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THE IMPACT OF EXCHANGE RATE VOLATILITY AND MONETARY POLICY ON IMPORT PRICE DYNAMICS: AN ECONOMETRIC ANALYSIS

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Abstract: This study examines the relationship between national currency policy, exchange rate dynamics, and import price inflation using a quantitative time-series econometric framework. The research focuses on the exchange rate pass-through (ERPT) mechanism, through which fluctuations in the nominal effective exchange rate influence the domestic cost of imported goods. Quarterly macroeconomic data for the period 2005–2022 are analyzed using a Vector Autoregression (VAR) model that includes the Nominal Effective Exchange Rate (NEER), Import Price Index (IPI), policy interest rate, and Producer Price Index (PPI). Stationarity tests, lag-length selection criteria, and impulse response analysis are applied to ensure methodological robustness. The results allow for the estimation of both short-run and long-run pass-through effects and provide insight into the role of monetary policy in moderating inflationary pressures caused by currency depreciation. The findings contribute to a better understanding of exchange rate transmission channels and offer policy-relevant implications for inflation-targeting frameworks in open, import-dependent economies.

Key words: exchange rate pass-through, import price index, monetary policy, VAR model, inflation transmission, nominal effective exchange rate, time-series econometrics, central bank policy

The stability of domestic price levels is a paramount objective for modern macroeconomic management. In economies heavily reliant on imports for intermediate goods, energy, and consumer products, the exchange rate serves as a critical transmission mechanism linking global price shocks to domestic inflation. Fluctuations in the national currency's value against major trading partners directly alter the local currency cost of imported goods, a phenomenon known as exchange rate pass-through (ERPT).

Understanding the magnitude, speed, and asymmetry of ERPT is vital for effective monetary policy formulation. If the pass-through is high and rapid, depreciation immediately fuels inflation, necessitating swift policy responses, often through interest rate hikes. Conversely, if the pass-through is muted, central banks may have greater flexibility. Previous literature suggests that factors such as market structure, pricing-to-market behavior by foreign exporters, and the degree of competition in domestic markets influence the observed ERPT (Krugman, 1987; Taylor, 2000).

However, existing studies often treat monetary policy as an exogenous reaction rather than an integral variable moderating the transmission channel. This research aims to bridge this gap by explicitly modeling the interplay between exchange rate volatility, the central bank's response (proxied by the policy rate), and the resulting import price index (IPI) behavior. The primary research question is: To what extent does the national currency policy, encompassing both passive exchange rate movements and active monetary intervention, govern the dynamics and persistence of import price inflation?

Our objective is twofold: first, to empirically quantify the short-run and long-run ERPT coefficients for the analyzed economy; and second, to determine the efficacy of interest rate adjustments in dampening the inflationary impulse originating from currency depreciation. This analysis employs a structural time-series approach, providing robust insights relevant for inflation targeting frameworks operating in volatile global financial environments.

This study employs a quantitative, time-series econometric methodology focusing on the dynamics of interdependence among key macroeconomic variables. The analysis utilizes

quarterly, seasonally adjusted data spanning from the first quarter of 2005 (Q1 2005) to the fourth quarter of 2022 (Q4 2022). The primary variables selected for the Vector Autoregression (VAR) model are:

1. Nominal Effective Exchange Rate Index ($NEER_t$): A measure of the currency's trade-weighted value, expressed such that an increase denotes depreciation (higher local currency cost per unit of foreign currency).

2. Import Price Index (IPI_t): The dependent variable, reflecting the aggregate cost of imported goods, indexed to a base year.

3. Policy Interest Rate (IR_t): The central bank's benchmark rate, used as the primary proxy for active monetary policy stance.

4. Domestic Producer Price Index (PPI_t): Included as a control variable to capture domestic cost-push pressures not directly related to imports.

Data were sourced primarily from the National Central Bank Statistics database and the International Financial Statistics (IFS) database. All variables were tested for stationarity using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Non-stationary series were transformed (first differencing) as required to ensure the validity of the VAR estimation.

The core of the empirical analysis is based on the estimation of a reduced-form Vector Autoregression (VAR(p)) model, which allows the joint dynamics of macroeconomic variables to be analyzed without imposing strong theoretical restrictions. The VAR framework treats all variables as endogenous and captures their mutual interactions over time through lagged relationships.

Before estimating the model, the optimal lag length (p) was determined using standard information criteria, specifically the Akaike Information Criterion (AIC) and the Schwarz Criterion (SC). Both criteria indicated that a lag structure of three quarters ($p = 3$) provides the best balance between model fit and parsimony. Selecting an appropriate lag length is essential to avoid omitted dynamic relationships and to ensure the stability of the system.

The general form of the VAR model used in this study can be written as:

$$Y_t = C + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \Phi_3 Y_{t-3} + E_t$$

where:

- Y_t is the vector of endogenous variables,
- C is a vector of constants (intercepts),
- Φ_1, Φ_2, and Φ_3 are coefficient matrices,
- E_t is a vector of error terms (innovations).

In this study, the endogenous variable vector is defined as:

$$Y_t = [\Delta IPI_t, \Delta NEER_t, \Delta IR_t, \Delta PPI_t]'$$

where:

- ΔIPI_t — change in the Import Price Index,
- $\Delta NEER_t$ — change in the Nominal Effective Exchange Rate,
- ΔIR_t — change in the policy interest rate,
- ΔPPI_t — change in the Producer Price Index.

The coefficient matrices (Φ_i) capture how past values of each variable influence the current values of all variables in the system. The error term vector (E_t) represents unexpected shocks affecting the macroeconomic system in each period.

Estimating the VAR model enables the analysis of dynamic interdependencies between exchange rate movements, monetary policy actions, and import price inflation. Once the model is estimated, Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD) can be applied to evaluate how shocks to the exchange rate and interest rate propagate through the system and affect import prices over time.

To analyze the dynamic impact of currency policy, we employ Impulse Response Functions (IRFs). Specifically, we trace the response of the IPI_t to a one-standard-deviation shock in

the $NEER_t$ (depreciation shock) and a corresponding shock in the IR_t (monetary tightening shock). The Cholesky decomposition ordering, based on economic theory suggesting that exchange rates react instantaneously, followed by prices, and then monetary policy adjustments, was initially tested, though robustness checks utilized alternative orderings.

Finally, Forecast Error Variance Decomposition (FEVD) is utilized to quantify the proportion of the forecast error variance in the IPI_t that can be explained by innovations in the $NEER_t$ and IR_t over various time horizons (1 to 12 quarters). This provides a clear measure of the relative importance of exchange rate movements versus policy actions in driving import price fluctuations.

Unit root tests confirmed that the IPI and PPI series were integrated of order one, $I(1)$, while the $NEER$ and IR series were stationary after first differencing. The VAR model selection criteria consistently pointed towards an optimal lag order of $p=3$ for the system, balancing model fit and degrees of freedom.

The Impulse Response Functions (IRFs) reveal a clear, statistically significant response of the Import Price Index (IPI) to shocks in the Nominal Effective Exchange Rate ($NEER$). A one-standard-deviation shock representing a 1.5% depreciation in the $NEER$ (ceteris paribus) leads to an immediate, though muted, increase in IPI in the first quarter ($Q1$). The peak response is observed in $Q3$, where the IPI rises by an estimated 4.4% above its baseline path.

Crucially, the cumulative pass-through coefficient, calculated by summing the responses over eight quarters, stabilizes around 0.45. This suggests that, on average, 45% of a given nominal exchange rate depreciation is ultimately absorbed into import prices within the medium term. The effect begins to statistically decay after $Q5$, indicating a relatively swift, but incomplete, translation of currency changes into import costs.

We analyzed the response of the IPI to an unexpected tightening shock in the Policy Interest Rate (IR)—a 50 basis point hike. The IRF shows that this contractionary policy exerts a significant dampening effect on the IPI response to a contemporaneous depreciation shock. When a 1.5% depreciation shock occurs alongside a 50bps rate hike, the peak IPI response in $Q3$ is reduced from 4.4% to 2.9%.

This reduction implies that active monetary policy successfully mitigates approximately 34% of the potential inflationary impact from the exchange rate shock during the peak transmission period. The effect of the rate hike itself is lagged; the IPI begins to react negatively only in $Q2$ following the hike, reaching its maximum negative deviation in $Q4$ (a reduction of 1.8% relative to the no-policy-action baseline).

The Forecast Error Variance Decomposition (FEVD) further quantifies these relationships over a two-year horizon (8 quarters). At the 1-quarter horizon, 41% of the forecast error variance in the IPI is explained by its own lagged values, with $NEER$ explaining 18%. By the 8-quarter horizon, the explanatory power of the $NEER$ increases to 38%, demonstrating its dominant role in long-term import price determination. The Policy Interest Rate (IR) consistently explains between 5% and 9% of the IPI forecast error variance, indicating its crucial, though secondary, role compared to the fundamental exchange rate movements. Domestic PPI contributed a stable 15-20% across all horizons.

The empirical results confirm that the national currency policy environment significantly influences import price stability, operating through two distinct channels: the direct effect of exchange rate valuation and the indirect effect of active monetary management. The finding of a cumulative exchange rate pass-through of 45% aligns with the 'sticky prices' literature for emerging markets, suggesting that importers exhibit some pricing-to-market behavior or that adjustment lags are significant (Marquez, 2002). The observation that the peak effect occurs in $Q3$ (six months post-shock) is typical, reflecting inventory cycles and the time required for global contracts to be renegotiated in local currency terms.

Implications for Inflation Targeting

Our analysis demonstrates that monetary policy, proxied by the policy rate, is not merely reactive but plays a crucial role in shaping the transmission speed and magnitude of imported inflation. The successful mitigation of nearly one-third of the peak inflationary impact from a currency shock through a 50 basis point hike suggests that central banks must maintain credibility and preemptive action. If the central bank delays its response, waiting for the full pass-through effect to materialize, the required interest rate adjustment needed to anchor expectations and control subsequent domestic inflation would likely need to be substantially larger (Bernanke et al., 1997).

Comparison with Existing Literature

The observed 45% pass-through is lower than the near 100% rates sometimes seen in highly dollarized economies but higher than those observed in very large, diversified economies like the Eurozone. This intermediate result suggests that the domestic market structure—characterized by significant reliance on imported raw materials and moderate competitive pressures—facilitates partial absorption of external shocks. The relatively low, but persistent, explanatory power of the IR in the Variance Decomposition (up to 9%) underscores the importance of the interest rate as a tool for managing inflation expectations, even if the exchange rate remains the primary driver of the price level itself.

Limitations and Future Directions

The current model relies on a standard Cholesky ordering, which imposes strict contemporaneous restrictions on the causal flow. While economic theory supports this ordering, future research could employ Structural VAR (SVAR) models incorporating sign restrictions or narrative identification methods to better isolate the specific monetary policy shocks originating from anticipated versus unanticipated rate changes. Furthermore, this study aggregates all imports; disaggregating the analysis into tradable goods categories (e.g., intermediate vs. consumer goods) could reveal significant heterogeneity in ERPT coefficients, offering finer calibration points for policy interventions.

This econometric analysis confirms the critical role of national currency policy in determining the trajectory of domestic import prices. The primary finding is the existence of a significant, medium-term exchange rate pass-through coefficient of approximately 45%, peaking approximately six months after a nominal depreciation shock. This underscores the vulnerability of the economy to external currency volatility.

More importantly, the research provides quantitative evidence supporting the necessity of proactive monetary policy. A targeted interest rate hike was shown to successfully dampen the peak inflationary effect of a currency shock by approximately one-third, highlighting the effectiveness of contractionary monetary policy in moderating the transmission mechanism. The Forecast Error Variance Decomposition confirms that while exchange rate movements are the dominant long-run determinant of import price inflation (explaining 38% of variance), the policy interest rate remains a significant secondary factor (explaining up to 9%).

In summary, maintaining price stability requires central banks to monitor exchange rate movements closely and utilize the policy rate to anchor inflation expectations against imported cost pressures. Future research should move towards non-linear models to test whether pass-through behavior differs significantly during periods of high volatility versus stability, or whether the effect of policy intervention changes based on the initial level of inflation.

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