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Foreign Exchange Rate and GDP Growth Vis-À-Vis Trade Balance in Sub-Saharan Africa

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Abstract: We investigate the interaction effect of foreign exchange rate and economic growth on the trade balance in Sub-Saharan Africa (SSA). We utilize balanced annual panel data for 20 SSA countries covering the period 2005 to 2024. We source the data from the World Development Indicators. We employ the Generalized Method of Moments (GMM) estimator to address endogeneity, dynamic effects, and unobserved country-specific heterogeneity. Empirical results reveal a negative and statistically significant interaction between foreign exchange rate and GDP growth. Specifically, the estimated coefficient of the interaction term (FER*GDP) of -0.190271 implies that a simultaneous 10 percent increase in exchange rate and GDP growth is associated with a deterioration of the trade balance by approximately 1.9 percent. These findings indicate that economic growth occurring alongside exchange rate depreciation is linked to weaker trade balance outcomes, consistent with import-intensive growth structures and limited export supply responsiveness in SSA economies. These results highlight the importance of accounting for structural characteristics when assessing trade balance effects of exchange rate movements and growth dynamics.

Keywords: *GMM, Foreign exchange rate, Gross domestic product, Trade Balance, SSA*

1. Introduction

The relationship between foreign exchange rate movements, economic growth, and external trade performance has long occupied a central place in international macroeconomics and development economics. Exchange rate dynamics influence trade competitiveness by affecting the relative prices of exports and imports, while economic growth shapes trade outcomes through demand expansion, structural transformation, and productive capacity (Krugman et al., 2018). In theory, currency depreciation is expected to improve the trade balance by stimulating exports and discouraging imports, particularly when the Marshall–Lerner condition holds (Marshall, 1923; Lerner, 1944). However, empirical evidence from developing regions, especially Sub-Saharan Africa (SSA), has remained mixed and often contradictory.

Since the mid-1970s, most SSA economies have experienced persistent trade balance deterioration, characterized by chronic current account deficits, rising import dependence, and weak export diversification (UNCTAD, 2019; World Bank, 2023). Despite multiple exchange rate regime reforms including devaluations under structural adjustment programs and the adoption of flexible exchange rate systems, improvements in trade balances have remained limited and short-lived (Edwards, 1989; Rodrik, 2008). At the same time, periods of positive GDP growth in SSA have frequently coincided with widening trade deficits, suggesting that growth has been largely import-intensive and weakly linked to export expansion (Adeniyi et al., 2011).

Existing empirical studies have largely examined the effects of exchange rate movements and economic growth on trade balance independently, often overlooking the possibility that their interaction may be critical in shaping trade outcomes (Bahmani-Oskooee & Ratha, 2004; Wilson, 2001). This omission is particularly consequential for SSA, where structural rigidities, limited manufacturing capacity, and low export supply elasticity may cause economic growth and exchange rate depreciation to jointly exacerbate trade imbalances rather than correct them. Moreover, much of the available evidence is country-specific or based on static models that fail to adequately address endogeneity, dynamic adjustment, and cross-country heterogeneity.

We address this critical gap by explicitly examining the interaction effect of foreign exchange rate movements and GDP growth on the trade balance in SSA. By employing a dynamic panel Generalized Method of Moments (GMM) framework and utilizing balanced panel data for 20 SSA countries over the period 2005 to 2024, we provide robust empirical insights into how growth and exchange rate dynamics jointly influence external trade performance. Understanding this interaction is essential for clarifying why sustained economic growth in SSA

has not translated into improved trade balances and for enriching the broader literature on growth–trade–exchange rate linkages in developing economies.

2. Literature Review

The relationship between foreign exchange rate movements and trade balance has been extensively examined in international economics, with early studies grounded in the Marshall–Lerner condition, which posits that currency depreciation improves trade balance if the sum of export and import demand elasticities exceeds unity (Marshall, 1923; Lerner, 1944). Subsequent empirical work introduced dynamic considerations, notably the J-curve hypothesis, suggesting that trade balance may initially deteriorate following depreciation before improving in the long run (Magee, 1973; Bahmani-Oskooee & Ratha, 2004).

Empirical findings from developed and emerging economies remain mixed. Studies focusing on advanced economies often find support for long-run trade balance improvement following depreciation (Rose & Yellen, 1989; Bahmani-Oskooee & Brooks, 1999). However, evidence from developing economies frequently reports weak or insignificant effects, attributed to low export diversification, rigid production structures, and high import dependence (Goldstein & Khan, 1985; Chinn, 2005).

Beyond exchange rates, economic growth has been shown to exert ambiguous effects on the trade balance. While growth can enhance export capacity through productivity gains, it may simultaneously increase import demand for capital goods and intermediate inputs, leading to trade balance deterioration (Thirlwall, 1979; Krugman et al., 2018). Importantly, most global studies examine exchange rate and growth effects independently, implicitly assuming separability between the two variables. This assumption overlooks potential interaction effects whereby the impact of exchange rate movements on trade balance may depend on the pace and structure of economic growth, a limitation increasingly acknowledged in recent macroeconomic literature (Rodrik, 2008; Aizenman et al., 2012).

Empirical studies focusing on developing regions, particularly SSA, reveal persistent trade balance challenges despite extensive exchange rate reforms since the mid-1970s. Structural adjustment programs across SSA emphasized currency devaluation as a mechanism for correcting external imbalances, yet outcomes have been largely disappointing (Edwards, 1989; UNCTAD, 2019). Several studies find that exchange rate depreciation either worsens trade balance or produces statistically insignificant effects in African economies (Bleaney & Greenaway, 2001; Ng et al., 2008).

Regional analyses attribute these outcomes to weak export supply responsiveness, limited industrialization, and dependence on primary commodity exports with inelastic global demand (Fosu, 2013; World Bank, 2023). Moreover, economic growth episodes in SSA, particularly during commodity booms, have often coincided with widening trade deficits, reinforcing concerns about import-intensive growth patterns (Adeniyi et al., 2011; UNDP, 2020).

Only a limited number of studies have examined the joint role of exchange rate and economic growth in determining trade balance outcomes in SSA. Where interaction effects are implicitly considered, findings suggest that growth amplifies import demand faster than export expansion, thereby offsetting potential gains from currency depreciation (Ohiomu, 2020). However, most regional studies rely on static panel models or country-specific time-series analyses, limiting their ability to address endogeneity, dynamic adjustment and cross-country heterogeneity, key methodological gaps that this study seeks to address.

Country-level studies within SSA further illustrate the complexity of the exchange rate–growth–trade balance nexus. Evidence from Nigeria, Ghana, Kenya, and Uganda suggests that exchange rate depreciation has had limited success in improving trade balances, particularly in the presence of rapid GDP growth driven by imports of consumer goods, fuel, and capital equipment (Alege & Osabuohien, 2013; Kinyua, 2016). These studies consistently highlight structural constraints such as low manufacturing capacity, weak value addition, and narrow export bases.

However, local studies are often constrained by short time spans, small samples, and methodological limitations, including failure to control for simultaneity between growth, exchange rates, and trade outcomes. Crucially, very few explicitly model the interaction between exchange rate movements and economic growth, leaving unresolved questions about whether growth conditions mediate the effectiveness of exchange rate adjustments in SSA economies.

Our study is anchored in three complementary theoretical perspectives. Firstly, the Marshall–Lerner condition provides the foundational framework linking exchange rate depreciation to trade balance adjustment through price elasticities of exports and imports (Marshall, 1923; Lerner, 1944). Secondly, the J-curve theory introduces short-run versus long-run dynamics, emphasizing adjustment lags in trade volumes following exchange rate changes (Bahmani-Oskooee & Ratha, 2004). Thirdly, the absorption approach to the balance of trade posits that trade balance outcomes depend on the relationship between national income and domestic absorption, implying that economic growth may worsen the trade balance if absorption rises faster than output (Alexander, 1952; Thirlwall, 1979).

Together, these frameworks suggest that the effect of exchange rate movements on trade balance is conditional on growth dynamics and structural characteristics of the economy. This theoretical insight motivates the use of an interaction term between foreign exchange rate and GDP growth in the empirical model.

Conceptually, our study posits that trade balance in SSA is influenced by foreign exchange rate movements and economic growth interactively. Exchange rate depreciation affects trade balance through relative price effects, while GDP growth influences trade through changes in import demand and export capacity. The interaction between exchange rate and GDP growth captures the extent to which growth conditions amplify or dampen trade balance response to exchange rate movements. Structural factors such as export diversification, productive capacity, and trade openness serve as underlying channels through which these relationships operate, though they are not explicitly modeled in the interaction term.

3. Data and Method

We adopt a quantitative, explanatory research design based on dynamic panel data econometric analysis. This design is appropriate for examining macroeconomic relationships that evolve and vary across countries, while accounting for persistence, simultaneity, and unobserved heterogeneity (Baltagi, 2021). A dynamic specification is particularly relevant for trade balance analysis, as external sector outcomes tend to exhibit adjustment inertia and path dependence (Bahmani-Oskooee & Ratha, 2004).

We utilize balanced annual panel data for 20 SSA countries (Appendix 11) covering the period 2005 to 2024. Country selection follows a purposive sampling approach, dictated by data availability and completeness across all variables for the full study period. Such non-random sampling is standard practice in macro-panel studies, where coverage is constrained by reliable longitudinal data rather than probabilistic considerations (Hsiao, 2014).

All variables are sourced from the World Development Indicators (WDI) database, which provides harmonized and internationally comparable macroeconomic data widely used in empirical development and international economics research (World Bank, 2023). The dependent variable is trade balance (TB), measured as exports minus imports in absolute terms (TB = |X - M|), reflects the difference between a country's exports (X) and imports (M) and is a key indicator of a nation's economic health and external sector performance (Krugman et al., 2018); Salvatore, 2016). The core explanatory variable is the interaction term between the foreign exchange rate and GDP growth (FER*GDP), designed to capture the conditional and non-linear effects of exchange-rate movements on trade balance outcomes as mediated by growth dynamics, macroeconomic structure, and external adjustment capacity in Sub-Saharan Africa (Goldstein & Khan, 1985; Rodrik, 2008).

To examine the interaction between foreign exchange rate movements and economic growth, the study specifies the following dynamic panel model:

$$TB_{it-1} = \alpha_0 + \alpha_1 TB_{it-1} + \beta_1 FER_{it} * GDP_{it} + \varepsilon_{it} \quad \ldots\ldots(1)$$

Where:
TB_{it} : Trade balance in country *i* at time *t*
TB_{it-1} : Lagged dependent variable capturing trade balance persistence
FER_{it} : Foreign exchange rate in country *i* at time *t*
GDP_{it} : Gross domestic product (GDP) growth in country *i* at time *t*
ε_{it} : Error term.

The interaction term captures the conditional effect of exchange rate movements on trade balance under different growth regimes, consistent with insights from the absorption approach and structuralist trade theories (Alexander, 1952; Thirlwall, 1979). The lagged dependent variable reflects the dynamic adjustment process commonly observed in trade flows (Magee, 1973).

TB and FER are first transformed using natural logarithms to enhance econometric reliability and interpretability. GDP growth, measured in percentage terms and therefore not log-transformed. Logarithmic transformation compresses large numerical scales and reduces the influence of extreme values, which are common in cross-country macroeconomic data. For instance, while the absolute distance between 10 and 10^{10} is enormous, their logarithmic values differ modestly (from 1 to 10), making relationships more stable and comparable. This transformation also helps linearize potentially nonlinear relationships, mitigate heteroskedasticity, and allows estimated coefficients to be interpreted as elasticities, which is particularly useful for policy analysis in international trade and investment studies (Wooldridge, 2010; Baltagi, 2021).

We employ the GMM estimator, specifically the Arellano–Bond (1991) difference GMM approach, to estimate the dynamic panel model. This technique is well-suited for addressing endogeneity arising from reverse causality and simultaneity between trade balance, exchange rate movements, and economic growth (Arellano & Bond, 1991; Roodman, 2009). By using internal instruments derived from lagged values of the endogenous variables, GMM produces consistent and efficient estimates in the presence of unobserved country-specific effects and potential measurement errors (Blundell & Bond, 1998).

Empirical analysis proceeds in several stages. First, descriptive statistics are computed to summarize variable distributions and cross-country variation. Second, the dynamic panel GMM model is estimated to identify both direct and interaction effects of the foreign exchange rate and economic growth on trade balance. Robust standard errors are employed to correct for heteroskedasticity and autocorrelation, in line with best practices in macro-panel analysis (Wooldridge, 2010).

The baseline dynamic specification includes a lagged dependent variable to capture persistence in trade balance performance, alongside the interaction effect of FDI and ECI. The interaction term (FDI*ECI) tests the hypothesis that the impact of FDI on trade balance is conditional on the level of export sophistication, reflecting the complementarity between foreign investment and productive export structures.

To address endogeneity, lagged values of the endogenous regressor (FER*GDP) are used as the instrument. The instrument is valid under the assumption that lagged levels of the endogenous variable are uncorrelated with the contemporaneous error term (Arellano & Bover, 1995). Furthermore, the instrument satisfies the orthogonality condition required by GMM, ensuring identification of structural parameters (Bowsher, 2002). Validity is tested using the Hansen J-statistic, which assesses over-identifying restrictions.

Estimation is conducted using a two-step system GMM with robust standard errors to correct for heteroskedasticity and autocorrelation. Instrument validity is assessed using the Hansen test of over-identifying restrictions. Arellano–Bond serial correlation tests are also employed to confirm model consistency. The number of instruments is carefully controlled to avoid instrument proliferation, in line with best econometric practice (Roodman, 2009).

GMM estimator is expressed as:

$$\hat{\theta}_{GMM} = \underset{\theta}{\operatorname{argmin}}\left[\frac{1}{n}\sum_{i=1}^{n} g(X_i,\theta)\right]' W_n \left[\frac{1}{n}\sum_{i=1}^{n} g(X_i,\theta)\right] \quad \ldots\ldots (2)$$

Where:

$g(X_i,\theta) = \frac{1}{n}\sum_{i=1}^{n} Z_i' \, \varepsilon_i(\theta)$ is the vector of moment conditions,
W_n : A consistent estimate of the weighting matrix,
θ: Vector of structural parameters (Arellano & Bond 1991; Blundell & Bond 1998).

The GMM framework is preferred due to its capacity in handling potential bias from endogenous regressors while accounting for heteroskedasticity and autocorrelation of unknown form (Baltagi, 2021).

4. Results and Discussion

Appendix 1 presents descriptive statistics for the key explanatory variables. Foreign exchange rate, expressed in natural logarithms (LNFER), has a mean value of 4.96, indicating moderate exchange rate levels across SSA economies over the study period. The relatively large standard deviation (2.03) reflects substantial cross-country and temporal variation in exchange rate movements, consistent with the prevalence of currency volatility in the region. The negative skewness (-0.26) suggests a longer left tail, while the kurtosis value of 1.78 indicates a platykurtic distribution, implying fewer extreme observations relative to a normal distribution.

GDP growth, measured in percentage terms and therefore not log-transformed, exhibits a mean of 5.12 percent, underscoring the generally positive growth performance of SSA during the study period. However, the high standard deviation (3.13), pronounced positive skewness (1.67), and excess kurtosis (8.78) indicate significant volatility and the presence of extreme growth episodes, often associated with commodity booms or macroeconomic shocks. The Jarque–Bera statistics strongly reject the null hypothesis of normality for both variables, a common feature of macroeconomic panel data for developing economies.

Stationarity properties of trade balance (LNTB), foreign exchange rate (LNFER), and gross domestic product (GDP) growth were examined using the Augmented Dickey–Fuller (ADF) unit root test (Appendices 2–6). Results indicate that LNTB and LNFER are non-stationary in levels, as the null hypothesis of a unit root cannot be rejected at conventional significance levels ($p > 0.05$). In contrast, GDP growth is stationary in level and therefore does not require differencing. Upon first differencing, the null hypothesis of a unit root is rejected for both LNTB and LNFER ($p < 0.05$), indicating that they become stationary. Accordingly, trade balance and foreign exchange rate are integrated of order one, I(1), while GDP growth is integrated of order zero, I(0). The presence of variables integrated of different orders further supports the use of a dynamic panel GMM estimator, which is particularly appropriate for accommodating mixed orders of integration, addressing endogeneity, and capturing dynamic adjustments in macroeconomic panel data (Dickey & Fuller, 1979; Arellano & Bond, 1991; Baltagi, 2021).

Generalized Method of Moments (GMM) model results (Appendix 7)

$\widehat{\text{LNTB}} = 0.129922 LNTB_{it-1}$ - 0.190271LNFER*GDP …….. (3)

Hence,

$$\hat{\theta}_{GMM} = \begin{bmatrix} 0.129922 \\ -0.190271 \end{bmatrix}$$

The dynamic specification of the trade balance model reveals that the lagged dependent variable, $LNTB_{it-1}$, is positive and statistically significant, with an estimated coefficient of 0.129922. This result indicates partial persistence in trade balance dynamics, suggesting that past trade balance outcomes exert a meaningful influence on current performance. Such persistence reflects adjustment costs, contractual rigidities, and slow structural responses in SSA external sectors, consistent with findings in the empirical trade literature (Bahmani-Oskooee & Ratha, 2004; Edwards, 1989).

Our core finding is the negative and statistically significant interaction effect between foreign exchange rate and GDP growth. The estimated coefficient of the interaction term (FER*GDP) of -0.190271 implies that a simultaneous 10 percent increase in exchange rate and economic growth is associated with approximately a 1.9 percent deterioration in the trade balance. This result suggests that economic growth in SSA, when accompanied by currency depreciation, tends to intensify import demand more rapidly than export expansion.

As a result, the potential competitiveness gains from depreciation are offset by growth-induced import surges, leading to worsening trade balance outcomes.

The interaction result represents a unique contribution to the literature by explicitly demonstrating that trade balance effects of exchange rate movements in SSA are conditional on growth dynamics. While traditional theory predicts that depreciation should improve trade balance under the Marshall–Lerner condition, the present findings align more closely with the absorption approach, which emphasizes the role of income-driven import demand (Alexander, 1952; Thirlwall, 1979).

Our results corroborate earlier regional studies that report weak or adverse trade balance responses to exchange rate depreciation in SSA (Bleaney & Greenaway, 2001; Ng et al., 2008), but extend the literature by showing that GDP growth amplifies these adverse effects. Unlike most previous studies that examine exchange rate and growth effects independently, our study demonstrates that their interaction is a critical transmission channel through which trade imbalances persist in the region. This finding also supports Rodrik's (2008) argument that growth in developing economies may be associated with external imbalances when productive structures remain import-dependent.

Robustness checks indicate that the residuals deviate from normality, as evidenced by a kurtosis value of 4.71 and a Jarque–Bera probability of 0.00 (Appendix 8), leading to rejection of the null hypothesis of normality. Residual plots further reveal that some observations fall outside the confidence bands (Appendix 9), suggesting leptokurtic behavior. Such non-normality is typical in macro-panel data for developing economies, where structural breaks, external shocks, and cross-country heterogeneity are prevalent (Baltagi, 2021). Importantly, this does not invalidate the GMM estimates, as the estimator does not rely on the assumption of normally distributed errors but instead on moment conditions and orthogonality assumptions (Arellano & Bond, 1991; Roodman, 2009).

Hansen J-statistic yields a probability value of 0.449, indicating failure to reject the null hypothesis of instrument validity. This confirms that the instruments employed are exogenous and appropriately specified, alleviating concerns of over-identification or instrument proliferation bias (Roodman, 2009). Further diagnostic testing using the Arellano–Bond serial correlation test reveals statistically significant first-order autocorrelation (AR(1): $m = -3.04$, $p < 0.05$), which is expected in first-differenced dynamic panel models and does not indicate misspecification. In contrast, second-order autocorrelation is absent (AR(2): $m = -1.36$, $p = 0.1747$), confirming the validity of the moment conditions and the consistency of the GMM estimator (Arellano & Bond, 1991).

Limitations

Notwithstanding the empirical rigor and robustness of the analytical framework, several limitations of the study warrant acknowledgment. Firstly, regarding research design, the study employs a dynamic panel estimation approach that identifies average effects across countries and over time. While suitable for regional-level inference, this approach may obscure country-specific heterogeneity and asymmetric responses to exchange rate movements and economic growth, which are often pronounced in developing regions such as SSA (Baltagi, 2021; Hsiao, 2014). Consequently, our findings should be interpreted as representative regional tendencies rather than precise country-level dynamics.

Secondly, the sample is limited to 20 SSA countries over the period 2005 to 2024, selected based on the availability of balanced panel data. Although this enhances econometric consistency and reduces estimation bias, it restricts the external validity of the results. Countries excluded due to data gaps, often those experiencing heightened macroeconomic volatility may exhibit different exchange rate–growth–trade balance relationships, thereby introducing potential sample selection bias (Wooldridge, 2010).

Thirdly, our study relies on secondary data from the World Development Indicators, which, despite being widely used and standardized, may be subject to measurement errors, revisions, and cross-country reporting inconsistencies. Such data limitations are common in macroeconomic analyses of developing economies and may affect the precision of estimated coefficients (Deaton, 1997; World Bank, 2023).

Fourthly, with respect to data analytical procedures, the GMM estimator, though appropriate for addressing endogeneity, unobserved heterogeneity and dynamic adjustment, is sensitive to instrument selection and specification. While diagnostic tests confirm instrument validity, the possibility of weak instruments and finite-sample bias cannot be entirely eliminated (Arellano & Bond, 1991; Roodman, 2009). In addition, the linear interaction specification between foreign exchange rate and GDP growth may not fully capture potential nonlinearities or threshold effects documented in the exchange rate and trade literature (Bahmani-Oskooee & Ratha, 2004).

Last but not least, the model does not explicitly incorporate structural and institutional variables such as export diversification, industrial capacity, trade policy regimes, or institutional quality, which may condition the effectiveness of exchange rate movements and growth on trade balance outcomes. The exclusion of these factors reflects data constraints rather than theoretical omission and points to important directions for future research (Rodrik, 2008; UNCTAD, 2019).

5. Conclusion and Recommendations

Our study provides a comprehensive assessment of the relationship between foreign exchange rate dynamics, economic growth, and trade balance performance in SSA by emphasizing the importance of interaction effects and dynamic adjustment processes. By moving beyond conventional single-channel analyses, the study demonstrates that trade balance outcomes in the region are best understood as the product of interdependent macroeconomic forces operating within structurally constrained economies. In this regard, the study contributes to the literature by clarifying why sustained economic growth in SSA has often coincided with persistent external imbalances rather than trade improvement.

Our analysis reinforces long-standing theoretical insights from the absorption approach and structuralist trade theory, which posit that growth-driven increases in domestic absorption can offset potential competitiveness gains from exchange rate movements in economies with limited export diversification and low supply responsiveness (Alexander, 1952; Thirlwall, 1979; Rodrik, 2008). By explicitly incorporating interaction effects, our study advances empirical understanding of how growth conditions mediate trade balance response to exchange rate changes, a dimension that has been largely overlooked in prior regional and country-specific studies (Bahmani-Oskooee & Ratha, 2004; Edwards, 1989).

More broadly, our study underscores the relevance of dynamic macroeconomic analysis for SSA, where structural rigidities, import dependence, and exposure to external shocks continue to shape external sector performance (UNCTAD, 2019; World Bank, 2023). By adopting a dynamic panel framework that accounts for endogeneity and heterogeneity, our study provides a robust analytical foundation for future research on exchange rate–growth–trade interactions in developing economies. In doing so, it enriches the ongoing discourse on external balance sustainability and macroeconomic adjustment in Sub-Saharan Africa.

Recommendations

Our findings suggest that exchange rate management in SSA should be considered within a broader macroeconomic and structural context rather than as an isolated tool for correcting trade imbalances. Given the interaction between foreign exchange rate movements and economic growth, macroeconomic policies should recognize that growth processes characterized by high import dependence may weaken trade balance response to exchange rate depreciation. This reinforces the importance of coordinating exchange rate policy with growth strategies that enhance domestic productive capacity and export responsiveness, consistent with insights from the absorption approach and structuralist trade theory (Alexander, 1952; Thirlwall, 1979; Rodrik, 2008).

In addition, macroeconomic stability remains critical for moderating the adverse interaction between growth and exchange rate movements. Policies that reduce excessive exchange rate volatility can help limit uncertainty faced by exporters and importers, thereby improving external sector performance over time (Edwards, 1989; Aizenman et al., 2012). Overall, our results point to the need for integrated macroeconomic frameworks that align exchange rate dynamics with sustainable growth and external balance objectives.

At the program level, our study highlights the relevance of initiatives aimed at strengthening export supply capacity and reducing structural import dependence. Programs that promote value addition, industrial upgrading, and diversification away from primary commodity exports are particularly important for improving the effectiveness of exchange rate movements in influencing trade outcomes (UNCTAD, 2019; World Bank, 2023). Such programs may enhance the elasticity of exports and mitigate the tendency for growth-induced import surges to dominate trade dynamics.

Furthermore, regional economic integration programs within SSA such as those supporting intra-African trade, may help reduce vulnerability to external shocks and improve trade balance sustainability by expanding regional markets and supporting economies of scale (UNECA, 2020). Strengthening institutional capacity in trade facilitation, customs administration, and infrastructure development can also support more efficient transmission of macroeconomic policies to the external sector.

Our study opens several avenues for future research. Firstly, subsequent studies could explore country-specific or sub-regional analyses to account for heterogeneity in exchange rate regimes, export structures, and growth patterns across Sub-Saharan Africa (Hsiao, 2014; Baltagi, 2021). Secondly, future research may consider nonlinear or threshold models to examine whether the interaction between exchange rate movements and economic growth varies across different growth or volatility regimes, as suggested in the broader exchange rate literature (Bahmani-Oskooee & Ratha, 2004).

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APPENDICES

Appendix 1: Descriptive Statistics

	LNFER	GDP
Mean	4.958466	5.120312
Median	6.100319	4.834623
Maximum	8.317795	21.07901
Minimum	1.061114	0.033794
Std. Dev.	2.030916	3.129834
Skewness	-0.25531	1.665509
Kurtosis	1.7845	8.783068
Jarque-Bera	26.0726	668.0932
Probability	0.000002	0
Sum	1785.048	1843.312
Sum Sq. Dev.	1480.738	3516.715
Observations	360	360

Appendix 2: Unit root test, LNTB (in Level)

Panel unit root test: Summary
Series: LNTB
Date: 12/23/25 Time: 03:14
Sample: 2005 2024
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.36325	0.0004	20	360
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.78989	0.2148	20	360
ADF - Fisher Chi-square	50.4277	0.1249	20	360
PP - Fisher Chi-square	58.0121	0.0326	20	380

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Appendix 3: Unit root test, LNTB (in first difference)

Panel unit root test: Summary
Series: D(LNTB)
Date: 12/23/25 Time: 03:13
Sample: 2005 2024
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-8.17086	0.0000	20	340
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.35184	0.0000	20	340
ADF - Fisher Chi-square	112.028	0.0000	20	340
PP - Fisher Chi-square	146.681	0.0000	20	360

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Appendix 4: Unit root test, LNFER (in Level)

Panel unit root test: Summary
Series: LNFER
Date: 12/24/25 Time: 08:28
Sample: 2005 2024
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	1.56496	0.9412	20	360
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	5.34094	1.0000	20	360
ADF - Fisher Chi-square	14.7314	0.9999	20	360
PP - Fisher Chi-square	8.31841	1.0000	20	380

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Appendix 5: Unit root test, LNFER (in first difference)

Panel unit root test: Summary
Series: D(LNFER)
Date: 12/24/25 Time: 08:26
Sample: 2005 2024
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.56359	0.0000	20	340
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.43966	0.0000	20	340
ADF - Fisher Chi-square	113.624	0.0000	20	340
PP - Fisher Chi-square	130.304	0.0000	20	360

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Appendix 6: Unit root test, GDP (in Level)

Panel unit root test: Summary
Series: GDP
Date: 12/24/25 Time: 08:32
Sample: 2005 2024
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.14804	0.0000	20	320
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.07505	0.0000	20	320
ADF - Fisher Chi-square	112.484	0.0000	20	320
PP - Fisher Chi-square	155.679	0.0000	20	340

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Appendix 7: Generalized Method of Moments (GMM) model results

Dependent Variable: D(LNTB)
Method: Panel Generalized Method of Moments
Transformation: First Differences
Date: 12/24/25 Time: 08:51
Sample (adjusted): 2008 2022
Periods included: 15
Cross-sections included: 20
Total panel (balanced) observations: 300
White period (period correlation) instrument weighting matrix
White period (cross-section cluster) standard errors & covariance (d.f. corrected)
Standard error and t-statistic probabilities adjusted for clustering
Instrument specification: @DYN(D(LNTB),-2) D(LNFER)*GDP(-1)
Constant added to instrument list

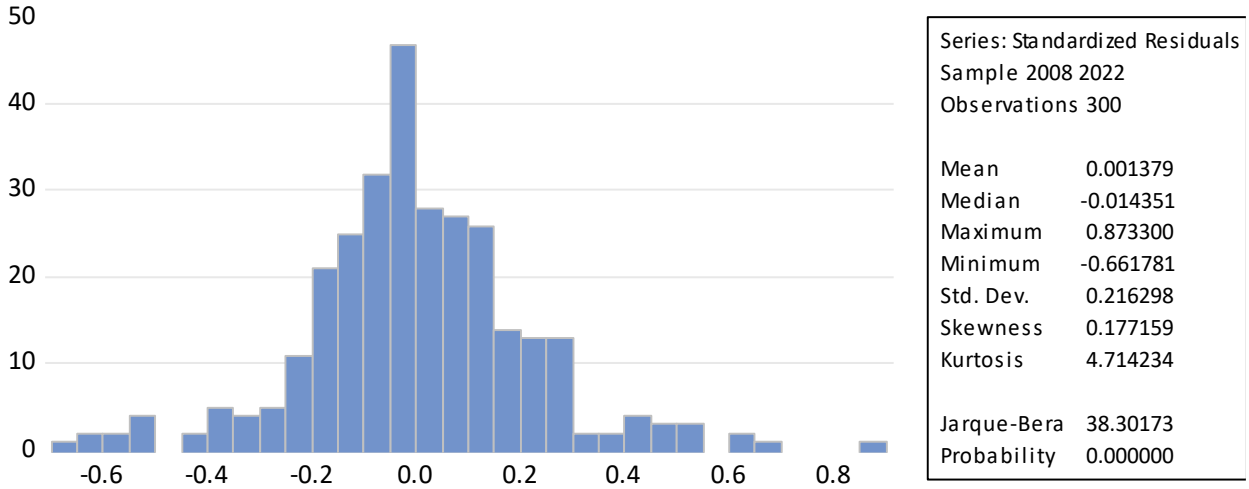
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTB(-1))	0.129922	0.029468	4.408904	0.0003
D(LNFER)*GDP	-0.190271	0.014357	-13.25247	0.0000

Effects Specification

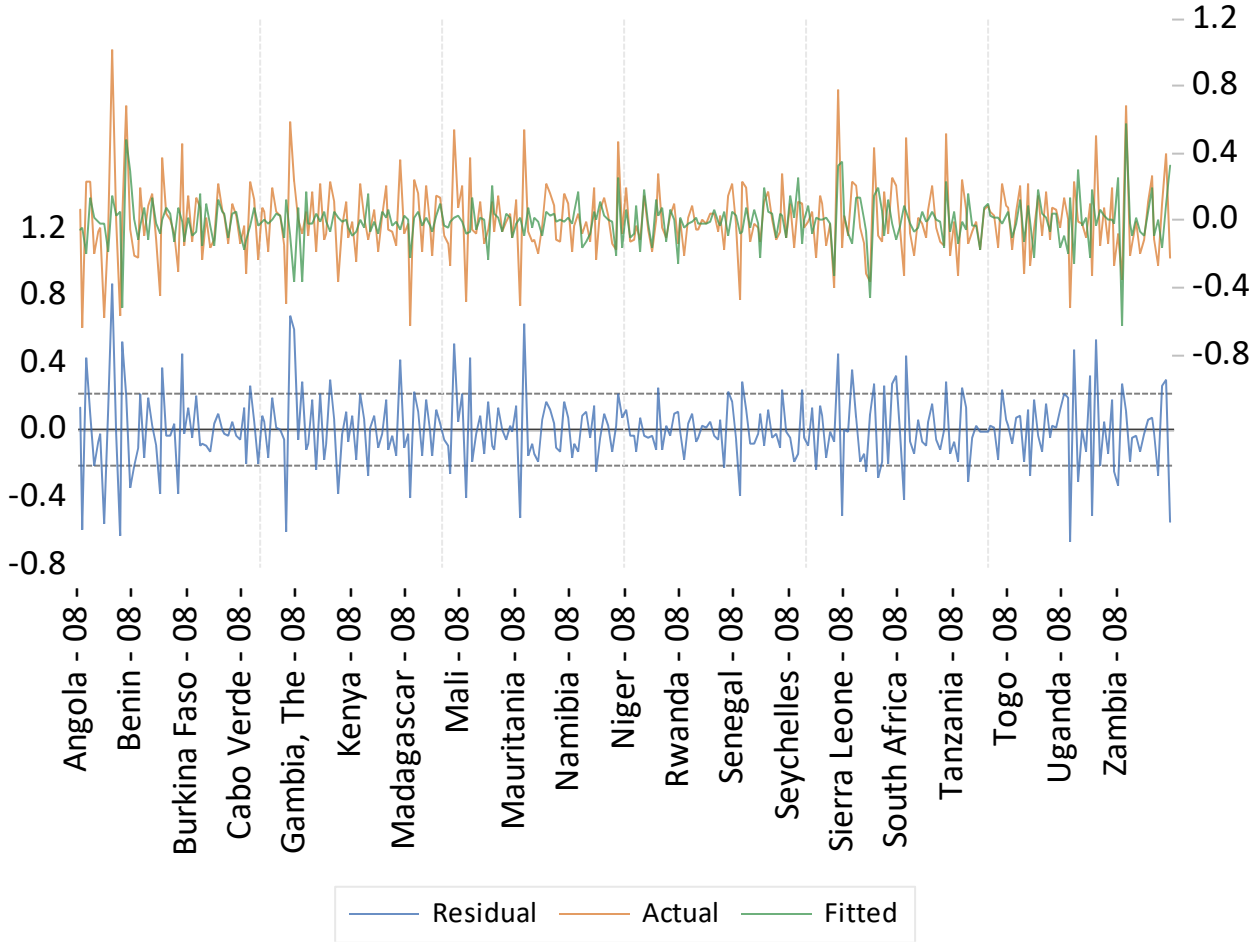
Cross-section fixed (first differences)

Mean dependent var	-0.003795	S.D. dependent var	0.219948
S.E. of regression	0.216665	Sum squared resid	13.98917
J-statistic	18.10059	Instrument rank	20
Prob(J-statistic)	0.449045		

Appendix 8: Normality test



Appendix 9: Graph of residuals



Appendix 10: Serial Correlation Test

Arellano-Bond Serial Correlation Test
Equation: Untitled
Date: 12/24/25 Time: 08:54
Sample: 2005 2024
Included observations: 300

Test order	m-Statistic	rho	SE(rho)	Prob.
AR(1)	-3.044847	-4.928462	1.618624	0.0023
AR(2)	-1.357258	-2.335056	1.720422	0.1747

Appendix 11: List of Sub-Saharan Africa countries in the study

Angola	Gambia, The	Mauritania	Senegal	Tanzania
Benin	Kenya	Namibia	Seychelles	Togo
Burkina Faso	Madagascar	Niger	Sierra Leone	Uganda
Cabo Verde	Mali	Rwanda	South Africa	Zambia