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Asymmetric Sectoral Impact of Exchange Rate Movements in India: Evidence from the IT Services Sector and Fuel-Intensive Industries

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ABSTRACT

Exchange rate fluctuations are often treated as a uniform macroeconomic shock, however their real effects depend on how a sector's revenues and costs are exposed to a foreign currency. This study investigates the asymmetric sectoral impact of USD/INR exchange rate movements in India over the period of FY2014-15 to FY2024-25, comparing India's export-oriented IT services sector to the import-oriented fuel-dependent industries with structurally opposite currency exposures. By collecting annual data for the exchange rate, net software export revenues, firm-level operating margins for seven IT companies, Brent crude oil prices, India's oil import bill, and Aviation Turbine Fuel Consumption, the study tests three hypotheses concerning revenue, cost, and net sectoral effects of currency depreciation. Results show a very strong positive association between INR depreciation and IT services export revenue, but it does not translate into improved profitability for the firms (sector-average operating margins), showing a negative correlation with the exchange rate, indicating that rising domestic costs offset currency-driven revenue gains. For fuel-intensive sectors, the exchange rate shows no significant independent relationship with global crude prices, yet a significant moderate relationship with India's oil import bill, which confirms that currency depreciation amplifies energy import costs as a separate mechanism from global price shocks. These findings demonstrate that exchange rate movements simultaneously function as a competitive advantage for some sectors and a structural cost burden for others, which underscores the need for sector-differentiated approaches to exchange rate policies and corporate risk management in import-dependent, trade integrated economies like India.

1. Introduction

An exchange rate refers to the value of an economy's currency in comparison to another (Chen, 2024) . Exchange rates are a key macroeconomic variable as they influence trade inflation, trade competitiveness, and sectoral performance in open economies. For an import-dependent

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economy like India, fluctuations in the Indian Rupee (INR) against the United States Dollar (USD) can have significant implications (Sharda & Khanna, 2026), especially due to India's deep integration with global trade and commodity markets (World Bank, 2025).

Since 2014, the INR has exhibited considerable fluctuations, following a predominantly depreciating trend (Trading Economics, 2025) , shaped by inflation differentials, global monetary tightening, volatile capital flows and recent commodity price shocks (Rajeswari Sengupta et al., 2023).

While exchange rate movements are often analysed at a macroeconomic level, their effects do not have uniform effects across sectors. The scale of effects as a result of exchange rate movements depends on how each sector's revenues and costs are exposed to a foreign currency. The key distinction is the currency composition of a firm's earnings relative to its expenses: a sector that earns revenue in USD but pays its costs in rupees gains when the INR depreciates as the same dollar of revenue converts into more rupees while the costs are untouched (Gopinath et al., 2010). On the other hand, export-oriented sectors with the opposite currency structure, with dollar-priced inputs and rupee-denominated revenue, face the reverse problem where depreciation raises the rupee cost of production without any proportional gain on the revenue side. Fuel-intensive and import-dependent industries that rely on globally dollar-priced energy inputs fall within this category. Consequently, the same exchange rate movement does not constitute a uniform macroeconomic shock, rather producing two opposing effects with the direction and scale of the impact depending on the sector's revenue-cost currency structure (Mallick & Marques, 2006).

Understanding these asymmetrical sectoral impacts is important for businesses, investors and policymakers that seek managing the effects of exchange rate volatility in an economy that is increasingly becoming more globalized. Despite the broad macroeconomic significance of exchange rate movements, comparing their effects across sectors with fundamentally different revenue-cost structures remains an important area of inquiry. Accordingly, this study explores the asymmetric impact of INR-USD exchange-rate fluctuations on India's export-oriented IT services sector and import-oriented fuel-intensive industries over the period 2014–2025. By comparing sectors that respond to currency movements through contrasting transmission mechanisms, this study aims to provide a clearer understanding of how exchange-rate movements redistribute economic gains and losses across the Indian economy.

2. Literature Review

Exchange rate movements have been recognised as a key determinant of trade competitiveness and macroeconomic performance in open economies such as India. Classical theory states that

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exchange rates adjust over time toward levels that are consistent with relative price levels across economies, and short-run deviations are a result of capital flows, interest rate differentials and shifts in global risk appetite (Krugman et al., 2012). Expanding upon this, Dornbusch (1976)'s overshooting model illustrates that because prices of goods adjust slower than prices of assets, nominal exchange rate fluctuations can deviate from their long-run equilibrium substantially in the short and medium run. This is a feature directly relevant to India's experience over the 2014-2025 period, where the depreciation of the INR has neither been uniformly paced nor smooth, instead concentrated in discrete episodes driven by capital flow reversals and global monetary tightening rather than only domestic inflation differentials (Sengupta Rajeshwari, 2022).

While these frameworks explain why and how exchange rates fluctuate, there is comparatively little said about how the resulting movements are distributed across an economy.

2.1 Exchange Rate Pass-Through

Exchange rate pass-through is a concept: the extent to which a change in the exchange rate is transmitted into domestic prices, costs, or revenues. It provides the theoretical foundation for this study's revenue-channel and cost channel-framework. One important finding in this literature is that pass-through is rarely complete as firms often absorb part of an exchange rate shock into their margins instead of passing it fully through to prices (Campa & Goldberg, 2005). Furthermore, Gopinath et al. (2010) extend this insight by showing that the currency in which a transaction is invoiced is itself a pivotal determinant of pass-through — goods and services priced in the producer's own currency show substantially higher pass-through than those priced in the buyer's currency. This finding is relevant to the present study as IT services exports are predominantly dollar-invoiced with rupee-denominated costs: the configuration in which revenue side pass-through should be strong, while cost side margin pass-through depends on other domestic factors.

For the point of view of India specifically, an established body of work confirms that pass-through is real but incomplete. Bhattacharya et al. (2008) provide an earlier empirical estimate of ERPT into Indian prices, while Khundrakpam (2007) traces how the extent of pass-through shifted after India's post-1991 liberalization reforms. Additionally, more recent work using non-linear autoregressive distribute lag (ARDL) methods finds that pass-through in India is not only incomplete but asymmetric, as the effect of INR depreciation on domestic prices is significantly larger than the effect of an equivalent appreciation (Mendali & Das, 2024). This asymmetry matters methodologically for the present study because the 2014-2025 study period is dominated by periods of depreciation rather than a symmetric two-way movement, the relationships this paper documents should be read as characteristic of a depreciation regime specifically instead of exchange rate movements in general.

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Parab (2022) offers further refinement, finding that pass-through into India's wholesale price index consistently exceeds pass-through into consumer price index — a gap attributed largely due to the inelastic nature of India's crude oil imports. Indian demand for imported crude does not fall meaningfully even as depreciation raises its rupee cost, so the cost shock passes on to the wholesale prices largely undamped. This finding provides direct theoretical support for the cost-channel mechanism this study documents in fuel-dependent sectors in Section 6.4, and helps explain why the oil import bill and ATF costs examined in this paper rise even in years when global crude prices are moderate.

2.2 Sectoral Asymmetry in Exchange Rate Transmission

A smaller but important strand of the ERPT literature moves from aggregate, economy wide pass-through to sectoral pass-through. This strand most directly motivates the present study's design. Mallick & Marques (2006) provide early evidence that exchange rate pass-through in India varies across sectors and shifted post trade policy reforms, which established empirically that the "exchange rate effect" is a distribution across the whole economy rather than a single, uniform number. Dash & Narasimhan (2011) further extend this by examining how exchange rate fluctuations affect Indian export and import prices separately, reinforcing that revenue-side and cost-side transmission are analytically distinct processes that do not necessarily move together.

In order to explain why sectors diverge rests on a simple yet powerful distinction that sectors differ in the currency composition of their revenue relative to their costs. Export-oriented services such as IT generate revenue that is noticeably dollar-denominated while their principal cost of labour is paid in rupees. Thus, a depreciation raises rupee-denominated value without a matching rise in rupee-denominated cost, producing a clean and mechanical gain (Gopinath et al., 2010). Fuel intensive and import-dependent industries are at the opposite end of this spectrum. Imported crude and refined fuel, their principal cost, is dollar-priced globally, while much of their revenue is rupee-denominated. Thus, a depreciation raises rupee-denominated costs without a proportional rise in rupee-denominated revenue. This mismatch in revenue-cost currency is the theoretical core of the asymmetry this paper documents.

2.3 Exchange Rate Effects on the IT Services Sector

Existing literature on India's IT services sector supports the revenue-side mechanism this study documents, whilst cautioning against treating varying exchange rates as the primary or sole driver of sectoral performance. Malik & Velan (2020)'s use of an ARDL framework over 1980-2017 identified external demand conditions, human capital availability, trade openness, and exchange rates as the long-run determinants of India's IT export performance. While exchange

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rate depreciation played a role in stronger export competitiveness, it operated alongside, rather than instead of the other structural drivers that drove India's IT export competitiveness. This finding is consistent with the pattern this study documents.

However, the existing literature on India's IT sector is heavily weighted towards a revenue point of view, with a focus on export growth, volume and competitiveness, with comparatively less focus on whether revenue gains translate into higher profitability. This gap is meaningful as revenue and margin are not the same object, as a firm can grow dollar-denominated revenue greatly, while its operating margin remains the same or declines if increasing domestic costs most likely including wages, onsite delivery costs, compliance and technology spending and pricing concessions to clients absorb the currency-driven gain in revenue. General pricing-to-market theory (Campa & Goldberg, 2005; Gopinath, Itskhoki, & Rigobon, 2010) predicts this incomplete pass-through from revenue to bottom-line outcomes under competitive market conditions exactly However, this mechanism has rarely been tested for India's IT sector specifically using margin data rather than export data — the gap this study is designed to fill.

2.4 Exchange Rate Effects on Fuel-Intensive and Import-Dependent Sectors

The literature on fuel-intensive sectors approaches the exchange rate question in the opposite direction as it emphasises cost-side vulnerability instead of gains in competitiveness. India's dependence on crude oil, where it meets the large majority of domestic demand via imports, means the global crude prices and exchange rate interact rather than operating independently, meaning a weaker rupee raises the domestic currency cost of crude even when dollar-denominated crude prices are stable or falling, compounding when they move together, as seen around FY 2022-23 (Petroleum Planning & Analysis Cell [PPAC], various years). Parab (2022)'s findings on India's crude oil imports's inelasticity is the clearest empirical anchor for this dynamic, directly supporting this paper's finding that the oil bill remained elevated even in years when global crude prices moderated.

Beyond the oil-marketing and refining sector narrowly defined, broader literature on energy-intensive industries finds that sectors with high input shares, such as steel, cement, aluminium and aviation with the primary variable cost of jet fuel, are structurally exposed to combined oil-price and currency shocks in a way that less energy-intensive, lighter industries are not (Papapetrou, 2001). This supports the inclusion of Aviation Turbine Fuel (ATF) as a sector-specific stress indicator in this study.

2.5 Firm-Level Heterogeneity in Exchange Rate Exposure

A further relevant strand of literature complicates the image of sectors as internally homogenous, as studies of exchange rate exposure among emerging-market firms find that exposure and the

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ability to absorb or hedge it varies significantly even when specific to a sector or country, shaped by firm size, financing structure, and greater market power (Chue & Cook, 2008).

Larger, more diversified firms with stronger pricing power and greater scale are generally better positioned to absorb cost shocks and defend margins than smaller firms that possess less negotiating leverage or thinner service diversification. This finding provides a theoretical basis for the firm-level heterogeneity this study documents.

2.6 Research Gap and Contribution of this study

When the literature reviewed above is gathered, three things are clearly established:

1. Exchange rate pass-through in India is real, but incomplete and asymmetric across exchange rate depreciation and appreciation episodes

2. Pass-through differs systematically by sector, according to the currency composition of each sector's revenues and costs

3. Both the IT services sector and fuel-intensive industries show patterns that are consistent with a revenue-channel/cost-channel divide

However, what the existing literature does not accomplish is bringing the IT services sector and fuel-intensive industries together within a single, matched comparative framework over a common and recent period. Studies of India's IT export competitiveness and studies of oil-import cost transmission exist as separate literatures while addressing separate research questions rather than a deliberate paired comparison to show that a single macroeconomic variable: the USD/INR exchange rate, is producing opposing outcomes across the same economy at the same time.

Additionally, even within literature of the IT sector, the revenue point of view, including export growth and competitiveness has received more attention than the profitability side. Whether currency-driven revenue gains survive the transition into operating margin, once domestic cost pressures and competitive dynamics are accounted for remain comparatively unexplored.

This study addresses both gaps directly. First by analysing the IT services sector and fuel-intensive industries side by side over the period of 2014-2025, covering data from a decade spanning multiple INR depreciation episodes, offering an explicit comparative test of sectoral asymmetry rather than two separate single-sector narratives. Second, by distinguishing between revenue-side and margin-side outcomes for the IT sector, it tests whether the well documented gain in revenue from depreciation survives the transition into profitability — a distinction the

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existing literature has largely assumed rather than tested. In doing so, this study contributes a sector-comparative, channel-differentiated perspective on exchange rate fluctuations that complements the largely single-sector, revenue-focused, or aggregate-price focus of the existing literature.

3. Research Objectives and Hypotheses

3.1 Research Objectives

The primary objective of this study is to examine the asymmetric sectoral impact of exchange rate movements in India by comparing an export-oriented IT service sector with fuel-intensive industries over a time period of 2014-2025.

Particularly, the study pursues the following objectives:

- To analyse the relationship between exchange rate movements and the performance of the IT services sector in India, particularly focusing on export revenues and sector-level operating margins.
- To examine the cost-side impact of exchange rate movements on fuel-intensive industries, implementing indicators related to crude oil prices, fuel imports, and energy consumption.
- To compare the asymmetric effects of exchange rate movements across these sectors, highlighting differences in revenue-side and cost-side transmission mechanisms.

3.2 Research Hypotheses

Based on the theoretical framework and existing literature, the study tests the following hypotheses:

- H1: Exchange rate movements, especially episodes of depreciation, are associated with higher export revenues in the IT services sector but do not lead to a proportional improvement in sector-level operating margins.
- H2: Exchange rate movements that result in currency depreciation increase cost pressure in fuel-intensive industries done through raising the domestic currency cost of imported energy inputs.
- H3: Exchange rate movements create asymmetric sectoral outcomes that benefit export-oriented services while adversely affecting fuel-intensive industries.

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4. Data

This study solely relies on secondary data obtained from publicly available, credible sources. The analysis covers a period characterised by substantial INR/USD exchange rate fluctuations, global commodity price volatility, and structural shifts in India's external sector: 2014-15 to 2024-25. This timeframe allows for examining exchange rate movements under both stable and stressed macroeconomic conditions.

4.1 Exchange Rate Data

The primary explanatory variable is the nominal USD/INR exchange rate, capturing movements in the Indian Rupee relative to the US dollar, unadjusted for inflation. Monthly exchange rate data were sourced from the Reserve Bank of India (RBI) Database on the Indian Economy. In order to ensure consistency with annual sectoral indicators, monthly observations were aggregated into annual averages. Furthermore, the nominal exchange rate is employed as it directly influences export invoicing, the domestic currency of imports, and export invoicing. This makes it the most relevant measure for sectoral analysis.

4.2 IT Services Sector Data

In order to assess the response of the IT services sector to exchange rate fluctuations, the study employs three indicators:

1. Net IT Services Export Revenue (USD):

   Data on net software exports were obtained from the Reserve Bank of India's Balance of Payment statistics. Net exports (credits minus debits) were employed to capture the sector's net foreign exchange earnings

2. IT Export Growth Proxy

   Due to unavailability of a consistent long-term series on Gross Value Added (GVA) at constant prices for the IT services sector, officially reported IT export data from government publications were used as a proxy for sectoral output trends.

3. Sector-Average Operating Margin (%)

   Firm-level operating margin data for major Indian IT companies including Infosys, Tata Consultancy Services (TCS), LTIMindtree, HCL Technologies, Wipro, Tech Mahindra, and Persistent Systems were compiled from CompaniesMarketCap. An unweighted annual average was calculated to represent sector-level profitability.

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Together, these indicators showcase revenue-side effects, profitability outcomes, and firm-level heterogeneity within the IT services sector.

4.3 Fuel-Intensive Sector Data

Fuel-intensive industries are represented using indicators that reflect exposure to imported energy and foreign exchange costs, including:

- Global crude oil prices (Brent, USD per barrel)
- India's oil import bill (USD)
- Aviation turbine fuel (ATF) consumption
- Fuel imports as a share of total merchandise imports

Information and data were collected from the U.S. Energy Information Administration (EIA), the Petroleum Planning & Analysis Cell (PPAC), and the Ministry of Commerce and Industry. These indicators capture the cost-side transmission of exchange rate fluctuations to energy-dependent sectors.

5. Methodology

This study adopts a comparative and descriptive analytical approach to examine the asymmetric sectoral impact of exchange rate movements in India. Given the exploratory nature of the research and the level of available data, the methodology focuses on graphical examination, trend analysis, and simple correlation.

5.1 Analytical Framework

The analysis is conducted in three stages. First, trends in USD/INR exchange rate are gathered and examined to identify periods of significant movement over the time period. Second, sector-specific responses to the movements are analysed using relevant indicators for both industries discussed in the study. Third, the outcomes across sectors are compared to assess asymmetry in exchange rate transmission through revenue-side and cost-side channels.

5.2 Measurement of Exchange Rate Movements

Exchange rate movements are measured using annual averages of the nominal USD/INR exchange rate. An increase in the exchange rate value indicates a depreciation in the INR against the USD, while a decrease in the exchange rate indicates appreciation. Annual averages are used

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to ensure consistency with annual sector-level indicators and to smooth fluctuations in the short-term.

Although both appreciation and depreciation are captured by this measure, the analysis primarily focuses on periods of INR depreciation which are more relevant for assessing export competitiveness in the IT services sector and cost pressures in fuel-intensive industries.

5.3 Sectoral Impact Assessment

For the IT services sector, exchange rate movements are evaluated against trends in net export revenues and sector-average operating margins in order to assess revenue realization and profitability effects. For fuel-intensive industries, exchange rate movements are evaluated alongside crude oil prices, the oil import bill, aviation turbine fuel consumption, and fuel imports as a share of total imports to capture cost-side transmission mechanisms.

5.4 Tools and Techniques

The analysis employs tabular comparisons, graphical trend analysis, and simple correlation measures where appropriate. All visualizations and computations were conducted using spreadsheet tools to ensure replicability.

6. Analysis and Discussion

6.1 Exchange Rate Movements and IT Services Sector

6.1.1 Exchange Rate Movements and IT Services Export Revenue

This section examines the relationship between the INR exchange rate movements and the performance of the IT services sector. This is done using net software services exports as a proxy for sectoral output and foreign exchange earnings. Export-based indicators provide the most reliable measure of sectoral exposure to exchange rate movements given the absence of a consistent long-term series on IT sector GVA at constant prices.

Table 6.1 presents the underlying annual data used in the analysis. It summarises the evolution of the INR/USD exchange rate along with net software exports, measured in USD.

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Table 6.1: USD/INR Exchange Rate and Net Software Exports in India (FY 2014-15 to FY 2024-25)

Financial Year	USD/INR Annual Average	Net Software Exports (USD billion)
2014–15	61.14	70.4
2015–16	65.47	71.45
2016–17	67.07	70.76
2017–18	64.46	72.19
2018–19	69.92	77.65
2019–20	70.9	84.64
2020–21	74.23	89.74
2021–22	74.5	109.54
2022–23	80.36	131.28
2023–24	82.79	142.07
2024–25	84.58	159.61

Note: USD/INR annual averages are computed from monthly exchange rate data. Net software exports represent net receipts (credit minus debit) under software services in India's Balance of Payments.

Source: Reserve Bank of India (RBI): (Reserve Bank of India - Special Data Dissemination Standards, 2024)

Table 6.1 illustrates a sustained depreciation of the INR over the study period, with the USD/INR annual average rising from 61.14 in the FY 2014-15 to 85.58 in FY 2024-25. Over the same period, net software services exports rose from USD 70.4 billion to USD 159.6 billion, reflecting substantial growth in the sector during a phase of the rupee depreciating.

This relationship is illustrated in Figure 6.1, which plots the annual average USD/INR exchange rate against net software services exports.

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Figure 6.1: USD/INR Exchange Rate and Net Software Services Exports (2014–15 to 2024–25)

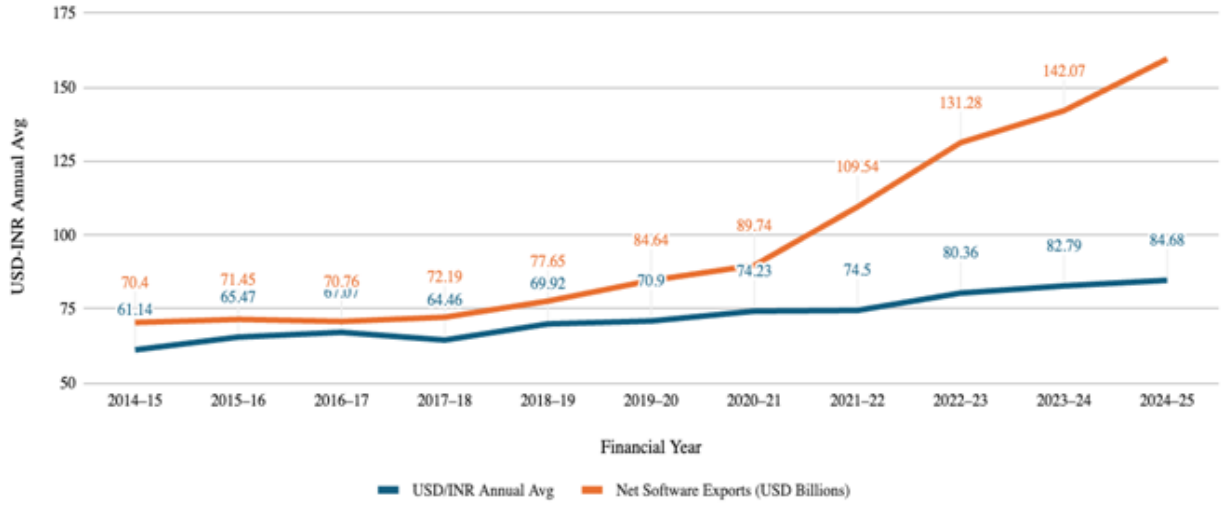
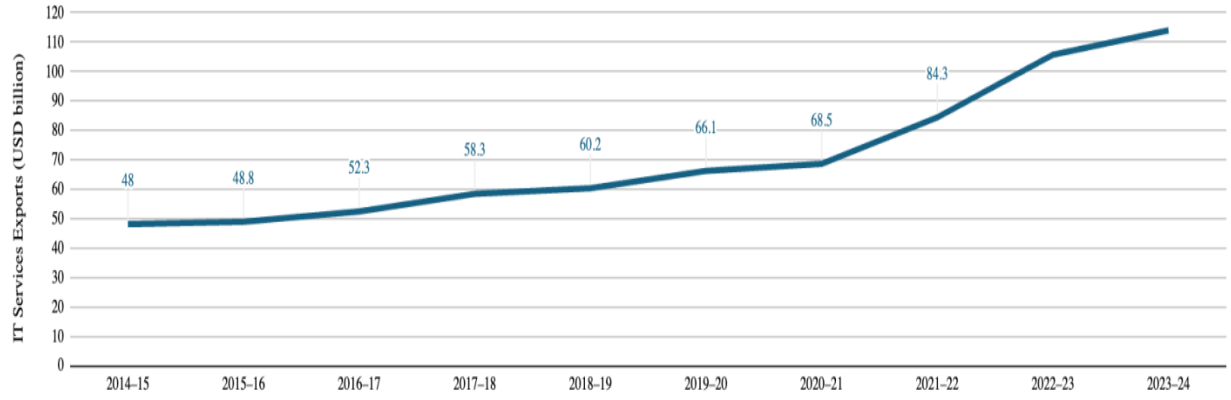


Figure 6.1 suggests a positive association between rupee depreciation and export receipts, with periods of a weaker rupee coinciding with higher levels of net software exports. The positive association between the exchange rate movements and export performance is further reinforced by industry level evidence.

In order to further contextualise export performance, Figure 6.3 presents the growth trajectory of India's IT services exports over time. The figure demonstrates a steady upward trend in export revenues, with particularly strong increases visible after 2020-21, coinciding with a combination of sustained rupee depreciation and rising global demand for digital and remote IT services. (*Technology Sector In India 2021- New World: The Future Is Virtual/Strategic Review*, 2021)

Figure 6.2: Growth of India's IT Services Exports (2014–15 to 2023–24)



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A correlation analysis between the annual average USD/INR exchange rate and net software services exports yields a Pearson correlation coefficient of approximately 0.95. This indicates a very strong positive association, reflecting the export oriented structure of the IT services sector, where a substantial share of revenues is denominated in USD while a large portion of operating costs are incurred in INR.

Overall, the evidence presented in Table 6.1 and Figures 6.1 and 6.2 confirms that rupee depreciation is strongly associated with higher export revenues in the IT services sector.

However, as explored in subsequent sections, this revenue-enhancing effect does not necessarily automatically translate into proportional improvements in profitability for these IT sector firms, highlighting the importance of examining margin dynamics and firm-level heterogeneity separately.

6.1.2 Exchange Rate Movements and IT Sector Profitability

This section examines the association between fluctuations in the INR and operating profitability in the IT services sector using each company's operating margin — a key indicator to assess profitability. While export revenues tend to rise during periods of depreciation, the transmission to profitability is less direct.

In order to examine this dimension, Figure 6.3 plots the USD/INR nominal exchange rate (annual average) against the IT sector average operating margin constructed using the average operating margin of nine major IT firms that encompass large-cap and mid-cap companies in order to capture broad industry dynamics as shown in Table 6.2 (next page).

Table 6.2: Firm-Level Operating Margins and Sector Average for Major Indian IT Companies (FY 2014-15 to FY 2024-25)

Operating Margins								**Sector Avg Margin (%)**	**USD/INR Annual Average**
Year	TCS	Infosys	Wipro	HCL Tech	LTI Mindtree	Tech Mahindra	Persistent Systems		
2014	*31.05*	*29.32*	*23.26*	*24.63*	*18.36*	*20.26*	*20.53*	*23.92*	*61.14*
2015	*27.79*	*32.35*	*23.79*	*24.84*	*18.63*	*15.99*	*20.62*	*23.43*	*65.47*

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2016	*29.31*	*30.01*	*22.43*	*22.71*	*17.70*	*14.56*	*15.99*	*21.82*	*67.07*
2017	*29.26*	*29.13*	*20.05*	*22.16*	*19.01*	*13.22*	*13.92*	*20.96*	*64.46*
2018	*27.69*	*28.73*	*18.81*	*21.80*	*19.73*	*15.85*	*14.15*	*20.97*	*68.41*
2019	*28.38*	*25.45*	*19.70*	*20.89*	*21.47*	*15.96*	*14.45*	*20.90*	*69.92*

Operating Margins (contd)								**Sector Avg Margin (%) (contd)**	**USD/INR Annual Average**
Year	TCS	Infosys	Wipro	HCL Tech	LTI Mindtree	Tech Mahindra	Persistent Systems		
2021	*26.65*	*26.52*	*22.44*	*21.03*	*20.92*	*15.73*	*14.55*	*21.12*	*74.23*
2022	*26.95*	*24.74*	*19.13*	*19.15*	*20.28*	*16.69*	*16.18*	*20.45*	*74.50*
2023	*25.24*	*22.65*	*16.32*	*16.32*	*17.45*	*12.10*	*14.86*	*17.85*	*80.36*
2024	*25.74*	*23.41*	*16.40*	*16.40*	*17.03*	*6.20*	*14.74*	*17.13*	*82.79*
2025	*25.59*	*23.07*	*19.64*	*19.87*	*16.35*	*10.67*	*15.26*	*18.64*	*84.58*

Note: Operating margin is calculated as operating profit divided by total revenue, expressed as a percentage, as reported in each company's annual financial statements. Sector average margin represents the unweighted mean operating margin, in percentage, across the seven sampled companies (TCS, Infosys, Wipro, HCL Technologies, LTIMindtree, Tech Mahindra, and Persistent Systems) for each year. USD/INR Annual Average represents the value of one USD in INR. Source: All values are collected from companiesmarketcap.com.

Additionally, a correlation analysis between the USD/INR exchange rate and IT sector average operating margin yields a Pearson correlation coefficient of -0.889, which indicates a statistically significant negative correlation, confirming that the divergence between rising export revenues and declining sector margins is not a coincidental pattern, rather a statistically important one.

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Figure 6.3; Relationship between USD/INR Exchange Rate and IT Sector Average Operating Margin (FY 2014–15 to FY 2024–25)

Figure 6.3a: USD/INR Exchange Rate over time

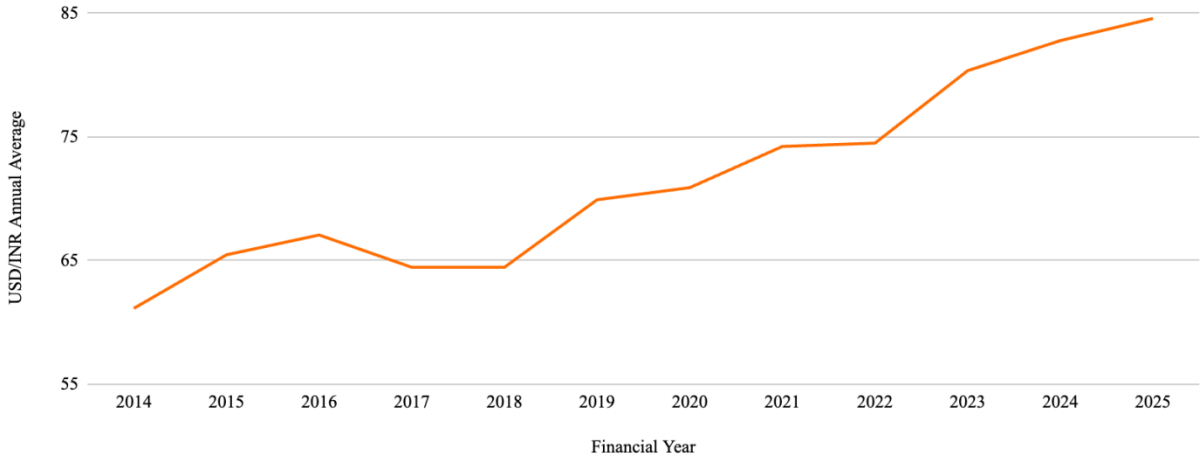

Figure 6.3b: Sector Avg Margin (%) over time

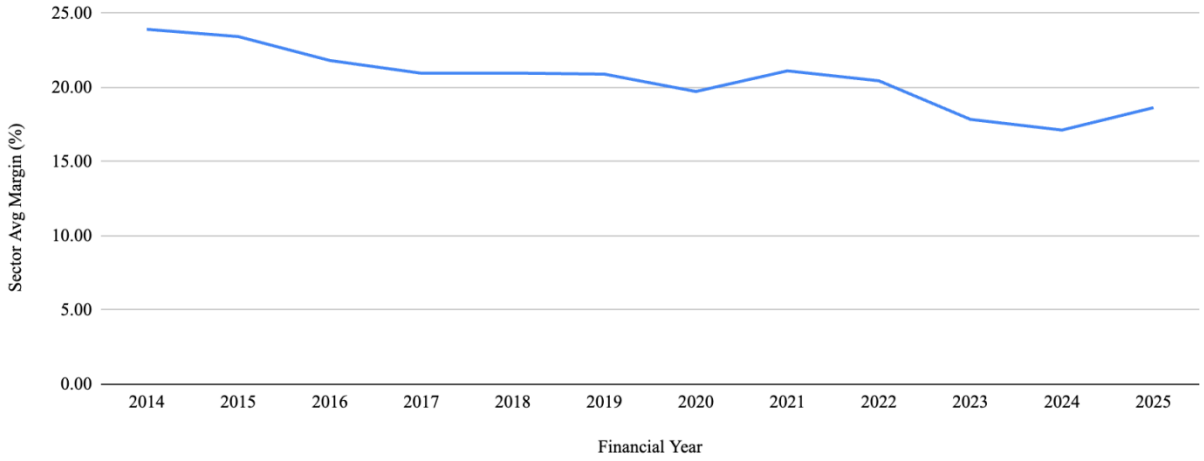

Figure 6.3a plots the annual average USD/INR exchange rate, that is the value of one USD in terms of INR, against the time period of FY 2014-15 to 2024-25, creating a line chart that shows an upward trend. Figure 6.3b plots the IT sector average margin, in percentage, with the values calculated in Table 6.2. Together, Figure 6.3 illustrates the relationship between rupee depreciation and IT sector firm profitability. While the Indian rupee exhibits a clear long-term depreciation trend, IT sector margins do not display a corresponding upward movement. Instead, sector margins show a gradual decline from above 22 percent in the mid-2010s to approximately

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17 percent by 2024–25. This divergence suggests that although a depreciating INR increases export revenues in nominal terms, it is not fully transmitted to operating profitability. Rising wage costs, increased on-site expenses, higher compliance, technology costs, and pricing pressure from global clients appear to offset any gains due to depreciation.

As a result, exchange rate movements alone are insufficient to sustain margin expansion at a sector-level. The findings reinforce the asymmetric effects of currency impacts — while revenue indicators respond positively to INR depreciation, profitability outcomes are mediated by firm-specific cost structures and competitive conditions, explaining why larger firms, such as TCS and Infosys consistently maintain higher and relatively stable margins, while mid-tier companies, like Tech Mahindra and Persistent Systems, experience higher volatility despite similar currency exposure. This divergence reflects differences in scale, service mix, client concentration, cost structures, and hedging practices. Larger firms benefit from economies of scale and stronger pricing power, which enable them to better absorb cost increases and moderate the impact of exchange rate volatility. Smaller and mid-tier firms, despite similar exposure to foreign currency revenues, are more vulnerable to cost pressures and competitive dynamics.

Overall, the evidence indicates that INR depreciation provides limited and uneven support to IT sector margins, which highlights the importance of micro-level analysis, operational, and structural factors in determining profits.

6.2 Exchange Rate Movements and Fuel-Intensive Sectors

This section examines the implications of exchange rate movements, especially INR depreciation, on fuel-intensive sectors through a cost-side transmission framework.

Unlike export-oriented sectors, import-oriented fuel-intensive industries are more vulnerable to a weakening domestic currency due to their heavy reliance on dollar-dominated energy imports (Parab, 2022).

6.2.1 Exchange Rate Movements and Global Crude Oil Prices

This section examines global crude oil prices alongside the USD/INR annual average exchange, using Brent crude as the benchmark. Since crude is priced in USD internationally, its price fluctuations are driven independent of the INR, and isolating this series opens the possibility to distinguish global price effects from currency effects when assessing cost pressure on fuel-intensive sectors. Table 6.3 presents annual average Brent crude oil prices alongside the USD/INR exchange rate for the study period.

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Table 6.3: Annual Average Brent Crude Oil prices in Comparison to the USD/INR Annual Average Exchange Rate (FY 2014-15 to FY 2024-25)

Financial Year	USD/INR Annual Average	Annual Average Brent Crude Oil Price (USD)
2014–15	61.14	85.24
2015–16	65.47	50.06
2016–17	67.07	50.93
2017–18	64.46	58.91
2018–19	69.92	70.78
2019–20	70.9	58.36
Financial Year (contd)	**USD/INR Annual Average (contd)**	**Annual Average Brent Crude Oil Price (USD) (contd)**
2020–21	74.23	46.41
2021–22	74.5	79.83
2022–23	80.36	94.23
2023–24	82.79	82.20
2024–25	84.58	77.13

Note: Monthly Brent crude oil prices were collected. The Annual Average was calculated by calculating the average of the monthly Brent crude oil price in each financial year. Source: historical data was collected from investing.com

Figure 6.4; Relationship between USD/INR Exchange Rate and Annual Average Brent Crude Oil Prices (FY 2014–15 to FY 2024–25)

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Figure 6.4a: USD/INR Exchange Rate over time

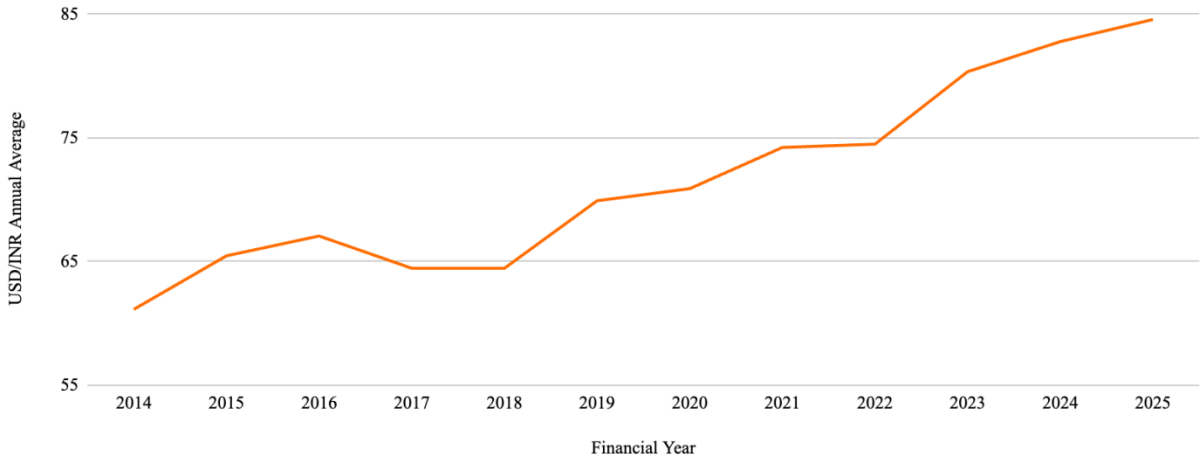

Figure 6.4b: Annual Avg Brent Crude Oil Prices over Time

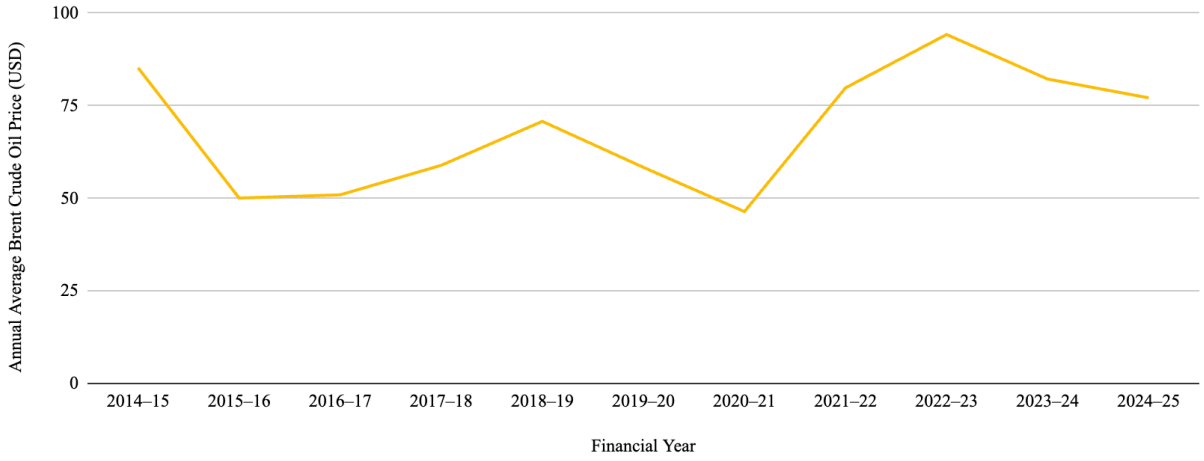

Figure 6.4a presents the depreciation of the INR against the USD, previously explained, while Figure 6.4b plots the annual average Brent crude oil prices over the study period.

Brent crude oil prices exhibit pronounced volatility driven by global supply-demand dynamics and geopolitical shocks, while the INR displays a less volatile, more persistent depreciation trend.

Moreover, a correlation analysis between the USD/INR exchange rate and Brent crude oil prices yields a Pearson correlation coefficient of 0.438, which is not very statistically significant at conventional levels, supporting the framing above that global crude oil prices and INR exchange

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rate move largely independent of each other over the study period. This confirms that they represent two different cost drivers instead of a single, combined shock.

6.2.2 Exchange Rate Movements and India's Oil Import Bill

This section shifts from the global crude price to its actual cost impact on India. This is measured using its total crude oil import bill. Unlike the Brent price alone, the oil import bill reflects the combined effects of global prices, import values, and the exchange rate, which offers a more complete perspective of the economic burden that fuel-intensive sectors face.

Table 6.4: India's Yearly Oil Import Bill in Comparison to the USD/INR Annual Average Exchange Rate (FY 2014-15 to FY 2024-25)

Financial Year	USD/INR Annual Average	Oil Import Bill (USD Billion)
2014–15	61.14	124.88
2015–16	65.47	73.92
2016–17	67.07	80.81
2017–18	64.46	101.44
2018–19	69.92	128.26
2019–20	70.9	119.06
2020–21	74.23	77.02
2021–22	74.5	144.33
Financial Year (contd)	**USD/INR Annual Average (contd)**	**Oil Import Bill (USD Billion) (contd)**
2022–23	80.36	184.44
2023–24	82.79	156.30
2024–25	84.58	160.85

Note: Oil import bill represents the total value of crude oil and petroleum product imports, reported in USD million, converted to USD billion. Source: Petroleum Planning & Analysis Cell (PPAC).

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Figure 6.5: Relationship between the USD/ INR exchange rate and India's Oil Import Bill (FY 2014–15 to FY 2024–25)

Figure 6.5a: USD/INR Exchange Rate over time

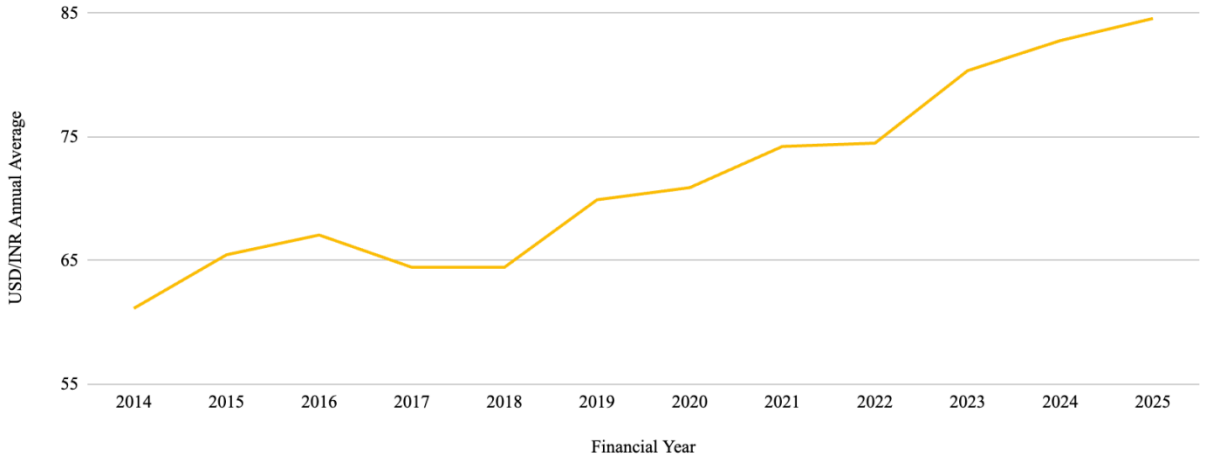

Figure 6.5b: Relationship between the USD/ INR exchange rate and India's Oil Import Bill

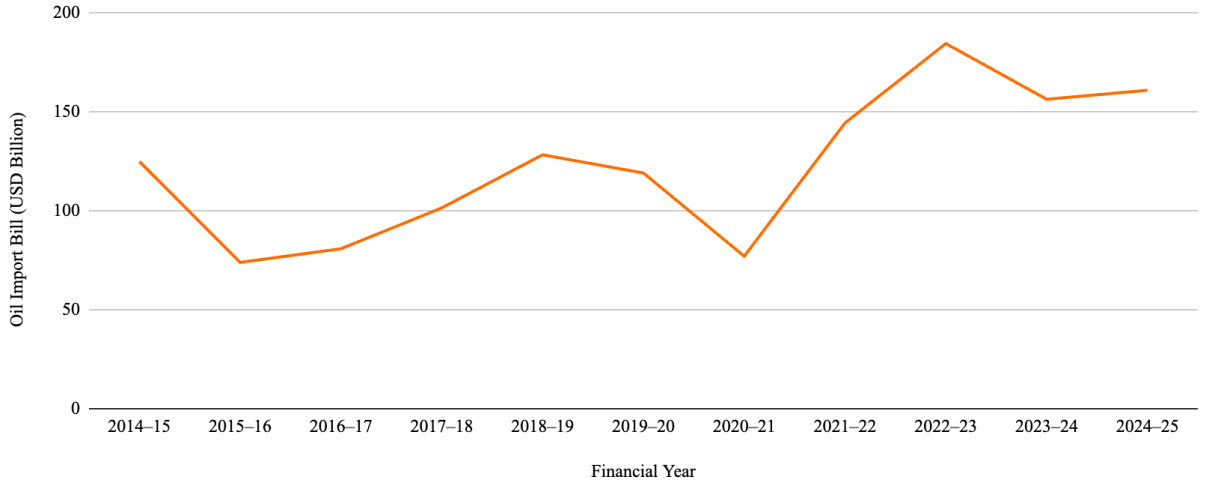

Figure 6.5 plots both the annual average USD/INR exchange rate movements and India's oil import bill over the study period. Figure 6.5b shows sharp increases in the oil import bill during periods of high crude prices, especially in FY 2022-23. Importantly, even when the global oil prices were moderate, the oil bill remained elevated. This reflects the amplifying role of rupee depreciation in determining effective import costs, indicating that exchange rate movements have a significant impact on India's foreign exchange outflows associated with energy imports, over and above global price fluctuations.

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6.2.3 Aviation Turbine Fuel Consumption and Cost Pressures

The aviation sector represents another fuel-intensive sector, offering a useful case study of fuel-cost exposure at the industry level given that Aviation Turbine Fuel (ATF) constitutes one of the largest components of airline operating costs and is priced in close alignment with global crude oil prices and the exchange rate. Thus, annual ATF consumption provides a sector-specific indicator of activity within an industry directly exposed to the cost pressures identified in the earlier sections of this study.

In order to assess how these external cost shocks translate into sector-specific stress, Table 6.5 reports annual Aviation Turbine Fuel (ATF) consumption in India over the study period. ATF consumption serves as a demand-side indicator of aviation sector activity operating under varying cost conditions.

Table 6.5: Annual Aviation Turbine Fuel (ATF) consumption in India, serving as a demand-side indicator of aviation sector activity and fuel usage.

Financial Year	ATF Consumption (Thousand Metric Tonnes)
2014–15	5722.90
2015–16	6,261.90
2016–17	6,997.60
2017–18	7,632.70
2018–19	8,300.00
2019–20	7,998.60
Financial Year (contd)	**ATF Consumption (Thousand Metric Tonnes) (contd)**
2020–21	3,697.80
2021–22	5,008.00
2022–23	7,378.10

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2023–24	8,247.00
2024–25	8,985.00

Note: ATF is measured in thousand metric tonnes. Source: Petroleum Planning & Analysis Cell (PPAC), Ministry of Petroleum & Natural Gas.

Between FY 2014-15 and FY 2018-19, ATF consumption steadily increased, which reflects strong growth in air traffic and sectoral expansion. Consumption sharply declined in FY 2020-21 due to the COVID-19 pandemic, but soon rebounded thereafter. Notably, the recovery in ATF consumption during FY 2022-23 and FY 2023-24 occurred alongside higher crude oil prices and sustained depreciation of the INR. This indicates that aviation activity resumed under significantly higher operating costs.

This pattern suggests that while global demand recovered, airlines faced intensified cost pressures due to the combined effects of global energy prices and a depreciation in exchange rate, which reinforces the adverse transmission mechanism for fuel-intensive sectors.

6.2.4 Structural Dependence on Fuel Imports

Beyond price and volume effects, India's exchange rate depreciation is amplified further by the structural importance of fuel imports in the country's trade composition. Table 6.6 below presents fuel imports as a share of total imports in India from FY2017-18 to 2024-25; however, data values before FY2017-18 were unobtainable.

Table 6.6: Fuel Imports as a Share of Total Merchandise Imports in India (FY2017-18 to FY 2024-25)

Financial Year	Fuel Imports (USD bn)	Total Imports (USD bn)	Fuel Share (%)
2017–18	132.29	465.58	28.42
2018–19	167.87	514.08	36.65
2019–20	153.65	474.71	32.37
2020–21	99.70	394.44	25.28
2021–22	194.86	613.05	31.78
2022–23	260.92	715.97	36.44

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2023–24	219.05	678.21	32.30
2024–25	218.46	721.20	30.29

Note: The time period of 2014-15 till 2016-17 could not be found at the time in the source.
Source: Ministry of Commerce and Industry, Department of Commerce, Import Data Bank

Fuel imports consistently account for around 25 to 36 percent of total imports in India, which indicates a persistent reliance on foreign currency-denominated energy supplies. During periods of INR depreciation, this high import share intensifies external sector vulnerability by increasing the domestic currency cost of imports and widening the trade deficit.

6.3 Synthesis of Findings on Asymmetric Sectoral Impact of Exchange Rate Movements

Taken together, the empirical data gathered in this study reveals a particular asymmetry in the sectoral effects of exchange rate movements in India, especially during periods of INR depreciation. For fuel-intensive sectors, exchange rate depreciation operates mostly via a cost-side transmission mechanism, where a weakening rupee amplifies the domestic currency cost of imported crude oil, which leads to higher input costs for energy-dependent industries, which exerts pressure on India's external balance. This pattern is evident from the observed association between the USD/INR exchange rate, global crude oil prices, and India's oil import bill documented earlier.

Contrastingly, the IT services sector exhibits a different transmission channel: periods of INR depreciation were associated with higher export revenues, which underscored the revenue-enhancing effect of a weaker currency for export-oriented industries. However, these revenue gains did not proportionally translate to improvements in profitability; instead, profitability outcomes were moderated by rising domestic costs, competitive pressures, and wage and operational rigidities, which limited the pass-through of exchange rate gains into company margins.

Furthermore, firm-level analysis reinforced this asymmetric adjustment within the IT services sector, with larger firms with diversified service offerings, global delivery models, and greater pricing power better positioned to absorb cost pressures and maintain relatively stable margins, while mid-tier firms exhibited greater volatility in profitability, which reflected heterogeneous adjustment capacities, even in an export-oriented sector.

Overall, the findings demonstrate that exchange rate movements create uneven and sector-specific outcomes across the Indian economy. While export-oriented industries such as IT services tend to primarily benefit through enhanced revenues, fuel-intensive sectors face increased vulnerability as a result of higher import costs and increased foreign exchange

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outflows. These results underscore that the macroeconomic consequences of exchange rate movements in an import-dependent economy like India cannot be assessed uniformly, rather to be evaluated through a sector-specific perspective which accounts for differences in trade orientation, import dependence and firm-level resilience

7. Conclusion

This study's goal was to examine whether the exchange rate movements in India over the time period of FY 2014-15 to FY 2024-25 produced uniform macroeconomic effects, or whether their impact was asymmetric across sectors with contrasting revenue-cost currency structures. The evidence presented across Sections 6.1 and 6.2 supports the latter.

For the IT services sector, INR depreciation was strongly associated with higher export revenues with a Pearson correlation coefficient of 0.953, consistent with the sector's dollar-denominated revenue and rupee-dominated cost structure. However, as examined in section 6.1.2, this revenue gain did not have a proportional impact on profitability, as sector average operating margins declined over the same period, with the strong negative correlation of r=-0.889 confirming that this divergence is systematic. This finding directly supports H1 and highlights a distinction that the existing literature has largely assumed: that currency-driven revenue growth and currency-driven profitability growth are not the same phenomenon.

For fuel-intensive industries, the evidence supports a cost-side transmission mechanism that largely operates independent of global crude price fluctuations. The exchange rate showed no statistically significant relationship with Brent crude prices with r=0.437, and p=0.179. This confirms that currency and global price shocks are distinct forces, while India's oil import bill showed a moderate yet significant relationship with the exchange rate depreciation, with r=0.687. Together, these results support H2, where currency depreciation raises the domestic cost burden of energy imports independently of, and in addition to global price movements, which was reinforced by the aviation sector's ATF consumption, and fuel's persistently high share of total imports in India.

Taken together, these findings support H3, where exchange rate movements over the study period produced clear asymmetric outcomes, with the export-oriented services benefitting, while imposing cost pressure on fuel-intensive, import-dependent industries.

To conclude on a broader note, this study's central contribution is demonstrating that a single macroeconomic variable: the USD/INR exchange rate can simultaneously represent a competitive advantage and also a cost burden within the same economy depending on a sector's currency exposure structure, which reinforces the need for sector-differentiated economic

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analysis in policymaking, rather than treating the effects of varying exchange rate as a single, uniform macroeconomic outcome.

8. Limitations and Scope for Future Research

This study has limitations that must be considered when interpreting its findings.

First, the analysis is descriptive and rooted in correlation rather than cause. While strong and statistically significant associations were observed between the sectoral outcomes of India's exchange rate movements, the study does not control for confounding macroeconomic factors, such as global IT demand cycles, domestic wage inflation, or pandemic-related demand shocks that could independently influence both the exchange rate and sectoral performance. Future research that employs multivariate regression or time-series causality techniques could help isolate the exchange rate's independent effect from these confounding influences.

Second, the study relies on a relatively small number of annual observations (n=11) for each correlational analysis spanning the study period. While the reported coefficients hold statistical significance despite this limited sample size, a longer time series or higher frequency data, such as on a quarterly basis, would improve statistical power, which would allow for more robust inference, particularly around structural breaks such as the COVID-19 pandemic.

Third, this study uses the nominal USD/INR exchange rate instead of the real USD/INR exchange rate that is adjusted for inflation. This choice is appropriate given the study's focus on direct currency conversion effects on exports and imports, but it does not account for the effects of differing inflation rates between India and its trading partners over the study period. Future work could compare findings using the Real Effective Exchange Rate to assess whether the reported associations hold after adjusting for price level changes.

Fourth, the IT sector analysis is based on a sample size of seven major listed firms, which, while representative of large and mid-cap segments of the industry, does not capture the full breadth of the IT services sector of India, including smaller firms, and unlisted companies. Similarly, fuel-intensive sector analysis relies on economy-wide and industry-level indicators, such as crude oil prices, oil import bill, and ATF consumption, rather than firm-level financial data, which limits direct comparisons with firm level granularity available for the IT sector.

Fifth, the study's operating margin data is collected from a single secondary source — CompaniesMarketCap, and while cross-verified for consistency in this study, was not independently reconciled against each company's annual report filings for every year in the sample. Future research would benefit from verifying firm-level financial data directly against primary company disclosures.

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Lastly, this study focuses on two sectors chosen for their contrasting currency exposure — that is the export-oriented IT services sector and the import-dependent fuel-intensive industries — as a comparison. Future research could extend this framework to other sectors with differing revenue-cost currency structures, such as pharmaceuticals, electronics manufacturing, or agriculture, to build a more comprehensive sector-by-sector analysis of exchange rate exposure across India's economy. Extending the analysis period beyond FY2024-25 as new data becomes available would allow further assessment of whether the asymmetric patterns identified in this study persist under different global monetary policy regimes.

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