



Impact of Exchange Rate Volatility on International trade in Developing economies

Antara Shah

ABSTRACT

This paper examines the relationship between exchange rate volatility, trade, and foreign direct investment (FDI) in eight developing economies from 2005 to 2023. Departing from prior level-based analyses, it uses year-on-year percentage changes to better capture short-term dynamics and sectoral heterogeneity. Exchange rate volatility is calculated as a three-year moving average of percentage changes, and exports are disaggregated into four trade-orientation categories to account for varying import intensity.

Results show predominantly negative correlations between volatility and FDI, while sectoral export responses differ by structure: export-intensive sectors in Brazil benefit from depreciation, whereas India's import-dependent sectors often gain from appreciation through lower input costs. Case studies of India's 2013 taper tantrum, Malaysia's 1998 peg, and Brazil's 2013–15 derivative program highlight how financial depth and policy mix shape outcomes. The study addresses a key gap in volatility literature by focusing on developing economies and sector-specific dynamics.

LITERATURE REVIEW

Research on exchange rate volatility and its impact on trade and investment has evolved substantially since the collapse of the Bretton Woods system in 1971, when countries transitioned to floating exchange rate regimes. Theoretical foundations draw on the “impossible trinity,” which posits that fixed exchange rates, independent monetary policy, and free capital mobility cannot coexist (Obstfeld et al., 2005)^[1]. In this context, volatility emerges as a crucial determinant of trade and foreign direct investment (FDI), influencing pricing, competitiveness, and investor confidence.

Volatility–Trade Nexus: Aggregate vs. Sectoral Perspectives

Early studies typically analyzed aggregate trade flows, often finding a negative relationship between exchange rate volatility and trade volumes. Rose (2000) documented that increased nominal exchange rate volatility reduces bilateral trade among 186 countries, while Dell’Araccia (1999)^[2] reported similar effects within the EU. These studies relied on standard deviations of exchange rate movements as proxies for volatility. However, results have not been unanimous: McKenzie and Brooks (1997)^[3] found a positive impact of volatility on German–US bilateral trade, suggesting firms may increase exports to diversify risk, while Kasman and Kasman (2005)^[4] observed comparable effects for Turkey.

More recent work emphasizes sectoral heterogeneity. Tarasenko (2021)^[5] disaggregated Russian trade into eight product groups—agricultural raw materials, chemicals, food, fuels, manufactured goods, ores/metals, textiles, and machinery—using a gravity model with instrumental variables to address reverse causality. The findings reveal negative effects on manufactured goods, agricultural raw materials, and machinery, but positive effects on fuels and imports of chemicals and textiles. This mixed pattern underscores how sector-specific characteristics, such as input dependencies and hedging opportunities, mediate the volatility–trade relationship.

Volatility and FDI

Exchange rate fluctuations also shape FDI decisions. Kılıçarslan (2018), examining Turkey (2005–2018), employed a Toda–Yamamoto causality framework and found unidirectional causality from FDI to exchange rate volatility, indicating that FDI inflows can stabilize rather than destabilize exchange rates. Theoretical work suggests that depreciation can attract FDI by lowering asset prices and production costs in the host country (Chowdhury & Wheeler, 2008)^[6], though market-seeking vs. export-oriented motivations lead to divergent outcomes.

Diversification, Financial Development, and Policy Frameworks

Yakubu et al. (2022)^[7] explored how export diversification influences growth in G7 economies and found that while diversification boosts growth, exchange rate volatility weakens this positive effect. This aligns with the notion that economies with concentrated exports (e.g., commodities) are more exposed to volatility shocks. Financial development also moderates impacts: countries with advanced hedging instruments (forward/option markets) face reduced adverse effects (Héricourt & Poncet, 2013)^[8].

Policy frameworks further shape outcomes. Kuncoro (2020)^[9] assessed Indonesia’s inflation-targeting regime and found that interest rate policies failed to reduce volatility, reflecting a focus on domestic price stability rather than external equilibrium. Similarly, Stavrakeva and Tang (2023)^[10] highlight the “exchange rate volatility puzzle”: despite declining macroeconomic

volatility during the Great Moderation, exchange rate volatility persisted, driven by shifts in currency risk premia and changing correlations between policy rates and inflation expectations.

Synthesis

The literature presents no universal conclusion: while volatility generally discourages trade and investment, effects are highly context- and sector-specific. Commodity exporters (e.g., fuels) may benefit from volatility, while manufactured goods and machinery are typically harmed. Financial market depth and hedging access reduce exposure, and policy frameworks (managed float vs. flexible targeting) determine the degree of intervention. The field increasingly emphasizes granular analysis—by sector, partner country, and policy regime—over aggregate correlations.

Gap in the Literature

Despite all this research, most studies remain aggregated and level-based, focusing on total exports or imports and absolute exchange rate movements (Rose, 2000; Dell'Araccia, 1999). This approach overlooks two critical aspects relevant to developing economies:

1. **Use of Percentage Changes Instead of Absolute Levels**

Existing literature typically correlates export levels with exchange rate levels, which can produce spurious results due to shared upward trends over time. By contrast, this study employs year-on-year percentage changes for both export growth and exchange rate volatility. This captures short-term responsiveness and filters out structural growth trends—a crucial consideration for economies where trade flows are highly cyclical and sensitive to external shocks.

2. **Focus on Developing Economies and Sectoral Heterogeneity**

Much of the empirical work (e.g., Tarasenko, 2021 on Russia; Yakubu et al., 2022 on G7 economies) examines advanced or single-country contexts. Few studies systematically compare multiple developing economies with varying exchange rate regimes and export profiles. This research addresses that gap by analyzing eight major developing economies (India, Indonesia, Bangladesh, Nigeria, Brazil, Mexico, Thailand, Malaysia) across four sectoral trade orientations—export-intensive, import-intensive, trade-intensive, and domestic-oriented sectors.

By filling these gaps, this research contributes a granular, percentage-change-based framework that captures the true short-term dynamics between exchange rate volatility and trade, highlights sector-specific sensitivities, and informs targeted policy interventions rather than one-size-fits-all prescriptions.

METHODOLOGY

1. Research Design

This study employs a mixed-methods approach. It combines quantitative time-series analyses to examine the relationship between exchange rate volatility and foreign direct investment, as well as export performance, across developing economies, with a qualitative component, using cross-country case studies based on notable volatility events. For these, qualitative timelines of policy responses will supplement the quantitative findings and illustrate what central bank tools worked at different thresholds of volatility.

2. Sample Selection

Eight major developing economies—India, Indonesia, Bangladesh, Nigeria, Brazil, Mexico, Thailand, and Malaysia—were chosen for their diverse export bases, economic structures, and exchange rate regimes. Selection was based on trade volume, regional representation, and data availability from major international and domestic sources. The period of analysis (2005–2023) captures multiple global economic cycles, commodity shocks, and a variety of volatility episodes.

3. Data Collection

a. Exchange Rate Data

- Sources: Reserve Bank of India, Bank Negara Malaysia, Central Bank of Brazil, Bangladesh Bank, Bank Indonesia, Bank of Thailand, Central Bank of Nigeria, Banco de México, IMF International Financial Statistics,

World Bank World Development Indicators, BIS exchange rate databases.

- Variable: Annual average nominal exchange rate (local currency per US dollar) from 2005 to 2023.
- Volatility Metric: Calculated as the 3-year moving average of year-on-year percentage changes to smooth transient spikes and highlight sustained fluctuation.

b. Export Data (by Sector)

Sources:

- India: Directorate General of Commercial Intelligence & Statistics (DGCI&S), Ministry of Commerce; Export Promotion Councils (GJEPC, Texprocil, EEPC), RBI Handbook of Statistics.
- Brazil: Ministério da Economia (COMEX), Banco Central do Brasil, UN Comtrade.
- Mexico: INEGI, Banco de México, UN Comtrade.

Four sectors per country were selected to typify -

- Export-Intensive,
- Import-Intensive,
- Trade-Intensive, and
- Domestic-Oriented activities

(e.g., electronics for Malaysia/Thailand, textiles for Bangladesh/India, machinery for India/Brazil, processed food/agriculture for Nigeria/Brazil/Bangladesh).

c. Foreign Direct Investment (FDI)

- Sources: World Bank World Development Indicators, UNCTAD World Investment Report, country central banks/statistical offices, IMF BOP statistics.
- Annual net FDI inflow data, cross-referenced for consistency.

4. Policy and Qualitative Data

- Central bank monetary reports, press releases, policy papers.
- IMF country program reviews, World Bank country economic memoranda.
- Academic literature (e.g., Economic Annals, RBI and Exim Bank research).
- Trade association annual reviews and sector studies.

QUANTITATIVE APPROACH

5. Data Processing

- All monetary values harmonized to current US dollars.
- Sector classifications harmonized using HS codes and industry-agency mappings.

a. Export Growth Rate Calculation

Year-on-year export growth for each sector calculated as:

$$\varepsilon_t = \frac{\epsilon_t - \epsilon_{t-1}}{\epsilon_{t-1}} \times 100$$

Where,

- ε_t represents the YoY export growth for a sector,
- ϵ_t represents the total exports of a particular sector.

b. Exchange Rate Volatility Calculation

IN EXPORT VS VOLATILITY REGRESSION:

The volatility measure used in this study is defined as the three-year moving average of the absolute year-on-year percentage changes in the chosen variable (e.g., exchange rate, sectoral export value). For each year t , volatility V_t is calculated as follows:

$$\Delta_t = \frac{(X_t - X_{t-1})}{X_{t-1}} \times 100$$
$$V_t = \frac{\Delta_t + (\Delta_{t-1}) + (\Delta_{t-2})}{3}$$

where

- X_t is the value of the exchange rate (taken as local currency by USD for each country) in year t ,
- Δ_t is the year-on-year percentage change in X ,

- V_t is the average of the absolute values of changes for year t and the previous two years.

IN FDI VS VOLATILITY REGRESSION

The same steps as taken above, but this time the standard deviation of 3 years was taken for the YoY% changes to smooth the volatility.

6. Empirical Analysis

This study empirically assesses how exchange rate volatility shapes sectoral export performance and foreign direct investment (FDI) flows across developing economies. For each country-sector and country-FDI pair, two types of scatter plots are generated, each incorporating a linear regression trendline and annotating the Pearson correlation coefficient (r) to indicate the direction and strength of association.

1. FDI vs Volatility Regressions

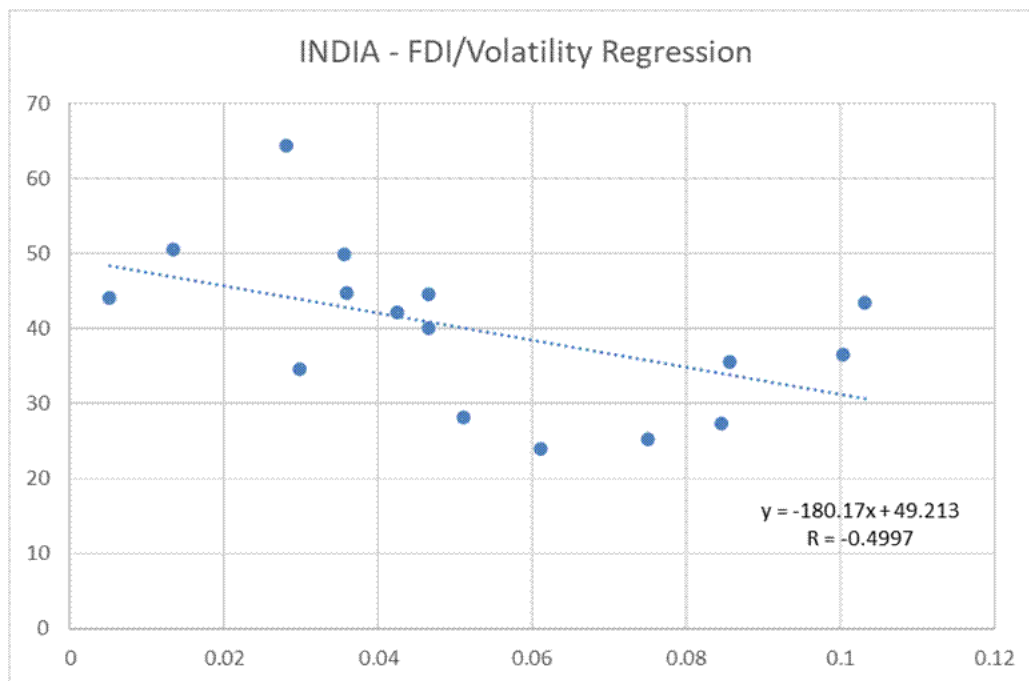


Fig 1. FDI/Volatility regression plot for India

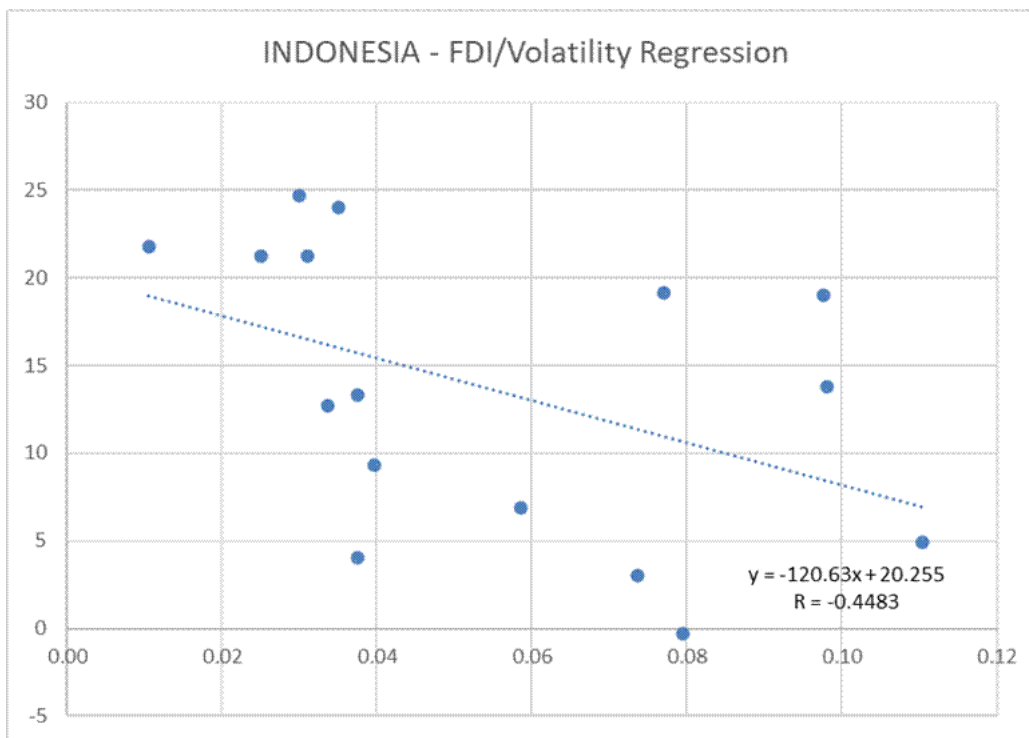


Fig 2. FDI/Volatility regression plot for Indonesia

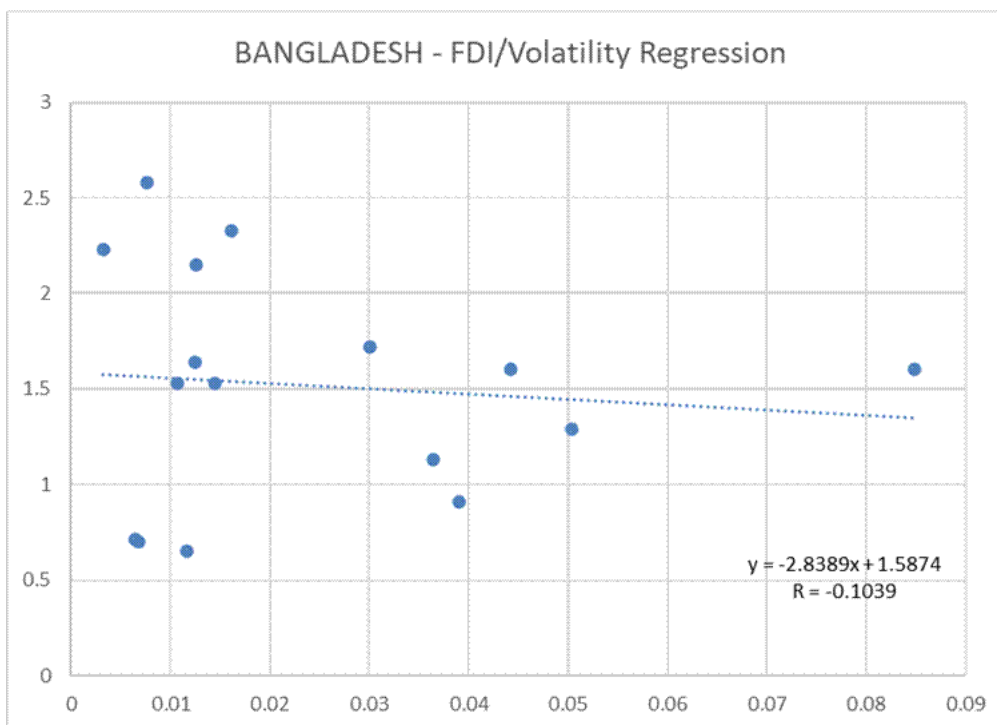


Fig 3. FDI/Volatility regression plot for Bangladesh

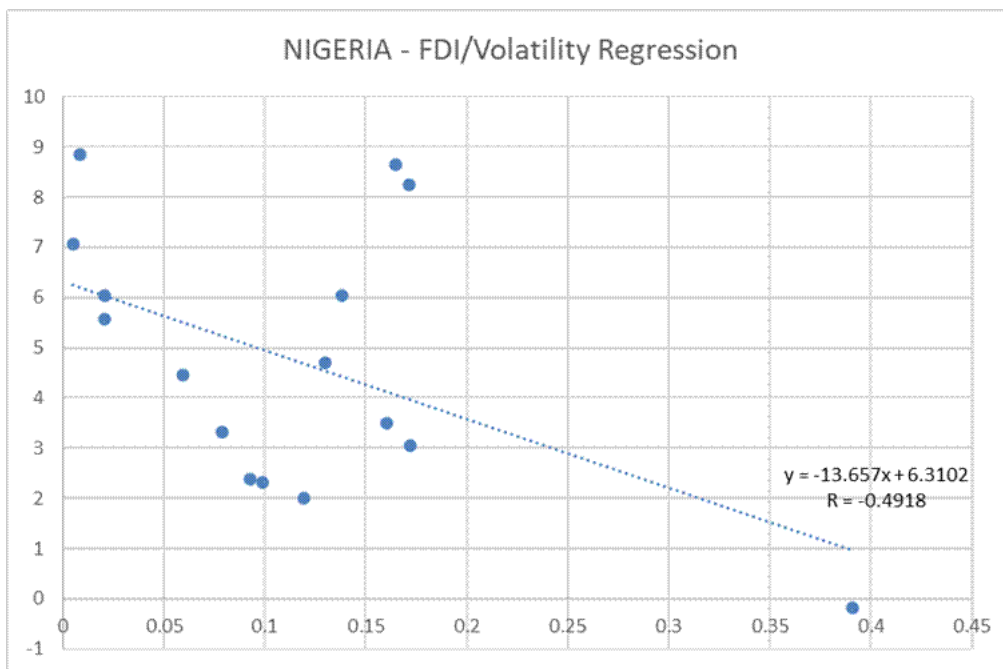


Fig 4. FDI/Volatility regression plot for Nigeria

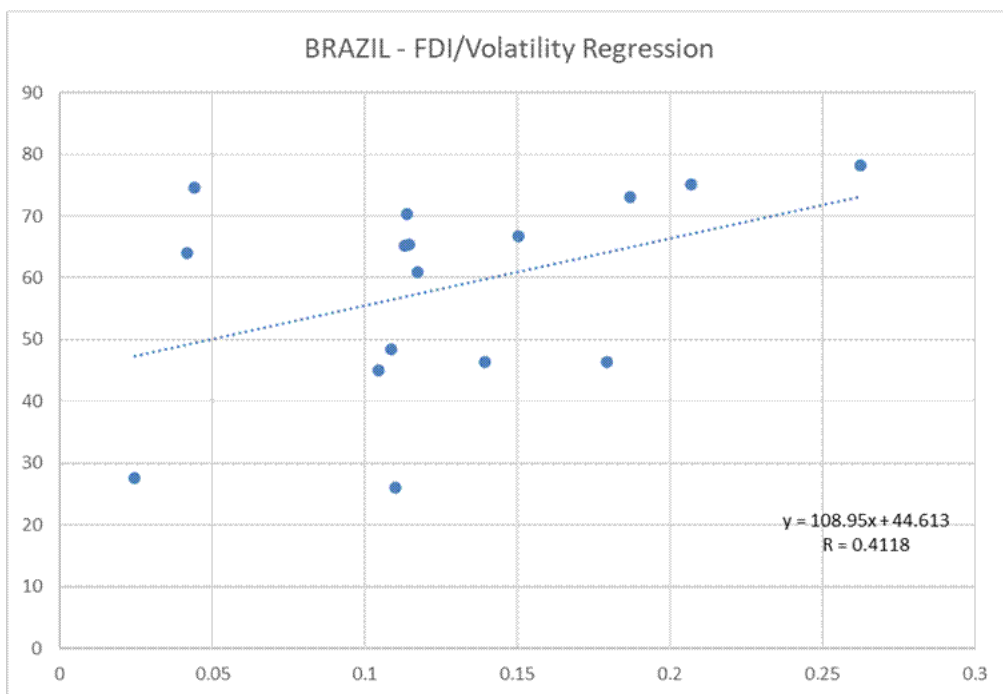


Fig 5. FDI/Volatility regression plot for Brazil

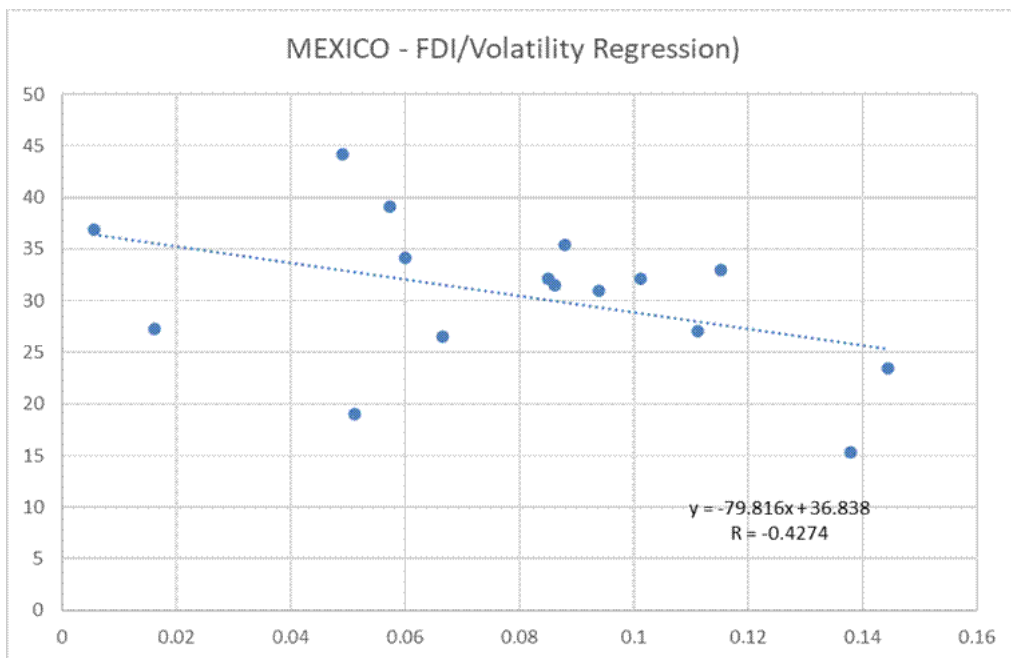


Fig 6. FDI/Volatility regression plot for Mexico

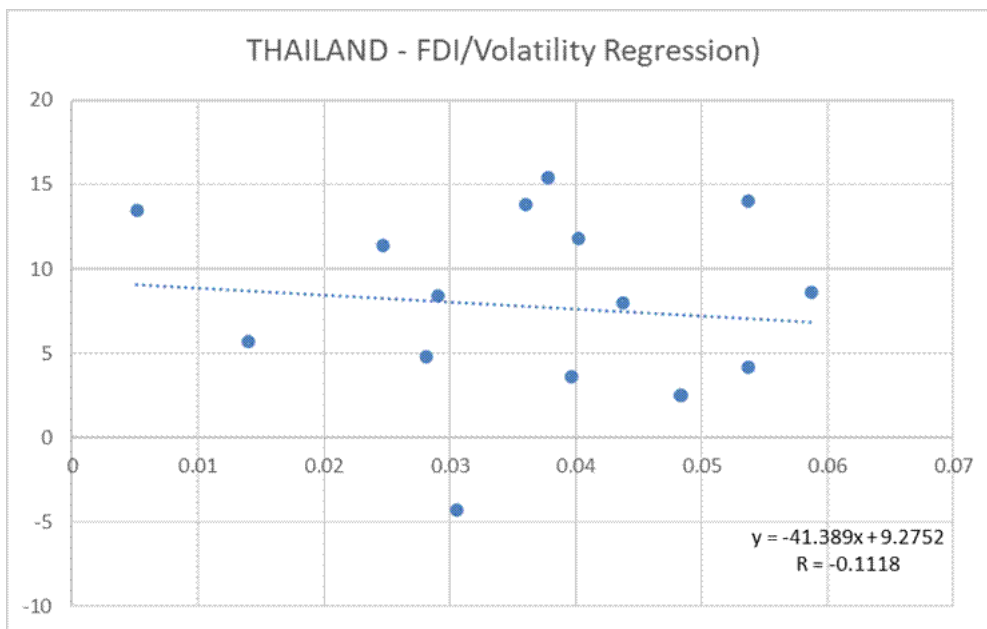


Fig 7. FDI/Volatility regression plot for Thailand

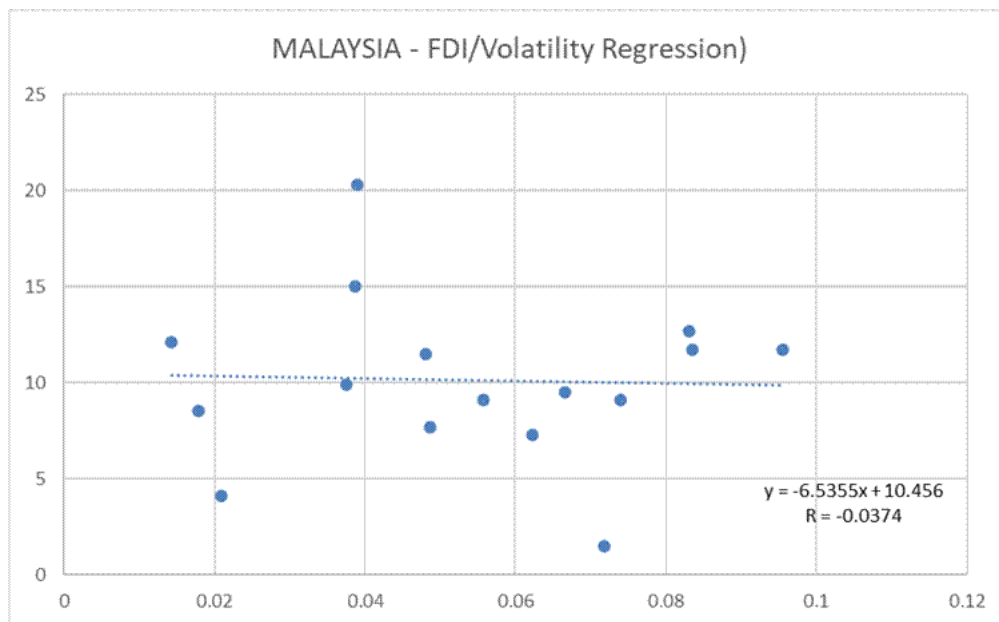


Fig 8. FDI/Volatility regression plot for Malaysia

2. Sectoral exports vs Volatility Regressions

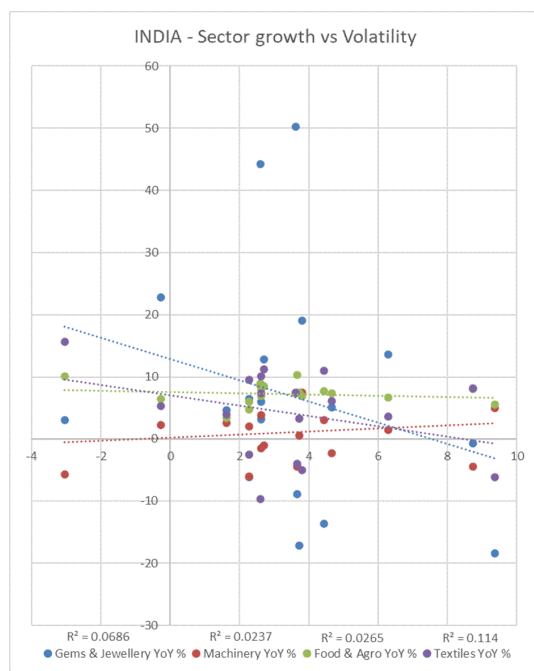


Fig 9. Sectoral YoY% Growth vs Volatility for India

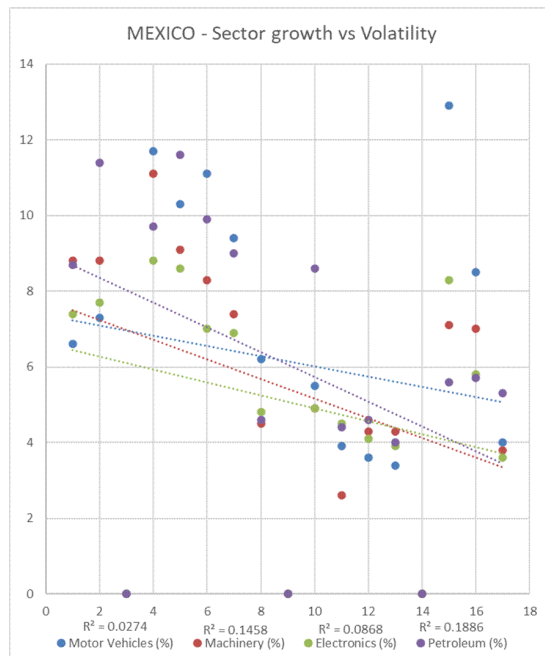


Fig 10. Sectoral YoY% Growth vs Volatility for Mexico

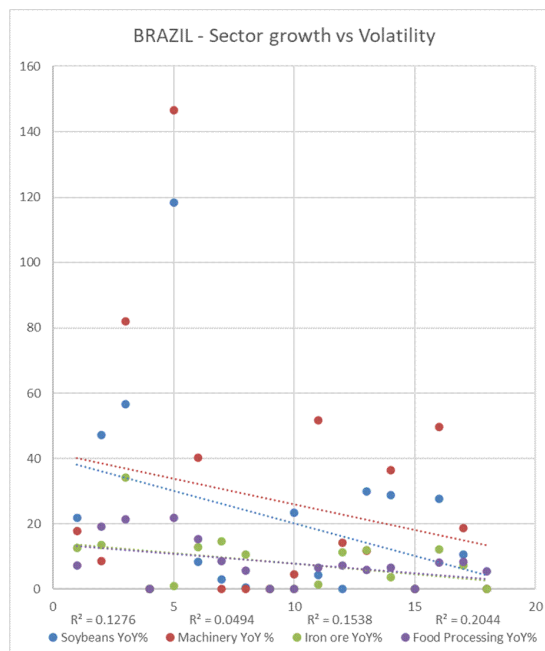


Fig 11. Sectoral YoY% Growth vs Volatility for Brazil

Brazil:

- Soybeans (Export Intensive),
- Iron Ore (Trade Intensive),
- Machinery (Import Intensive),
- Food Processing (Domestic Oriented)

Mexico:

- Sectors: Motor Vehicles (Export Intensive),
- Machinery (Trade Intensive),
- Petroleum (Import Intensive)
- Electronics (Domestic Oriented)

India:

- Textiles & Apparel (Export Intensive)
- Gems & Jewellery (Trade Intensive)
- Machinery (Import Intensive)
- Food & Agro-Based (Domestic Oriented)

QUALITATIVE APPROACH

Developing economies confront unprecedented challenges in managing exchange rate volatility due to structural vulnerabilities, limited institutional capacity, and heightened exposure to external shocks. Unlike advanced economies with deep financial markets and established monetary credibility, emerging markets must navigate the complex "impossible trinity" of monetary policy—the inability to simultaneously maintain fixed exchange rates, independent monetary policy, and free capital mobility. This fundamental constraint forces difficult trade-offs that directly impact export competitiveness and foreign direct investment flows.

Research by the World Bank shows that reducing exchange rate volatility by 10 percent can boost FDI inflows by an estimated 0.48 percentage points of GDP, while studies of G-3 currency volatility indicate that a one percentage point increase in major currency volatility decreases real exports of developing countries by approximately 2 percent on average. These findings underscore the critical importance of effective currency management strategies for sustaining economic growth in developing nations.

Case Study Analysis: Diverse Approaches and Outcomes

1. India's Multi-Pronged Sterilization Strategy (2013)

In mid-2013 India faced intense volatility as the rupee plunged ~25% amid the U.S. Fed's "taper tantrum" and investor outflows. The rupee hit an all-time low near ₹68.8 per US\$ in August 2013, reflecting high external deficits and global risk aversion. Volatility spiked, threatening domestic inflation and investor confidence.^[11]

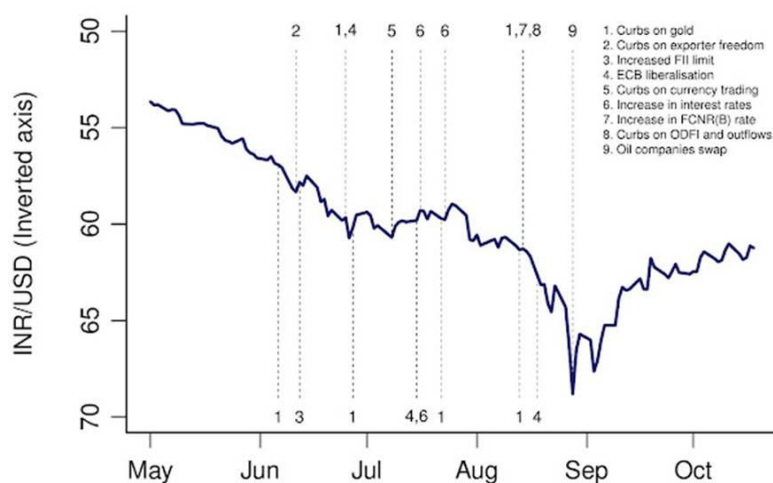


Fig 12. USD/INR exchange rate during 2013, with policy intervention events marked. A sharp rupee depreciation (peaking around Aug–Sept 2013) was partially reversed after intervention measures.

Policy Intervention

Indian authorities launched a multi-pronged defense. The Reserve Bank of India (RBI) aggressively tightened monetary policy (raising short-term interest rates by 300+ bps) and intervened in FX markets by selling dollars. Capital flow measures were used: outflow restrictions (to curb speculation) and incentives for inflows – notably a special foreign-currency deposit scheme for Non-Resident Indians. This scheme (FCNR-B deposits) raised about \$30 billion by offering banks swaps at attractive rates, effectively pulling in FX liquidity. RBI's approach was *“leaning against the wind”* – aiming to cushion volatility without a fixed target rate.

Outcomes

The combination of measures succeeded in stabilizing the rupee. After intervention, the rupee recovered to around ₹60–62 per US\$ by end-2013^[12]. Volatility subsided as panic eased. External buffers improved (the \$30bn inflow boosted reserves), helping restore market confidence. In fact, India has repeatedly used such tools: earlier in 1998 (after sanctions) and 2000, India issued diaspora bonds (Resurgent India Bonds, India Millennium Deposits) raising ~\$5 billion each, which stemmed the rupee's fall in those episodes. The RBI's sustained interventions are credited with “cushioning volatility and restoring orderly conditions” in the forex market. While growth temporarily slowed under high rates, the policy mix averted a deeper crisis and inflation was reined in. This Indian case shows that a blend of monetary tightening, FX market intervention, and innovative external borrowing can successfully mitigate a high-volatility episode.

2. Malaysia (1998) – Capital Controls and a Peg to Halt Collapse

During the 1997–98 Asian Financial Crisis, Malaysia's ringgit was extremely volatile – plummeting from about MYR2.5/USD pre-crisis to ~MYR4.88/USD at its worst in 1998. The currency's wild swings and sharp depreciation (over 50% drop) were fueling economic chaos and scaring off investors. By mid-1998, despite orthodox measures, Malaysia's recession deepened and markets remained turbulent.



Fig 13. Malaysian ringgit vs US\$ in 1997–98. The currency dropped sharply during the Asian crisis (volatility “uppy-downy” movement), then became stable at a fixed rate (MYR3.80 per US\$) after September 1998 when Malaysia imposed a peg and capital controls.^[13]

Policy Intervention

In September 1998, Malaysia took the bold step of pegging the ringgit at MYR3.80 per USD and imposing capital controls. The central bank fixed the exchange rate and *banned offshore trading of the ringgit*, effectively shutting down speculative attacks. Controls were placed on capital outflows (e.g. one-year moratorium on foreign funds’ repatriation) to trap liquidity and stabilize the currency market. These unorthodox measures were paired with expansionary fiscal policy (reversing austerity) and lower interest rates, since the peg gave room to ease monetary policy.

The results were striking. Volatility vanished almost overnight – the ringgit’s value flat-lined at the stable MYR3.80 rate, ending the freefall. This stability restored a degree of certainty for businesses and investors. Crucially, Malaysia’s emergency controls did not deter real investment. With the currency anchor in place, Malaysia aggressively cut interest rates and enacted fiscal stimulus. The economy, which had contracted in 1998, rebounded by the second quarter of 1999^[14]. The IMF acknowledged the 3.80 peg as a “*stability anchor*.”

3. Brazil's Derivative Shield Strategy (2013-2015)

In 2013, Brazil's currency (the **real**) came under severe pressure from global shocks. As U.S. taper fears led to capital flight from emerging markets, the real rapidly **depreciated** – from about R\$2.0/USD in April 2013 to roughly R\$2.4 by August. This ~20% slide, amid already high inflation, threatened Brazil's macro stability. Prior ad-hoc interventions by the central bank had failed to stem the real's fall^[15]

Policy Intervention

In August 2013, Brazil launched an unprecedented large-scale FX intervention program. Rather than a one-off action, the Central Bank of Brazil (BCB) pre-announced daily currency swap auctions and dollar repurchase agreements to provide USD liquidity to the market on an ongoing basis. Essentially, the BCB used *derivative FX swaps* (settled in local currency) to relieve pressure on the real without directly selling down reserves. Initially sized at \$60 billion, the program was later extended; by end-2013 about \$50B in swaps had been deployed, and ultimately the outstanding swaps reached ~\$110B by early 2015 (about one-third of Brazil's reserves). This was one of the largest FX intervention campaigns ever in a floating-rate emerging market. The BCB also continued raising interest rates during 2013–14 to bolster confidence.

4. Azerbaijan's Adjustment Strategy (2015)

As oil prices fell dramatically in late 2014 and early 2015, Azerbaijan faced intense pressure on its manat, which had been managed under a dollar peg since the early 2000s.

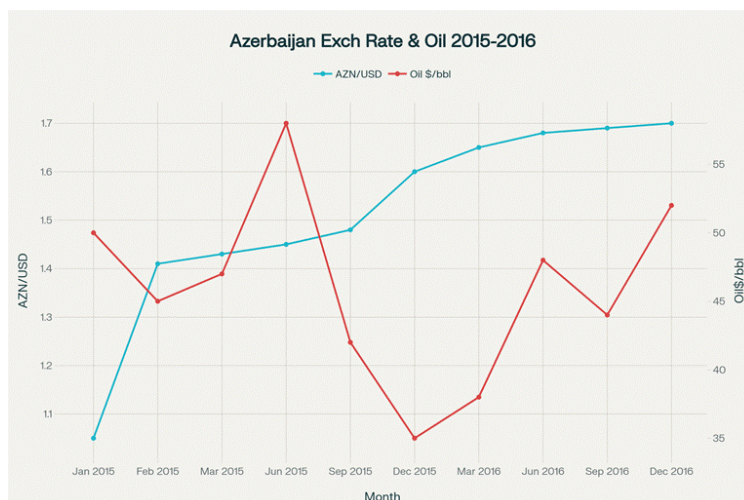


Fig 14. Azerbaijan's "Big Bang" Devaluation Strategy During 2015 Oil Crisis

Policy Intervention

Rather than gradually adjusting the exchange rate or attempting to defend the peg through massive reserve depletion, Azerbaijan implemented two large devaluations: a 34% devaluation in February 2015 followed by an additional 48% devaluation in December 2015, with a simultaneous shift to a managed float regime.

This approach was accompanied by selective import compression measures, fiscal support for the banking sector, and the launch of strategic roadmaps for non-oil sector development.

The immediate costs were substantial: inflation jumped to 12.4% in 2016, four banks lost their licenses, and deposit dollarization exceeded 80%. However, the medium-term benefits included improved competitiveness, with non-oil exports growing from 10% to 15% of total exports between 2014 and 2019, and stabilization of oil fund reserves.

RESULTS AND DISCUSSION

QUANTITATIVE APPROACH

Exchange Rate Volatility and Foreign Direct Investment (FDI)

The quantitative analysis across the eight developing economies reveals a predominantly negative association between exchange rate volatility and FDI inflows—contrary to some theoretical expectations that volatility might sometimes attract opportunistic inflows. This is clearly evidenced by the negative regression coefficients and moderate to strong negative R values for most sample countries, except for Brazil, which shows a positive correlation.

Why Brazil?

Brazil's experience during the period of strong capital inflows after the global financial crisis demonstrates why FDI increased even as exchange rate volatility rose. Unlike the standard case where volatility signals risk and deters investment, Brazil's volatility in this era was primarily tied to rapid currency appreciation rather than sustained depreciation.

The real appreciated by more than 40% against the U.S. dollar between December 2008 and July 2011, making Brazilian assets increasingly attractive to foreign investors hunting for yield and local currency gains. Deep capital markets, high interest rates, and a large, liquid

derivatives market further heightened Brazil's appeal as one of the preferred destinations for global capital, enabling investors both to capture returns and to hedge risks efficiently.

Moreover, Brazil's policy response played a crucial role in shaping the nature of these inflows. Even as the government imposed capital controls (notably the IOF tax), and macroprudential measures to dampen speculative inflows, the total volume of FDI remained robust. The data show that controls altered the composition rather than the aggregate size of inflows—FDI actually increased, partially due to investors using intercompany loans to circumvent taxes on other financial channels.

Implications of the Predominantly Negative Pattern

With seven out of eight countries showing negative volatility-FDI relationships (ranging from weak to moderate strength), the evidence strongly supports the hypothesis that exchange rate stability enhances FDI attractiveness in developing economies. Brazil's exceptional positive relationship underscores how specific macroeconomic contexts—particularly commodity booms combined with currency appreciation—can fundamentally alter investment dynamics.

The variation in coefficient magnitudes across countries highlights that while the direction of the volatility effect is mostly negative, the quantitative impact varies significantly based on structural factors including institutional quality, market development, and economic diversification. Countries like India and Mexico, with larger absolute coefficients, face greater FDI sensitivity to volatility, while Bangladesh's minimal coefficient suggests other factors dominate investment decisions.

These findings reinforce that volatility reduction should remain a priority for most emerging markets seeking to attract foreign investment.

Sectoral Export-Volatility Analysis

For India, Brazil and Mexico country-sector combinations, scatter plots were generated with exchange rate volatility (three-year moving average of year-on-year percentage changes) on the X-axis and annual sectoral export growth rates on the Y-axis. Each plot incorporates a linear regression trendline and reports the Pearson correlation coefficient (r) to quantify the direction and strength of association.

The correlation analysis enables identification of sectors where exchange rate movements significantly impact export performance versus those where other factors dominate. R-squared values indicate the proportion of export growth variation explained by exchange rate volatility.

Methodological Advantages

This study's sectoral export volatility analysis addresses a fundamental gap in existing literature by employing year-over-year percentage changes in both exchange rates and export growth, rather than the absolute level correlations commonly used in previous research. This methodological distinction proves crucial for understanding the actual short-term responsiveness of exports to currency movements, particularly in developing economies with high import intensity across key sectors.

A critical insight from the Exim Bank (2025) study^[16] supports our methodological approach: their ARDL model analysis reveals that "an appreciation of the Indian Rupee exerts a positive influence on India's real exports" with a 1% increase in Real Effective Exchange Rate translating to a 1.07% increase in real exports. This finding directly contradicts traditional trade theory expectations and validates our focus on sector-specific import intensity as a key explanatory variable.

Spurious Correlation Avoidance: The volatility-growth approach eliminates trending biases common in absolute level analyses where both exchange rates and exports tend to rise over time, creating misleading positive correlations.

Sectoral Heterogeneity Recognition: The four-way trade orientation classification enables identification of why currency policies succeed in some contexts but fail in others, moving beyond the "mixed results" characterizing previous aggregate studies.

Policy Relevance: Sector-specific findings enable targeted policy interventions rather than economy-wide measures that may be ineffective or counterproductive for certain industries.

Import Intensity as the Critical Factor

My sectoral classification framework directly addresses this reality:

Import-Intensive Sectors (High Import Dependence-Low Export Orientation): Machinery and similar sectors show consistently weak correlations ($R^2 = 0.024$ for India) because currency depreciation raises input costs more than it improves competitiveness. As the Exim Bank (2025) notes, "nearly 56.2% of India's merchandise exports come from industries where the import intensity of raw material is greater than the overall manufacturing average of 33.4%."

Trade-Intensive Sectors (High Export Orientation-High Import Intensity): Gems & Jewellery exemplifies this category with moderate negative correlation ($R^2 = 0.069$) reflecting the Exim Bank's finding that "in the trade intensive gems and jewellery sector, rupee appreciation has a positive impact on export performance, as cheaper imports of raw material can enable production of value-added exports more cost-effectively."

Short-Term vs. Long-Term Relationship Dynamics

The year-over-year percentage change approach captures what actually matters for volatility and short-term policy: currency depreciation does not reliably boost export growth year-by-year for most sectors, especially import-dependent ones.

Why Percentage Changes Reveal True Relationships:

1. Eliminates Trending Bias: Absolute level correlations often reflect common upward trends in both exchange rates and export values over time, creating misleading positive correlations that don't represent causal relationships.
2. Captures Business Cycle Sensitivity: Year-over-year changes reveal how sectors actually respond to currency movements during economic cycles, accounting for hedging behavior, contract stickiness, and supply chain adjustments.
3. Policy Relevance: Policymakers need to understand short-term export responses to currency interventions, not long-term structural trends.

Cross-Country Validation of Sectoral Patterns

The analysis reveals distinct patterns across countries that validate the import intensity framework:

Brazil and Mexico: Show stronger positive correlations in export-intensive sectors (soybeans $R^2 = 0.128$, electronics $R^2 = 0.189$) because these economies have lower import intensity in key export sectors compared to India.

India: Demonstrates consistently weak correlations across all sectors (ranging from $R^2 = 0.024$ to 0.114), reflecting the economy's high integration into global value chains and substantial import content in export production.

This pattern confirms the finding that "import intensity affects exports positively by facilitating production when imported inputs are not available domestically, but negatively when imported inputs become costlier due to currency depreciation."

Sector-Specific Results and Policy Implications

- Export-Intensive Sectors: Even sectors traditionally expected to benefit from depreciation show weak responses in India. Textiles ($R^2 = 0.114$) represents the strongest relationship, yet remains modest compared to theoretical predictions, suggesting that global demand cycles and supply chain factors dominate over pure price competitiveness.

- Trade-Intensive Sectors: Gems & Jewellery's negative correlation validates the Exim Bank's sectoral analysis, demonstrating how high import dependence for raw materials (gold, diamonds) makes the sector vulnerable to currency depreciation despite its export orientation.
- Domestic-Oriented Sectors: Food & Agro-based products show minimal correlation ($R^2 = 0.027$), confirming theoretical expectations of limited direct exchange rate exposure while potentially benefiting from reduced import competition during depreciation episodes.

Reconciling with Level-Based Studies

The Exim Bank (2025) Table 9 correlations using absolute levels should be interpreted as structural co-movement indicators rather than evidence of short-term policy effectiveness. As their own ARDL analysis demonstrates, the "contrary trend" where rupee appreciation benefits exports reflects India's import-dependent export structure—a finding that emerges clearly only when examining actual volatility relationships rather than level correlations. This methodological distinction explains why policy interventions based on traditional "depreciation boosts exports" assumptions often fail in practice.

QUALITATIVE APPROACH

Comparative Analysis of Policy Effectiveness

The diverse experiences across India (2013), Brazil (2013-15), Malaysia (1998), and Azerbaijan (2015) reveal critical patterns in exchange rate management effectiveness. Success depends on matching policy tools to structural characteristics, institutional capacity, and shock nature, as shown in Fig 15.

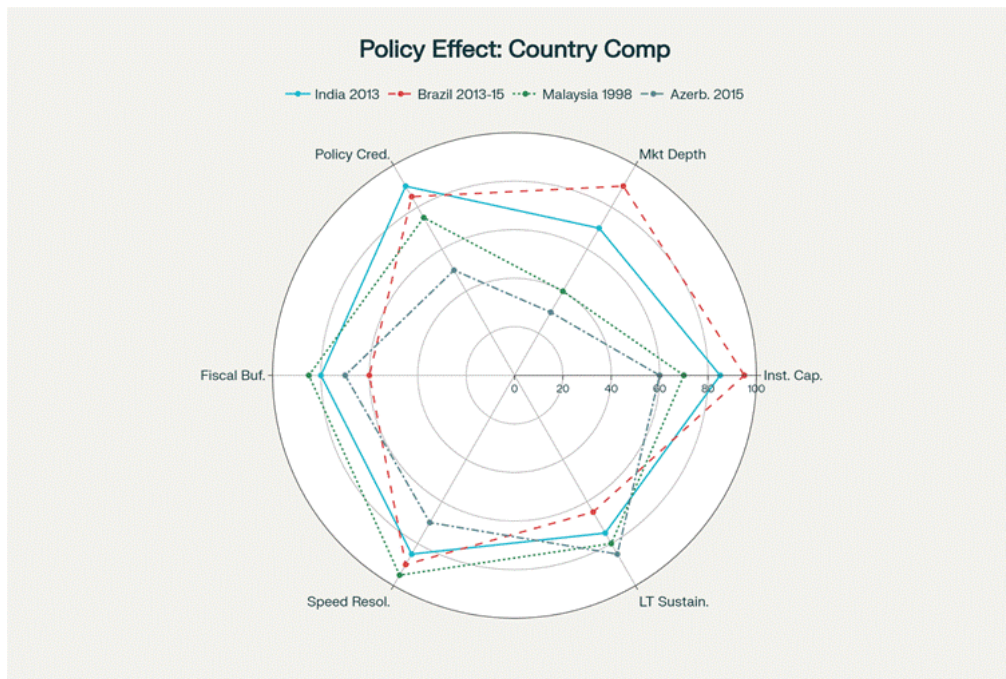


Fig 15. Comparative radar chart illustrating the effectiveness of exchange rate management policies across India (2013), Brazil (2013–15), Malaysia (1998), and Azerbaijan (2015).

Tool Matching and Structural Compatibility

- **Brazil's Derivatives Success:** Deep financial markets enabled sophisticated swap-based intervention (\$110B notional) without reserve depletion. However, this required advanced institutional capacity and created fiscal contingencies (0.7% GDP losses).
- **India's Sterilization Strategy:** Strong operational capacity enabled multi-pronged approach combining FX intervention, sterilization, and sectoral measures. Minimal fiscal costs (0.1% GDP) due to effective coordination between monetary and liquidity management.
- **Malaysia's Capital Controls:** Shallow markets made extreme measures necessary but effective. Currency peg (MYR3.80/USD) plus capital controls instantly eliminated volatility, enabling expansionary policies and growth recovery.

- Azerbaijan's "Big Bang" Approach: Limited institutional capacity led to discrete large devaluations (82% total). Restored competitiveness but required substantial fiscal support for the banking sector.

Policy Recommendations

Country Characteristics	Low Volatility	Moderate Volatility	High Volatility	Extreme Volatility
Deep Financial Markets + High Institutional Capacity	Build derivatives capacity	Brazil derivatives model	Comprehensive sterilized intervention	Enhanced Brazil model + emergency measures
High Institutional Capacity + Limited Markets	Develop market infrastructure	India sterilization model	Multi-pronged India approach	India model + capital controls

Limited Institutional Capacity	Basic capacity building	Simple spot intervention + communication	Malaysia capital controls model	Azerbaijan devaluation + external support
--------------------------------------	-------------------------------	--	------------------------------------	--

INTEGRATING QUALITATIVE AND QUANTITATIVE FINDINGS

Linking Data Patterns to Policy Outcomes

The quantitative analysis and case studies complement each other in a straightforward way: the sectoral export data helps explain why certain policy approaches worked while others might not have.

India

India's weak export-volatility correlations ($R^2 = 0.024$ to 0.114 across sectors) align with the RBI's 2013 decision to focus on stabilizing the currency rather than letting it depreciate. Since the data shows Indian exports don't respond strongly to currency movements—due to high import content in production—the policy emphasis on reducing volatility through monetary tightening and FX intervention made economic sense.

The strong negative FDI-volatility correlation ($R = -0.50$) for India further supports this stability-focused approach, as reducing volatility was more important for attracting investment than achieving a competitive exchange rate.

Brazil

Brazil's stronger sectoral correlations (soybeans $R^2 = 0.128$, iron ore $R^2 = 0.154$) help explain why the Central Bank of Brazil's derivative swap strategy worked differently. Brazilian commodity exports show clearer benefits from currency depreciation, so the policy of allowing controlled weakening while managing volatility through sophisticated financial instruments aligned with the country's export structure.

Brazil's positive FDI-volatility correlation ($R = 0.41$) reflected the unique period when volatility was associated with currency appreciation during the commodity boom, making it attractive to foreign investors.

Simple Policy Framework

The combined evidence suggests a basic diagnostic approach:

- Countries with weak export-volatility correlations (like India): Prioritize stability over depreciation
- Countries with stronger export-volatility correlations (like Brazil): Can benefit from managed depreciation strategies
- All countries: Generally benefit from volatility reduction for FDI attraction (7 of 8 countries show negative volatility-FDI relationships)

LIMITATIONS

A. Data and Methodological Constraints

Temporal Resolution Issues

- Annual data frequency may understate short-term exchange rate impacts and adjustment dynamics, as monthly or quarterly data might capture more immediate export and investment responses
- Potential lags between exchange rate movements and observed export responses may not be fully captured, particularly given hedging behavior and contract "stickiness" in international trade
- The three-year moving average volatility measure, while smoothing transient spikes, may obscure rapid adjustment periods that are policy-relevant

Sectoral Aggregation Limitations

- Incomplete sub-sector disaggregation within the four trade orientation categories may mask significant intra-sector heterogeneity

- Broadly defined sectors like "machinery" or "food processing" may contain industries with vastly different import intensities and export sensitivities
- HS code mapping and harmonization across countries may introduce classification inconsistencies despite standardization efforts

Statistical Methodology Constraints

- The correlation-based approach identifies statistical associations rather than establishing definitive causal relationships between exchange rate volatility and economic outcomes
- Linear regression assumptions may not capture non-linear relationships or threshold effects in volatility-export dynamics
- Observed patterns may reflect global economic shocks, commodity price cycles, or other external factors coinciding with currency movements rather than direct exchange rate effects

B. Sample and Coverage Limitations

Geographic and Temporal Scope

- Focus on eight developing economies may limit generalizability to other emerging markets with different economic structures, institutional frameworks, or development stages
- Country selection based on data availability may introduce selection bias, potentially excluding economies with more limited statistical capacity but different volatility experiences
- The 2005-2023 analytical period coincides with major global disruptions (2008 financial crisis, 2013 taper tantrum, COVID-19 pandemic) that may have fundamentally altered normal exchange rate-trade relationships

Sectoral Coverage Gaps

- Analysis limited to four sectors per country, while representative of major trade orientations, may miss important export industries or emerging sectors

- Service sector exports, increasingly important for developing economies, are not systematically analyzed
- Digital economy and technology sectors, which may have different exchange rate sensitivities, are underrepresented

C. Policy Analysis Limitations

Case Study Selection and Scope

- Qualitative case studies focus on notable intervention episodes, potentially overrepresenting dramatic policy responses while underweighting routine exchange rate management
- Success/failure assessments may be influenced by the specific timeframes chosen for evaluation, potentially missing longer-term consequences or delayed adjustment costs
- Limited coverage of failed intervention attempts may bias conclusions toward successful policy models

Institutional Context Variations

- Policy recommendations may not adequately account for differences in central bank independence, political economy constraints, and regulatory frameworks across countries
- The transferability of successful policy models (e.g., Brazil's derivatives strategy, India's multi-pronged approach) to other institutional contexts remains uncertain
- Administrative capacity constraints and implementation challenges are not systematically evaluated

CONCLUSION

This study provides new evidence on how exchange rate volatility influences trade and foreign direct investment in developing economies by shifting the analytical lens from aggregate,

level-based approaches to sectoral, percentage-change dynamics. The findings reveal three key insights.

- First, volatility predominantly deters FDI inflows across the eight sampled economies, reinforcing the importance of currency stability for investment attraction.
- Second, export responses are heterogeneous: while depreciation supports export-oriented and commodity sectors in countries like Brazil, appreciation can enhance performance in import-intensive sectors, as observed in India and Bangladesh, where cheaper inputs offset price competitiveness losses.
- Third, policy case studies highlight that successful interventions—ranging from India’s sterilized interventions to Malaysia’s capital controls—depend on aligning tools with structural characteristics and financial depth.

By capturing short-term fluctuations and sectoral heterogeneity, this study fills a critical gap in volatility literature and underscores the need for targeted, context-specific exchange rate management rather than uniform depreciation strategies in developing economies.

REFERENCES

Journal Articles & Reports

Exim Bank of India (2025) *Impact of Exchange Rate Movements on India’s Exports*. Mumbai: Export-Import Bank of India.

Kılıçarslan, Z. (2018) ‘Foreign direct investment and exchange rate volatility in Turkey: A Toda–Yamamoto causality test’, *International Journal of Economics and Financial Issues*, 8(4), pp. 61–67.

McKenzie, M. and Brooks, R. (1997) ‘The impact of exchange rate volatility on German–US trade flows’, *Journal of International Financial Markets, Institutions and Money*, 7(1), pp. 73–87.

Rose, A.K. (2000) ‘One money, one market: The effect of common currencies on trade’, *Economic Policy*, 15(30), pp. 7–45.

Stavrakeva, V. and Tang, J. (2023) ‘Five decades of exchange rate volatility’, *Journal of Monetary Economics*, 132, pp. 90–112.

Tarasenko, I. (2021) ‘The impact of exchange rate volatility on trade: Evidence from Russia’, *Russian Journal of Economics*, 7(3), pp. 213–232. Available at: <https://rujec.org/article/57933/>

Yakubu, I., Mahalik, M.K. and Mahatma, S. (2022) 'Export diversification, exchange rate volatility and economic growth: Evidence from G7 economies', *Journal of Risk and Financial Management*, 15(5), 197.

Websites + Institutional Sources

Bank for International Settlements (2013) *Foreign exchange market intervention: India case study*.

Reserve Bank of India (2013) *Monetary policy measures during taper tantrum*.

International Monetary Fund (2018) *Annual Report on Exchange Arrangements and Exchange Restrictions*.

World Bank (2024) *Exchange rate pass-through in developing economies: Policy implications*.

[1] <https://eml.berkeley.edu/~obstfeld/ost12.pdf>

[2] <https://ideas.repec.org/p/imf/imfwpa/1998-107.html>

[3] <https://www.sciencedirect.com/science/article/pii/S1042443197000127>

[4] <https://www.sciencedirect.com/science/article/abs/pii/S0264999307000636>

[5] <https://rujec.org/article/57933/>

[6] <https://www.researchgate.net/publication/46270084>

[7] <https://dergipark.org.tr/tr/download/article-file/2148595>



[8] <https://www.researchgate.net/publication/256976904>

[9] <https://ideas.repec.org/a/cbk/journal/v9y2020i2p19-42.html>

[10]

<https://www.imf.org/-/media/Files/News/Seminars/2023/ARC/session-i-second-paper-stavrakeva-tang.ashx>

[11] <https://www.bis.org/publ/bppdf/bispap73l.pdf>

[12] <https://pep.vse.cz/pdfs/pep/2022/05/05.pdf>

[13] <https://cilisos.my/5-reasons-why-pegging-the-ringgit-might-not-work-like-1997/>

[14] https://unctad.org/system/files/official-document/gdsmdpbpg2420053_en.pdf

[15]

<https://www.atlantafed.org/-/media/documents/news/conferences/2016/1201-impact-of-extraordinary-monetary-policy-on-the-financial-sector/papers/garcia-fx-interventions-in-brazil.pdf>

[16]

<https://www.eximbankindia.in/Assets/Dynamic/PDF/Publication-Resources/ResearchPapers/205file.pdf>