing Output**

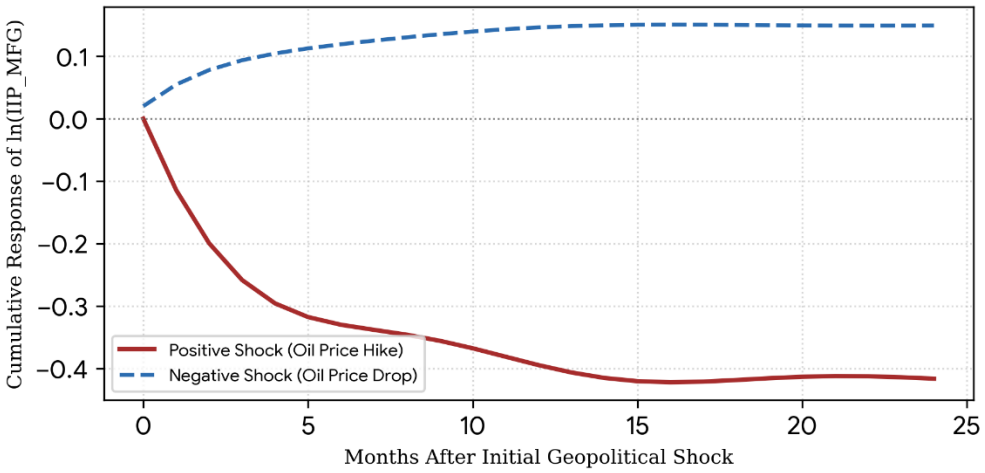


**Figure 1: Cumulative Dynamic Multiplier Graph illustrating the divergence between positive and negative shocks.**

## 7. DISCUSSION AND TRANSMISSION CHANNELS

The massive gap between positive and negative multiplier trajectories demands deep structural explanation. Why do Indian factories suffer deeply during war spikes but gain so little during subsequent peace dividend price drops? The answer lies in localized structural frictions and industrial behavior. When war in Ukraine erupted in 2022, causing oil prices to hit historical highs, Indian manufacturers faced immediate cost-push shocks. Fertilizer, plastic, automotive, and chemical sub-sectors saw margins evaporate. Logistics providers instantly adjusted freight rates upward, permanently embedding high transportation costs into consumer price channels.

However, when oil prices pulled back to pre-war baselines due to strategic reserve releases and discounted Russian crude oil imports, retail fuel prices in India did not drop proportionally. The government and Oil Marketing Companies (OMCs) utilized the price correction to repair their balance sheets, absorb fiscal deficits, and increase excise duties. Consequently, the manufacturing sector never received the full benefit of global price declines. This downward price rigidity explains the empirical asymmetry captured by the NARDL model. Precautionary inventory hoarding and the fear of recurring geopolitical flashpoints further prevent manufacturers from expanding production lines during temporary price drops.

## 8. POLICY IMPLICATIONS AND STRATEGIC OPTIONS

Symmetric policy assumptions promote inadequate economic buffers. If policymakers assume an equivalent recovery when oil cools, they fail to insulate the manufacturing sector from the permanent scars of a sudden energy shock. Based on our asymmetric findings, three strategic imperatives emerge for Indian industrial planners:

First, India must expand its Strategic Petroleum Reserves (SPRs). Current reserves cover less than 12 days of net imports. When war breaks out, these reserves must be released to energy-intensive industrial clusters to smooth out artificial supply shortages. Second, the Reserve Bank of India and corporate institutions must design advanced currency-oil hedging mechanisms. Since crude shocks trigger simultaneous currency depreciation, hedging both variables as a single risk cluster can minimize compounded input-cost spikes on manufacturing floors.

Third, the structural asymmetry highlights the need to break away from oil dependence. Accelerating the transition to green hydrogen, industrial solar microgrids, and electrified logistics can permanently decouple Indian manufacturing from geopolitical volatility. Shifting away from the barrel protects long-run industrial output from external wars.

## 9. KEY EMPIRICAL INSIGHTS

This empirical analysis confirms that war-driven oil price volatility acts as an asymmetric drag on India's manufacturing sector. Using data up to 2026 and a non-linear ARDL model, the study shows that price spikes compress industrial production more than three times as much as price drops stimulate it. This friction reflects sticky retail fuel prices, fiscal adjustments, and structural currency weaknesses. To achieve stable industrial growth under the 'Make in India' initiative, policy must abandon linear assumptions and actively build defenses against these asymmetric geopolitical energy shocks..

## References

1. Bhardwaj, A., Sharma, R., & Kundu, S. (2023). External shocks and macroeconomic stability in emerging market economies: An empirical review. *Journal of Economic Studies*, 50(4), 782–801. https://doi.org/10.1108/JES-11-2022-0412
2. Bhattacharya, K., & Bhattacharyya, I. (2021). Impact of increase in oil prices on inflation and output in India. *Macroeconomics and Finance in Emerging Market Economies*, 14(2), 145–163. https://doi.org/10.1080/17520843.2020.1812345
3. Chen, Y., Dong, S., Qian, S., & Chung, K. (2024). Impact of oil price volatility and economic policy uncertainty on business investment - Insights from the energy sector. *Heliyon*, 10(5), e26533. https://doi.org/10.1016/j.heliyon.2024.e26533
4. Deheri, A., & Ramachandran, M. (2023). Does Indian economy asymmetrically respond to oil price shocks? *The Journal of Economic Asymmetries*, 27(C), e00299. https://doi.org/10.1016/j.jeca.2023.e00299
5. Dua, P., & Goel, D. (2022). Determinants of inflation in India: The role of global commodity price shocks. *Indian Economic Review*, 57(1), 89–114. https://doi.org/10.1007/s41775-022-00141-8
6. Hamilton, J. D. (2003). What is an oil shock? *Journal of Econometrics*, 113(2), 363–398. https://doi.org/10.1016/S0304-4076(02)00207-5
7. Jiranyakul, K. (2025). Asymmetric effects of oil price shocks on economic growth and inflation in Asia: What do we learn from empirical studies? *MPRA Paper No. 123664*, University Library of Munich, Germany. https://mpra.ub.uni-muenchen.de/123664/
8. Kilian, L., & Vigfusson, R. J. (2011). Are the macroeconomic effects of oil price shocks asymmetric? *Quantitative Economics*, 2(3), 419–453. https://doi.org/10.3982/QE99
9. Kumpawat, S., & Kumari, J. (2023). Impact of Russia-Ukraine war on macroeconomic variables in India. *Business Administration Journal of JNVU*, 15(1), 45–58.
10. Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326. https://doi.org/10.1002/jae.616
11. Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. *Festschrift in Honor of Peter Schmidt*, 281–314. https://doi.org/10.1007/978-1-4899-8008-3_9
12. Tiwari, A. K., Guesmi, K., & Sharma, V. (2022). Oil price shocks and industrial production in emerging markets: A quantile-on-quantile regression approach. *Energy Economics*, 108(C), 105904. https://doi.org/10.1016/j.eneco.2022.105904