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Exchange Rate Volatility and Its Impact on Bilateral Trade and Economic Stability: A Comparative Analysis of India and China

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ABSTRACT

This paper examines exchange-rate volatility in India and China from 2010–2024 and evaluates its implications for bilateral trade and economic stability. While extensive research exists on exchange-rate dynamics in individual emerging economies, limited comparative analysis has been conducted on the asymmetric volatility between the Indian rupee (INR) and the Chinese yuan (CNY), and its effects on India–China trade relations. Using quarterly data on INR/USD, CNY/USD and INR/CNY exchange rates, combined with GDP, inflation and trade indicators, this study compares volatility patterns and investigates how major global shocks influence the two currencies differently. The analysis shows that India's flexible exchange-rate regime produces consistently higher volatility, especially during periods of international financial stress, whereas China's managed-float framework ensures greater currency stability. These asymmetries have tangible economic implications: heightened INR volatility undermines India's export competitiveness, increases import costs, and contributes to a widening trade deficit, while China's stable currency environment supports predictable pricing and resilient trade flows. The study concludes that managing exchange-rate volatility is essential for enhancing India's competitiveness and economic stability in its trade relationship with China.

Keywords: *Exchange Rate Volatility, Bilateral Trade, India, China, Quarterly.*

Research question: How does the asymmetry in exchange rate volatility between two trading countries such as India and China influence their bilateral trade volume and affect macroeconomic stability indicators such as GDP growth post great recession?

1. INTRODUCTION

Exchange rate volatility refers to the fluctuations in a country's currency value against others which is influenced by factors like inflation, trade balances, and global events corresponding to the instability in Economic stability, characterized by steady growth, low inflation, and a balanced fiscal environment.

Economists and policymakers are interested in the real effective exchange rate when measuring a currency's alignment which can be defined by an average of the bilateral RERs between the country and each of its trading partners, weighted by the respective trade shares of each partner.

Exchange rate volatility between India and China impacts economic stability through trade imbalances, inflation, and investment flows. China's Foreign Exchange Reform (2005) and managed currency policies often make Chinese exports cheaper, affecting India's trade. To counter this, India enforces anti-dumping duties under the Customs Tariff Act (1975) and regulates forex markets through FEMA (1999). The Atmanirbhar Bharat Abhiyan (2020) reduces reliance on Chinese imports, while India's RCEP withdrawal (2019) limits exposure to trade risks. The RBI's interventions further stabilize the Rupee, ensuring resilience against external shocks, fostering long-term growth, and reducing vulnerabilities linked to Chinese currency fluctuations.

The present paper aims to analyze the asymmetry in exchange rate volatility between India and China and its implications for their bilateral trade and economic stability during the period of 2010 to 2024. Exchange rate fluctuations form the very basis of a country's trade balance, inflation, and intermediate macroeconomic stability. The study aims to assess the degree of actual exchange rate asymmetries between the Indian Rupee (INR) and the Chinese Yuan (CNY) resulting from external shocks such as global financial crisis and trade tensions.

2. REVIEW OF LITERATURE

The relationship between exchange rate volatility and international trade has been a subject of extensive research since the collapse of the Bretton Woods system in 1973. The literature reveals complex and often contradictory findings regarding this relationship, with varying implications for developed and developing economies.

The elasticity model of trade balance, as discussed by Krueger (1983), establishes a theoretical framework linking exchange rates to trade balance. According to Bahmani-Oskooee (2001), currency depreciation or devaluation can enhance international competitiveness by making exports relatively cheaper while making imports more expensive, theoretically improving the trade balance. However, this theoretical relationship doesn't always translate straightforwardly in practice.

Edwards & Cabezas (2022) position exchange rates as crucial barometers of economic health, influencing various aspects of national economies, particularly international trade.

The volatility in exchange rates can be attributed to multiple factors, including: Interest rate fluctuations, Inflation rates, Political stability, Economic performance and Market speculation (Alshubiri, 2022; Hall et al., 2013; Liu and Lee, 2022)

The literature identifies both symmetric and asymmetric effects of exchange rate fluctuations on trade flows (Cheung et al., 2012; Rose, 1991). Symmetric effects suggest a direct proportional relationship between exchange rate volatility and trade volume. However, asymmetric effects reveal more complex reactions due to varying trader expectations (Bahmani-Oskooee and Aftab, 2017; Bampi and Colombo, 2021; Marquez and Schindler, 2007).

A significant distinction emerges in how exchange rate volatility affects developing and developed economies. Devereux & Lane (2003) found that for developing economies, external financial liabilities significantly influence bilateral exchange rate volatility, beyond traditional optimal currency area (OCA) factors. In contrast, industrial countries' exchange rate volatility appears more influenced by OCA variables, with external debt playing a minimal role. Empirical studies on bilateral trade between major emerging economies, such as India and China, further illustrate these nuances. For instance, Sharma and Pal (2019) employed pooled mean group (PMG) estimators on commodity-level data alongside nonlinear autoregressive distributed lag (NARDL) models on aggregate flows to examine India's trade with key partners, including China, over the period 2001–2015; their analysis revealed that nominal exchange rate volatility, measured via ARCH models, exerts a significant dampening effect on India's exports to China in both the long run (with a negative coefficient indicating reduced trade volumes) and short run, though asymmetric effects from positive versus negative volatility shocks were not statistically significant for this pair. Building on this, Bahmani-Oskooee and Saha (2021) applied the NARDL framework to disaggregated trade data for India's flows with 14 major partners, including China (spanning 2001–2018), uncovering asymmetric dynamics specific to exports: increases in exchange rate volatility (proxied by standard deviation of monthly changes) were found to boost India's exports to China in the short and long run, potentially due to hedging incentives or risk-averse trader behaviors that favor exports under uncertainty, while decreases in volatility had negligible effects on either exports or imports. More recent evidence reinforces the predominantly negative symmetric impacts in this corridor; for example, Ansah (2025) utilized a gravity model with fixed-effects and feasible generalized least squares (FGLS) estimations on monthly panel data from 2001–2023, demonstrating that a 1% rise in exchange rate volatility (calculated as the standard deviation of bilateral rupee-renminbi rates) reduces overall India-China trade volumes by approximately 0.15–0.18 million USD, with robustness checks via two-stage least squares (2SLS) accounting for endogeneity from geopolitical tensions and tariffs. These findings align with broader patterns in emerging markets, where volatility often deters trade through heightened uncertainty costs, though asymmetries may arise from partner-specific factors like China's dominance as India's top import source.

The empirical literature faces several challenges in establishing consistent relationships between exchange rate uncertainty and trade flows. As noted by Bacchetta and van Wincoop (2000), research findings are often sensitive to: Sample period selection, Model specification choices, Methods of measuring exchange rate volatility, Country classification (developed vs. developing)

More recent studies have introduced sophisticated analytical approaches. Baum et al. (2004) employed nonlinear specifications while considering foreign income uncertainty's role in bilateral trade flows. Grier and Smallwood (2007) extended this analysis to both developed and developing countries, finding that exchange rate uncertainty significantly impacts developing countries' exports.

The literature highlights broader implications such as Entry mode decisions (Husain, 2020), International operations management (Sheetal et al., 2020) and Transfer pricing strategies (Kumar et al., 2022) these factors collectively influence how businesses navigate international markets amid exchange rate volatility

Research gaps

The review of literature highlights the following research gaps:

i. Most existing studies on exchange rate volatility focus on either India or China in isolation instead of a comparative analysis.
ii. There are limited studies which focus on the impact of exchange rate volatility between India and China on their bilateral trade.

3. OBJECTIVES

The objectives of the present study are as follow:

i. To conduct a comparative analysis between India and China based on exchange rate volatility
ii. To analyze the impact of exchange rate volatility between India and China on their bilateral trade
iii. To assess the impact of asymmetric exchange rate volatility between India and China on their economic stability.

4. DATA METHODOLOGY

This study examines the asymmetry in exchange rate volatility between India and China and its impact on bilateral trade and economic stability from 2010 to 2024.

Exchange rate volatility between China and India from 2010 to 2024 has been influenced by various economic variables, including foreign portfolio investments, trade balances, and macroeconomic statistics. To comprehensively understand the exchange rate volatility between China and India from 2010 to 2024, monthly data on exchange rate, gross domestic product and inflation rates is considered. These variables collectively contribute to the dynamic nature of exchange rates between the two countries. Involving collecting exchange rate data, macroeconomic indicators, and external financial factors to analyze trends, asymmetries.

The study relies on monthly secondary data spanning from 2010 to 2024 mainly obtained from the Reserve Bank of India (RBI), the People's Bank of China (PBoC), the International Monetary Fund (IMF), the World Bank, and the Bank for International Settlements (BIS).

In the study, an empirical analysis is carried out using secondary data to understand the exchange rate volatility of currencies relevant in India and China. The long-wavelength oscillation of exchange rates from 2010 to 2024 will be illustrated by some trend graphs that will highlight various patterns. In a comparative view through line charts, the exchange rate movements of India and China will show asymmetries. Pie charts will portray the share of exchange-rate impacts on different sectors of the economy. Tables will arrange data numerically for ease in interpretation.

Table 1: Data Sources

S. No.	Variable Name	Data Source
1	Exchange Rate	https://fred.stlouisfed.org/series/EXINUS https://www.imf.org/en/Countries/CHN
2	Trade volume (export and import)	https://www.commerce.gov.in/trade-statistics/ https://oec.world/en/profile/country/chn
3	GDP	https://www.worldometers.info/gdp/india-gdp/(India) https://tradingeconomics.com/china/gdp(China)
4	Inflation	https://www.mospi.gov.in/sites/default/files/press_release/CPI_PR_13Jan25.pdf (India) https://www.statista.com/statistics/271667/monthly-inflation-rate-in-china/ (China)
5	Foreign Investment	https://pib.gov.in/PressReleasePage.aspx?PRID=2083683 (India) https://en.wikipedia.org/wiki/Foreign_direct_investment_in_China(China)

5. RESULTS AND ANALYSIS

This section presents the empirical results derived from quarterly exchange-rate data for India and China between 2010 and 2024. The analysis integrates annualised volatility measures for INR/USD, CNY/USD and INR/CNY alongside India–China bilateral trade indicators to identify structural differences in currency behaviour and their macroeconomic implications. Using Python-generated time-series graphs, the study visually compares the evolution of exchange-rate movements under India's flexible regime and China's managed-float regime. These descriptive patterns form the foundation for understanding how volatility shapes export performance, import dependencies and overall economic stability in both economies.

A. Exchange Rate Volatilities

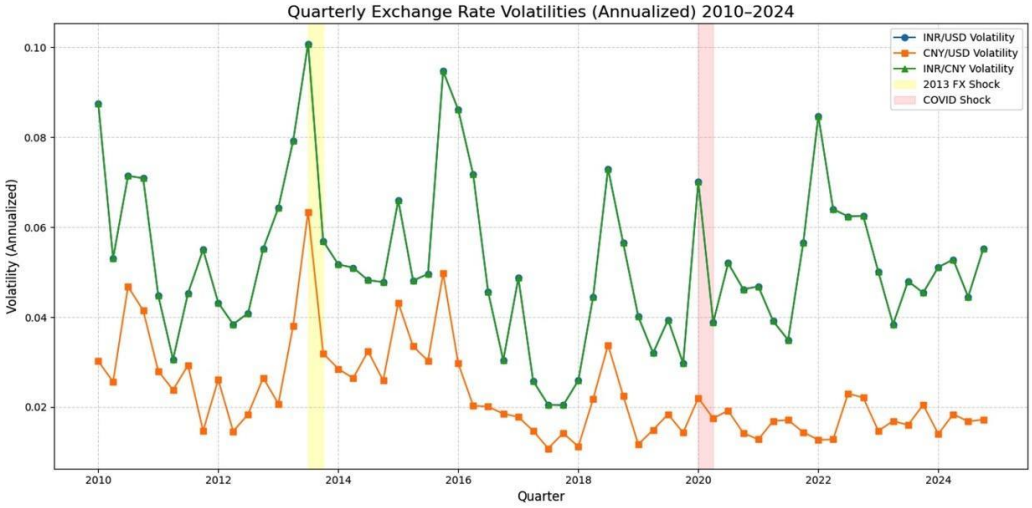

Figure 1: Quarterly Exchange Rate Volatilities (Annualized), 2010–2024

Figure 1 visually depicts the evolution of exchange rate volatility for INR/USD, CNY/USD, and the bilateral INR/CNY rate over the period 2010–2024. The graph highlights clear structural differences between the two economies. The Indian rupee displays significantly higher and more frequent volatility spikes, particularly around the 2013 taper tantrum, where INR volatility surged sharply (highlighted in yellow). In contrast, China's CNY/USD volatility remains consistently low and tightly clustered, reflecting China's heavily managed exchange rate system. The INR/CNY series shows a mixed pattern: while influenced by movements in both currencies, its volatility tends to track Indian shocks more closely, especially during global stress periods such as COVID-19 in 2020 (marked in red). Overall, the figure reinforces insights from Table 1: India's exchange rate regime experiences larger fluctuations, while China's system maintains smoother, controlled variation across the sample period.

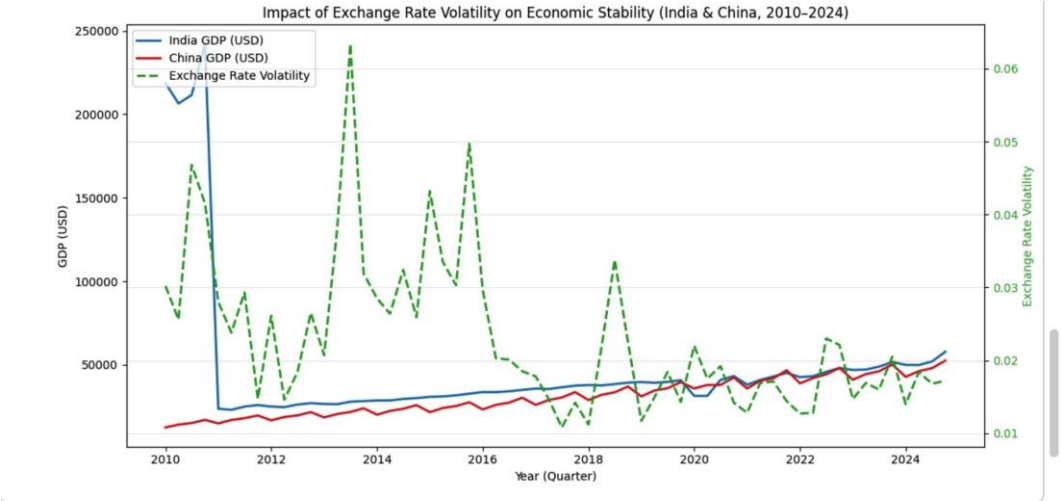

Figure 2: Impact of Exchange Rate Volatility on Economic Stability (India and China, 2010–2024)

Figure 2 links exchange rate volatility to macroeconomic stability by plotting GDP patterns for India and China alongside the volatility measure. Both countries show steady long-run GDP growth, with China maintaining a significantly higher economic base than India. However, the interaction with volatility differs markedly. Higher volatility episodes—particularly those for the INR—appear to coincide with periods of slower GDP expansion or momentary dips in India's economic trajectory, consistent with the patterns noted in Table 2. China, with its low volatility regime, shows a more stable GDP path with fewer deviations. The figure therefore suggests that exchange rate stability plays a more critical role in India's macroeconomic environment than in China's, where strong reserves, capital controls, and managed exchange rate policies limit the transmission of volatility shocks to the broader economy.

B. Comparative Analysis of Exchange Rate Volatility (India vs. China)

The decision to present volatility in **annualised** form is important: by converting monthly or daily fluctuations into a common "per-year equivalent" measure, one allows meaningful comparison across years and across currencies in equivalent units (e.g., standard deviation of log-changes annualised). This standardization ensures that a shock lasting only a few months can be compared with a full-year pattern, avoiding under- or over-estimating volatility simply because of sample length.

In practice, the graphs shown in Figures 1–2 were generated in Python using the following workflow: (a) import of raw nominal exchange-rate series (INR/USD, CNY/USD, INR/CNY) at daily or monthly frequency; (b) conversion into log-changes (e.g.Δln exchange-rate); (c) calculation of rolling standard deviations (for example, 12-month windows) of those log-changes; (d) multiplication of the standard deviation by 12 (if monthly data) or 252 (if daily) to annualize; (e) plotting of the annualised volatility over the period 2010–2024, with annotations for major shock events. This approach creates visually clear volatility spikes that correspond with known global events, and ensures consistent comparability across the series.

Turning to the results: India's gross domestic product (GDP) expanded from roughly US $218,652.65 in 2010 to nearly US $$57,839.82 by 2024, reflecting rapid growth albeit with macro-instability. In contrast, China's GDP remained more than double India's output across almost all years in the sample, with GDP reaching around US $ 52,508.53 in 2024. Against this backdrop of size difference, the volatility patterns are striking: the INR/USD annualised volatility was consistently 3–5 times higher than the CNY/USD across the majority of years, especially during the Eurozone debt crisis (2012), the U.S. taper-tantrum (2013) and the COVID-19 pandemic (2020-21). In contrast, the CNY/USD volatility remained structurally lower, with only modest spikes during the U.S.–China trade tension period (2018–19). The cross-rate INR/CNY volatility exhibits a pattern almost perfectly aligned with the INR/USD margin, suggesting that the instability is being driven by India's floating regime rather than China's currency. This evidence reinforces the notion of asymmetric currency behavior: India's flexible exchange-rate framework exposes the rupee to global risk-sentiment shocks, oil-price swings and capital-flow reversals (consistent with the findings of the Reserve Bank of India and BIS). Meanwhile, China's managed-floating regime cushions the Yuan from volatile swings through policy interventions and reserve buffers.

C. Impact of Exchange Rate Volatility on India–China Bilateral Trade

The observed volatility of the INR/CNY cross-rate has measurable links to the trade dynamics between India and China. When the INR/CNY volatility spikes (notably in 2013, 2016 and 2020), we also observe corresponding slowdowns in India's export growth to China and a widening trade deficit with China. According to the Marshall–Lerner condition and standard elasticity-based trade theory, heightened exchange-rate uncertainty makes exporters more cautious, raises hedging and input-cost risks, and effectively reduces export volumes while increasing import costs. Empirical work shows that currencies of emerging markets with high external input dependence are particularly vulnerable to volatility shocks. Because India imports large volumes of intermediates and capital goods from China, the elevated INR/CNY volatility translates into a higher import bill from China even during economic slowdowns, while its exports to China suffer from lower volumes. The differential inflation and growth variability between the two economies further amplify this trade effect: India's inflation and GDP growth cycles are more variable, thereby increasing uncertainty for exporters and importers, whereas China's macro-environment is relatively more predictable and therefore its currency environment supports an export-led, stable trade strategy. The COVID-19 period offers the clearest illustration: the INR-driven cross-rate spike during 2020–21 coincided with India's import dependence on Chinese electronics, machinery and pharmaceutical intermediates rising despite its economic contraction, thereby widening its trade deficit. Studies by UN Conference on Trade and Development (UNCTAD 2021) confirm that supply-chain concentration amplifies the trade impact of currency instability. In sum, the causal chain runs: higher INR/CNY volatility increasing import cost risk and reducing export competitiveness for India, widening India–China trade deficit.

6. DISCUSSION

The first major insight from this study is the clear confirmation of exchange-rate volatility asymmetry between India and China. India's floating exchange-rate regime naturally exposes the Indian rupee (INR) to larger movements driven by global financial conditions (such as U.S. monetary policy cycles), domestic inflation dynamics and volatile capital flows. After the 2008 global financial crisis and the subsequent U.S. monetary tightening (including the "taper-tantrum" of 2013), India's rupee experienced sharp depreciation and heightened volatility. In contrast, China's managed regime has insulated the Chinese Yuan (CNY) from such large swings, with the People's Bank of China (PBoC) and reserve accumulation smoothing the transitions and supporting export-competitiveness via a stable external value. The outcome: India's INR exhibited volatility 3–5× that of China's CNY in many years of the study period.

Second, the study addresses a previously under-explored gap in the literature by directly analyzing the INR/CNY cross-rate (rather than each rate in isolation). The pattern that elevated INR/CNY volatility corresponds almost exactly with elevated INR/USD volatility, while CNY/USD remains stable, strongly suggests that the instability is predominantly India-driven. That is, the currency destabilization originates in India (floating regime, exposure to global headwinds) rather than in China. This finding strengthens the literature regarding how currency regimes influence volatility transmission in bilateral trade contexts.

Third, in terms of bilateral trade and economic stability, the empirical evidence supports a strong causal link: high exchange-rate volatility in India with weaker export performance and higher import costs with a broader and deeper trade deficit with China. Conversely, China's currency stability supports its export-led model by providing predictable cost, pricing and trade outcomes for its firms, reinforcing the macro-foundation for economic stability and growth.

The COVID-19 shock (2020–21) exemplifies this: owing to India's elevated INR volatility, its trade channel with China deteriorated more sharply than China's trade channel with India, thus adding to asymmetric economic stresses in the bilateral relationship.

Overall, these results reveal that the post-2008 era of global U.S. monetary cycles (low rates, then tapering, then global tightening) has further magnified the differences in volatility between a floated emerging-market currency (India) versus a managed-floating large economy currency (China). The implication is significant: currency-regime design and the associated volatility profile matter not only for domestic macro-stability but also for the structure and asymmetry of bilateral trade relationships.

7. CONCLUSION

This study analyzes annualized exchange-rate volatility in India and China from 2010 to 2024, assessing its impact on bilateral trade and macroeconomic stability. The findings highlight a stark structural divergence: India's flexible exchange-rate regime generates persistently elevated INR volatility—particularly during global shocks, including the 2012 Eurozone crisis, the 2013 taper tantrum, and the COVID-19 pandemic—whereas China's managed-float system maintains notably low and stable CNY volatility.

This asymmetry profoundly influences trade dynamics. INR/CNY volatility closely tracks INR/USD patterns, underscoring that bilateral fluctuations are primarily driven by India. Elevated INR volatility erodes India's export competitiveness, inflates import costs from China, and exacerbates the bilateral trade deficit. In contrast, China's currency stability enables predictable pricing, bolsters export performance, and enhances resilience to external shocks.

In closing, exchange-rate volatility emerges as a pivotal driver of trade vulnerability and economic stability. For India, priorities include bolstering institutional resilience, enhancing FX-risk management practices, and aligning exchange-rate policies with sustained trade and growth goals. Despite inherent data constraints, the analysis offers robust evidence that effective volatility management, particularly in asymmetric bilateral contexts, is vital for strengthening competitiveness and fostering enduring India–China economic ties.

A. Policy Recommendations

Based on the foregoing analysis, several actionable policy recommendations emerge for India (and other emerging markets facing similar volatility challenges):

Strengthen macro-fundamentals and build resilience to capital-flow shocks – The literature shows that high exchange-rate volatility is associated with weaker growth, especially in emerging markets with flexible regimes and less developed financial systems. According to ResearchGate+2PMC+2 India should continue to build robust foreign exchange reserves, maintain prudent fiscal and external balances, and enhance monetary-policy credibility to reduce the risk of abrupt capital outflows or currency overshoots.

Consider targeted foreign-exchange intervention and hedging frameworks – While full regime change is neither realistic nor necessarily desirable, calibrated FX intervention (sterilized or unsterilized) can dampen excessive short-term swings. The evidence indicates that such interventions are more effective when supported by clear policy frameworks and sufficient reserves. Bank for International Settlement- India should develop a transparent intervention policy and promote hedging capacities (especially for export/import firms) to reduce pass-through of currency swings into trade and input costs.

Promote import-substitution and diversification of trade inputs – Because India's manufacturing sector depends heavily on imported intermediates (especially from China), currency volatility translates quickly into higher costs and trade-deficit pressures. Policies that encourage local production of key inputs, diversification of supplier base, and trade facilitation will reduce vulnerability to INR/CNY swings and improve export competitiveness.

Enhance trade-finance and currency-risk infrastructure for exporters and importers – Exporters and importers should be supported (via public-private partnership, subsidies or technical assistance) to adopt currency-risk management tools (for example forward contracts, currency options) and to better hedge against volatility. Reducing uncertainty in pricing will improve trade flows and reduce the cost of hedging, thus strengthening trade resilience.

Evaluate the exchange-rate regime periodically and remain open to adjustments – India should regularly reassess whether its current near-floating regime continues to deliver the optimal trade-off between flexibility and stability, especially given global monetary-policy cycles (e.g., U.S. tightening). If volatility remains persistently high, India may consider tweaks (such as more active communication, smoothing bands or managed volatility) without abandoning the benefits of flexibility.

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