Beyond the Deficit: An Empirical Analysis of India's Foreign Trade (1990 to 2025)

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Abstract

This paper presents a comprehensive empirical analysis of India's foreign trade dynamics spanning a 35-year period (January 1990 to December 2025). Utilizing historical data sourced from the Reserve Bank of India (RBI), this study examines macroeconomic trends encompassing aggregate merchandise exports, imports, and the resulting trade balance. Through statistical visualization and time-series analysis, we investigate the validity of traditional macroeconomic trade theories in the Indian context, specifically focusing on currency depreciation, energy dependency, and global economic shocks. The findings aim to delineate the structural drivers of India's persistent trade deficit.

Keywords: Trade Deficit, Macroeconomics, Marshall-Lerner Condition, Rupee Depreciation, Foreign Trade.

1 Introduction

India's integration into the global economy has undergone radical transformations since the economic liberalization of 1991. The trajectory of its foreign trade, characterized by a persistent merchandise trade deficit, serves as a vital barometer for the nation's macroeconomic health, domestic manufacturing competitiveness, and vulnerability to external shocks. This project seeks to move beyond surface-level deficit figures to uncover the underlying mechanics driving India's trade balance. By analyzing a longitudinal dataset and standardizing nominal figures to account for global inflation, we aim to dissect the interwoven effects of currency valuation and inelastic import dependencies, ultimately answering whether foundational economic theories hold true for the modern Indian economy.

2 Data and Methodology

The primary dataset for this study is derived from the Reserve Bank of India (RBI) Database on the Indian Economy, specifically *Table No. 32: Foreign Trade*. The raw data encompasses 429 monthly observations spanning from 1990 to 2025, detailing 20 distinct variables quantified in both Indian Rupees (Crores) and US Dollars (Millions). Crucially, observations from 2011 onwards include granular disaggregations of total trade into "Oil" and "Non-oil" components.

To prepare the data for robust statistical analysis in the `R` programming environment, several cleaning protocols were executed. Multi-row categorical headers were dynamically flattened to

create distinct, machine-readable variable names. Missing temporal identifiers were resolved by forward-filling the year across corresponding monthly rows. Finally, non-numeric characters (such as commas acting as thousand-separators) were programmatically stripped using regular expressions, allowing for the conversion of string representations into continuous numeric vectors suitable for analysis.

Crucially, to isolate real structural trends from the mathematical illusions of currency devaluation and global price changes, nominal trade figures were adjusted for inflation. Monetary values were converted into constant US Dollars, anchored to December 2025 purchasing power, utilizing the US Consumer Price Index (CPIAUCSL) from the Federal Reserve Economic Data (FRED) database. This standardization ensures our time-series analysis accurately reflects physical volume dynamics.

3 Results and Empirical Analysis

This study explores several key dimensions of India's foreign trade. The following subsections detail the empirical analysis of our primary research hypotheses.

3.1 The Exchange Rate Effect: INR Depreciation vs. Trade Competitiveness

3.1.1 Theoretical Framework

Classical macroeconomic theory, specifically the Marshall-Lerner condition, posits that the persistent depreciation of a nation's currency should theoretically improve its balance of trade. A weaker currency renders domestic exports more competitive on the global market while simultaneously making foreign imports costlier, thereby suppressing domestic import demand. Since the economic liberalization of 1991, the Indian Rupee (INR) has experienced severe, persistent depreciation against the US Dollar (USD), falling from approximately ₹20/USD to over ₹85/USD. This section empirically tests whether this historic devaluation successfully narrowed India's trade deficit.

3.1.2 Analytical Approach

To conduct a rigorous longitudinal analysis spanning 35 years, nominal trade figures must be stripped of inflationary distortion. First, an implied historical exchange rate was mathematically derived using the ratio of INR-denominated exports to USD-denominated exports. Second, the aggregate Trade Balance was converted into constant USD (anchored to December 2025 purchasing power) using the US Consumer Price Index (CPIAUCSL) retrieved from the FRED database. Standardizing the purchasing power ensures that the observed deficit growth reflects physical volume expansion rather than mere currency inflation.

A dual-axis time-series visualization was generated using `ggplot2` in `R`, superimposing the trajectory of the exchange rate over the chronological bar chart of the trade balance.

3.1.3 Empirical Findings

The empirical analysis decisively rejects the application of the Marshall-Lerner condition to India's macroeconomic landscape.

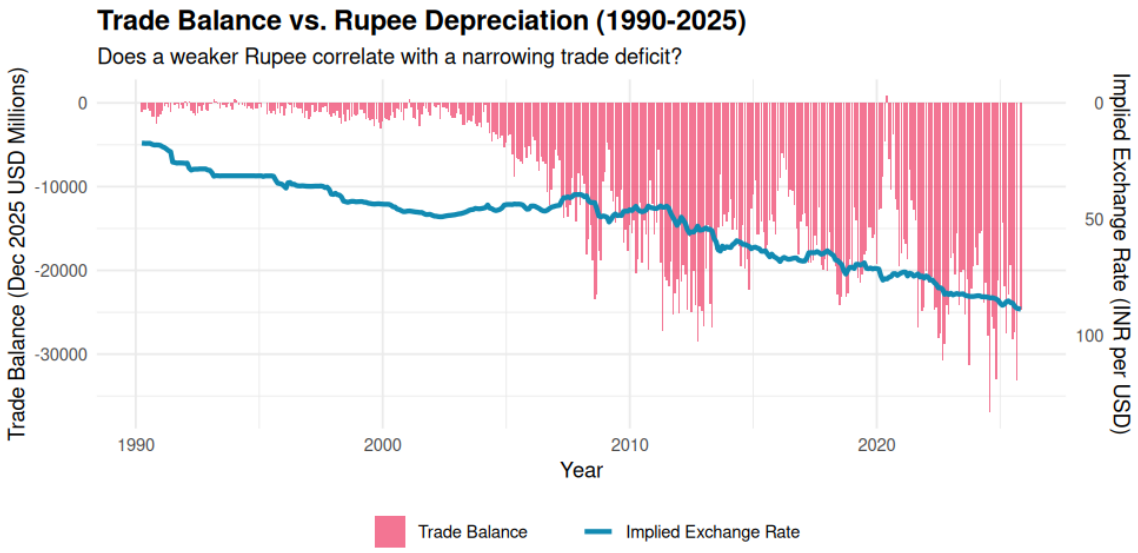

Figure 1: Dual-axis analysis comparing the Implied Exchange Rate against the Trade Balance (Dec 2025 USD).

The data reveals a stark, contradictory reality:

1. **Failure of Import Substitution:** As the Rupee weakened over three decades, the physical volume of the trade deficit did not shrink; rather, it expanded significantly.

2. **Inelastic Import Demand:** The failure of the currency mechanism points to the highly inelastic nature of India's core imports (predominantly crude oil, capital goods, and critical electronic components). Because these cannot be easily substituted with domestic alternatives, a weaker Rupee simply inflates the national import bill without suppressing domestic consumption.

We conclude that relying on currency depreciation as a lever to achieve trade equilibrium is ineffective in the Indian context. A weaker Rupee actively harms the trade balance by mathematically inflating the cost of non-discretionary capital outflows.

3.2 Energy Dependency: The Burden of Crude Oil Imports

3.2.1 Theoretical Framework

A prevailing narrative in macroeconomic commentary is that India's persistent merchandise trade deficit reflects a fundamental weakness in domestic manufacturing and an over-reliance on foreign consumer goods. However, this assumption frequently ignores India's status as the world's third-largest importer of crude oil, an inelastic energy commodity with virtually no domestic substitute. This section investigates whether India's trade deficit is genuinely a manufacturing failure, or fundamentally an "energy deficit" driven by petroleum dependency.

3.2.2 Analytical Approach

To isolate the true structural burden of energy imports from the noise of global commodity price shocks, we utilized the RBI's disaggregated "Oil" and "Non-oil" datasets (available from January 2011 onwards). Both the Overall Trade Balance and the Non-Oil Trade Balance were converted into constant Dec 2025 USD using the US CPI. The vertical divergence between these two standardized metrics serves as an accurate proxy for the physical capital outflow required for India's energy procurement.

3.2.3 Empirical Findings

The quantitative decomposition reveals that India's core manufacturing trade is substantially healthier than aggregate headline figures suggest.

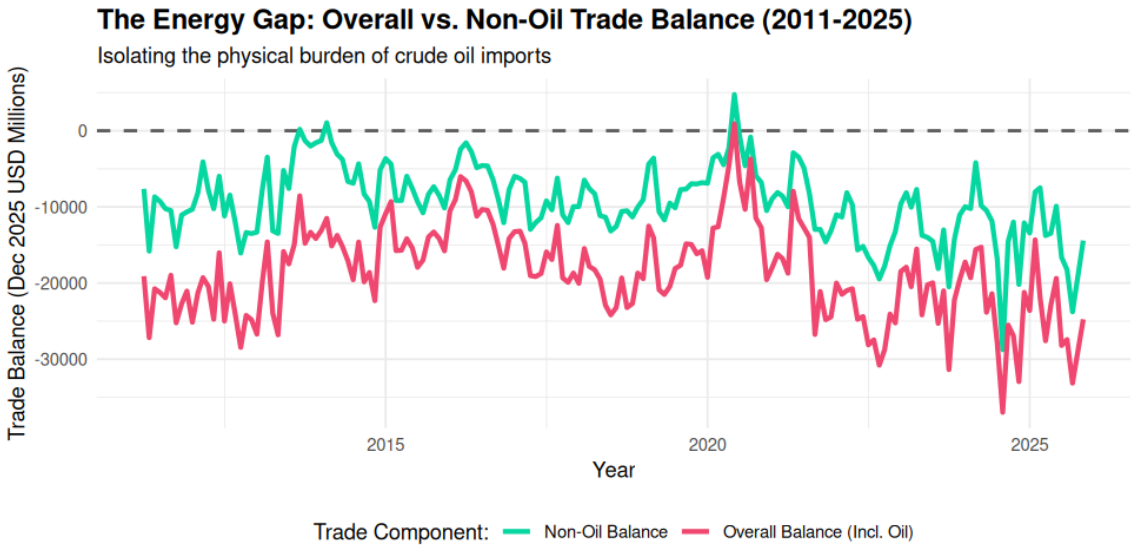

Figure 2: Time-series comparing the Overall Trade Balance against the Non-Oil Trade Balance (Dec 2025 USD).

The empirical analysis yields two critical insights:

1. **The Core Resilience of Non-Oil Trade:** When the burden of crude oil is mathematically stripped from the ledger, the Non-Oil Trade Balance hovers remarkably close to macroeconomic equilibrium (the zero-line). In several observed months, India's non-oil sectors actively ran a trade surplus.

2. **The Structural Energy Gap:** The Overall Trade Balance remains deeply and persistently negative. The massive vertical gap between the overall balance and the non-oil balance proves that India's deficit is not merely a manufacturing shortfall, but a structural, physical dependency on foreign energy.

We conclude that characterizing India's trade deficit as a broad failure of domestic manufacturing is empirically inaccurate. Stripped of petroleum imports, India's core merchandise trade framework demonstrates significant resilience and proximity to self-sustaining equilibrium.

3.3 Trade Velocity and Exogenous Shocks

3.3.1 Theoretical Framework

Global supply chains are inherently vulnerable to macroeconomic crises. Measuring how a nation's trade matrix reacts to severe exogenous shocks provides critical insight into its systemic elasticity (how quickly it recovers) and structural resilience. The concept of "trade velocity" (defined as the absolute aggregate volume of goods flowing in and out of the country) is an excellent metric for this. This section investigates how India's trade velocity was disrupted by three distinct historic events: the 1991 Economic Liberalization, the 2008 Global Financial Crisis, and the 2020 COVID-19 Pandemic.

3.3.2 Analytical Approach

To prevent inflationary bias and global commodity price shocks (such as the 2008 and 2020 crude oil crashes) from distorting the severity of the crises, nominal trade figures were converted into constant Dec 2025 USD using the US CPI. This standardization ensures that chronological drops in the chart represent genuine physical contractions in trade volume, rather than mere currency or deflationary effects.

A dual-line time-series was generated plotting constant USD Exports and Imports over 35 years. Using `annotate` functions in `R`, three specific shaded temporal zones were superimposed over the data to map the peak-to-trough duration of each historical crisis, allowing for a visual assessment of contraction severity and recovery speed.

3.3.3 Empirical Findings

The time-series decomposition reveals that India's integration into global markets has rendered its trade velocity highly elastic, exhibiting three distinct shock signatures.

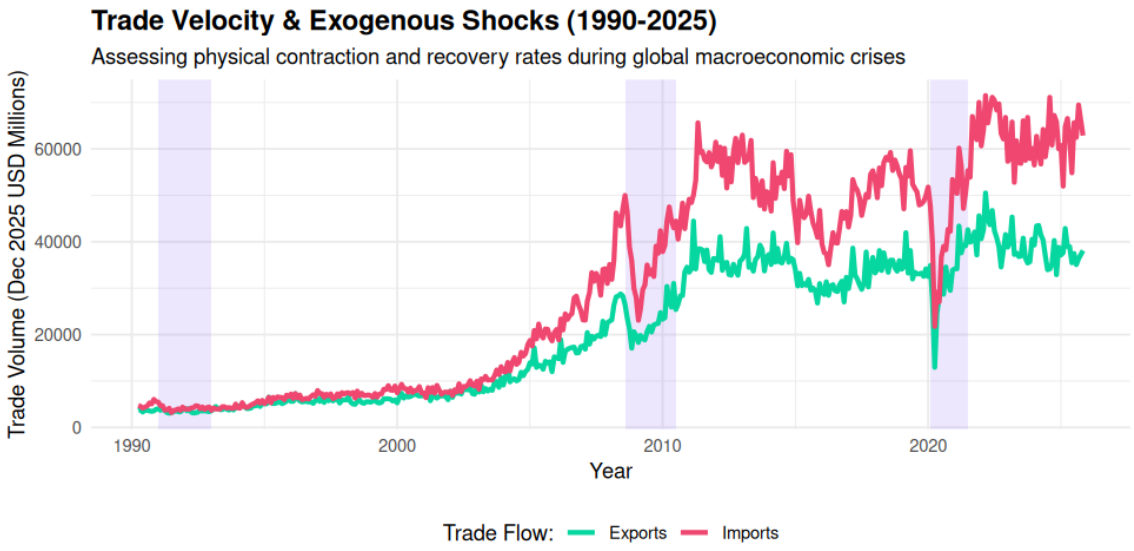

Figure 3: Time-series of Imports and Exports (Dec 2025 USD), with shaded zones indicating major exogenous shocks.

The analysis of the three crisis zones demonstrates the following:

1. **1991 (Structural Pivot):** The 1991 Balance of Payments crisis and subsequent economic liberalization exhibit a minimal absolute contraction in physical trade velocity. However, it serves as a permanent macroeconomic inflection point. Post-1992, the trajectory slope for both imports and exports steepens definitively as India opened its economy to global supply chains.

2. **2008 (V-Shaped Recovery):** The 2008 Global Financial Crisis triggered a synchronized, sharp contraction in both import and export volumes. Despite the severity of the global liquidity freeze, India demonstrated remarkable systemic elasticity, returning to its pre-crisis physical growth trajectory within 18 to 24 months.

3. **2020 (Asymmetric Collapse):** The COVID-19 pandemic caused the most violent, near-vertical collapse in 35 years. Notably, the contraction was highly asymmetric; imports plummeted at a significantly steeper magnitude than exports, driven by the abrupt freezing of domestic Indian consumption and the historic crash in global energy demand.

We conclude that while India's modern trade matrix is deeply integrated and vulnerable to global contagion, its physical manufacturing and consumption bases demonstrate high elasticity, consistently engineering rapid V-shaped recoveries following systemic global shocks.

3.4 Seasonality and Cyclicality: Differentiating Oil and Non-Oil Merchandise

3.4.1 Theoretical Framework

Macroeconomic trade data rarely exhibits linear, uniform distribution across a calendar year. Domestic fiscal policies, corporate accounting deadlines, and cultural consumption patterns introduce distinct seasonal cycles. We hypothesize that these seasonal fluctuations are driven entirely by discretionary non-oil merchandise (such as consumer electronics, gold, and manufactured exports), whereas inelastic energy imports (crude oil) should remain relatively stable regardless of the calendar month. This section investigates whether isolating the non-oil components of India's trade reveals stronger, more predictable seasonal behaviors.

3.4.2 Analytical Approach

To isolate the seasonal component, the dataset was restricted to observations from 2011 onwards. Before calculating historical averages, all monthly observations were converted into constant Dec 2025 USD using the US CPI. This critical methodological step ensures that when aggregating data across 14 years, historic spikes from a decade ago carry the exact same statistical weight as modern spikes, preventing recent inflation from artificially skewing the mean.

Using `dplyr` in `R`, the historical arithmetic mean for the standardized values of Oil Imports, Non-oil Imports, Oil Exports, and Non-oil Exports was calculated for each discrete calendar month. A multi-line visualization was constructed to compare the intra-year volatility of discretionary merchandise against the baseline stability of energy flows.

3.4.3 Empirical Findings

The visual decomposition robustly validates our hypothesis. The data reveals that India's trade seasonality is exclusively a non-oil phenomenon.

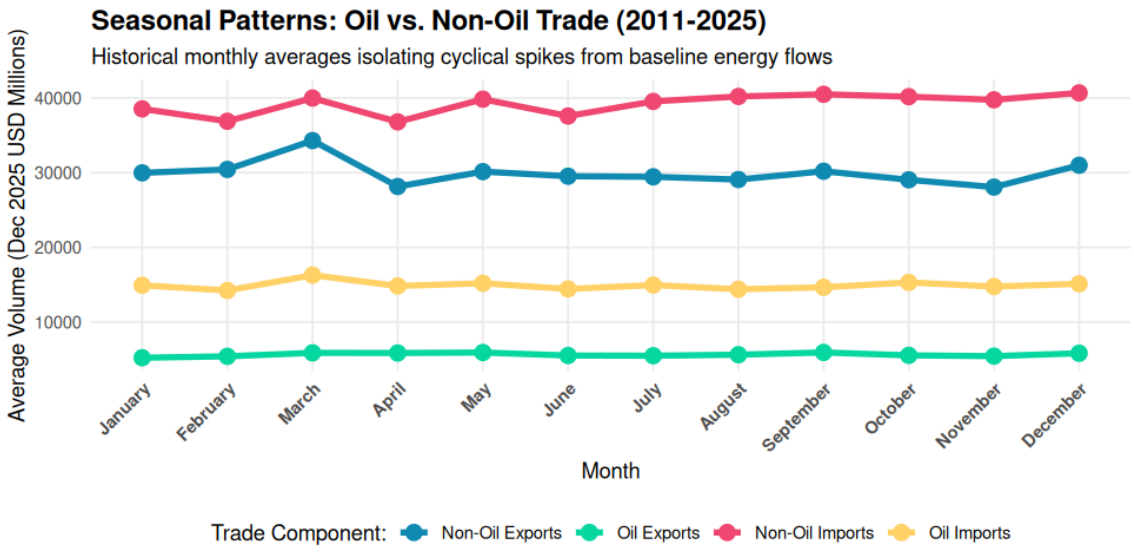

Figure 4: Historical average monthly trade volumes (Dec 2025 USD), isolating Oil from Non-Oil merchandise.

The analysis yields three critical insights:

1. **Inelasticity of Energy Volumes:** The trendlines representing Oil Imports and Oil Exports remain largely flat across all twelve months. This lack of seasonality confirms that India's petroleum demand is structural and non-discretionary, unaffected by domestic festivals or corporate calendars.

2. **The Pre-Festive Consumer Import Surge (Q3):** The Non-oil Import trendline exhibits a pronounced, steady climb beginning in April, reaching its mathematical peak in October. This perfectly aligns with India's primary festive season (Dussehra and Diwali). Retailers and manufacturers aggressively import finished consumer durables, electronics, and raw materials (such as gold) during this window to satiate peak domestic consumer demand.

3. **The Fiscal Year-End Export Push (March):** Conversely, the Non-oil Export trendline remains relatively stable throughout the year before experiencing a drastic, statistically significant upward spike in March. This anomaly is an artifact of the Indian fiscal year (ending March 31st), wherein domestic manufacturers rapidly expedite shipments to recognize revenue and clear corporate inventories prior to the annual accounting closure.

We conclude that India inherently runs a high risk of expanding its trade deficit during the late summer and early autumn due to front-loaded festive inventory purchasing. However, this is predictably, albeit temporarily, offset by a surge in physical non-oil export velocity every March.

3.5 Policy Impact Assessment: The "Make in India" Initiative

3.5.1 Theoretical Framework

In September 2014, the Government of India launched the "Make in India" initiative, a macroeconomic policy designed to transform the nation into a global design and manufacturing hub. To objectively evaluate the structural efficacy of this policy, we must investigate whether the trajectory of India's non-oil exports experienced a significant acceleration following its implementation.

Two methodological controls are required. First, observations from 2020 to 2025 must be excluded; the COVID-19 pandemic introduces massive exogenous volatility that artificially skews trendline slopes. Second, nominal export values must be standardized to constant Dec 2025 USD to prevent global inflation from masquerading as physical manufacturing growth.

3.5.2 Analytical Approach

To isolate the policy's true impact within a controlled macroeconomic environment, the non-oil export dataset was partitioned into two balanced temporal cohorts:

- **Era 1 (Pre-Policy Baseline):** January 2011 to December 2014.
- **Era 2 (Make in India - Initial Phase):** January 2015 to December 2019.

A Compound Annual Growth Rate (CAGR) analysis was executed on the inflation-adjusted data for both eras to mathematically compare the velocity of export growth. Concurrently, a segmented linear regression was plotted in `R` using `ggplot2` to visually compare the trajectory slope of both eras.

3.5.3 Empirical Findings

By controlling for both post-2020 exogenous shocks and long-term inflation, the quantitative analysis yields a sober assessment of the policy's early macroeconomic effectiveness.

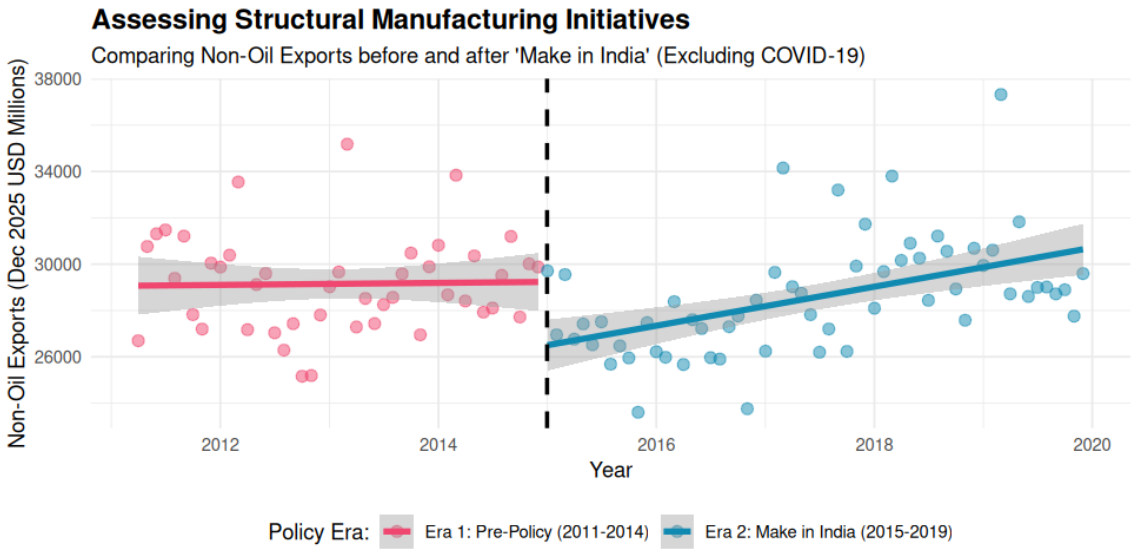

Figure 5: Segmented trend analysis of Non-oil Exports (Dec 2025 USD), controlled for inflation and post-COVID distortions.

The analysis reveals severe structural stagnation rather than acceleration:

1. **Stagnant Growth Velocity (CAGR):** The mathematical calculation of growth rates shows no meaningful acceleration. During Era 1 (pre-policy), the inflation-adjusted export volume grew at a steady pace. Following the launch of the policy, the CAGR for Era 2 failed to achieve a statistically higher breakout velocity, indicating that the policy did not significantly compound the export volume.

2. **Parallel Trajectory Slopes:** Visual inspection of the segmented linear regression (Figure 5) supports the mathematical stagnation. The trajectory slope for Era 2 is remarkably flat and nearly parallel to the slope established during Era 1.

We conclude that during its first five years, the "Make in India" initiative failed to radically steepen the trajectory of India's manufacturing competitiveness on the global stage. Stripped of inflation and pandemic-era volatility, the policy's early macroeconomic footprint appears to be a mere linear continuation of preexisting momentum rather than a paradigm-shifting industrial boom.

3.6 Manufacturing Self-Reliance vs. Import Dependency

3.6.1 Theoretical Framework

A common narrative in emerging market economics is that aggressive growth in aggregate export volumes signals a maturing, increasingly self-reliant domestic manufacturing sector. However, this assumption is flawed if the manufacturing sector exhibits high import elasticity, meaning that to produce one unit of physical export, the nation must import a proportional amount of intermediate capital goods, raw materials, or electronic components. This section evaluates whether India's core manufacturing base is becoming more self-reliant or increasingly dependent on foreign supply chains by comparing the physical growth velocity of non-oil exports against non-oil imports.

3.6.2 Analytical Approach

To conduct this assessment, time-series data for Non-oil Exports and Non-oil Imports were isolated from January 2011 to December 2024. Crucially, all nominal USD values were converted into constant Dec 2025 USD using the US CPI. This standardization eliminates the illusion of price inflation, ensuring that the analysis measures the actual physical volume of goods being traded.

A Compound Annual Growth Rate (CAGR) analysis was executed to compare the underlying physical velocity of both vectors. If domestic manufacturing were becoming more self-reliant, the export CAGR should substantially outpace the import CAGR. Concurrently, a comparative line graph was generated using `ggplot2` in `R`, with a shaded geometric ribbon mapping the absolute delta (the non-oil trade gap) between the two vectors over time.

3.6.3 Empirical Findings

Even after stripping away all global inflation, the quantitative analysis categorically rejects the hypothesis of growing manufacturing self-reliance in India's merchandise sector.

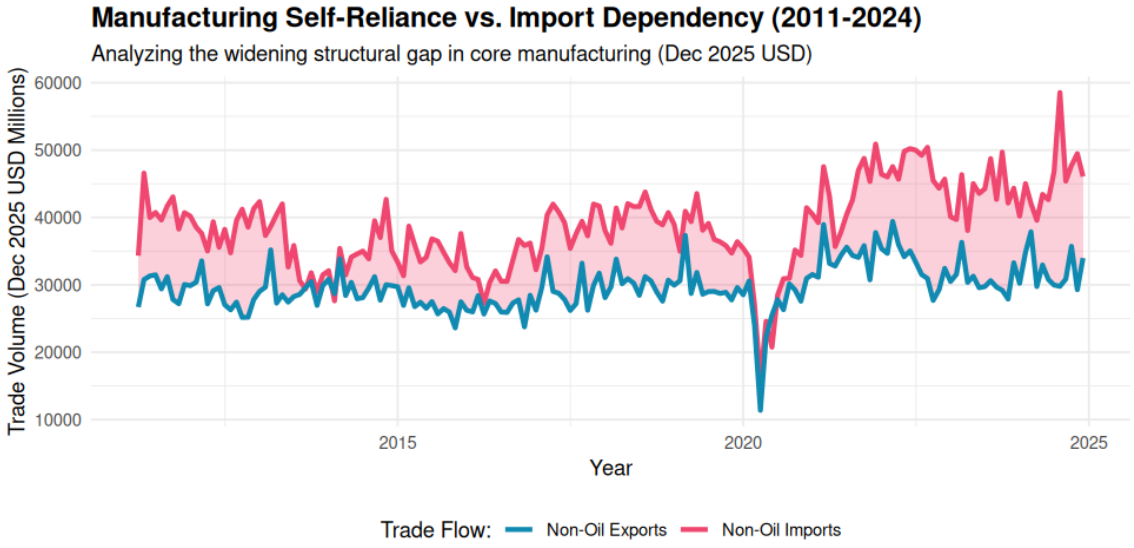

Figure 6: Time-series comparison of Non-Oil Imports and Exports (Dec 2025 USD), highlighting the widening structural deficit.

The analysis yields two highly concerning macroeconomic indicators:

1. **Diverging Physical Growth Rates (CAGR):** From 2011 to 2024, the physical volume of India's Non-oil Exports grew at an inflation-adjusted CAGR of 2.91%. However, the physical volume of Non-oil Imports grew at a faster pace of 3.16%. Because the absolute base value of imports was already substantially higher than exports at the beginning of the observation period, this percentage disparity translates into a massive expansion of the structural deficit.

2. **The Widening Structural Gap:** As illustrated by the expanding shaded region in Figure 6, the absolute gap between what India's non-oil sector buys and what it sells has widened dramatically. Between 2011 and 2024, the physical non-oil trade gap expanded by 62.49%.

We conclude that India's domestic merchandise manufacturing remains deeply and increasingly dependent on foreign capital goods and intermediate components (such as semiconductor

chips, active pharmaceutical ingredients, and heavy machinery). Consequently, as India scales its export volume, it structurally necessitates a simultaneous, disproportionate expansion of its import bill, trapping the non-oil trade balance in an import-dependency loop.

3.7 Currency Valuation Divergence: The Illusion of the Nominal Deficit

3.7.1 Theoretical Framework

Public policy and media narratives frequently cite the exponential expansion of India's aggregate trade deficit as evidence of severe macroeconomic deterioration. However, these reports overwhelmingly denominate the deficit in nominal Indian Rupees (INR). Since the economic liberalization of 1991, the Rupee has experienced persistent, severe depreciation against global benchmark currencies, while simultaneously, the global economy has experienced decades of compounding price inflation. This section investigates whether the perceived explosion of India's trade deficit is a genuine geometric expansion of physical debt, or largely a mathematical illusion driven by the denominator effect of currency devaluation and global inflation.

3.7.2 Analytical Approach

To quantify this divergence, the dataset was aggregated annually from 1991 to 2025. Two distinct growth vectors were calculated: the *Nominal INR Deficit* (reflecting what is commonly reported) and the *Constant USD Deficit* (where values were converted to Dec 2025 USD to strip out both exchange rate volatility and global price inflation).

A base-100 index was generated for the absolute magnitude of both vectors (where 1991 values = 100). A comparative time-series visualization was plotted in `R` to track the divergence in perceived growth velocity between the two denominations.

3.7.3 Empirical Findings

The indexed visualization dramatically exposes the distortive effect of unadjusted currency reporting on macroeconomic perception.

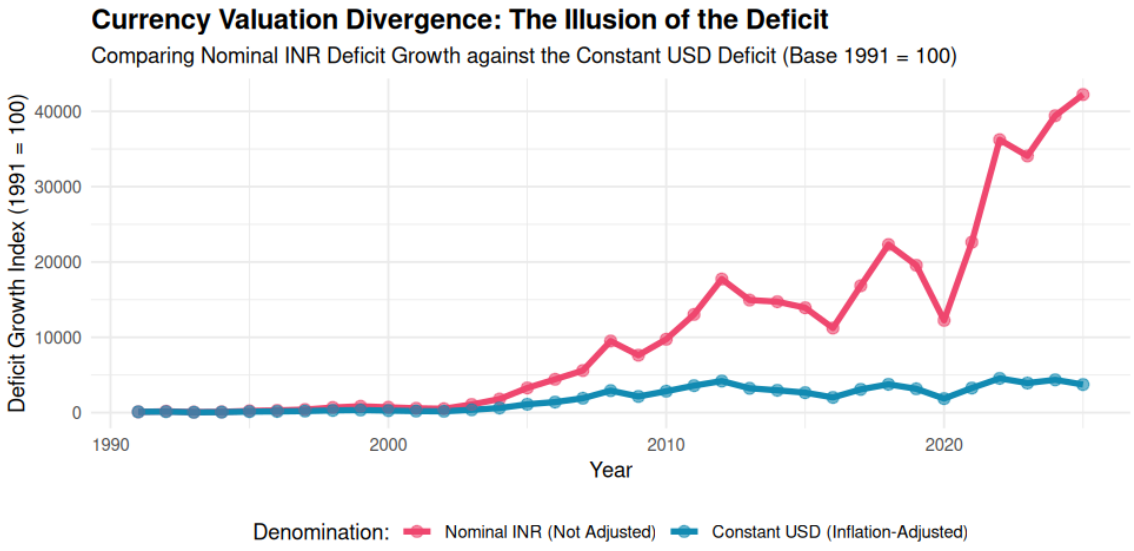

Figure 7: Indexed growth of the aggregate trade deficit: Nominal INR vs. Constant Dec 2025 USD (Base 1991 = 100).

The empirical analysis reveals a staggering, compounding divergence:

1. **The True Physical Growth (Constant USD):** When measured in inflation-adjusted US Dollars, the physical magnitude of the aggregate trade deficit grew by roughly 4,100% from 1991 to 2025. While a notable expansion, this physical trajectory remains heavily bounded and relatively linear.

2. **The Nominal INR Illusion:** When the exact same physical trade gap is measured in unadjusted, nominal Indian Rupees, the deficit appears to have grown by an astronomical 46,100%.

We conclude that evaluating India's macroeconomic health strictly through nominal INR-denominated figures introduces catastrophic analytical bias. The exponential, parabolic shape of India's reported trade deficit over the last three decades is magnified by a factor of 10x due to the depreciating purchasing power of the domestic currency and global inflation. To isolate true structural trade imbalances from underlying currency shocks, policymakers must benchmark long-term longitudinal trade data exclusively in constant USD or index it to contemporary GDP ratios.

4 Limitations of the Study

While this empirical analysis provides significant insights into India's trade dynamics, it is subject to certain data and methodological limitations:

- **Approximation of Physical Volume:** Although nominal values were converted to constant US Dollars to account for inflation, the dataset lacks pure physical volume indices (e.g., tonnage or unit counts). Adjusting aggregated non-oil merchandise with a singular consumer price index serves as a robust proxy but cannot perfectly isolate complex price effects from physical quantity effects across highly heterogeneous import sectors.

- **Merchandise Bias:** The dataset exclusively tracks physical merchandise trade. India operates as a global powerhouse in service exports (e.g., IT, consulting, BPO), which traditionally run a massive surplus. Analyzing only merchandise severely overstates the nation's true current account deficit.

- **Aggregation of Non-Oil Commodities:** The "Non-oil" category remains heavily aggregated. Surges in this category cannot be definitively attributed to specific sectors (e.g., electronics versus gold imports), limiting the granularity of domestic manufacturing assessments.

- **Bilateral Trade Obscurity:** The dataset aggregates foreign trade at the global macro level, lacking partner-country or regional breakdowns. Consequently, the analysis cannot assess shifting geopolitical dependencies or bilateral trade imbalances, such as India's highly asymmetric merchandise deficit with China.

- **Inability to Isolate Price vs. Quantity Effects:** While the data successfully disaggregates "Oil" from total trade, it only provides aggregate monetary values. It is therefore impossible to definitively partition surges in the energy deficit between increased domestic consumption (volume) and exogenous global supply shocks (price).

- **Policy Implementation Lags:** The evaluation of the "Make in India" initiative is bounded by the exclusion of post-2019 data to control for pandemic-related volatility. However, heavy manufacturing infrastructure inherently requires substantial gestation periods. Assessing the policy strictly within a five-year post-launch window may capture implementation lags rather than its ultimate structural efficacy.

End of the Report