The Dynamics of Exchange Rate Pass-through to Consumer Prices in Tanzania: Pre- and Post-Liberalisation Analysis

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Abstract
This study examines the relationship between exchange rate pass-through and inflation in Tanzania from 1988 to 2023, highlighting the effects of exchange rate fluctuations on consumer prices within an open economy. The Vector Error Correction Model indicates a significant long-term relationship between exchange rates and inflation. Granger causality tests demonstrate a bidirectional causal relationship between exchange rates and inflation, alongside a unidirectional influence from exchange rates to money supply, highlighting the significant impact of exchange rate dynamics on inflationary trends. Impulse response functions show that while the immediate effect of exchange rate shocks on inflation is modest, it intensifies over time and stabilises thereafter. Variance decomposition further identifies money supply as a key driver of inflation, particularly in the long run. Prior to liberalisation, ERPT was weak and statistically insignificant; post-liberalisation, however, it became negative and persistent, suggesting that stronger monetary policy frameworks and enhanced central bank independence have moderated inflationary pressures. The findings highlight the significance of exchange rate stability in maintaining price control and affirm the effectiveness of liberalisation in strengthening Tanzania's monetary transmission mechanism.
Keywords: Exchange Rate Pass-Through, Inflation Dynamics, Monetary Policy, Monetary Transmission Mechanism, Tanzania

Introduction
Exchange rate pass-through (ERPT) describes how fluctuations in a country's exchange rate affect domestic prices, especially consumer prices and inflation (Vo & Vu, 2024; Ha et al.,

2020). In an open economy, when a country's currency depreciates or appreciates against other currencies, it directly influences the cost of imported goods and services (Mahat & Kunwar, 2021; Krugman & Obstfeld, 2017). These changes can then ripple through the economy, impacting overall inflation (Karakostas, 2021; Forbes et al., 2017). However, the extent of exchange rate pass-through to inflation varies significantly across countries and depends on several factors, including the economy's structure, the type of imports, the level of competition, and the monetary policy framework (Frimpong & Adam, 2010).

Understanding the dynamics of ERPT is especially important for developing countries like Tanzania, where trade flows and exchange rate fluctuations significantly influence macroeconomic stability, inflation, trade competitiveness, and the effectiveness of monetary policy. ERPT is relevant in this economy because it heavily relies on imports for intermediate and final goods, and changes in the exchange rate can significantly impact the cost structure of domestic prices (Hamzat et al., 2024; Oseni, 2016; López-Villavicencio & Mignon, 2011). Additionally, ERPT is vital for Tanzania, which relies heavily on foreign-denominated loans to drive economic growth. Currency devaluation can increase the local currency cost of external debt payments, reducing public spending on economic development (Yusuf & Mohd, 2021; Nurjanah & Mustika, 2021). Ultimately, the stability of ERPT is crucial for attracting Foreign Direct Investment, as higher exchange rate volatility and pass-through effects create uncertainty for investors' profits, discouraging foreign investment (Shiyalin, 2022; Edem et al., 2022; Eregha, 2018).

In Tanzania, the relationship between exchange rate fluctuations and inflation has changed significantly over the years. After gaining independence in 1961, the country initially adopted a liberalized economic model, but in 1967, it shifted toward a socialist economic system with extensive government control (Chindengwike, 2024; Nyirenda, 2021). The introduction of structural adjustment programs in the 1980s, which included exchange rate devaluation and liberalization, led to increased macroeconomic instability and volatility in exchange rates (Suleiman & Makongo, 2000). Since 1986, Tanzania's currency, the Tanzanian Shilling (TZS), has experienced substantial depreciation against the US dollar and other currencies. For example, the exchange rate rose from 32.69 TZS per US dollar in 1986 to about 2410 TZS per dollar in 2023 (World Bank, 2023). The exchange rate has fluctuated sharply over the years, with notable devaluations from 2000 to 2010 (a 64% increase) and from 2011 to 2022 (a 65% increase), indicating a continuous trend of depreciation, as shown in Figure 1 (World Bank, 2023).

The volatility of the exchange rate in Tanzania has significantly impacted inflation, primarily through the rising cost of imports, which in turn influences domestic prices. Tanzania has experienced a growing trade deficit, with imports, particularly capital goods, intermediate goods, and petroleum, surpassing exports in recent years. While exports, especially gold, have contributed to some growth, the rapid increase in imports worsens the trade imbalance (World Bank, 2019). The impact of exchange rate fluctuations on import prices becomes more pronounced when the local currency weakens, making imported goods more expensive and fueling domestic price increases, a phenomenon known as exchange rate pass-through. This is a significant factor behind the inflation trends seen in Tanzania over the past decades (Mwase, 2006; Choudhri & Hakura, 2001). The recent trend in Figure 1 also shows that the exchange rate has experienced fluctuations.
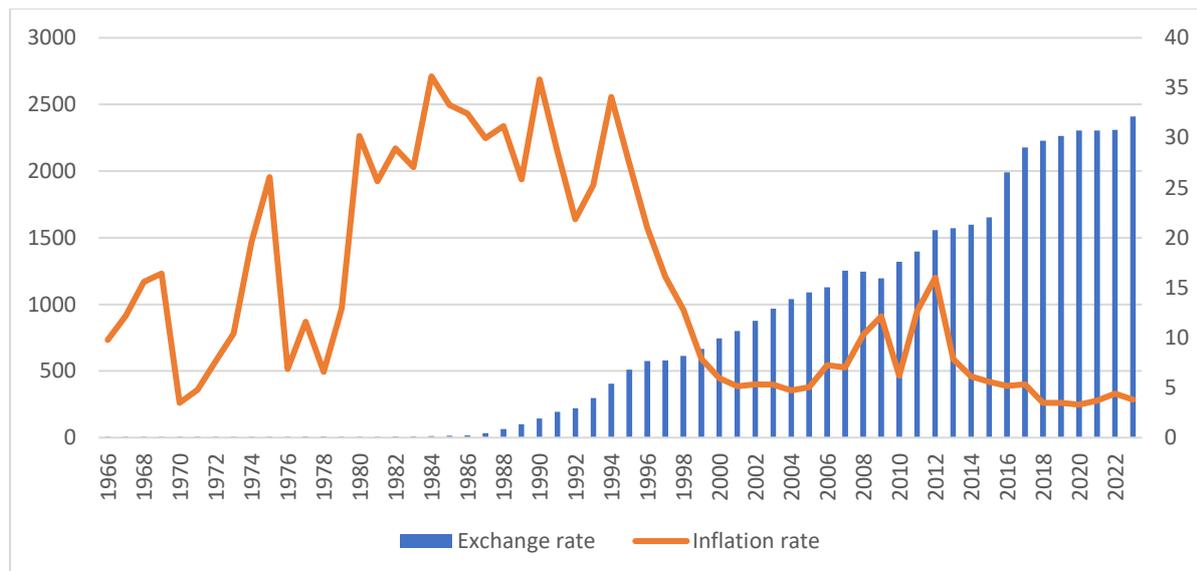
Figure 1: Nominal exchange rate and inflation rate
Source: World Bank data, 2024.

Tanzania's inflation history shows a strong connection between exchange rate depreciation and rising domestic prices. From the high inflation rates of the 1980s, which peaked at 36% due to external economic shocks, to the more stable single-digit inflation rates during the 1990s and early 2000s, the country's inflation pattern has undergone significant changes (World Bank, 2019). Despite some stability in the 2000s, inflation spiked again during the 2008 global financial crisis before gradually falling to 3.46% in 2019 (World Bank, 2019). These fluctuations highlight the importance of understanding the mechanisms of exchange rate pass-through, where imported goods greatly influence price levels (Zhang, 2021; Kotil, 2020). Fluctuations in exchange rates and inflation both impact import prices, which then affect consumer prices. This occurs especially when two major trading countries have markedly different inflation rates, affecting both traded and non-traded goods prices. Tanzania heavily relies on imports for economic growth, with 85% of its goods coming from abroad (BOT, 2024). Therefore, examining exchange rates, inflation, and their effects on domestic prices is crucial. Thus, the objective of the study is to examine the following: -

i.   To explore the current economic situation in Tanzania
ii.   To examine the impact of exchange rate pass-through on inflation in Tanzania.
iii.   To examine the impact of exchange rate pass-through on inflation in Tanzania pre- and post-liberalization.
iv.   To provide policy implications of the study.

Over the past two decades, Tanzania's economy has experienced significant structural and policy changes, such as the liberalisation of financial markets, the expansion of trade, and the development of monetary policy frameworks. The transmission of exchange rate disruptions to domestic prices is likely to have been altered by these changes; however, empirical evidence is scarce, particularly in the post-2005 period (Mwase, 2006). In light of recent global economic shocks, such as the COVID-19 pandemic and commodity price volatility, which have reignited concerns about inflation stability in import-dependent economies, this study is motivated by the need to provide current insights into the evolution of exchange rate pass-through in Tanzania.

This research contributes to the existing literature in several important ways. First, this study expands the examination of exchange rate pass-through in Tanzania by incorporating recent data from 1988 to 2023, addressing a notable deficiency in prior research that concluded in 2005. Secondly, it utilises sophisticated econometric methods—such as Vector Error Correction Models, Impulse Response Functions, and Variance Decomposition—to analyse both short- and long-term dynamics, providing a more refined comprehension of the inflation–exchange rate relationship. Third, by analysing the pre- and post-liberalisation periods independently, the analysis elucidates the impact of policy reforms on the efficacy of monetary transmission. The findings offer practical policy advice for sustaining pricing stability in Tanzania and comparable emerging economies, thus facilitating better-informed and effective macroeconomic management.

The paper is organised as follows: it presents a review of the theoretical and empirical literature. It also describes data and methods and discusses the empirical results. It concludes the findings and proposes some policy implications.

Literature Review

Exchange rate pass-through (ERPT) to inflation has been extensively studied across various countries, regions, and time periods, providing valuable insights into how exchange rate changes impact domestic prices. Early research, such as McCarthy (1999), examined the impact of exchange rates on inflation in nine developed nations. Using Ordinary Least Squares (OLS) regression, McCarthy found that countries with a higher share of imports experienced a higher pass-through from exchange rate fluctuations to inflation. This underscored the important role of trade openness in shaping how sensitive domestic prices are to exchange rate movements. Building on this, Choudhri & Hakura (2001) expanded the analysis by examining 77 countries, including developed, emerging, and developing nations, from 1979 to 2000 using OLS. They identified a significant and positive link between exchange rate pass-through and inflation, further emphasizing that ERPT was common across various economies. However, it was likely to differ in intensity based on the economic structure and trade patterns.

In the early 2000s, several studies provided a more detailed understanding of ERPT in different contexts. Gagnon & Ihrig (2004) and Hyder & Shah (2004) highlighted that countries with stable exchange rates and strong monetary policies tend to experience lower pass-through effects. Specifically, Hyder & Shah suggested that Pakistan's low pass-through could be attributed to the free-floating rupee and government interventions in key markets, such as sugar and wheat. These studies suggest that sound monetary policies and effective exchange rate stabilization efforts play a crucial role in mitigating the sensitivity of inflation to exchange rate fluctuations. Korhonen & Wachtel (2006), on the other hands, studied the Commonwealth of Independent States (CIS) using monthly data from 1999 to 2004 with Vector Autoregressive (VAR) models. They found that the pass-through effect was particularly pronounced in the CIS region, which was attributed to the region's open economy and heavy reliance on imported goods. This supported the idea that economies with high import dependence are more sensitive to exchange rate fluctuations, which directly affect domestic inflation.

Similarly, Goldfajn & Werlang (2005) examined 71 developed and emerging nations from 1980 to 1998. They observed that the pass-through was significantly higher in emerging

economies than in developed countries, which they linked to factors such as currency overvaluation. Their study also highlighted that changes in raw material and energy prices, driven by exchange rate fluctuations, played a significant role in accelerating the pass-through effect. Coricelli et al. (2006) conducted further investigations of ERPT in emerging economies, analysing the impact of exchange rate fluctuations on inflation in four Central and Eastern European countries: the Czech Republic, Hungary, Poland, and Slovenia, during the period from 1999 to 2004. Using the Autoregressive Distributed Lag (ARDL) model, they found a significant pass-through effect in countries with floating or managed exchange rate regimes, indicating that the structure of exchange rate policies played a key role in the degree of pass-through to inflation. This study reinforced the notion that exchange rate regimes influence the extent to which exchange rate fluctuations impact inflation.

Expanding on this line of inquiry, Frankel et al. (2012) conducted a cross-country analysis using data from 76 countries, including both developed and emerging economies, from 1990 to 2001, employing VAR and VECM. Their study found that middle-income and lower-income countries experienced higher exchange rate pass-through, while the overall trend of pass-through declined globally. This decrease was primarily attributed to the global reduction in inflation during that period. These findings suggest that inflation targeting and improved monetary policies in many countries have contributed to lowering the pass-through from exchange rates to domestic inflation over time. Pham (2019) focused on Vietnam and found that exchange rate pass-through was exceptionally high, primarily due to the pricing strategies employed by importers. He explained that changes in the exchange rate were almost directly transferred into import prices and, consequently, consumer prices. This result highlights the vulnerability of developing economies like Vietnam, where a significant portion of goods is imported, making the economy more sensitive to exchange rate fluctuations.

In the recent studies, Ha et al. (2020), analyzing 55 countries including developed, emerging, and developing nations with the Generalized Method of Moments (GMM) model, confirmed that exchange rate fluctuations have a higher impact on inflation in lower-income and developing economies, further emphasizing the varied effects of exchange rate movements across different income groups. Pham et al. (2023) analyzed the ERPT in the ASEAN-5 countries from 2000 to 2019 using both time series and panel regression models. Their study found that currency appreciation generally reduces inflation, while depreciation tends to increase inflation. This relationship aligns with the J-curve effect, which explains how trade balances and inflation usually respond to changes in exchange rates. These findings are significant for countries in transition or with volatile exchange rates, as such dynamics can create significant inflationary pressures.

Meanwhile, in Africa, there are fewer studies that focus on ERPT. For instance, Mwase (2006) analyzed ERPT in Tanzania using data from 1990 to 2005, employing VAR and VECM, and found that exchange rate fluctuations had a small but long-term impact on inflation. He linked the decline in pass-through to macroeconomic and structural improvements in the country. Similarly, Frimpong & Adam (2012) studied Ghana and found that the exchange rate pass-through effect was moderate and decreasing, which they attributed to greater trade openness and tighter monetary policies. Razafimahefa (2012) also noted that the pass-through was more pronounced during currency depreciation than during currency appreciation and attributed the reduction in pass-through to improvements in

macroeconomic performance and political stability in the region. Finally, Kemoe et al. (2024) studied Sub-Saharan Africa and found that exchange rate pass-through in the region was lower. They suggested that structural initiatives, such as fostering domestic market competitiveness and increasing economic diversification, could reduce the impact of exchange rate fluctuations on inflation.

It is evident from the literature review that many studies have explored the impact of exchange rate pass-through on inflation and other macroeconomic variables. The findings are mixed; differences depend on the exchange rate pass-through coefficient, with some studies reporting lower, moderate, and higher pass-through effects of the exchange rate on inflation. However, few studies have specifically examined the impact of exchange rate pass-through on inflation; most focus on other domestic prices such as import prices, production prices, and interest rates. Therefore, in Tanzania and Africa generally, there are only a few studies related to the exchange rate. To the best of our knowledge, only one study on exchange rate pass-through in Tanzania has been conducted since 2006, with no recent research on this topic. Given its importance for monetary policy, this study aims to fill that gap by investigating the effect of exchange rate pass-through on inflation in Tanzania.

Methodology
Data Sources and Measurements
This study utilizes secondary data from the World Development Indicators database, a statistical database compiled as of 2024. The selection of variables in the estimation model is based on empirical justification. The data used to analyze the impact of the exchange rate pass-through on the inflation rate covers the period 1988–2023.

Variable Description
Exchange rate: It indicates the worth of the domestic currency in terms of another currency. Mwase (2006) and Mishkin (2008) use the nominal effective exchange rate, which is an unadjusted weighted average rate at which one country's currency is exchanged for a pool of multiple foreign currencies, based on the traded rates. The study used a similar measurement.
The domestic price: It is measured using the consumer price index, aligning with Mwase (2006) and Frimpong & Adam (2010), with the expected result being negative. Fluctuations in inflation are believed to change the purchasing power of consumers, which will cause variations in the exchange rate, either devaluation or appreciation.
Monetary variable: It refers to the broad money supply, M2, to represent the money supply in the market, as it is believed that changes in the money supply and credit availability to consumers may affect the exchange rate and inflation rate. This measurement was empirically used by (Mwase, 2006; Pham, 2019).

Model Specification
To analyse the exchange rate pass-through on inflation in Tanzania, the Mwase (2006) model was used. The model is expanded to include current macroeconomic developments by incorporating data up to 2023. It captures increased exchange rate flexibility, shifts in monetary policy, and global shocks like COVID-19 and commodity price volatility. The model's structure remains relevant and robust for examining the exchange rate-inflation relationship, while the updated dataset improves the empirical relevance and timeliness of the results. The equation of the model is as follows:

$LINF_t = \beta_0 + \beta_1 LEX_t + \beta_2 LMs_t, + \mu$ (1)

where INF refers to inflation, Ex is the exchange rate level of the national currency per US dollar, Ms is broad money supply (M2), and μ represents the error term.

Estimation Method

The paper employs a time series approach to analyze the effects of exchange rate pass-through on inflation in Tanzania from 1988 to 2023 as well as during both pre- and post-liberalization periods. The first step involves testing the stationarity of the variables. Unit root tests are commonly employed in econometrics to eliminate biases and spurious relationships between variables. If a variable is non-stationary, it indicates that its mean and variance change over time. To address this, the regression must be performed on the first difference of the variable, which is integrated at I (1). The most common tests for determining whether a variable is level or first-difference stationary are the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) and the Phillips-Perron (PP) test (Phillips & Perron, 1988). The ADF unit root tests are based on the following equation, which includes a constant and a trend.

$\Delta Y_t = \beta_0 + \beta_1 Y_{t-1} + \sum_{j=1}^{p} + \rho j \, \Delta Y_{t-j} + et$ (2)

Where ΔY_t is the changes of series in time t, $\beta_1 Y_{t-1}$ represent error correction parameter term, $\rho j \, \Delta Y_{t-j}$ represent short term dynamic coefficient and e_t is error term. The null hypothesis (H0) of a unit root indicates that the coefficient of Y_{t-1} is non-stationary, while an alternative hypothesis (H1) implies Y_t is stationary if non-stationarity detected in the variable can be eliminated by differencing the series until stationarity is obtained.

The second step is to perform the cointegration test to determine if a long-term relationship exists between the variables. The test is applied after confirming that both Y_t and X_t are non-stationary and integrated of order 1 (i.e., Yt ~ I (1) and Xt ~ I (1)). A long-term and short-term relationship exists if the cointegration test fails to reject the null hypothesis. For Y_t and X_t to be cointegrated, the necessary condition is that the estimated variable from equation (3) must be stationary I (1). This method uses two test statistics: the trace statistic and the maximum eigenvalue, which help identify the number of cointegrating vectors. The test is expressed as given below:

$\lambda_{trace}(r) = -T \sum_{i=r+1}^{k} \ln(1 - \overset{\wedge}{\lambda_i})$ (3)

$\lambda_{max}(r, r+1) = -T \ln(1 - \overset{\wedge}{\lambda}_{t+1})$ (4)

where λ_i's are the ordered Eigenvalues of the matrix $_\pi$, and T is the total number of available observations. Both procedures test the null hypothesis of at most r cointegrating vectors. The null hypothesis of the test is that there are r cointegration vectors (r = 0), and the alternative hypothesis of the test is that there are r + 1 cointegration vectors.

The third step is to apply the Vector Error Correction Model (VECM) analysis after having cointegration between the variables. The test is used to capture the simultaneous relationship between proposed non-stationary variables and the error correction that may lead to the convergence between the dependent and independent variables in the long run. The VECM equation is developed as follows: -.

$\Delta LEx_t = \beta_0 + \beta_1 \Delta LINF_t + \beta_2 \Delta LMS_t + BECM_{t-1} + \mu_{1t}$ (5)

$$\Delta LINF_t = \beta_0 + \beta_1 \Delta LEX_t + \beta_2 \Delta LMS_t + BECM_{t-1} + \mu_{2t} \tag{6}$$

$$\Delta LMS_t = \beta_0 + \beta_1 \Delta LEX_t + \beta_2 \Delta LINF_t + BECM_{t-1} + \mu_{3t} \tag{7}$$

where Δ represents the first difference, all variables are in log form, and ECM_{t-1} is the Error Correction Term (ECT), derived from the long-term relationship. Long-term causality is assessed by the significance of the lagged ECT's coefficient, as indicated by t-statistics. $\mu 1t$, $\mu 2t$, and $\mu 3t$ are error terms assumed to be uncorrelated and normally distributed with a mean of zero. The model is considered significant only when all variables are stationary at order one I (1) and are cointegrated. Conversely, ECT is excluded from the estimation process when the variables are not cointegrated.

A further step involves applying Engle and Granger's (1987) Granger-causality test to examine the short-run effects between the variables. The analysis uses the VAR Granger causality model. Specifically, we employ the VAR to identify the causal relationship between EX, GDP, INFL, and MS in order to capture their short-term interactions. The test determines the direction of causal influence among these variables. Granger causality helps identify which variable helps predict the other.

Finally, to examine the pass-through from the exchange rate to domestic inflation, the study employed Vector Autoregression (VAR), a method that has been used in recent empirical research (Mwase, 2006; Bwire et al., 2013; and Helmy, 2018). VAR was developed by Sims (1986) and Bernanke (1986) to capture the effect of shocks between the variables using impulse response functions and variance decomposition to measure the percentage contribution of shocks. The whole process can be illustrated in Figure 2.
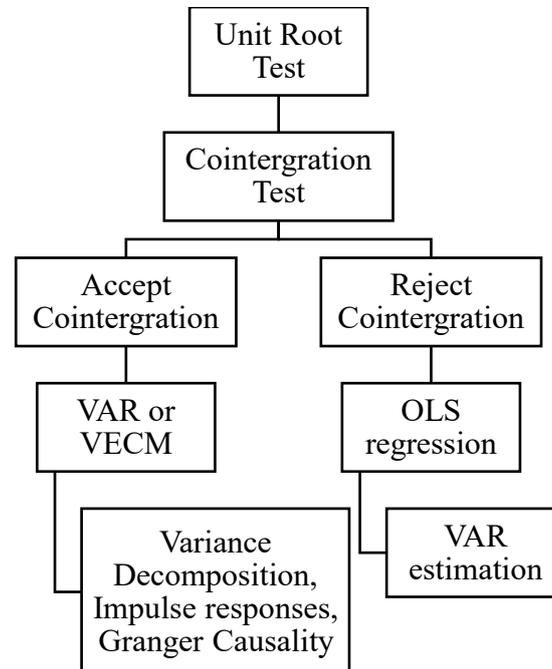

Figure 2: Flow of Methodology
Source: Authors' illustration

Empirical Results
This section presents the results of the analysis, including unit root tests, cointegration analysis, and the VECM results, as well as results from the VAR model in terms of impulse response functions (IRFs) and variance decomposition (VD) analysis.

Examine the impact of exchange rate pass-through on inflation in Tanzania
Unit Root Tests
Table 1 demonstrates that the ADF test results for exchange rate (LEX), inflation (LINF), and Money supply (LMS) show non-stationarity at their levels, with ADF statistics and p-values indicating failure to reject the null hypothesis of a unit root. After applying first differencing, all three variables become stationary, indicating they are integrated of order one, I (1). This is common in time series, where short-term fluctuations are present, but long-term relationships can be analyzed through cointegration.

Table 1
Unit Root Tests (ADF)

Variable	Level	First Difference
LEX	-1.499	-3.653 **
	(0.519)	(0.011)
LMS	-1.807	-2.828*
	(0.369)	(0.067)
LINFL	-2.086	-3.006*
	(0.251)	(0.047)

Note: *, **, *** represent 10%, 5% and 1%.
Note: The numbers in parentheses are *p*-values.

Cointegration Tests
The Johansen cointegration test (Table 2) indicates the presence of at least one significant long-term relationship among the variables related to Exchange Rate Pass-Through in Tanzania. The trace (40.327) and max-eigen (26.604) statistics exceed their critical values, leading to the rejection of the null hypothesis of no cointegration. This implies a stable long-term connection, especially between exchange rates and inflation. However, there is no evidence of more than one cointegrating vector, suggesting the relationship is singular and straightforward. Overall, the results confirm that exchange rate fluctuations have a consistent long-term impact on domestic price levels in Tanzania.

Table 2
Cointegration Test

Hypothesized No. of CE(s)	Trace statistics	0.05 Critical Value	Max-Engine Statistics	0.05 Critical Value
None *	40.327	29.797	26.604	21.132
At most 1	13.723	15.495	7.2564	14.265
At most 2 *	6.4664	3.8415	6.4664	3.8415

Note: *, **, *** represent 10%, 5% and 1%.

VECM Results

The VECM analyzes the link between the exchange rate (LEX) and Inflation (LINF) in Tanzania, showing a long-term equilibrium relationship (Table 3). The exchange rate coefficient is -1.479 with a t-statistic of 9.303, indicating a statistically significant and strong correlation. The negative sign implies that, over time, an increase in the exchange rate (currency depreciation) is correlated with a decrease in inflation, resulting in lower domestic prices. This finding is counterintuitive because standard economic theory typically suggests that exchange rate depreciation would prices, leading to higher inflation due to increased import costs. The negative coefficient may reflect specific economic conditions in Tanzania, where other factors could be mitigating the expected rise in domestic prices resulting from exchange rate movements.

Conversely, the coefficient for LMS is 3.489, with a t-statistic of 8.029, indicating a positive and significant relationship between inflation and the exchange rate. This positive coefficient more closely aligns with traditional economic theory, which states that higher inflation tends to lead to currency depreciation. An increase in domestic inflation or rising prices usually correlates with a weakening of the currency, as higher domestic prices reduce the currency's competitiveness and affect market perceptions of currency stability. The positive LMS sign supports this view, showing that inflationary pressures contribute to exchange rate depreciation over time.

Given these results, further study of the specific mechanisms of ERPT in Tanzania is essential. The surprising relationship between the exchange rate and inflation suggests that the usual assumptions of exchange rate pass-through may not be fully applicable in this situation. Future research could investigate the short-term dynamics of ERPT in Tanzania, considering factors such as market expectations, price rigidity, and the impact of monetary and fiscal policies. Additionally, investigating sectoral differences in price responsiveness and the level of openness to international trade may offer more profound insights into what influences the pass-through effect in Tanzania.

Table 3
VECM Test

Variable	c	LEX	LMS
Results	-1.822	-1.479 (9.303)	3.489 (8.029)

Note: The numbers in parentheses are t-values.

Granger Causality Results

Table 4 shows the results of the Granger causality test, providing key insights into the dynamic relationships among Tanzania's exchange rate, inflation, and money supply, with relevance to ERPT. The results indicate that inflation significantly Granger causes the exchange rate, with a notable F-statistic of 9.399 (p = 0.009), suggesting that inflationary pressures influence exchange rate movements. This aligns with economic theory, which states that persistent inflation tends to cause a currency to depreciate over time, especially when inflation

expectations are high. Conversely, the causality from the exchange rate to inflation was marginally significant (F = 5.741, *p* = 0.056), implying that exchange rate fluctuations may impact inflation, but with a weaker and less consistent effect in the short term in Tanzania.

Further analysis reveals that neither exchange rates nor Money supply exhibits significant Granger causality to each other. Specifically, exchange rate changes do not Granger-cause money supply, with an F-statistic of 0.805 (*p*-value = 0.668), indicating that exchange rate fluctuations do not directly influence money supply levels in Tanzania. Similarly, money supply does not Granger-cause inflation, as reflected by an F-statistic of 2.024 (*p*-value = 0.363), suggesting that money supply does not directly affect inflation in the Tanzanian economy. These findings suggest that the absence of a causal relationship between MS and INFL may imply that inflation is driven by structural or cost-push factors such as import tariffs, energy price shocks, and supply chain disruptions, rather than by demand-side monetary expansion.

These results suggest that in Tanzania, inflation trends have a greater impact on the ERPT process than the direct effects of exchange rates on money supply. The limited or absent causal relationship between exchange rates and local prices may be due to factors such as pricing rigidities, government interventions, or structural economic issues that weaken the typical pass-through effect. This also suggests that the exchange rate may not be the primary driver of domestic prices, challenging the common assumption that depreciation automatically leads to higher local costs. The findings underscore the need for further research into the relationship between inflation and exchange rates, as well as other economic factors influencing pass-through in Tanzania. More detailed analysis, especially of short-term fluctuations and external factors, could help clarify the complexities of ERPT in the country.

Table 4
Granger Causality Test

Variable	LEX	LINF	LMS
LINF	5.741 (0.056) *	-	0.826 (0.661)
LEX	-	9.399 (0.009) **	0.805 (0.668)
LMS	2.351 (0.309)	2.024 (0.363)	-

Note: *, **, *** represent 10%, 5% and 1%.
Note: The numbers in parentheses are *p*-values.

Impulse Response Results
Figure 3 presents the impulse response results for Tanzania's economic indicators, including inflation, exchange rate, and money supply, which offer insight into how these variables react to internal shocks. Initially, an inflation shock produces a significant positive response in LINF (0.2267), indicating a substantial initial impact. However, the effect of the inflation shock fades and becomes negative with time, with the magnitude decreasing (e.g., -0.0307 by period 6). This shows that inflationary shocks in Tanzania may have a transient effect, with inflationary pressures diminishing over time. In contrast, the exchange rate initially exhibits a

slight negative response to inflation, which becomes more pronounced in subsequent periods, suggesting a modest long-term depreciation of the exchange rate in response to rising inflation. This trend represents the interaction of inflation and the exchange rate, in which inflation gradually reduces pressure on the currency.

The exchange rate responds more strongly to its shock than to shocks in inflation or the money supply, with a substantial initial appreciation (0.0590) in the first period. Over the following periods, the effect of exchange rate shocks gradually decreases but remains positive throughout, demonstrating that the exchange rate is relatively sticky and responsive to its own changes. The exchange rate's response to inflation remains marginally negative, indicating that the currency tends to devalue in response to inflationary pressures, but to a lesser level. These findings underscore the Tanzanian exchange rate's relative stability in the face of internal shocks, indicating that external variables may have a greater influence on the exchange rate than home inflationary pressures.

In the case of money supply, the response to its own shock is robust and positive (0.1009) in the first period, highlighting the immediate and considerable impact of money supply shocks. However, like with the other variables, the reaction decreases over time, reaching a more muted effect in later periods (0.0046 in period 6). Interestingly, the money supply is generally insensitive to shocks in inflation and exchange rates, implying that the Tanzanian money supply may be reasonably insulated from these influences in the short term. This low interaction between the money supply and other macroeconomic variables may indicate that monetary policy, such as changes in interest rates or the money supply itself, is not heavily influenced by fluctuations in inflation or exchange rates in the Tanzanian context. Overall, the findings indicate that while each variable exhibits a significant initial response to shocks, the impact tends to stabilize over time, demonstrating the economy's inherent ability to adjust to changes.
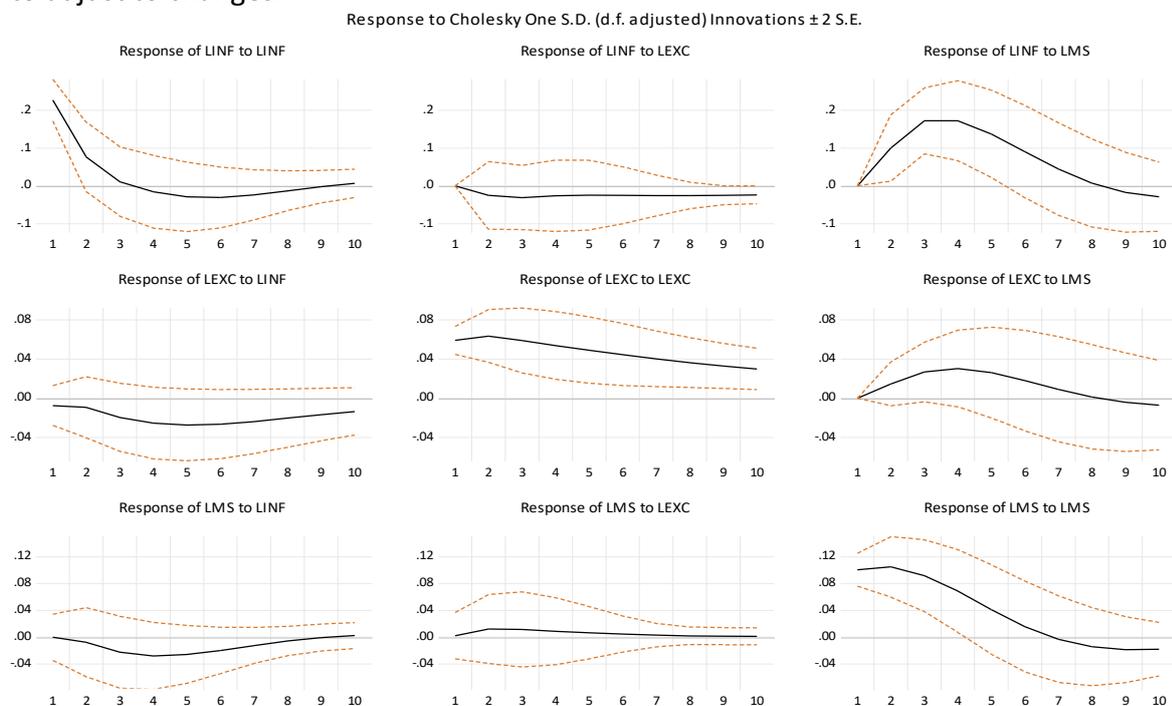

Figure 3: Impulse Response Function

Variance Decomposition Results

The variance decomposition results in Table 5 offer important insights into the dynamic relationships among inflation, the exchange rate, and money supply in Tanzania, especially regarding Exchange Rate Pass-Through. In the first period, inflation explains 100% of its forecast error variation, which is typical at the start of the analysis when the variable is entirely driven by its previous values. However, as time progresses, inflation's explanatory power over its forecast error variance decreases, reaching 42.11% by the ninth period. This decline indicates that, over time, inflation becomes less determined by internal factors and more influenced by external forces such as the exchange rate and money supply. This shift shows that these variables are becoming increasingly important in affecting Tanzanian inflation.

The exchange rate accounts for only a small part of its overall volatility over time. It starts at 0% but gradually increases, reaching a peak of 2.04% by the ninth session. This suggests that Tanzania's exchange rate is less influenced by internal economic factors and more driven by external factors, such as global market trends, foreign reserves, and trade dynamics. The minor impact of the currency rate on its fluctuations suggests it reacts more to external shocks than to domestic economic conditions. Regarding ERPT, this implies that changes in Tanzania's exchange rate likely have a more indirect effect on domestic inflation and prices, influenced primarily by global factors rather than domestic ones.

A key finding is the growing importance of money supply in explaining their own forecast error variance over time. Initially, domestic prices contribute 0% to their variance, but by Period 10, they account for 55.85%. This trend reflects a shift toward more self-determined domestic prices in Tanzania, indicating that local economic conditions, market dynamics, and government policies increasingly drive their movements. The increasing role of domestic prices in their variability suggests that while the exchange rate pass-through may have significant initial effects, over time, domestic factors such as supply and demand dynamics, inflation expectations, and market structures become more influential. This evolution demonstrates how ERPT in Tanzania is changing, with the exchange rate's impact on domestic prices potentially diminishing as local conditions take greater precedence in price formation.

Generally, the results from variance decomposition show that inflation accounts for 100 per cent of its variance but declines to 77 per cent in the second year and 42 per cent in the tenth year. The influence of exchange rates on inflation increases from 1 percent in the second year to 2.04 percent in the tenth year; however, the overall percentage impact remains very low. Additionally, the results indicate that the influence of money supply on the speed of adjustment is very high, rising from 22 percent in the second year to 56 percent in the tenth year. Overall, the results suggest that exchange rate pass-through to inflation is incomplete, with an effect that persists in the short run. At the same time, the money supply has a significant influence on inflation and exchange rates in the long run.

Table 5
Variance decomposition results

Period	1	2	3	4	5	6	7	8	9	10
LINF	100	77.10	49.87	45.18	44.24	41.44	39.52	40.05	41.39	42.11
LEX	0.00	0.74	0.77	0.54	1.61	2.37	2.24	2.10	2.10	2.04
LMS	0.00	22.16	49.35	54.29	54.14	56.19	58.24	57.85	56.51	55.85

Exchange rate pass-through pre- and post-liberalization in Tanzania Results
Cointegration Test
Table 6 presents the Johansen cointegration test results in Tanzania prior to liberalization. The trace statistic (96.578) and the maximum eigenvalue statistic (87.001) significantly exceed the 5% critical values of 29.797 and 21.132, respectively, leading to the rejection of the null hypothesis of no cointegration. These findings suggest a significant correlation between the exchange rate and inflation. However, the tests for at most 1 and 2 cointegrating vectors are not significant, so the null hypothesis of cointegration cannot be rejected. This confirms the presence of a single cointegration equation. The results suggest that, prior to liberalization, the exchange rate and domestic prices were closely aligned in the long run. This may be due to a highly restrictive macroeconomic environment with a fixed exchange rate, price controls, and limited access to international markets.

In contrast, the results show that post-liberalization trace statistics (39.213) and max-engine statistics (29.797) exceed the critical values of 28.205 and 21.132, respectively, but are lower than those observed before liberalization. The results also fail to reject the hypothesis of no cointegration at most 1 and 2, indicating that there is a single long-run relationship between the exchange rate and inflation. The findings suggest that, although there is a single cointegration equation, the long-run relationship between the exchange rate and inflation has weakened compared to pre-liberalization levels. This weaker relationship may be linked to economic reforms brought about by liberalization, which include a market-determined exchange rate, free financial flows, unregulated prices, and open trade.

Table 6
Cointegration Test

Period analysis	Hypothesized No. of CE(s)	Trace statistics	0.05 Critical Value	Max-Engine Statistics	0.05 Critical Value
Pre - liberalisation	None *	96.578	29.797	87.001	21.132
	At most 1	9.577	15.495	9.4088	14.265
	At most 2	0.168	3.8415	0.1680	3.8414
Post - liberalisation	None *	39.213	29.797	28.205	21.132
	At most 1	11.007	15.495	10.131	14.2646
	At most 2	0.8767	3.8415	0.8767	3.8415

Note: *, **, *** represent 10%, 5% and 1%.

VECM Results
The VECM results before liberalisation (Table 7) indicate a positive long-term pass-through between the exchange rate and the inflation. The exchange rate coefficient is estimated at 0.715, indicating a higher degree of pass-through, with 71.5% of exchange rate changes

reflected in domestic prices over the long run. The findings align with a strongly managed economy, where prices are controlled, market flexibility is limited, and the exchange rate is fixed, resulting in a direct impact on exchange rates. Additionally, the money supply coefficient of -2.4382 indicates an inverse relationship between money supply and the price level, which could suggest that the monetary response to inflation pressures was contractionary during this period.

During the post-liberalization period, the results indicate a shift in the dynamic exchange rate pass-through, as shown in the VECM estimation results. The results show that the exchange rate coefficient is negative, at -1.079, indicating a delay or incomplete pass-through, which has a greater impact on market expectations. The log of monetary policy displays a positive and significant association of 3.102, suggesting that monetary expansion plays a key role in influencing price levels after liberalization. This shift suggests that, in a liberalized economy characterized by free trade, floating exchange rates, and inflation, domestic monetary policy has become a more significant factor in determining price changes than exchange rate movements.

Table 7
VECM Test

Period analysis	c	LEX	LMS
Pre -liberalisation	5.733	0.7151	-2.4382
		(4.496)	(3.744)
Post -liberalisation	-0.2323	-1.0799	3.1022
		(11.747)	(12.282)

Note: The numbers in parentheses are t-values.

Granger Causality Results
Table 8 indicates that, prior to liberalization, a strong unidirectional relationship ($p < 0.000$) existed between the exchange rate, money supply, and inflation. This suggests that the exchange rate and the money supply are key factors in determining domestic prices. This unidirectional causality aligns with Tanzania's macroeconomic management during this period, when policy tools were limited and less responsive to domestic inflation dynamics.

Following liberalization, the results indicate that the money supply and exchange rate patterns continue to contribute to inflation, with a higher level of statistical significance (p-value = 0.000). The findings suggest that exchange rate pass-through persisted despite economic reforms like exchange rate flexibility, autonomous monetary policy, and free trade. These results highlight Tanzania's ongoing sensitivity to external and monetary shocks, even with a liberalized policy environment. It underscores the need for stronger inflation-targeting tools and exchange rate management to reduce the inflationary impact of exchange rate volatility in an increasingly open economy.

Table 8
Granger Causality Test

Period analysis	Variable	LEX	LINF	LMS
Pre-liberalisation	LINF	13.981***	-	12.515***
		(0.000)		(0.000)
	LEX	-	0.6967	0.881
			(0.404)	(0.347)
	LMS	0.7002	0.057	-
		(0.810)	(0.810)	
Post-liberalisation	LINF	15.205***	-	13.806***
		(0.000)		(0.000)
	LEX	-	0.3693	0.5657
			(0.543)	(0.452)
	LMS	0.489	0.2358	-
		(0.484)	(0.627)	

Note: *, **, *** represent 10%, 5% and 1%.
Note: The numbers in parentheses are *p*-values.

Variance Decomposition Results

The variance decomposition reveals that before liberalization, inflation was mainly influenced by the money supply rather than exchange rates (Table 9). In the first period, as expected, period 1 accounts for 100% of inflation variation due to its own shocks. By period 2, LMS's contribution decreases slightly to 55.29%, and it continues to increase gradually to 76.14% by period 10. Conversely, LEX's impact on inflation variation remains small throughout this period, rising slowly from 0.05% in period 2 to just 1.98% by period 10. This suggests that domestic monetary factors were the primary drivers of inflation in the restricted, pre-liberalization macroeconomic environment, which was characterized by a fixed exchange rate and limited economic openness. The minimal role of LEX suggests that exchange rate pass-through had a limited dynamic effect, likely due to the rigidity of exchange rates and price controls that dampened the influence of external price changes on domestic inflation.

Following the liberalization period, the variance decomposition reveals a clear shift in the factors influencing inflation variability. Initially, inflation continues to make a significant contribution to its own forecast error, but over time, the roles of LEX and LMS become more balanced. By period 10, LMS accounts for 50.62% of inflation variation, while LEX explains 9.97%, both figures notably higher than those before liberalization. The increasing influence of LEX from 1.91% in period 2 to nearly 10% by period 10 suggests that exchange rate shocks have become more important in understanding inflation dynamics in a more open economy. This change reflects Tanzania's increased openness, the shift to a more flexible exchange rate regime, and greater integration into global markets, resulting in more external price fluctuations that affect local inflation. Although LMS remains the primary factor, the increasing importance of LEX suggests a more open and dynamic inflation environment, where external shocks, particularly exchange rate changes, have a greater impact on prices.

Table 9

Variance decomposition results

Period analysis	Period	1	2	3	4	5	6	7	8	9	10
Pre - liberalisation	LINF	100	44.65	33.98	29.43	26.88	25.21	24.03	23.14	22.44	21.88
	LEX	0.00	0.053	0.054	0.161	0.362	0.630	0.943	1.282	1.631	1.979
	LMS	0.00	55.29	65.97	70.40	72.76	74.16	75.03	75.58	75.93	76.14
Post - liberalisation	LINF	100	68.06	53.16	46.67	43.49	41.76	40.75	40.12	39.70	39.41
	LEX	0.00	1.912	3.451	4.705	5.815	6.820	7.734	8.561	9.304	9.970
	LMS	0.00	30.02	43.39	48.62	50.69	51.42	51.51	51.32	50.99	50.62

Impulse Response Results

The impulse response analysis of the inflation (LINF) to the exchange rate (LEX) in Tanzania before liberalization reveals a weak and negative pass-through effect over time. Initially, there is no observed reaction of inflation to the exchange rate (0.000), but starting from period 2, the impact of a shock to LEX becomes somewhat positive (0.006). Then it turns negative from period 3 onward, gradually increasing in magnitude to -0.0325 by period 10. This indicates that, rather than raising inflation, exchange rate shocks during the pre-liberalization system led to a small, delayed deflationary response. Although this result might seem contradictory given the expected high ERPT in controlled regimes, it is probably due to the highly manipulated and distorted nature of the pre-liberalization economy.

The impulse response results for Tanzania's post-liberalization period show a negative and gradually diminishing exchange rate pass-through to inflation. After an exchange rate, the inflation response becomes negative from the second period onward and steadily declines, reaching -0.035 by the tenth period. This persistent negative pass-through indicates that exchange rate depreciation has a slight disinflationary effect, contrary to the traditional view that currency depreciation leads to higher inflation by raising import prices. Several factors may explain this outcome in the liberalized environment. Post-liberalization reforms increased market competitiveness, enhanced central bank independence, and established a more credible monetary policy framework, which may have helped stabilize inflation expectations and limit the transmission of foreign shocks to domestic prices. These findings suggest that Tanzania's liberalized economy has contributed to a more stable and muted ERPT, emphasizing the importance of macroeconomic reforms in shielding domestic prices from exchange rate fluctuations.
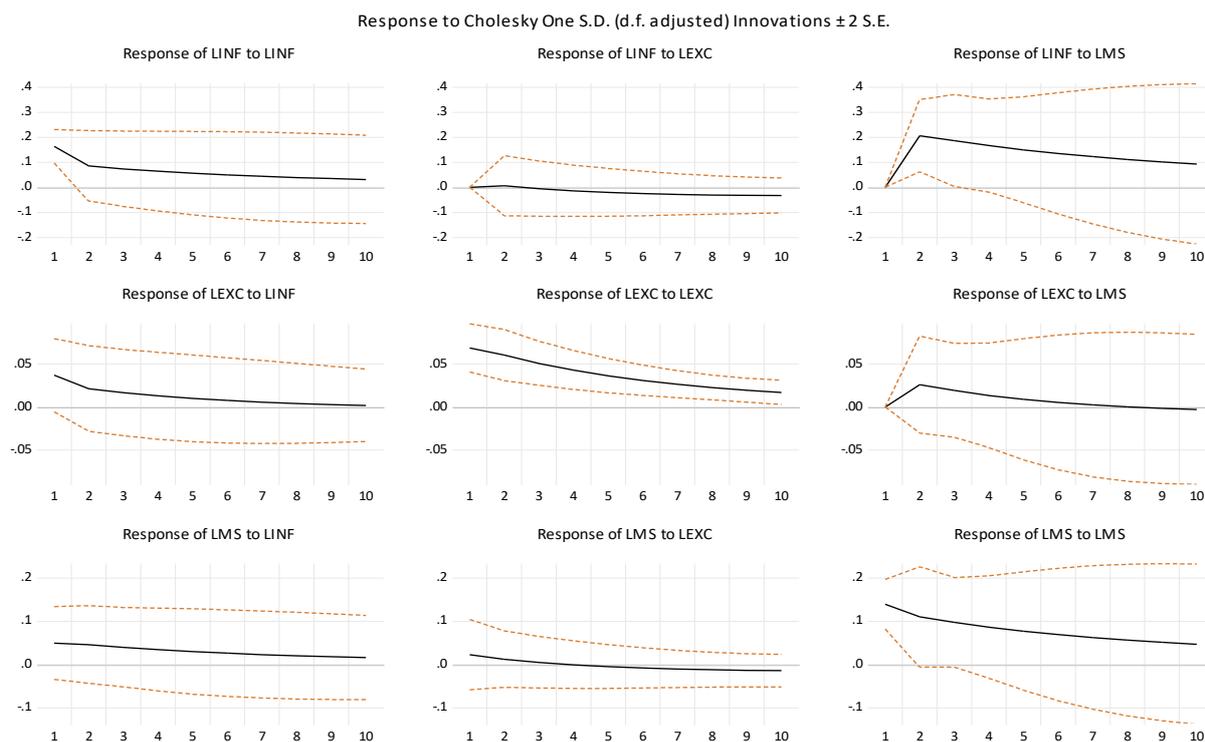
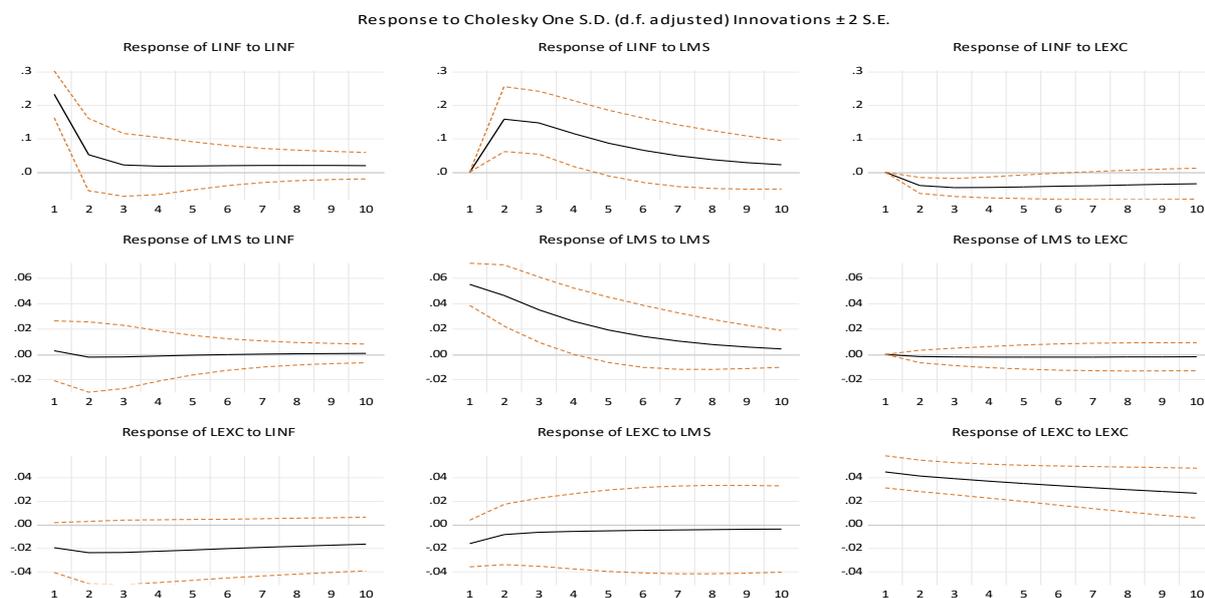Figure 4: Impulse Response Function pre-liberalization

Figure 5: Impulse Response Function post-liberalization

Conclusion & Policy Implications

In conclusion, this study provides valuable insights into the Exchange Rate Pass-Through in Tanzania, emphasizing the dynamics of inflation exchange rates, and money supply over both the short and long term. The results from the cointegration test, especially the rejection of the null hypothesis of no cointegration, indicate a long-term equilibrium relationship among these variables. Identifying a single cointegrating equation means that, although these variables may fluctuate in the short term, they will eventually align over the

long run. This finding is significant because it highlights the importance of considering long-term interactions when evaluating macroeconomic factors in Tanzania. Specifically, the long-run relationship indicates that changes in inflation, exchange rates, and the money supply have lasting effects that policymakers must consider in their decision-making processes.

The findings from the Vector Error Correction Model (VECM) study emphasize the long-term relationships among the variables. Inflation adjusts in response to its own shocks, while the exchange rate responds significantly to shocks in both inflation and its own level. Importantly, the Granger causality test reveals that inflation influences exchange rates, suggesting that inflationary pressures in Tanzania play a key role in exchange rate fluctuations. Conversely, the lack of strong causation between exchange rates and the money supply suggests that short-term fluctuations in exchange rates may not have a direct impact on Tanzania's money supply. These results are important for understanding how inflation affects currency rate movements and changes in the money supply in Tanzania.

The impulse response functions provide a more detailed view of short-term dynamics, showing that while inflation initially reacts strongly to shocks in both inflation and exchange rates, these effects lessen over time. This temporary nature of the inflation response suggests that Tanzania's inflationary pressures might be short-lived and influenced by stabilizing factors. On the other hand, the exchange rate reacts more persistently to its own shocks, emphasizing its sensitivity to external factors and relative independence from domestic inflationary pressures. Although the money supply responds positively to its own shock, it reacts slowly to shocks in inflation and exchange rates, indicating that Tanzania's monetary policy may be less responsive to these changes in the short run. These results underscore the necessity for a well-coordinated policy approach that considers both the short-term and long-term effects of inflation, exchange rates, and money supply, particularly when aiming to stabilize the economy against external shocks.

The empirical findings before and after liberalization indicate that the exchange rate initially had a minimal impact on inflation, with impulse responses being small and diminishing over time. The variance decomposition attributed less than 2% of inflation variability to exchange rate shocks by the tenth period. However, after liberalization, exchange rate shocks had a more substantial negative effect on inflation, evidenced by more significant and dramatic impulse responses and an increasing share in variance decomposition (nearly 10% by period 10). These results suggest a growing effectiveness of monetary policy, increased exchange rate flexibility, and more responsive markets. Granger causality tests support this shift by showing consistent causality from the currency rate and money supply to inflation in the post-reform period. Overall, the findings confirm that liberalization leads to a more stable and responsive macroeconomic environment, which helps reduce inflation pressures and strengthen the stability of Tanzania's monetary system.

The findings are beneficial for policymakers, highlighting the importance of stable and consistent exchange rates. They emphasize the crucial role of monetary policy in shaping inflation expectations. Policymakers need to respond proactively to changes in exchange rates, as fluctuations in the exchange rate can impact domestic inflation through the import of goods. They should aim for specific inflation targets to maintain price stability despite fluctuations in the exchange rate. Furthermore, the results indicate that currency values have

a significant impact on inflation levels. As a result, policymakers may consider strategies to mitigate excessive volatility in exchange rates, such as intervening in foreign exchange markets to mitigate the impact of global price shocks on domestic inflation. Additionally, they should consider the links among inflation, exchange rate movements, and the demand for money. Ultimately, since inflation is a major driver of exchange rate fluctuations, the government should develop policies to lessen dependence on imported goods while boosting domestic production and increasing exports of competitive products.

Every study has its limitations, and this one is no exception. We were unable to include import price data due to its unavailability, which would have improved our understanding of the topic. Additionally, monthly statistics could offer deeper insights into the findings. Therefore, future research may incorporate more pricing elements for imported goods to understand their impact better. Moreover, the model's variables exchange rate, money supply, and inflation rate are limited in scope. Various macroeconomic factors, such as Foreign Direct Investment (FDI), wages, trade openness, interest rates, external shocks, and government expenditure, also influence inflation volatility. Including these variables could provide a more detailed understanding of ERPT. Our analysis employs VECM and VAR as dynamic methods for examining both long-term and short-term effects. However, due to the complexity of exchange rate dynamics, employing Markov-switching or Threshold VAR models may better capture the asymmetric effects of exchange rate fluctuations on inflation. Finally, this analysis does not examine ERPT by sector, and exchange rate fluctuations can impact different industries in different ways. A sectoral approach could lead to targeted policy recommendations for sectors significantly affected by exchange rate shifts.

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