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Original Article

The Effects of Exchange Rates Volatility and Inflation on Tanzania's Trade Balance: Evidence from J-Curve Effect

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ABSTRACT

All economies today are experiencing the volatility of exchange rates and inflation in global markets. Consequently, this affects the trade performance among trading partners globally. This study examines the effects of exchange rate volatility and inflation on Tanzania's trade balance. Time series data spanning 1990 to 2020 were used from the World Bank and Bank of Tanzania (BOT). Moreover, J-Curve and Marshall Lerner's theories provided the theoretical arguments. Systematically, a Vector Error Correction Model (VECM) was employed for short- and long-run analysis. The findings reveal that, in the long run, inflation, Foreign Direct Investment, and Gross Domestic Product have a positive impact on the trade balance, while the Exchange Rate exerts a negative influence. In the short run, the exchange rate negatively affects Foreign Direct Investment, while Gross Domestic Product has a positive influence. Further, the gross domestic product also positively influences inflation. Furthermore, the exchange rate and gross domestic product significantly affect the trade balance negatively and positively respectively. Analysis of impulse response functions confirms the presence of the J-Curve effect, showing an initial deterioration in the trade balance following a depreciation of the domestic currency, which reverses after three periods. These findings suggest the need for effective exchange rate management, promotion of export competitiveness, and a good environment for foreign direct investment to enhance trade performance in Tanzania.

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INTRODUCTION

Exchange rate and inflation play a key role in determining trade dynamics worldwide (Mosbei et al., 2021). Both directly affect the pricing of goods and services traded internationally, which in turn impacts trade volumes and the overall competitiveness of nations in global markets (Akosah et al., 2017). Exchange Rate (EXR) refers to the rate of change in one country's currency in terms of the other (Fofanah, 2020). Over the recent decade exchange rates across the country have been volatile due to some monetary policy, global market conditions, and variations in foreign investment flows (Olamide et al., 2022). The exchange rate has been one of the most significant factors that affect a country's comparative economic positions, and the national trade volumes (Milanzi & Sanga, 2019). The Tanzania Shilling (TZS) has depreciated by 2.2% against the US Dollar in the second quarter of 2024, which was a quicker rate than the 1.8% depreciation in the first quarter (NBS, 2023). This increases the volume of exports and demand for exports induces investment, productivity, and favourable trade flows. On the other hand, depreciation of currency increases the cost of imports and hence inflationary pressures from the imported goods and services, this lowers the trade volumes, especially for less developed countries whose exports are less than the country imports (BOT, 2023).

Exchange rate volatility refers to the fluctuations in the value of a country's currency relative to others (Ekanayake & Dissanayake, 2022). These fluctuations can result from several factors, including changes in global market conditions, shifts in domestic monetary policies, and variations in foreign investment flows (BOT, 2023). In Tanzania, the exchange rate has been subject to considerable instability, after COVID-19, Russian-Ukraine Evasion, World crude oil price hikes, periodic adjustments in monetary policy, and the country's dependence on agricultural and mineral output export (Mfugale & Olomi, 2023). In 2010 the average exchange rate was TZS 1395.63 per 1 USD and TZS 2,375.5 per USD in June 2024, up from TZS 2,330.7 per USD in March 2024, this rate has reached TZS 2567. 45 per USD by July 2024 as per Inter-Bank Foreign Exchange Markets (IFEM) (BOT, 2023). The volatility in the exchange rate has brought several consequences among others, uncertainty in exports and imports, portfolio and foreign direct investment fluctuations, cost-push inflation stock market flow decrease (Nyamrunda & Mbogela, 2014).

Inflation refers to the rise in the general price levels. It can be broadly classified as headline inflation and core inflation (Olamide et al., 2022). In Tanzania, over the decades core inflation has been single digit, 1990 inflation rate was 35%, 5.92% in 2000, 6.20% in 2010, and 3.29% in 2020 showing that it has been decreasing at an increasing rate for three decades (Milanzi & Sanga, 2019). This is articulated among others by; global commodity prices, moderate and timely fiscal subsidies, and tightening monetary policies (Mbwambo et al., 2024). Interestingly, the Tanzanian government through the Bank of Tanzania (BOT) adopted an "interest-rate-targeting monetary policy regime in January 2024 to strengthen inflation controls and anchor inflation expectations" (BOT, 2023).

Trade Balances refer to the difference between the value of a country's exports and imports over a specific period, typically calculated on an annual or quarterly basis. It is used to determine the country's trade positions in international trade (Tarawalie & Kpana, 2022). Tanzania has experienced a rise in exports and imports

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progressively from the early 1990s, where exports counted $0.54 billion, $1.6 billion, $ 1.25 billion exports and 1.76 billion in 2000, 6.2 billion exports, and 8.97 billion imports in 2010 (BOT, 2023). This increase continued until the end of 2020 when exports counted $8.92 billion and imports of $9.55 billion. The statistics have shown that Tanzania exports less than it imports from the rest of the world for the past three decades. Tanzania has recorded a deficit in trade balance from 1990 to date (WB, 2023). This has been attributed to changes in exchange rates, low productivity, and dependency on technology imports from China, Japan, Singapore, and the United States (Mosbei et al., 2021).

In Tanzania, few studies have been done on determining the impact of volatility of exchange rate and inflation on trade volumes. The study by Mfugale & Olomi (2023) explored the effect of exchange rates and inflation on stock markets; Nyamrunda & Mbogela (2014) examined the effects of exchange rates on economic growth; Milanzi & Sanga (2019) conducted a study on the nexus between inflation and exchange rates; and Prot (2013) examined the key determinants of exchange rate volatility. All these studies have not explained the impacts of the volatility of exchange rates and inflation on trade balance. Notably, there exists a research gap on how the volatility of the exchange rate and inflation affects the trade balance performance of Tanzania in the global context. Therefore, this study aims to fill the existing research gap by determining the effects of volatility in exchange rates and inflation in Tanzania's trade balances. This study will increase the existing body of knowledge on the interplay of exchange and inflation rate movements toward international trade. Further, the study will have paramount importance to policymakers and government on the best way to control the adverse impacts of volatility in exchange rates and inflation rates in achieving a competitive economy in the global markets.

This study specifically seeks to First: Identify if there exists a relationship between the volatility of exchange rate, inflation, and trade balance in Tanzania over three decades. Second: To assess the impact of volatility of exchange rate and inflation on Tanzania's trade balance over three decades.

H01: There is no relationship between the volatility of the exchange rate, inflation, and trade balance in Tanzania

H02: Volatility of exchange rate and inflation has no impact on the trade balance in Tanzania

The rest parts of this paper are as follows; Literature review, where empirical and theoretical foundations of this study are detailed, followed by methodology section, where econometric models and data are presented. The next section includes the results and discussions, where study findings are discussed in detail, and finally, conclusions and recommendations where a summary of the findings and policy recommendations are detailed.

LITERATURE REVIEW

Theoretical Keystones

J-Curve Effect (JCE) Theory

The J-Curve Effect (JCE) theory was advocated by American Economist Mohsen Bahmani-Oskooee and became widely in the early 1970s after the collapse of the Bretton Woods Systems (BWS) in 1971 (Bahmani-Oskooee, 1985). The theory was thought to find a solution after the movements of exchange rates and many countries adopted the floating exchange rate regimes after the collapse of BWS (Akosah et al., 2017) The theory further defines the short-run and long-run effects of the devaluation of currency on a country's trade balance (Ekanayake & Dissanayake, 2022). Remarkably, exports and imports are more inelastic in the short-run when the country devaluates its exchange rate as a result, the cost of imports increases and exports do not respond quickly causing a fall in trade balance and forming a J-shape before they start to rise later (Banik & Roy, 2021). In the long -run price elasticities tend to be elastic thereafter businesses and firms start to respond to a rise in prices caused by the devaluation of the currency, this causes an

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increase in the volume of exports since domestic goods and services become relatively cheap in the global markets and lower the imports since foreign goods and service become expensive in the global markets and thus rise in trade balances (Bahmani-Oskooee, 1985). This illustrates the trade balance's long-term rising trend on the J-curve, where it starts to recover and may eventually exceed its initial level before the depreciation (Bahmani-Oskooee, 1985)

Marshall-Lerner Condition (MLC) Theory

The MLC was advocated by Alfred Marshal and Abba Lerner (Marshall, 1933; Lerner, 1943). The theory is based on the condition that some of the demand elasticities of exports and imports should be greater than one. Then, there is the possibility that the devaluation of currency may improve the trade balance even if the country starts to trade with surpluses or trade deficits in the global markets (Kulkarni, 2011). If the initial trade surplus Exports (E) - Imports (M) > 0, The elasticities are less than 1 and if the currency depreciates it will then improve the trade balance (Ijirshar et al., 2022). Since X > M, according to Akosah et al. (2017), when the economy begins with a trade deficit and X - M < 0, the depreciation elasticities must add up to more than one to improve the trade balance. This is because a larger starting harmful price effect necessitates larger quantity responses to offset it.

These theories have some limitations including; Time lags in the decision of producers and consumers, recognition of the new currency devaluation, inelastic goods, and global demand factors which retard the improvements of trade balances after the exchange rates (devaluation) (Akosah et al., 2017). However, with these limitations, theories are still appropriate for this study due to the following reasons; First: JCE and MLC are useful tools for differentiating between the short- and long-term impacts of currency depreciation in short- and long-term dynamics. Second: Realistic Economic Behavior (Kulkarni, 2011); The JCE and MLC theories are consistent with empirical data in which trade agreements, demand in elasticities, and gradual market corrections obstruct rapid responses to exchange rate fluctuations (Senadza & Diaba, 2018)

Empirical Review

Fofanah (2020) employed Pooled Ordinary Least Square, fixed, and random effect models to explore the impact of the volatility of the exchange rate on trade flow in West Africa. The key findings from this study showed that there exists a positive and significant linkage between exchange rate volatility and the trade balance. But also, depreciation of exchange rates was found to influence the trade exports. On the contrary, Yussif et al. (2024) found that the volatility of the exchange rate has negatively affected Ghanaian exports by employing time series data spanning from 1993 to 2017. In his study, GACH and EGACH models were utilized to capture the volatility in short and long-term periods from their trading partners. Surprisingly, Senadza & Diaba (2018) examined the effects of the volatility of the exchange rate on global trade in Sub-Saharan Africa (SSA) using secondary data from 1993 to 2014. The study employed Generalized Methods of Moments (GMM) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models to analyze the data. The study findings revealed that volatility of the exchange rate has no impact on imports but has a negative and significant impact on exports in the short-run while necessity substantial impacts on exports.

Ijirshar et al. (2022) employed ARDL and NARDL models to determine the impact of exchange rates and volatility on Nigeria's trade balances. The study used secondary time series data from 1986 to 2021. The study findings showed that there exists a causal impact between trade balance, exports, and imports after changes in exchange rates. Particularly, the finding revealed that the depreciation of exchange rates harms trade balance and exports. Similarly, Banik & Roy (2021) utilized the GMM and modified gravity model from panel data from 2005 to 2018 to examine how uncertainty in exchange rate affects international trade among eight SAARC countries. In this study among others, exchange

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rate volatility showed a negative impact on trade flows among SAARC members.

The study by Ekanayake & Dissanayake (2022) found that volatility of exchange rate has a negative and significant effect on trade exports in BRICS (Brazil, Russia, India, China, and South Africa) countries in the long-run period. However, in the short run, there exists a mixed effect on how exchange rate volatility impacted BRICS trade volumes. This study employed ARDL and GARCH, Panel Least Squares (PLS), and Fully Modified Least Squares (FMOLS) models, and time series data from 1993q1 to 2021q2 were employed for data analyses.

Another study by Abbas et al. (2020) employed the GVAR model to analyze time series data spanning from 1992 to 2017 to explore China's Exchange Rate Policy toward exchange. The outcomes revealed that since China's currency is devalued, it harms the volume of commerce with its partners which makes China's exports easier, unlike partners' exports. Likewise, Shah & Majeed (2014) examined the causal relationship between exchange rate and trade balance in Pakistan using time series data spanning from 1980 to 2011. The study employed an Autoregressive Distributed Lag (ARDL) model, bound test, and error correction mechanisms for data analyses. Among others, study findings showed a negative influence of the depreciation of currency on Pakistan's trade balance in the short and long-run periods. These results were confirmed by impulse response functions.

In a similar vein, Eke Ihuoma & Obafemi (2015) investigated the influence of exchange rate volatility on Nigeria's trade volumes in the era of 1970-2012 data. The study utilized the vector error correction model (VECM), Johansen cointegration test, and impulse response function to explore the causal linkage. The study findings revealed that there exists cointegration between exchange rate and trade volume, the exchange rate has a negative substantial effect on Nigerian's trade balance during the study period. Shaikh & Hongbing (2015) examined the effects of the volatility of the real exchange rate on trade flows among IPC countries (India, Pakistan, and China). The study employed secondary data from 1980 to 2013. The ARDL model, co-integration, and impulse response were used in this study. The study findings show that volatility of the exchange rate influence positively China's trade exports in the long run while negatively influencing India and Pakistan in both short and long-run trade periods.

Tarawalie & Kpana (2022) discovered a negative impact of the exchange rate on the trade balance in Sierra Leone, after employing the ARDL model for secondary data from year 1980 to 2020. Further, the study also revealed that there exists a long-run relationship between exchange rate and trade balance. On the contrary, Dimoso (2024) conducted a study on the causal link between exchange rate and inflation in Tanzania, employing secondary data spanning from 1981 to 2018. The study employed VECM to establish a short and long-term association between the variables. The findings revealed that exchange rates and inflation rates are cointegrated. Also, the Granger causality test showed a bidirectional relationship between the variables. Mosbei et al. (2021) explored the effects of exchange rates on Intra-trade within East African Communities (EAC) from secondary data sources for the period of 1980 to 2020 for Kenya, Tanzania, Rwanda, Uganda, and Burundi. The study employed GARCH models to execute such an impact. The study revealed among others, the regional trade volumes influence the exchange rate volatility among EAC member countries.

Bahmani-Oskooee & Nouira (2020) examined the effects of exchange rate volatility on Tunisia's trade volumes with its 16 trade partners. Time series data and the ARDL model were employed for analyses. The study findings show that exchange rate volatility affects negatively trade volume in the short run while, pauses a significant positive impact on trade flows in Tunisia in the long run. Antagonistically, Asteriou et al. (2016) assessed the impact of the volatility of exchange rates on trade balances in "Mexico, Indonesia, Nigeria, and Turkey". The study used time series

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data from 1995 to 2012, ARDL and GARCH models were employed for econometric analyses. The finding revealed that volatility of the exchange rate affects positively the trade balance in Indonesia and Mexico in the short run. In the short run, there is no effect of the volatility of the exchange rate on the trade balance between Indonesia, Mexico, and Nigeria.

METHODS AND MATERIALS

Data Source

The study on the effects of exchange rate volatility and inflation rate on Tanzania's trade balance has employed time series data from 1990 to 2020 sourced from the World Bank (WB) and Bank of Tanzania (BOT). The credibility of these data sources remains valuable since they are authorized financial institutions. Additionally, these data sources are publicly accessible and underwent rigorous peer review and verification which increases the researcher's confidence in the estimates (Mbwambo, 2024).

Empirical model

Vector Error Correction model (VECM) was employed in this study. The VECM was the suitable model for this study since it estimates both short-run and long-run relationships among variables. Additionally, VECM deals with a vector of several time series variables where each independent variable in one system becomes a dependent variable in another system (Mushendami et al., 2017). This model was also adopted by Dimoso (2024) and Ijirshar et al. (2022) with some adjustments to suit the study.

Trade balance (TB) which is the dependent variable in this study is expressed as the function of independent variables as shown in equation (1)

$$TB = f(RER, INF, GDP, FDI, MS) \quad (1)$$

Where TB= Trade balance, INF= inflation, GDP= Gross domestic Product, FDI= foreign direct investment, MS= money supply

Then, variables were transformed into natural logarithms for linearity as expressed in equation (2)

$$lnTB_t = \alpha_0 + \alpha_1 lnEXR_t + \alpha_2 lnINF_t + \alpha_3 lnGDP_t + \alpha_4 lnFDI_t + \alpha_5 lnMS_t + \varepsilon_t \quad (2)$$

$$lnTB_t = \beta + \sum_{i=1}^{z} \alpha_i TB_{t-i} + \sum_{i=1}^{z} \gamma_i lnEXR_{t-i} + \sum_{i=1}^{z} \phi_i lnINF_{t-i} + \sum_{i=1}^{z} \varphi_i lnGDP_{t-i} + \sum_{i=1}^{z} \pi_i lnFDI_{t-i} + \sum_{i=1}^{z} \omega_i lnMS_{t-i} + \varepsilon_{1t} \quad (3)$$

$$lnEXR_t = \delta + \sum_{i=1}^{z} \alpha_i TB_{t-i} + \sum_{i=1}^{z} \gamma_i lnEXR_{t-i} + \sum_{i=1}^{z} \phi_i lnINF_{t-i} + \sum_{i=1}^{z} \varphi_i lnGDP_{t-i} + \sum_{i=1}^{z} \pi_i lnFDI_{t-i} + \sum_{i=1}^{z} \omega_i lnMS_{t-i} + \varepsilon_{2t} \quad (4)$$

$$lnINF_t = \theta + \sum_{i=1}^{z} \alpha_i TB_{t-i} + \sum_{i=1}^{z} \gamma_i lnEXR_{t-i} + \sum_{i=1}^{z} \phi_i lnINF_{t-i} + \sum_{i=1}^{z} \varphi_i lnGDP_{t-i} + \sum_{i=1}^{z} \pi_i lnFDI_{t-i} + \sum_{i=1}^{z} \omega_i lnMS_{t-i} + \varepsilon_{3t} \quad (5)$$

$$lnGDP_t = \Omega + \sum_{i=1}^{z} \alpha_i TB_{t-i} + \sum_{i=1}^{z} \gamma_i lnEXR_{t-i} + \sum_{i=1}^{z} \phi_i lnINF_{t-i} + \sum_{i=1}^{z} \varphi_i lnGDP_{t-i} + \sum_{i=1}^{z} \pi_i lnFDI_{t-i} + \sum_{i=1}^{z} \omega_i lnMS_{t-i} + \varepsilon_{4t} \quad (6)$$

$$lnFDI_t = \lambda + \sum_{i=1}^{z} \alpha_i TB_{t-i} + \sum_{i=1}^{z} \gamma_i lnEXR_{t-i} + \sum_{i=1}^{z} \phi_i lnINF_{t-i} + \sum_{i=1}^{z} \varphi_i lnGDP_{t-i} + \sum_{i=1}^{z} \pi_i lnFDI_{t-i} + \sum_{i=1}^{z} \omega_i lnMS_{t-i} + \varepsilon_{5t} \quad (7)$$

$$lnMS_t = \rho + \sum_{i=1}^{z} \alpha_i TB_{t-i} + \sum_{i=1}^{z} \gamma_i lnEXR_{t-i} + \sum_{i=1}^{z} \phi_i lnINF_{t-i} + \sum_{i=1}^{z} \varphi_i lnGDP_{t-i} + \sum_{i=1}^{z} \pi_i lnFDI_{t-i} + \sum_{i=1}^{z} \omega_i lnMS_{t-i} + \varepsilon_{6t} \quad (8)$$

Then equation (3) to equation (8) represents short-run and long-run results for each cointegrating equation. $\beta, \delta, \theta, \Omega, \lambda,$ and ρ are the error correction mechanisms while ε_{it} where i= (1, 2, 3…………6) represents the white noise vector of error terms.

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FINDINGS AND DISCUSSION

Description of the Variables

Table 1: Description of the Variables

Variable	Measurement	Sources
TB	Differences between Exports and imports in (USD Billion)	World Bank
EXR	Real effective exchange rates	Bank of Tanzania
INF	Consumer Prices (annual percent)	World Bank
FDI	Net inflows (BOP, Current US$)	Bank of Tanzania
GDP	Real GDP per capita (Current US $)	World Bank
MS	Extended money supply (M3) in US $ Billion	Bank of Tanzania

Table 1 shows the variables, their measurements, and data sources used for analysis. Trade balance (TB) measures the difference between exports and imports was sourced from the World Bank. The real effective exchange rate (EXR) mirrors the country's currency power in the financial market about other currencies, adjusted for inflation, found from the BOT. Inflation (INF) measured as CPI indicates the annual rise in consumer prices from the World Bank, while foreign direct investment (FDI) captures net inflows of foreign investments in the country, with data from the BOT. Real gross domestic product per capita (GDP) measures economic output per individual, as found by the World Bank, and money supply (MS) echoes the extended money supply (M3), with data from the BOT.

Descriptive Statistics

This provides an overview of the distribution of the data set before further econometric analyses.

Table 2: Summary of Descriptive Statistics

	LNTB	LNEXR	LNINF	LNFDI	LNGDP	LNMS
Mean	21.8454	7.0697	2.2241	20.3209	7.6359	9.8288
Median	22.0540	7.0747	1.9811	20.1241	7.5136	10.1434
Maximum	22.3311	7.2919	3.5787	21.4591	8.5104	11.6736
Minimum	19.2707	6.8449	1.1909	18.8266	6.7593	7.2995
Std. Dev	0.6241	0.1216	0.7231	0.6911	0.6599	0.3323
Observation	31	31	31	31	31	31

Table 2 shows the summary of descriptive statistics. The mean and median values for all variables were close to each other, showing that the distribution is symmetric. Furthermore, the coefficient of standard deviation (SD) is relatively small across the variable indicating that the data set does not deviate from its central values and therefore that the data set forms normality assumptions

Test for Stationarity

One of the important things to remember when dealing with time series data is to check for stationarity of the data before further analysis to avoid spurious regression (Utouh et al., 2024). In this regard, Table 3 shows the EViews results of the ADF test.

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Table 3: Augmented Dickey-Fuller (ADF) Results

Augmented Dickey-Fuller (ADF) Test				
Variable	**Test-statistic**	**Critical value**	**Prob.**	**Order of Difference**
LNTB	-3.6578	-2.9640	0.0103**	I(1)
LNEXR	-5.2458	-4.3098	0.0011*	I(1)
LNINF	-4.0314	-3.6122	0.0215**	I(1)
LNFDI	-6.6462	-3.6793	0.0000*	I(1)
LNGDP	-3.3287	-2.9678	0.0227**	I(1)
LNMS	-4.4962	-3.7529	0.0018*	I(1)

*Notes: ***, **, and * indicates 1%, 5% and 10% significance level respectively*

Table 3 shows that all variables are non-stationary at level, however after taking the first differences they become stationarity. Thus, this confirms the application of VECM in this study.

Lag Selection Criterion

Table 4: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-85.43481	NA	2.21e-05	6.305849	6.588738	6.394446
1	45.96190	199.3605*	3.25e-08*	-0.273235*	1.706987*	0.346946*
2	74.40867	31.38953	7.79e-08	0.247678	3.925233	1.399442

*Notes: * indicate the lag order selected by the criterion at a 5% level of significance: Final prediction error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hanna-Quinn Criterion (HQC)*

Table 4 shows that lag one was selected by all the criteria. Therefore, VECM will employ lag 1 as the optimal lag to estimate the causal link between variables

Cointegration Test

One of the important conditions for VECM is that variables should exhibit a long-run relationship (Johansen, 1995). Thus, the Johansen Cointegration test was carried out to determine the number of cointegrating equations as the results shown in Table 5

Table 5: Johansen-Rank Test Results

Hypothesized No of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical value	Prob.
None*	0.715503	106.1744	95.75366	0.0079
At most 1	0.6555099	69.72046	69.81889	0.0509
At most 2	0.515789	47.85613	47.85613	0.2663
At most 3	0.307364	29.79707	29.79707	0.5795

Note: Trace test indicates 1 cointegration eqn (s) at 0.05 level of significance

Table 5 shows that there is only one cointegrating equation supported by the Trace statistic being greater than the 5% critical values and the probability of 0.0079. Therefore, further VECM analysis may be done.

Vector Error Correction Estimates

Table 6: Long Run Error Correction Model Estimates

Variables	Coefficients	Normalized Standardized Error	t-statistic
LNTB	1.000000	-	-
LNCPI(-I)	0.908223	0.14154	6.416571 [a]
LNEXR(-I)	-5.770828	1.06725	-5.407201[a]
LNFDI(-I)	0.786237	0.15506	5.070491 [a]
LNGDP(-I)	0.47566	0.20687	2.299271[b]
LNMS(-I)	0.10888	0.10346	1.052361
C	-3.704562	-	-

Notes: a & b indicate significance at 1 & 5% significance levels respectively.

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The findings in Table 6 show the long-run relationship between CPI, EXR, FDI, GDP, and MS as explanatory variables and TB as an explained variable. A one percent increase in CPI leads to a 0.91 percent increase in TB, depreciation of currency leads to a 5.8 percent decrease in TB, and an increase in FDI likewise leads to an increase in TB by 0.8 percent. Additionally, an increase in GDP and MS leads to an increase in TB by 0.5 percent and 0.1 percent respectively.

Table 7: Short Run Error Correction Model Estimates

Err. Correction	D(LNTB)	D(LNCPI)	D(LNEXR)	D(LNFDI)	D(LNGDP)	D(LNMS)
CointEq1	-0.678854	-0.084983	-0.033396	-0.627374	-0.041197	-0.17411
	(0.27230)	(0.11826)	(0.05257)	(0.22231)	(0.03581)	(0.32686)
	[-2.49300] [b]	[-0.71863]	[-0.63527]	[-2.82200] [b]	[-1.15058]	[-0.53268]
D(LNTB(-I))	-0.322627	-0.002781	-0.020665	0.172771	0.038062	0.099258
	(0.18308)	(0.07951)	(0.03534)	(0.14947)	(0.02407)	(0.21975)
	[-1.76226]	[-0.03497]	[-0.58469]	[1.15591]	[1.58114]	[0.45168]
D(LNCPI(-I))	0.56417	-0.248308	-0.023828	0.022978	-0.006474	0.159291
	(0.36143)	(0.15696)	(0.06977)	(0.29508)	(0.04752)	(0.43383)
	[1.56096]	[-1.58198]	[-0.34149]	[0.07787]	[-0.13622]	[0.36717]
D(LNEXR(-I))	-2.323943	0.936601	-0.134549	-4.166294	0.099686	-0.795459
	(1.53977)	(0.66869)	(0.29726)	(1.25710)	(0.20247)	(1.84824)
	[-2.50928] [b]	[1.40064]	[-0.45263]	[-3.31422] [a]	[0.49236]	[-0.43039]
D(LNFDI(-I))	0.344433	0.062257	0.038022	0.120295	-0.012364	0.119278
	(0.24096)	(0.10464)	(0.04652)	(0.19672)	(0.03168)	(0.28923)
	[1.42943]	[0.59494]	[0.817361]	[0.61149]	[-0.39023]	[0.41240]
D(LNGDP(-I))	7.132484	2.012825	-0.533974	2.952674	0.291616	-0.015852
	(1.80855)	(0.78542)	(0.34915)	(1.47654)	(0.23761)	(2.17087)
	[-3.94377] [a]	[2.56274] [b]	[-1.52937]	[-1.99973] [b]	[1.22627]	[-0.00730]
D(LNM6(-1))	-0.126943	-0.138826	-0.008539	-0.110437	0.012145	-0.034487
	(0.8517)	(0.08042)	(0.03575)	(0.15118)	(0.02435)	(0.22227)
	[-0.68555]	[-1.72636]	[-0.23886]	[-0.73052]	[0.49880]	[-0.15516]
c	0.461026	-0.205181	0.027913	0.184831	0.040932	0.062576
	(0.14552)	(0.06320)	(0.02809)	(0.11881)	(0.01913)	(0.17467)
	[3.16811] [a]	[-3.24668] [a]	[0.99359]	[1.55574]	[2.13914] [b]	[0.35825]
R-squared	0.611373	0.590906	0.150164	0.425643	0.399801	0.043994
Adi. R-squared	0.481831	0.454541	-0.133115	0.234191	0.199735	-0.274675
Sum sq. Resids	5.865159	1/06176	0.218594	3.909387	0.101408	8.450608
SE equation	0.528482	0.22951	0.102026	0.431464	0.069491	0.634358
F-statistic	4.71949	4.33328	0.530091	2.223231	1.998343	0.138055
Log-likelihood	-17.97436	6.21339	29.72439	-12.09245	40.86131	-23.26988
Akaike AC	1.791335	0.123214	-1.498234	1.385686	-2.266297	2.156544
Schwarz SC	2.16852	0.5004	-1.121049	1.762871	-1.889112	2.533729
Mean dependent	0.004616	-0.074682	-0.000635	0.018665	0.058743	0.052768
S.D. dependent	0.734166	0.310757	0.095846	0.493042	0.07768	0.561868

Notes: ( ) & [ ] indicate standard error and test statistics respectively; a & b indicate significance at 1 & 5% significance levels respectively.

The findings in Table 7 indicate the short-term estimates of the variables in response to deviations from long-run equilibrium, as captured by the error correction term (CointEq1). The findings revealed that all variables under study have negative coefficients for CointEq1, signifying a corrective change heading to long-term equilibrium after a shock. TB has a significant coefficient of 67.9%, indicating a strong speed of adjustment of the TB on the way to equilibrium when deviations occur. Similarly, FDI was also significant at the 5% level, implying that FDI quickly corrects back to the long-term equilibrium by 62.7% towards the long-term equilibrium. The

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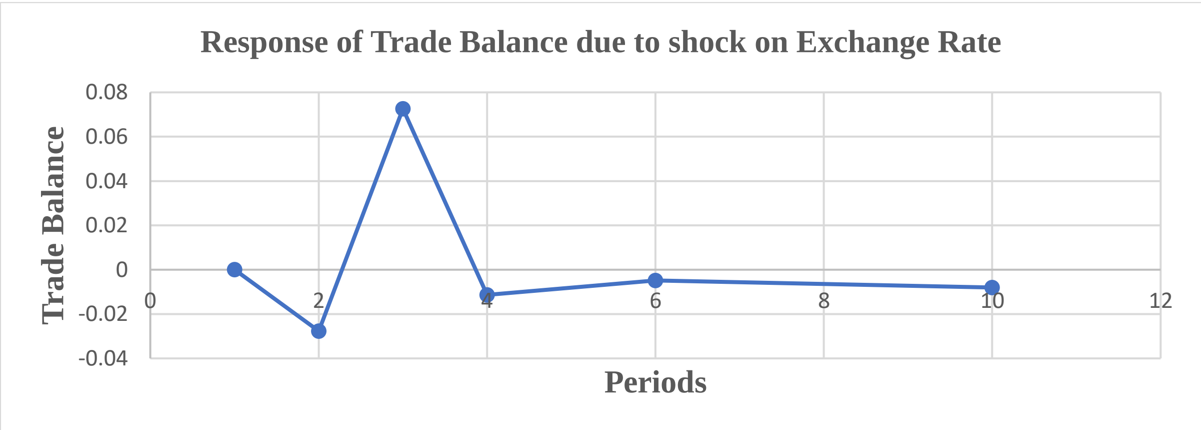
one-time lagged change in EXR shows a significant negative effect on both TB and FDI, reflecting that a depreciation in the EXR leads to a decrease in TB and FDI in the short run by 4.2 and 2.3 percent respectively. The lagged change in GDP has a significant positive effect on TB, suggesting that a one percent increase in GDP increases TB by 7.1 percent which was also found to have a positive impact on CPI, showing that higher GDP growth leads to a higher rate of inflation measured as CPI. The R-squared value signifies that the explanatory variables are explaining the changes in explained variable which is TB in this study by approximately 61.14% and only 38.86% is explained by other unexamined variables. The F-statistics was found to be significant suggesting that the variables jointly explain the changes in TB.

Table 8: Response of Trade Balance due to Shock on Exchange Rate

Period	TB Estimates
1	0.000000
2	-0.027669
3	0.072573
4	-0.011298
6	-0.004836
10	-0.007970

Table 8 indicates the response of the TB due to a shock in the EXR over time. In the first period, the effect is zero, suggesting no spot impact of an EXR shock on the TB. By the second period, the TB decreases steadily to -0.027669, signifying that the initial response to the shock is damaging. In the third period, the TB advances and becomes positive, reaching 0.072573, demonstrating a momentary upgrading in response to the shock. Nevertheless, in the fourth period, the TB drops again to -0.011298, displaying that the preliminary positive impact is transitory. The negative effects continue in the following periods, with TB values of -0.004836 in the sixth period and -0.007970 in the tenth period, indicating a gradual stabilization of TB but an overall negative impact in the long period. This pattern proposes that while there is a short-term enhancement in the TB following an EXR shock, the long-term effect inclines to be negative, leading to a worsening in the TB over time.

Figure 1. Response of Trade Balance Due to Shock on Exchange Rate



The results from Table 8 are explained in the setting of the J-Curve effect in Figure 1, which defines the short-term and long-term impact of an EXR shock on TB. To cement the theoretical background, the J-Curve effect proposes that afterwards a currency depreciation, the TB primarily worsens before improving in the longer run. In Figure 1, the TB initially decreases in the second period after the shock, as indicated by the negative estimated value of -0.027669, which

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concurs with the initial downward-sloping trend of the J-Curve. However, by the third period, the TB recovered, reaching 0.072573, which characterizes the upward-sloping trend of the J-Curve, demonstrating that the TB has started to recover.

Table 9: Residual Serial Correlation LM Test at lag 1 to h

Lag	LRE* Stat	Df	Prob.	Rao F-stat	df	Prob.
1	34.38147	36	0.5457	0.928216	(36, 46.7)	0.5879
2	68.46167	72	0.5964	0.760707	(72, 27.6)	0.8219

Table 9 displays the findings of the Residual Serial Correlation LM Test for lags 1 through 2 to lag h. The p-values for both lags are greater than 5% (0.5457 for lag 1 and 0.5964 for lag 2), signifying that the null hypothesis of the absence of serial correlation cannot be rejected. This means that there is a lack of evidence of serial correlation in the residuals.

Table 10: Residuals Heteroskedasticity Test

Joint test		
Chi-sq	**Df**	**Prob.**
296.1136	294	0.4544

Individual components					
Dependent	**R-squared**	**F (14,14)**	**prob.**	**Chi-sq (14)**	**Prob.**
resl*resl	0.6618	1.956832	0.1107	19.19221	0.1577
res2*res2	0.256388	0.344788	0.9722	7.43526	0.9166
res3*res3	0.342974	0.522009	0.8819	9.946238	0.7661
res4*res4	0.227446	0.294407	0.9855	6.595922	0.9492
res5*res5	0.563852	1.2928	0.3187	16.35171	0.2924
res6*res6	0.228948	0.296929	0.985	6.639482	0.9477
res2*res1	0.534655	1.148941	0.3993	15.50498	0.3445
res3*res1	0.432388	0.761768	0.6912	12.53926	0.5631
res3*res2	0.564991	1.298803	0.3157	16.38474	0.2904
res4*resl	0.505661	1.022905	0.4834	1466418	0.4015
res4*res2	0.257064	0.346012	0.9718	7.454865	0.9158
res4*res3	0.438352	0.780476	0.6754	12.71222	0.5493
res5*res1	0.527902	1.118206	0.4187	15.30917	0.3574
res5*res2	0.491054	0.964845	0.5262	14.24056	0.4319
res5*res3	0.505049	1.020404	0.4852	1464643	0.4027
res5*res4	0.519968	1.083193	0.4416	15.07906	0.3728
res6*res 1	0.492672	0.971113	0.5215	14.2875	0.4285
res6*res2	0.250707	0.334592	0.9753	7.270511	0.9238
res6*res3	0.242505	0.32014	0.9794	7.032633	0.9334
res6*res4	0.213888	0.272083	0.9897	6.202749	0.9611
res6*res5	0.324692	0.480807	0.9085	9.416081	0.8035

Table 10 reveals the results of the residuals heteroskedasticity test. The joint test shows a Chi-square statistic of 296.1136 with 294 degrees of freedom and a p-value of 0.4544. This p-value which is greater than the 5% conventional significance level suggests that the null hypothesis of heteroskedasticity (lack of constant variance of residuals) is rejected at any conventional significance level, meaning there is no evidence of heteroskedasticity in the residuals. Likewise, for the individual components, each dependent variable (such as resl*resl, res2*res2, etc.) is examined separately for heteroskedasticity. The p-values for each individual test are above 0.05, verifying that no residual components exhibit significant heteroskedasticity.

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Table 11: Residual Normality Test

Component	Skewness	Chi-sq	df	Prob. *
1	-0.00121	7.07E-06	1	0.9979
2	-0.219774	0.233452	1	0.629
3	0.080856	0.031599	1	0.8589
4	0.414179	0.829131	1	0.3625
5	-0.385021	0.716498	1	0.3973
Joint		**1.810688**	**5**	**0.8747**
Component	**Kurtosis**	**Chi-sq**	**df**	**Prob.**
	3.590916	0.421928	1	0.516
2	2.220545	0.734124	1	0.3915
3	3.576773	0.401973	1	0.5261
4	2.954014	0.002555	1	0.9597
5	2.869752	0.020499	1	0.8862
Joint		**1.581079**	**5**	**0.9035**
Component	**Jarque-Bera**	**Chi-sq**	**df**	**Prob.**
1	0.421935	NA	2	0.8098
2	0.967576	NA	2	0.6164
3	0.433572	NA	2	0.8051
4	0.831686	NA	2	0.6598
5	0.736997	NA	2	0.6918
Joint	**3.391767**	**NA**	**10**	**0.9706**

Table 11 presents the results of the residual normality test, which assesses whether the residuals from the model follow a normal distribution founded on their skewness and kurtosis. For skewness results, each component (1 to 5) has a skewness value near zero, signifying that the residuals are symmetrically distributed around their mean. The joint test for skewness has a Chi-square value of 1.810688 and a p-value of 0.8747, signifying that the residuals as a group are symmetric. Likewise, the kurtosis values for each component are approaching 3, which matches with the kurtosis of a normal distribution. Further, the joint test for kurtosis has a Chi-square value of 1.581079 and a p-value of 0.9035, meaning that the residuals do not indicate significant deviation from normal kurtosis. Furthermore, the Jarque-Bera test integrates skewness and kurtosis to examine the overall normality of residuals. The Jarque-Bera test estimates are found to have a Jarque-Bera statistic with a p-value greater than 5% (e.g., 0.8098 for component 1 and 0.6918 for component 5), indicating no normality significantly. Moreover, the joint Jarque-Bera statistic has a Chi-square estimate of 3.391767 and a p-value of 0.9706, indicating that the residuals follow a normal distribution.

DISCUSSIONS

This study's findings found that in the long run TB, CPI, FDI, and GDP positively impact TB whereas EXR was found to impact TB negatively whereas, in the short run, EXR and GDP were found to influence FDI negatively and positively respectively, GDP was found to influence CPI positively and EXR and GDP were found to negatively and positively influence TB respectively. Further, the results from Table 8 as explained in the setting of the J-Curve effect in Figure 1 confirm the presence of J-Curve in the short run up to three years.

The findings of this study concur with numerous previous studies regarding the relationship between EXR and TB. For instance, Yussif et al. (2024) in Ghana found that the exchange rate hurts the Trade Balance. Additionally, Senadza & Diaba (2018) in SSA found a negative and significant impact of EXR on TB in the short run. Also, Ijirshar et al. (2022) revealed that the depreciation of EXR hurts TB in Nigeria. Further, Banik & Roy (2021) found that EXR volatility shows a negative impact on trade flows among SAARC members. Furthermore, the study by Ekanayake & Dissanayake (2022) in BRICS

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countries found that the volatility of EXR has a negative and significant effect on TB in the long period. However, in the short run, there exists a mixed effect on how exchange rate volatility impacted BRICS trade volumes. Another study by Abbas et al. (2020) in China revealed that the devaluation of the currency hurts TB. This suggests that exchange rate instability negatively affects trade balance via increased importation costs, reduced export attractiveness due to pricing doubts, higher hedging expenses, altered investment choices, variations in consumer actions, and an overall opposing impact on trade forces at work that cause imbalances between imports and exports. Additionally, since GDP was found to affect TB in both the short run and long run this suggests that the positive influence of GDP on the trade balance works through increased export capacity, improved competitiveness, better terms of trade, foreign investment, and stronger currency effects, all contributing to a stronger trade position.

However, some study's findings went antagonistic to this study's findings. For instance, Fofanah (2020) found a positive and significant linkage between EXR volatility and TB. Also, Shaikh & Hongbing (2015) in China found a long run while negatively influencing India and Pakistan in both short and long-run trade periods. Further, Bahmani-Oskooee & Nouira (2020) in Tunisia found that EXR volatility affects negatively TB in the short run while pauses a significant positive impact on trade flows in Tunisia in the long run. Furthermore, Asteriou et al. (2016) in "Mexico, Indonesia, Nigeria, and Turkey revealed that volatility of the exchange rate affects positively the trade balance in Indonesia and Mexico in the short run. In the short run, there is no effect of the volatility of the exchange rate on the trade balance between Indonesia, Mexico, and Nigeria.

CONCLUSION

This study examined the impact of exchange rate volatility and inflation on Tanzania's trade balance using the J-Curve framework. The findings reveal that, in the long run, CPI, FDI, and GDP have a positive effect on TB, while EXR has a negative impact. In the short run, exchange rate and GDP were found to influence FDI negatively and positively, respectively. Additionally, GDP positively affects CPI, while EXR and GDP have a negative and positive effect on TB, respectively. The analysis further confirms the presence of the J-Curve effect in the short run, as demonstrated by the response of the trade balance to exchange rate shocks over three periods. This indicates that a depreciation of the Tanzanian shilling initially worsens the trade balance before improving it, consistent with the J-Curve theory.

Recommendations

Based on the findings of this study, this study recommends that policymakers should implement strategies to soothe the EXR through effective monetary policies and proper foreign exchange reserves management. It is also crucial for policymakers to be conscious of the temporary worsening of TB due to the J-Curve effect following currency depreciation, and thus, implement short-term measures like export promotion and strategic import management to minimize initial negative impacts. Finally, maintaining general macroeconomic constancy by positioning fiscal and monetary policies will support sustainable economic growth and contribute to a positive long-term trade balance. By assuming these procedures, Tanzania will better manage the short- and long-term effects of EXR fluctuations and inflation on its trade balance, ultimately fostering economic stability and growth.

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