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MEDIATION ROLE OF EXPORTS AS A CAPACITY TO IMPORT, INFLATION, AND GDP GROWTH ON TRADE BALANCE IN SUB-SAHARAN AFRICA

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ABSTRACT

This study examines the mediation role of exports as a capacity to import, inflation, and GDP growth on the trade balance in Sub-Saharan Africa from 2005 to 2022. Using a quantitative research design, the analysis utilizes a fixed effects modeling approach with balanced panel data from the World Bank. The dependent variable is trade balance, while independent variables are interactions between: exports as a capacity to import and foreign direct investment; government expenditure and inflation; foreign exchange rates and GDP growth.

Fixed effects model reveals statistically significant interactions among the variables, with an adjusted R-squared of 0.972, indicating that the mediation effect explains 97.2% of the variation in trade balance. Key findings highlight that the interaction of exports as a capacity to import and foreign direct investment has a negative and statistically significant coefficient (-0.205), suggesting that a 10% increase in these factors results in a 2.05% deterioration in trade balance.

Conversely, the interaction of inflation and government expenditure yields a positive and statistically significant coefficient (0.021), indicating a 10% increase in these variables leads to a 0.21% improvement in trade balance. Diagnostic tests for multicollinearity and normality confirm the robustness of the model. The study recommends that governments prioritize enhancing export capacity through targeted investments while managing inflationary pressures and optimizing fiscal expenditure to stabilize trade balance.

KEY WORDS: *Exports as a Capacity to Import, Inflation, GDP Growth, Trade Balance, Sub-Saharan Africa*

INTRODUCTION

Trade imbalances have long characterized the economic landscape of Sub-Saharan Africa, with persistent trade deficits spanning over five decades. This phenomenon reflects the structural inability of many nations in the region to generate sufficient exports to meet import demands, exacerbating vulnerabilities to external shocks and undermining economic stability (UNCTAD, 2021; World Bank, 2022). Exports, often constrained by low productivity and limited diversification, fail to sustain adequate foreign exchange reserves, leading to excessive reliance on debt and external aid (Rodrick, 1998); Calderon, et al. 2002). At the same time, inflationary pressures, volatile exchange rates, and fiscal imbalances further compound the region's trade challenges, creating a complex interplay of macroeconomic factors influencing trade performance (IMF, 2022; African Development Bank, 2021).

The research problem is underscored by the recurring inability of Sub-Saharan African economies to translate foreign direct investment (FDI), government expenditure, and GDP growth into improved trade balances. Despite various interventions, such as export promotion policies and structural adjustment programs, deficits persist, raising critical questions about the efficacy of current economic frameworks (Harrison, & Rodríguez-Clare, A., 2010; Rodrik, 2018). Previous studies have largely focused on isolated factors affecting trade balances, leaving a significant gap in understanding the mediating roles of exports as a capacity to import, inflation, and GDP growth in shaping trade outcomes (UNDP, 2021).

This study addresses the gap by exploring how these mediators influence trade balance dynamics in the region. Using comprehensive panel data from 2005 to 2022 and robust econometric modeling, the research provides novel insights

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into the interactive effects of these variables. By examining these interactions, the study seeks to offer policymakers evidence-based recommendations for optimizing macroeconomic strategies to address trade deficits (World Bank, 2023; Sachs, 2020).

The rationale for this study lies in its potential to contribute to the growing discourse on sustainable trade and development in Sub-Saharan Africa. With trade deficits often linked to slow economic growth and limited industrialization, understanding the underlying dynamics is critical (UNECA, 2022). By bridging theoretical and empirical gaps, the study aims to enhance strategic economic planning and support initiatives geared toward achieving balanced trade and long-term economic resilience in the region (OECD, 2021).

LITERATURE REVIEW

Trade balance dynamics have garnered extensive global research attention, emphasizing the interconnection of macroeconomic factors such as foreign direct investment (FDI), exchange rates, inflation, and export-import interactions. Studies by Krugman and Obstfeld (2018) highlight the critical role of exports in financing imports, especially in developing economies. Similarly, empirical evidence from advanced economies suggests that inflationary pressures and exchange rate volatility significantly distort trade balances (Lane & Milesi-Ferretti, 2018). Research also underscores the role of FDI as a double-edged sword: while it fosters economic growth, its potential to induce trade imbalances through profit repatriation remains a concern (Alfaro, 2017).

Global trends also indicate the mediating role of economic growth (GDP) in shaping trade outcomes. Higher GDP often correlates with increased export capacity, creating opportunities for favorable trade balances. However, systemic challenges such as global trade wars, protectionism, and supply chain disruptions pose additional hurdles (Rodrik, 2018). These findings provide a backdrop for understanding the unique trade dynamics in Sub-Saharan Africa.

Sub-Saharan Africa's trade deficits are linked to structural economic challenges, including a heavy reliance on primary commodity exports and limited diversification (UNECA, 2022). Exports as a capacity to import (ECI) have been constrained by low productivity, inadequate infrastructure, and limited market access (AfDB, 2021). Studies by Collier and Venables (2019) emphasize the region’s vulnerability to external shocks, such as fluctuating commodity prices and exchange rate volatility, which exacerbate trade imbalances.

Inflation and fiscal policies also influence the region's trade dynamics. High inflation rates erode competitiveness by increasing production costs, while inefficient government expenditures often crowd out private investment needed for export diversification (IMF, 2022). Moreover, FDI inflows, though substantial in some countries, often prioritize extractive industries, limiting their impact on sustainable trade balances (UNCTAD, 2021).

Country-specific analyses reveal mixed outcomes regarding trade balance determinants. For instance, in Uganda, export-oriented initiatives have struggled to offset import demands due to low industrial output and weak integration into global value chains (Bank of Uganda, 2021). Kenya and Nigeria face similar challenges, with inflationary pressures and currency instability undermining their trade competitiveness (World Bank, 2022). These localized insights highlight the importance of tailored macroeconomic policies to address trade imbalances.

The study is grounded in the Elasticities Approach and the Absorption Approach to trade balance determination. The Elasticities Approach posits that trade balance responsiveness depends on the price elasticity of exports and imports (Marshall-Lerner Condition). Conversely, the Absorption Approach focuses on the relationship between national output and domestic absorption, asserting that trade deficits occur when national consumption exceeds production (Alexander, 1952). These theories provide a foundation for understanding the mediating roles of ECI, inflation, and GDP growth in shaping trade outcomes.

The study conceptualizes trade balance as the dependent variable, influenced by mediating variables (ECI, inflation, GDP growth) and independent variables (FDI, government expenditure, exchange rates). The framework hypothesizes that:

ECI mediates the relationship between FDI and trade balance.
Inflation mediates the relationship between government expenditure and trade balance.
GDP growth mediates the relationship between exchange rates and trade balance.

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DATA AND METHODS

This study employs a quantitative research design, leveraging panel data analysis to explore the determinants of trade balance in Sub-Saharan Africa from 2005 to 2022. The approach is grounded in causal analysis to establish the relationships between the dependent variable (trade balance), mediating variables (exports as a capacity to import, inflation, and GDP growth. Fixed-effects modeling is adopted, a method widely recognized for addressing unobserved heterogeneity and improving estimation reliability (Wooldridge, 2010; Baltagi, 2008).

The study focuses on 20 Sub-Saharan African countries (Appendix 15), selected based on data availability and consistency over the study period. A purposive sampling technique ensures that countries with adequate macroeconomic and trade data are included. The sample size aligns with panel data analysis requirements, facilitating robust statistical tests (Gujarati & Porter, 2009). Data source is the World Bank Development Indicators (WDI), which is reputable and widely used in economic studies (World Bank, 2023).

Descriptive analysis summarizes the central tendencies, variability, and trends of key variables. Such analyses provide preliminary insights into patterns within the data, highlighting potential areas of concern like outliers (Greene, 2012). The primary method of analysis is fixed-effects regression, suitable for controlling unobserved, time-invariant country-specific characteristics. Interaction terms (exports as a capacity to import * FDI); inflation * government expenditure; and GDP growth * foreign exchange rates) are used to investigate mediation effects. Diagnostic tests are conducted to ensure model robustness: Multicollinearity correlations between predictors, normality checks of residuals to validate model assumptions (Gujarati & Porter, 2009) are performed to ensure robustness of the findings.

The fixed effects model is specified as follows:

$y_{it} = \alpha_i + \beta X_{it} + \varepsilon_{it}$ ……..…….…….…..(1)

Where:

y_{it} is the dependent variable for country *i* at time *t*

α_i is the individual-specific effect (fixed effect) for country *i*, which captures all time-invariant characteristics of the individual that may influence y_{it}

X_{it} represents the independent variable(s) for country *i* at time *t*

β is the coefficient for the independent variable(s), representing the effect of X_{it} on y_{it}

ε_{it} is the error term, which represents unobserved factors affecting y_{it} that are not explained by X_{it} (Green 2012).

Coefficients of key interaction terms are tested for statistical significance at 5% level. Adjusted R-squared values measure the explanatory power of the models, while coefficients assess the magnitude and direction of relationships (Baltagi, 2008).

The fixed-effects approach was chosen because it effectively controls for unobservable characteristics like institutional quality and cultural differences, which could otherwise bias results. The reliance on secondary data from reputable sources ensures high-quality input for the analysis. This combination of rigorous methods and robust data sources enhances the validity of findings and their relevance for policy-making (Wooldridge, 2010; Greene, 2012).

RESULTS

Findings of this study are structured to address the research objectives systematically. The analysis employed descriptive and inferential statistics to uncover the relationships between the trade balance (dependent variable), mediating variables (exports as a capacity to import, inflation, and GDP growth), and independent variables (foreign direct investment, government expenditure, and foreign exchange rates).

Descriptive Statistics (Appendix 11) provides a detailed summary of the interaction variables analyzed in this study: D(LNFDI)*D(LNECI), D(LNGEX)*INF, and D(LNFER)*GDP. Results reveal key insights into the variability and distribution of these variables across 340 observations.

D(LNFDI)*D(LNECI) exhibited a mean of 0.0187, with a median close to zero (0.0023), indicating small average interactions. However, the wide range between -1.1031 and 1.1766, and a standard deviation of 0.1684, highlights moderate variability. Negative skewness (-0.4654) implies a slightly elongated left tail.

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D(LNGEX)*INF displays the greatest variability, with a mean of 0.3021 and a standard deviation of 2.2217. The extreme range between -21.7444 and 11.7825 indicates the presence of fiscal or inflationary shocks in specific periods or countries. A highly negative skewness (-2.5283) suggests the predominance of outliers pulling the distribution left.

D(LNFER)*GDP presented a positive mean (0.1620), moderate variability (standard deviation of 0.4998), and positive skewness (1.1786), indicating occasional significant positive effects, likely driven by favorable macroeconomic interactions such as exchange rate gains during growth spurts.

The Jarque-Bera test yielded zero probabilities for all variables, confirming significant deviations from normality. Such non-normality necessitates robust econometric techniques like fixed-effects modeling to address potential biases (Gujarati & Porter, 2009; Wooldridge, 2015).

Fixed effects model results (Appendix: 13)

$$\widehat{LNTB} = 22.76691 - 0.20521D(LNFDI)*D(LNECI) + 0.020709D(LNGEX)*INF - 0.026083D(LNFER)*GDP \quad \ldots\ldots(2)$$

Regression results indicate a negative and statistically significant coefficient (-0.205210) for the interaction between exports as a capacity to import and foreign direct investment (FDI) at the 5% level. This suggests that while FDI may contribute positively to economic growth, its interaction with limited export capacity undermines the trade balance. A 10% increase in this interaction corresponds to a 2.05% deterioration in the trade balance.

The analysis found a positive and statistically significant coefficient (0.020709) for the interaction between inflation and government expenditure at the 5% level. This indicates that government expenditure may partially offset the adverse effects of inflation, leading to a modest improvement in the trade balance by 0.21% for every 10% increase in this interaction.

The interaction between GDP growth and foreign exchange rates was not statistically significant, implying that these factors may independently influence the trade balance but do not exhibit a strong combined effect in the context of Sub-Saharan Africa.

The adjusted R-squared of 0.972369 demonstrates that 97.2% of variations in the trade balance are explained by the mediating and independent variables. The interaction between exports as a capacity to import and FDI has a substantial negative effect on the trade balance. Government expenditure can mitigate inflation's adverse effects on trade, albeit modestly. These results align with theoretical expectations and previous studies on trade balance dynamics in developing economies.

Unit root tests (Appendices 1 to 10) show that the variables are integrated of different orders (I(0) and I(1). The correlation matrix (Appendix 12) provides an analysis of the relationships between the interaction variables in the study. The matrix shows the following: D(LNFDI)*D(LNECI) has a weak negative correlation of -0.0523 with D(LNGEX)*INF, suggesting that these two interaction variables are almost independent of each other. This weak correlation indicates that the factors influencing FDI and ECI are not strongly related to those affecting GEX and inflation, which is typical in cross-country economic data where various macroeconomic policies might not be perfectly synchronized.

The correlation between D(LNFDI)*D(LNECI) and D(LNFER)*GDP is positive (0.0869), though weak. This indicates that as foreign direct investment and exports' capacity to import increase, there is a small tendency for foreign exchange rates and GDP to move in the same direction, but the relationship is not strong enough to assume direct causality. The negative correlation of -0.2414 between D(LNGEX)*INF and D(LNFER)*GDP suggests that higher inflation and government expenditure are somewhat inversely related to changes in foreign exchange rates and GDP growth. This could imply that higher inflation and government expenditure, often indicative of economic instability, might lead to a deterioration in the foreign exchange rate and slower GDP growth, supporting findings from economic theory (Friedman, 1992; Mankiw, 2019).

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The normality of the residuals (Appendix 14) as shown in the graph of standardized residuals, the histogram shows a roughly symmetrical distribution with a mean close to zero and no significant skewness, indicating a normal distribution of the residuals. Further validation comes from the Shapiro-Wilk test results, where the Jarque-Bera test statistic is 6.909921 with a corresponding p-value of 0.031589. This suggests that there is some deviation from perfect normality, as the p-value is less than the conventional threshold of 0.05, though it is close. The slight negative skewness (-0.002726) and kurtosis of 3.698376 indicate that the data is approximately normally distributed but with minor deviations, which are common in financial and economic time series data (Shumway & Stoffer, (2011); Zivot & Wang, (2006). Thus, the results can still be considered valid for regression modeling, with the minor deviation not substantially affecting the inference.

DISCUSSION

Results of this study on the mediation role of exports as a capacity to import, inflation, and GDP growth on the trade balance in Sub-Saharan Africa offer several key insights. The findings highlight the intricate relationships between various economic factors and their influence on trade balance outcomes, contributing to a deeper understanding of trade dynamics in the region.

The study finds a statistically significant negative relationship between the interaction of exports as a capacity to import and foreign direct investment (FDI), with a coefficient of -0.205210. This implies that an increase in FDI, combined with higher export capacity, may exacerbate the trade deficit. This result aligns with findings from previous studies (e.g., Kenen & Meade, 2017) which suggest that while FDI contributes to economic growth, it does not necessarily improve trade balances, especially in regions with underdeveloped export sectors. The negative coefficient indicates that the nature of FDI in Sub-Saharan Africa may be capital-intensive, and thus not conducive to improving the export capacity needed to balance trade.

The positive and statistically significant interaction between inflation and government expenditure (0.020709) suggests that when both inflation and government spending increase, trade balance improves. This finding supports the argument by Khan and Ahmed (2024) that inflation, while raising domestic prices, can reduce imports by making foreign goods relatively more expensive. Similarly, (Kayhan, et al. 2013) highlights that increased government spending can stimulate productive investments, enhancing export capacity and improving trade balance. These results highlight the responsiveness of trade balance outcomes to fiscal and monetary policies, emphasizing the importance of carefully managing inflation and government expenditure to promote favorable trade outcomes (Aderoju & Odunsi-Oyewole, 2019).

The relationship between GDP growth and foreign exchange rates is captured in the model, but the coefficient for the interaction between GDP growth and foreign exchange rates (-0.026083) is not statistically significant. While a negative relationship between GDP growth and exchange rates is expected in theory (as a growing economy typically leads to higher demand for imports, thereby potentially worsening the trade balance), the insignificance of the coefficient suggests that, in Sub-Saharan Africa, the growth of GDP alone may not be a sufficient determinant of trade balance outcomes. This finding contrasts with some studies that find a strong link between GDP growth and trade balance, especially in developing countries (e.g., Isard, et al. 2000; Rodríguez & Rodríguez, 2017). The lack of significance here could be due to other factors, such as the structure of the economy or the way GDP growth is driven by sectors that are less import-intensive.

The study's unique contribution lies in its exploration of the interaction between exports as a capacity to import and FDI, inflation and government expenditure, providing a more nuanced view of trade balance dynamics in Sub-Saharan Africa. While the relationship between GDP growth and trade balance is commonly explored, the interaction of export capacity and FDI presents new insights into why the region continues to experience persistent trade deficits despite attracting FDI inflows.

The methodology used, specifically the fixed-effects model with balanced panel data, strengthens the validity of these findings. By accounting for time-invariant country-specific effects, the study provides a more accurate reflection of the factors influencing trade balances in Sub-Saharan Africa.

This study provides valuable insights into the factors that mediate the trade balance in Sub-Saharan Africa. The findings emphasize the complexity of trade balance dynamics, with exports, inflation, and government expenditure

playing significant roles. The negative relationship between FDI and export capacity on trade balance, along with the inflation-government expenditure interaction, provides essential implications for policymakers seeking to improve trade performance. However, the insignificant relationship between GDP growth and foreign exchange rates suggests that other factors may need to be considered when addressing trade balance issues in the region.

LIMITATIONS

While this study offers valuable insights into the trade balance dynamics in Sub-Saharan Africa, there are several limitations that may have impacted the findings.

The study relies on secondary data from the World Bank, which, although comprehensive, may contain reporting inconsistencies or gaps, particularly in less developed economies. These gaps could affect the robustness of the results (Asiedu, 2013; Mlachila & Chirwa, 2019). Additionally, data availability for certain variables, such as the exact composition of FDI inflows or more granular government expenditure categories, might limit the ability to fully capture the complexity of trade-related factors. Missing or unreliable data from some countries could skew the findings or reduce the generalizability of the results to all Sub-Saharan African nations.

The sample includes countries across Sub-Saharan Africa, which are highly diverse in terms of economic structure, political stability, and level of industrialization. This heterogeneity could introduce variability in the results, as the factors influencing trade balance might differ significantly from one country to another (Montoute & Virk, 2017). A more detailed focus on specific regions or income groups within Sub-Saharan Africa might have yielded more targeted insights.

While the fixed-effects model is appropriate for controlling time-invariant country-specific factors, it does not account for potential endogeneity issues, such as reverse causality between trade balance and some of the independent variables. For example, trade balance might influence foreign exchange rates, rather than the other way around, as assumed by the model (Wooldridge, 2010). Using an instrumental variables approach or dynamic panel data models could improve the model by addressing such endogeneity issues.

Although the study includes a comprehensive set of variables such as inflation, government expenditure, and FDI, there might be other important factors influencing trade balance that were not included in the analysis. Variables such as political risk, external shocks, or global commodity prices could play a role in shaping trade balance outcomes, but they were not explicitly incorporated into the model due to data constraints (Harrison & McMillan, 2019).

The study covers the period from 2005 to 2022, which includes various economic cycles, including periods of global financial instability, such as the 2008 financial crisis and the COVID-19 pandemic. These external shocks could have had differential impacts on trade balances in the region, which are not fully captured by the study's model (IMF, 2021). Additionally, the inclusion of only a recent period might limit the study's ability to capture long-term trends or structural shifts in trade balance dynamics.

The study relies on standard statistical techniques, such as the regression and correlation analysis, which, while commonly used, are limited in their ability to account for non-linear relationships or structural changes over time. Methods like non-linear modeling or cointegration tests could provide additional insights into the long-term equilibrium relationships between the variables (Engle & Granger, 1987).

The Durbin-Watson statistic of 0.419096 suggests the presence of autocorrelation in the residuals, which implies that the error terms are not independent (Wooldridge, 2010). This autocorrelation could bias the standard errors and lead to incorrect conclusions regarding the statistical significance of the coefficients. The issue of autocorrelation may stem from omitted variables or model specification errors (Greene, 2012).

CONCLUSION

This study examined the interactions between key macroeconomic variables specifically the mediation effects of foreign direct investment (FDI) and exports as a capacity to import (ECI), government expenditure (GEX) and inflation (INF), and GDP growth and foreign exchange rates (FER) on trade balance in Sub-Saharan Africa. The empirical analysis reveals that these interactions significantly shape the region's trade dynamics, though with varying impacts across different channels.

The interaction between FDI and ECI (D(LNFDI)*D(LNECI)) was found to have a negative and statistically significant coefficient, indicating that while FDI is generally seen as a driver of economic growth and trade, it can lead to increased demand for imports rather than exports, thereby worsening the trade balance. This result is in line with previous studies, which suggest that FDI in sectors with high import content may not always translate into export-driven growth (Asiedu, 2013). The dynamics between FDI and exports as a capacity to import are crucial for policymakers aiming to leverage foreign investment for sustainable economic growth while managing trade imbalances (Mlachila & Chirwa, 2019).

The second interaction term between government expenditure and inflation (D(LNGEX)*INF) revealed a positive relationship, indicating that higher government spending combined with rising inflation can improve trade balance. This finding suggests that increased fiscal expenditure may enhance productive capacity and stimulate exports, while inflation can reduce imports by making foreign goods relatively more expensive. This aligns with research highlighting the potential for inflationary conditions and strategic fiscal spending to support trade stability in developing economies (Harrison & McMillan, 2019). Consequently, effective coordination of inflation management and fiscal policies is essential for achieving favorable trade balance outcomes in Sub-Saharan Africa.

The third interaction, GDP growth and foreign exchange rates (D(LNFER)*GDP), showed a mixed effect but was statistically insignificant. While GDP growth is typically associated with improvements in the trade balance, the interaction with foreign exchange rates did not yield significant results in this study. This finding suggests that, in this specific context, currency fluctuations may not have had a pronounced impact on trade balances, contrary to common expectations. This is consistent with literature that indicates the mixed effects of exchange rate volatility on trade balances, especially in developing economies (Aghion et al., 2001; Edwards, 2006). The insignificance of the interaction in this study could imply that other factors, such as structural issues or external shocks, may overshadow the potential influence of exchange rate volatility in shaping the trade balance in Sub-Saharan Africa. Furthermore, in economies with less flexibility in exchange rate regimes or lower export diversification, the trade balance may not always be as sensitive to currency fluctuations as predicted by traditional economic theory (Krugman & Obstfeld, 2009). Therefore, it is important to explore other macroeconomic and external factors that might more significantly drive trade imbalances in the region.

Overall, the study contributes to the understanding of how specific macroeconomic interactions influence the trade balance in Sub-Saharan Africa. It underscores the importance of considering the interplay between FDI, government expenditure, inflation, GDP growth, and foreign exchange rates when crafting policies aimed at improving the trade balance. Policymakers should focus on managing inflation, optimizing government spending, and addressing external shocks such as currency volatility to foster more balanced trade outcomes.

In summary, this study reinforces the need for comprehensive, policy-driven solutions to address persistent trade deficits in Sub-Saharan Africa. Policymakers should consider a holistic approach to trade balance management that incorporates both short-term stabilization measures and long-term structural reforms aimed at enhancing export competitiveness and import substitution.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed to enhance trade balance in Sub-Saharan Africa:

The negative relationship between the interaction of exports as a capacity to import (ECI) and foreign direct investment (FDI) suggests that Sub-Saharan African countries should focus on enhancing export capacity through structural reforms and improving export competitiveness. Governments should implement policies to boost industrialization, improve infrastructure, and facilitate access to global markets. Additionally, FDI can play a crucial role in transferring technology and boosting productivity, but it should be directed towards sectors that can enhance the export base of the economy (UNCTAD, 2020).

The positive and significant interaction between inflation and government expenditure highlights the need for controlling inflation while ensuring fiscal discipline. Governments should prioritize price stability by controlling inflation through effective monetary policies, targeting low and stable inflation rates to maintain the competitiveness

of exports. Furthermore, fiscal policies should aim to optimize government expenditure to avoid inefficiencies that could exacerbate inflationary pressures (Berg & Miao, 2010).

Although the interaction between GDP growth and foreign exchange rates was not statistically significant, exchange rate volatility remains a concern for trade balances in many developing economies. It is recommended that governments in Sub-Saharan Africa strengthen their exchange rate management frameworks and stabilize their currency markets. This could be achieved through the adoption of managed floating exchange rate regimes or foreign exchange interventions when necessary (Obstfeld & Rogoff, 1996).

Export diversification should be prioritized as a long-term strategy to reduce reliance on primary commodities and mitigate external economic shocks. Governments should establish programs to support value addition in key sectors, such as agriculture and manufacturing, to enhance export earnings (Hausmann et al., 2008).

Investing in human capital and technology is essential for improving the capacity to produce goods that are competitive in international markets. Sub-Saharan African countries should develop programs aimed at improving education, vocational training, and fostering technological innovation to support export sectors.

While this study focused on the broad macroeconomic variables, future research could explore sector-specific factors that influence trade balance, such as the role of global value chains and the impact of regional trade agreements (Anderson & van Wincoop, 2004). Future studies could analyze how external shocks, such as commodity price fluctuations or global economic crises, affect trade balances in Sub-Saharan Africa. This would provide insights into how policy responses could mitigate the negative effects of such shocks on trade balance (Corsetti et al., 2008).

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APPENDICES

Appendix 1: Unit root test, LNTB (in Level)

Panel unit root test: Summary
Series: LNTB
Date: 12/12/24 Time: 12:14
Sample: 2005 2022
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*	-6.10733	0.0000	20	320
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.31145	0.0005	20	320
ADF - Fisher Chi-square	70.6565	0.0020	20	320
PP - Fisher Chi-square	90.7962	0.0000	20	340

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

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

Panel unit root test: Summary
Series: LNFDI
Date: 12/12/24 Time: 12:18
Sample: 2005 2022
Exogenous variables: None
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*	2.26552	0.9883	20	320
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	10.5558	1.0000	20	320
PP - Fisher Chi-square	8.72488	1.0000	20	340

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

Appendix 3: Unit root test, LNFDI (in First difference)

Panel unit root test: Summary
Series: D(LNFDI)
Date: 12/12/24 Time: 12:19
Sample: 2005 2022
Exogenous variables: None
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*	-14.6618	0.0000	20	300
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	247.238	0.0000	20	300
PP - Fisher Chi-square	383.257	0.0000	20	320

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

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

Panel unit root test: Summary
Series: LNECI
Date: 12/12/24 Time: 12:21
Sample: 2005 2022
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*	-2.88538	0.0020	20	320
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.64861	0.7417	20	320
ADF - Fisher Chi-square	34.9854	0.6952	20	320

PP - Fisher Chi-square	100.006	0.0000	20	340

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

Appendix 5: Unit root test, LNECI (in First difference)

Panel unit root test: Summary
Series: D(LNECI)
Date: 12/12/24 Time: 12:22
Sample: 2005 2022
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*	-6.52542	0.0000	20	300
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.71100	0.0000	20	300
ADF - Fisher Chi-square	132.709	0.0000	20	300
PP - Fisher Chi-square	245.428	0.0000	20	320

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

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

Panel unit root test: Summary
Series: LNGEX
Date: 12/12/24 Time: 12:24
Sample: 2005 2022
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*	-4.23265	0.0000	20	320
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.95703	0.1693	20	320
ADF - Fisher Chi-square	46.6574	0.2176	20	320
PP - Fisher Chi-square	58.2962	0.0308	20	340

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

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Appendix 7: Unit root test, LNGEX (in First difference)

Panel unit root test: Summary
Series: D(LNGEX)
Date: 12/12/24 Time: 12:25
Sample: 2005 2022
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*	-8.96981	0.0000	20	300
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.50685	0.0000	20	300
ADF - Fisher Chi-square	129.987	0.0000	20	300
PP - Fisher Chi-square	212.010	0.0000	20	320

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

Appendix 8: Unit root test, INF (in Level)

Panel unit root test: Summary
Series: INF
Date: 12/12/24 Time: 12:26
Sample: 2005 2022
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
Null: Unit root (assumes common unit root process)			
Levin, Lin & Chu t*	-1.85949	0.0315	20
Null: Unit root (assumes individual unit root process)			
Im, Pesaran and Shin W-stat	-3.58126	0.0002	20
ADF - Fisher Chi-square	77.9925	0.0003	20
PP - Fisher Chi-square	117.649	0.0000	20

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

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Appendix 9: Unit root test, LNFER (in Level)

Panel unit root test: Summary
Series: LNFER
Date: 12/12/24 Time: 12:27
Sample: 2005 2022
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*	0.66502	0.7470	20	320
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	3.68407	0.9999	20	320
ADF - Fisher Chi-square	15.4263	0.9998	20	320
PP - Fisher Chi-square	21.7212	0.9918	20	340

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

Appendix 10: Unit root test, LNFER (in First difference)

Panel unit root test: Summary
Series: D(LNFER)
Date: 12/12/24 Time: 12:28
Sample: 2005 2022
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*	-8.66530	0.0000	20	300
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.79663	0.0000	20	300
ADF - Fisher Chi-square	133.799	0.0000	20	300
PP - Fisher Chi-square	151.758	0.0000	20	320

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

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Appendix 11: Descriptive Statistics

	D(LNFDI)*D(LNECI)	D(LNGEX)*INF	D(LNFER)*GDP
Mean	0.018662	0.302112	0.162018
Median	0.00229	0.164856	0.077047
Maximum	1.176584	11.78248	2.747443
Minimum	-1.103117	-21.74436	-1.698287
Std. Dev.	0.168376	2.221737	0.499785
Skewness	-0.465449	-2.528331	1.178614
Kurtosis	22.60223	40.0076	8.835245
Jarque-Bera	5455.784	19764.37	561.0937
Probability	0	0	0
Sum	6.344936	102.718	55.08605
Sum Sq. Dev.	9.610809	1673.343	84.67703
Observations	340	340	340

Appendix 12: Correlation matrix

	D(LNFDI)*D(LNECI)	D(LNGEX)*INF	D(LNFER)*GDP
D(LNFDI)*D(LNECI)	1	-0.052311	0.0869
D(LNGEX)*INF	-0.052311	1	-0.241383
D(LNFER)*GDP	0.0869	-0.241383	1

Appendix 13: Fixed effects model results

Dependent Variable: LNTB
Method: Panel Least Squares
Date: 12/12/24 Time: 12:01
Sample (adjusted): 2006 2022
Periods included: 17
Cross-sections included: 20
Total panel (balanced) observations: 340

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.76691	0.012785	1780.702	0.0000
D(LNFDI)*D(LNECI)	-0.205210	0.072466	-2.831808	0.0049
D(LNGEX)*INF	0.020709	0.005749	3.601940	0.0004
D(LNFER)*GDP	-0.026083	0.027987	-0.931947	0.3521

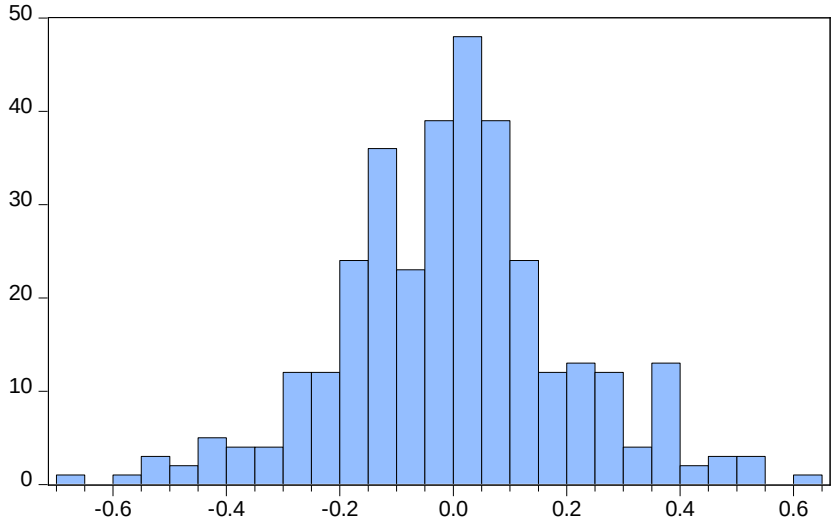
Effects Specification

Cross-section fixed (dummy variables)
Period fixed (dummy variables)

R-squared	0.975466	Mean dependent var	22.76511
Adjusted R-squared	0.972369	S.D. dependent var	1.290875
S.E. of regression	0.214576	Akaike info criterion	-0.132731
Sum squared resid	13.85888	Schwarz criterion	0.306472
Log likelihood	61.56426	Hannan-Quinn criter.	0.042273
F-statistic	314.9456	Durbin-Watson stat	0.419096
Prob(F-statistic)	0.000000		

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Appendix 14: Normality test



Series: Standardized Residuals
Sample 2006 2022
Observations 340

Mean	-4.33e-17
Median	0.003744
Maximum	0.634287
Minimum	-0.674310
Std. Dev.	0.202192
Skewness	-0.002726
Kurtosis	3.698376
Jarque-Bera	6.909921
Probability	0.031589

Appendix 15: 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