

TRADE OPENNESS AND FOOD SECURITY NEXUS IN SOUTH AFRICA: A VECTOR ERROR CORRECTION ANALYSIS

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Abstract

This study investigates how trade openness affects food security in South Africa from 2000 to 2021. Using a Vector Error Correction Model (VECM), the study analyses short-run and long-run impacts of trade policies on national food security, particularly within the context of the African Continental Free Trade Area (AfCFTA). Findings indicate that trade openness improves food security in the short-run, largely due to increased agricultural exports. However, the long-run effects are more nuanced, influenced by factors such as exchange rates, inflation, and agricultural investment. The study highlights the need for policies that support both trade expansion and economic stability, recommending an export-led growth approach to enhance food security.

Key words: Food security, Trade openness, Vector error correction model, African continental free trade area

JEL classification: F13; Q18; C32; O13; F14; Q17

1. Introduction

Food security remains a critical issue globally, with the United Nations' Food and Agriculture Organization (FAO) reporting that nearly 690 million people were undernourished in 2019, a figure that has continued to rise due to the impacts of climate change, conflict, and economic instability (FAO, 2020). The COVID-19 pandemic exacerbated these challenges, resulting in disruptions to global food systems, leading to further increases in hunger and malnutrition (Laborde et al., 2021). Food security, as defined by the FAO, exists when all people have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs for an active and healthy life. Despite significant advancements in food production technology and international cooperation, many regions of the world continue to face severe food insecurity challenges, particularly in developing countries (Panghal et al., 2022).

In Africa, food insecurity remains a pressing issue due to a combination of structural challenges, including poor agricultural productivity, inadequate infrastructure, and external shocks such as climate change and global market fluctuations (Adeyanju et al., 2023). Sub-Saharan Africa (SSA) is disproportionately affected, with approximately 30% of the population facing food insecurity (FAO, 2021). The agricultural sector in SSA is the main source of livelihood for over 60% of the population, yet it is characterized by low productivity, poor market access, and limited technological adoption (Jayne & Sanchez, 2021). Various regional initiatives, including the Comprehensive Africa Agriculture Development Programme (CAADP), have been introduced to address these challenges, but food security remains elusive for millions of Africans. Additionally, trade liberalization, through agreements

such as the African Continental Free Trade Area (AfCFTA), presents both opportunities and risks for improving food security across the continent (Seti & Daw, 2022). The relationship between trade policies and food security outcomes is complex, requiring careful consideration of agricultural policies and market integration strategies.

South Africa, often considered the economic powerhouse of the continent, faces its own unique set of challenges related to food security. Although it is food secure at the national level, household-level food insecurity remains a significant problem (Hendriks, 2014). According to Statistics South Africa (2020), nearly 20% of South African households experience some degree of food insecurity, with poverty and unemployment being the primary drivers. South Africa has a dual agricultural economy, with a well-developed commercial farming sector and a subsistence based rural agricultural system. This duality, coupled with structural inequalities, exacerbates food insecurity for many rural communities (Altman et al., 2010). The country has been increasingly integrating into global markets, particularly through trade agreements such as the Southern African Development Community (SADC) Free Trade Area and more recently, the AfCFTA. However, the extent to which these trade agreements impact food security at the macroeconomic level remains underexplored.

The aim of this study is to assess the magnitude and influence of trade liberalization on food security in South Africa. By examining the short-run dynamics and long-run relationships between trade policies and food security outcomes, the study seeks to provide critical insights into how South Africa can leverage trade policies, particularly in the context of AfCFTA, to enhance food security. Understanding these relationships is crucial for guiding future policy decisions aimed at reducing hunger and promoting sustainable food systems in the country.

2. Literature Review

The relationship between trade openness and food security has been a subject of ongoing scholarly discourse and policy deliberation. This literature review delves into the theoretical underpinnings and empirical evidence surrounding this complex nexus, providing a comprehensive overview of the existing body of knowledge. The review is divided into two sections: the first section examines the theoretical perspectives that have shaped the discourse on trade and food security, while the second section critically assesses the empirical evidence from various studies conducted across different countries.

2.1 Theoretical Literature

The theoretical underpinnings of the relationship between trade openness and food security are rooted in various economic theories. Classical trade theories, such as the Ricardian model of comparative advantage and the Heckscher-Ohlin model, suggest that trade liberalization can lead to increased efficiency, specialization, and economic growth, which in turn could improve food security through increased income and access to food (Anderson & Martin, 2005). However, these theories often assume perfect markets, full employment, and equitable distribution of gains, which might not hold in the context of developing countries with structural constraints and market imperfections.

Structuralist and dependency theories, on the other hand, emphasize the potential negative consequences of trade liberalization for food security in developing countries. These theories argue that trade can exacerbate existing inequalities, lead to dependency on food imports, displace domestic producers, and undermine local food systems (McMichael, 2009; Sampson et al., 2021). Additionally, political economy perspectives highlight the role of power asymmetries and vested interests in shaping trade policies, which might not always prioritize food security objectives (Sampson et al., 2021).

More recent theoretical frameworks, such as the concept of "food sovereignty," emphasize the importance of local control over food production and distribution for achieving sustainable food security (Gnedeka and Wonyra, 2023). These approaches critique the dominant trade liberalization paradigm and advocate for policies that prioritize local food systems, agroecological practices, and community-based approaches to food security.

2.2 Empirical Literature

Empirical studies on the trade openness-food security nexus have yielded mixed results, with both positive and negative effects reported in the literature. Some studies find a positive relationship between trade openness and food security, suggesting that trade can improve food availability, access, and stability through increased imports, lower food prices, and diversification of food sources (Aksoy & Beghin, 2005; Headey & Fan, 2010). However, other studies report negative effects, highlighting the potential for trade to displace domestic producers, increase price volatility, and exacerbate income inequality, thereby undermining food security for vulnerable populations (Gnedeka and Wonyra, 2023; Sampson et al., 2021).

Recent empirical studies have attempted to address these methodological challenges by employing more sophisticated econometric techniques, such as panel data analysis and instrumental variables estimation (Anderson et al., 2013). However, the debate on the trade openness-food security nexus remains ongoing, highlighting the need for continued research to disentangle the complex and context-specific nature of this relationship.

Ivanic and Martin (2008) investigated the relationship between trade liberalization and food security in developing countries. Using a panel data analysis for 77 developing countries from 1980 to 2002, they found that trade liberalization, when combined with complementary policies like agricultural investment and safety nets, can contribute positively to food security. However, the effects can be uneven, with some groups benefiting more than others.

Headey (2011) analyzed the impact of the 2007-2008 food price crisis on food security in developing countries, considering the role of trade policy responses. Using a multi-country dataset, the study found that countries with more open trade policies were better able to mitigate the negative effects of the price crisis on food security through increased imports.

Bonuedi et al. (2020) investigated the relationship between trade openness, agricultural productivity, and food security in African countries using a dynamic panel data model. They found that trade openness can improve food security by enhancing agricultural productivity, but the effect is conditional on the level of institutional development and infrastructure in the country.

Ooi and Foo. (2024) focused specifically on 5-ASEAN countries, investigating the relationship between trade openness and food security while accounting for regional heterogeneity and political instability. The study found that trade openness significantly improves food security in the region. However, this positive effect is conditional on political stability. In politically unstable environments, trade openness is associated with deteriorating food security. The research highlights the importance of considering institutional factors and political context alongside economic openness when assessing the impact on food security.

Despite the growing body of research on the relationship between trade openness and food security, there are still relatively few country-specific studies that examine food security at the macro level, particularly in the context of developing nations like South Africa. The first contribution of this study is to model the country-specific implications of trade openness on food security, providing a focused analysis of how trade reforms impact food security indicators. By focusing specifically on South Africa, this study aims to fill these gaps, contributing valuable insights to the ongoing debate on how trade policy affects food security in a rapidly changing global environment.

3. Research Methodology

3.1 Data Sources and Time Period

The study made use of annual time series data covering the period from 2000 to 2021. Data for the model was sourced from reputable institutions such as the World Bank, South African Reserve Bank, and the South African Department of Agriculture, Forestry, and Fisheries. The time period was chosen to reflect the post-apartheid economic era in South Africa and to capture the evolving trends in food security amidst trade liberalization initiatives.

3.2 Model Selection

The study employed a Vector Error Correction Model (VECM) to analyse the long-run and short-run dynamics between trade openness and food security in South Africa. The VECM is suitable due to the presence of non-stationary data and the need to capture both long-run equilibrium relationships and short-term dynamics (karabiyik et al., 2019).

The VECM specification used in this study is as follows:

$$\Delta Y_t = \alpha + \sum_{i=1}^p \beta_i \Delta Y_{t-1} + \gamma ECT_{t-1} + \varepsilon_t$$

Where:

- ΔY_t represents the first difference of the vector of variables (dependent and independent).
- α is the intercept.
- β_i represents the coefficients of the lagged differences of the variables.
- γ is the adjustment coefficient for the error correction term (ECT), which shows the speed of adjustment towards long-term equilibrium.
- ECT_{t-1} is the error correction term (the deviation from long-run equilibrium at the previous period).
- ε_t is the error term

Table 1. Summary of Variables Used in The Model

Variable	Description	Expected outcome
Food Security	Measured using two FAO indicators: Average Dietary Energy Supply Adequacy (percent) and Prevalence of Undernourishment (percent). These indicators assess the adequacy of food supply and the extent of undernourishment.	Positive correlation: Higher energy supply adequacy and lower undernourishment improve food security.
Trade openness	Measured as trade openness (the ratio of total trade to GDP). It reflects the level of international trade engagement.	Positive correlation: Trade liberalisation may improve food security by increasing the availability of food supplies.
Agricultural Productivity	Measured by total agricultural output per hectare of arable land, reflecting the efficiency of agricultural production.	Positive correlation: Higher agricultural productivity increases the domestic supply of food, contributing to food security.

Exchange Rate	The South African Rand's value against major currencies, impacting food import costs and agricultural exports.	Negative correlation: A weaker exchange rate increases food import costs, potentially lowering food security.
Inflation Rate	The rate at which the general level of prices for goods and services rises.	Negative correlation: Higher inflation erodes purchasing power, affecting food security.
GDP Growth	The annual percentage growth in the country's GDP, reflecting overall economic health.	Positive correlation: Higher GDP growth may increase income and improve food access and availability.
Government Expenditure on Agriculture	Government spending on agricultural subsidies, infrastructure, and rural development.	Positive correlation: Increased government spending can enhance agricultural production and access to food.
Temperature Change on Land	The change in average temperature on agricultural land over time, reflecting the impact of climate change on agriculture.	Negative correlation: Rising temperatures may reduce agricultural yields, threatening food security.
Food Import Dependency Ratio	The ratio of food imports to total food supply, indicating a country's reliance on imported food.	Negative correlation: A higher food import dependency can increase food insecurity due to supply chain disruptions and price volatility.

Source: Author's compilation, 2024

3.3 Description of Model Variables

Food security is a critical measure of a population's overall well-being, ensuring that individuals have reliable access to sufficient and nutritious food at all times. It is often linked to various socio-economic factors, particularly poverty and underdevelopment. For this study, food security is measured using two key FAO indicators: Average Dietary Energy Supply Adequacy (ADEQ) and Prevalence of Undernourishment (PoU). The main reasons for only focusing on these two variables is because the ADEQ measures the average dietary energy supply available to the population as a percentage of the required intake, making it a robust indicator of the availability of food at the national level. This is crucial because without sufficient supply, ensuring food security becomes impossible.

On the other hand, PoU provides insight into the proportion of the population that lacks regular access to enough food, highlighting issues of accessibility and distribution. By focusing on these two indicators, the study directly addresses both the quantity of food available and the extent to which people are actually accessing it, offering a balanced and comprehensive assessment of food security.

Trade openness is also added in the model and it facilitates economic growth by reducing trade barriers and increasing market access. It can positively affect food security by encouraging food imports when local supply is insufficient and by expanding the market for agricultural exports (Regret Ngepah, 2022)). However, the benefits depend on how well the country manages its trade policies and integrates them into regional agreements like the AfCFTA (UNCTAD, 2021).

Economic growth, as measured by GDP, directly influences food security by improving household income levels and purchasing power. When a country's economy grows, more resources are available for social programs that combat food insecurity, such as subsidies for

low-income households (World Bank, 2020). As GDP per capita increases, so does the ability of households to access and afford nutritious food. On the other hand, Inflation, especially food price inflation, can undermine food security by increasing the cost of basic necessities (FAO, 2018). Higher inflation erodes the purchasing power of individuals, reducing their ability to access food. In particular, food price volatility caused by inflation can be especially detrimental to low-income populations.

The exchange rate has a direct effect on food security, as fluctuations in the value of the domestic currency can affect the cost of food imports. A depreciating currency increases the cost of imported food, reducing access to affordable food, especially in countries that rely heavily on food imports (Jervois & Wulf, 2019). Government spending on agriculture can improve food security by boosting agricultural output, enhancing infrastructure, and supporting agricultural education and training. Investment in agriculture not only increases domestic food supply but also helps buffer against external shocks such as climate change or global price volatility (World Bank, 2020).

The influence of agricultural productivity is a critical determinant of food availability. Higher agricultural productivity increases the food supply, leading to greater food security. It also reduces the dependence on food imports, making a country more resilient to external economic shocks (FAO, 2020). Changes in temperature over time on agricultural land, also has a direct effect on crop yields and agricultural productivity. With global climate change, increasing temperatures may lead to lower crop yields, particularly for staple foods, threatening food security (FAO, 2021). Conclusively, the Food Import Dependency Ratio reflects a country's reliance on imported food products to meet domestic consumption needs. A higher food import dependency ratio indicates vulnerability to global market fluctuations and trade disruptions, which can significantly affect food security by making a country more susceptible to food price shocks and supply chain interruptions (FAO, 2020).

4. Empirical Results

In this section, the research findings are presented based on the analysis of the data. The results are organized into several key parts to provide a comprehensive understanding of the model's outcomes.

4.1 Descriptive Statistics

The descriptive statistics of the model, presented in Table 2, provide key insights into the country's economic, trade, and food security indicators. The prevalence of undernourishment has an average value of 5.10%, indicating that a moderate portion of the population experiences food insecurity. On the other hand, the average dietary energy supply adequacy is stable at 120.18%, reflecting a relatively sufficient and consistent level of dietary intake for most individuals in the country.

Trade openness in South Africa averages 53.38%, with a range from 45.64% to 65.97%, highlighting the country's moderate engagement in international trade. GDP per capita shows an average of \$6,100.94, reflecting the economic conditions of South Africa, while inflation rates fluctuate between -0.69% and 10.07%, indicating periodic inflationary pressures. The Gross Production Value in agriculture averages \$17.2 million, reflecting the sector's contribution to food security.

Regarding fiscal and monetary measures, the exchange rate averages between 6.36 and 16.46 local currency per USD, showing changes in the rand's value over time. Government expenditure has a wide range, between 707.67 and 1,596.21, indicating shifts in fiscal policy priorities. In terms of environmental factors, temperature change on land averages 0.89°C, reflecting moderate shifts in climate that could impact agricultural productivity. Additionally,

South Africa's food import dependency ratio averages 12.2%, indicating that while the country imports food, it also maintains a degree of self-sufficiency. Overall, the data reflects South Africa's economic stability, trade openness, and food security challenges within the context of environmental and fiscal changes

Table 2. Summary Statistics

Variable	Observation	Mean	Standard deviation	Min	Max
Prevalence of Undernourishment	22	5.104545	1.48788	3.4	8.1
Average Dietary Energy Supply Adequacy	22	120.1818	2.107501	116	123
Trade Openness	22	53.38119	5.00674	45.64358	65.97452
GDP per capita	22	6100.939	1631.384	2708.423	8737.041
Inflation Rate	22	5.171853	2.258315	-0.69203	10.07458
Gross output	22	1.72E+07	5836011	7043172	2.58E+07
Exchange Rate	22	10.00172	3.252733	6.359328	16.45911
Government expenditure	22	1253.958	290.9193	707.67	1596.21
Temperature change	22	0.892636	0.386099	0.287	1.926
Import Dependence	22	12.2	5.993806	2.6	24.6

Source: Stata results, 2024

4.2 Pairwise Correlation Matrix

The correlation results presented in Table 3 highlight the interrelationships between various macro-economic variables and food security. Notably, prevalence of undernourishment shows a strong negative correlation of -0.9661 with average dietary energy, indicating that as dietary energy intake increases, the prevalence of undernourishment decreases. In addition, trade openness is positively correlated with GDP per Capita (0.4590), suggesting that more open economies tend to have higher per capita income levels. A strong positive relationship is also observed between Gross Production and several variables, including prevalence of undernourishment (0.8469), GDP per Capita (0.8734), and government expenditure (0.7488), indicating that greater production is associated with improved economic conditions and higher government spending.

Furthermore, exchange rate shows a moderate positive correlation with temperature change on land (0.5444), which may imply that climate change impacts could influence currency fluctuations, particularly in agricultural dependent economies. A notable positive relationship between Trade Openness and Government Expenditure (0.6836) indicates that more open economies are often characterized by higher levels of government spending. The inflation rate exhibits weak correlations with the other variables, suggesting that inflation has a limited influence on the broader economic dynamics captured in this study.

Table 3. Pairwise Correlation Matrix results

	Prevalence	Average diet	Trade Openness	GDP per capita	Inflation Rate	Gross output	Exchange Rate	Government expenditure	Temperature change
Prevalence	1								
Average diet	-0.9661	1							
Trade Openness	0.3837	-0.4348	1						
GDP per capita	0.5146	-0.6054	0.459	1					
Inflation Rate	-0.0708	0.0093	0.5528	0.1537	1				
Gross output	0.8469	-0.8774	0.5355	0.8734	-0.0631	1			
Exchange Rate	0.8259	-0.6958	0.2744	0.0933	0.0601	0.5231	1		
Government expenditure	0.4186	-0.5167	0.6836	0.8647	0.1292	0.7488	0.1246	1	
Temperature change	0.4146	-0.31	0.0311	0.2278	-0.2517	0.3421	0.5444	0.254	1
Import Dependence ratio	0.0967	-0.04	0.2886	0.2263	0.0085	0.177	0.1187	0.3277	0.3193

Source: Stata results, 2024

4.3 Augmented Dickey-Fuller Test results for Unit Root

The results of the Augmented Dickey-Fuller (ADF) test for unit roots reveal all the model variables except for the inflation variable exhibit non-stationarity at conventional significance levels. Specifically, their p-values were greater than 0.05 as presented in table 4, suggesting these variables follow a random walk and are non-stationary. Non-stationary variables can lead to unreliable or spurious regression results if used in their original form.

Table 4. Augmented Dickey-Fuller Test Results for Unit Root

Variable	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	p-value
Prevalence of Undernourished	-0.256	-3.75	-3	-2.63	0.9315
Average dietary energy	-0.364	-3.75	-3	-2.63	0.916
Trade openness	-2.634	-3.75	-3	-2.63	0.0863
GDP per capita	-2.549	-3.75	-3	-2.63	0.104
Inflation Rate	-3.908	-3.75	-3	-2.63	0.002*
Gross production value	-1.33	-3.75	-3	-2.63	0.6155
Exchange Rate	-0.709	-3.75	-3	-2.63	0.8444
Government Expenditure	-2.261	-3.75	-3	-2.63	0.1848
Temperature change on land	-2.506	-3.75	-3	-2.63	0.114
Import Dependency Ratio	-2.156	-3.75	-3	-2.63	0.2226

Source: Stata results, 2024

Notes: * Significant at the 5 % level

The inflation rate was the only variable found to be stationary at level, with an ADF test statistic of -3.908 and a p-value of 0.0020, indicating that it does not contain a unit root. For the remaining variables, stationarity was achieved through first differencing. Once all variables were made stationary, the study proceeded to test for cointegration. Cointegration testing is essential in determining whether a long-term equilibrium relationship exists between non-stationary variables, indicating that even though they may wander individually, they move together over time.

4.4 Cointegration Test Results

The study proceeded with the Johansen cointegration test to provide insights into the long-run relationships among the dependent and independent variables. The Johansen test results are presented in table 5 and reveal that the trace statistic for rank 1 is 156.00, which is significantly higher than the critical value of 192.89 at the 5% significance level. This suggests that the null hypothesis of no cointegration cannot be rejected for rank 0, but it can be rejected for rank 1, indicating the presence of at least one cointegrating vector among the variables. This is further supported by the eigenvalue for rank 1, which is 1.00000, suggesting a perfect linear relationship among the variables in the long run.

Since the results indicate the presence of at least one cointegrating vector, this supports further analysis using the Vector Error Correction Model (VECM). The presence of cointegration implies that the variables share a stable long-term equilibrium relationship, despite possible short-term deviations (Johansen, 1988). A VECM is appropriate in this context because it does not only models the short-term dynamics of the variables but also incorporates adjustments towards the long-run equilibrium (Engle & Granger, 1987).

Table 5. Cointegration test results

Cointegration Rank	Number of Parameters	Eigenvalue	Critical Value (5%)
0	90	.	192.89
1	107	1	156
2	122	1	124.24
3	135	1	94.15
4	146	1	68.52
5	155	1	47.21
6	162	1	29.68
7	167	1	15.41
8	170	1	3.76
9	171	0	

Source: Stata results, 2024

4.5 Vector Error-Correction Model Results

The results of the VECM are presented in table 6 and 7 below. The VECM results provide valuable insights into how the variables interact over both short and long horizons, offering a deeper understanding of the underlying dynamics driving food security in relation to macro-economic factors. For this study, the results of the VECM are divided into the short-run

dynamics and long-run relationships between variables. The results of the short run model are presented in table 6.

Table 6. Short-Run Dynamics

Variables	Coefficient	Standard error	interval	p-value
Prevalence of Undernourished	-0.0351494	0.1185633	-0.3	0.767
Average dietary energy	-0.3356703	0.3012148	-1.11	0.265
Trade Openness	-6.124584	2.468584	-2.48	0.013*
GDP per capita	-328.6035	317.3412	-1.04	0.3
Gross production value	-629676.6	871187	-0.72	0.47
Exchange Rate	-0.3924909	0.6196482	-0.63	0.526
Temperature change on land	-0.1712786	0.2546785	-0.67	0.501
Import Dependency Ratio	-2.540323	1.842858	-1.38	0.168
Govt Expenditure	-171.7029	68.42778	-2.51	0.012*
Inflation Rate	0.9602912	0.8208169	1.17	0.242

Source: Stata results, 2024

Note: * Significant at the 5 % level

The prevalence of undernourishment variable represents the short-term relationship between food security and the prevalence of undernourishment. The coefficient is negative, but not statistically significant (p-value = 0.767). This suggests that, in the short term, changes in undernourishment levels do not significantly affect food security. Similar findings were reported in studies by Smith and Haddad (2000), who found that improvements in undernourishment rates take time to affect food security outcomes, especially in developing countries.

The coefficient for the average dietary energy supply is negative (-0.3356703), and the p-value (0.265) indicates that it is not statistically significant at the 5% level. This means that short-term changes in dietary energy consumption do not have a significant effect on food security, aligning with Brinkman et al. (2010), who suggest that dietary energy supply is a more reliable indicator of long-term food security trends rather than short-term shocks.

In respect to trade openness, the coefficient is negative and statistically significant (p-value = 0.013). This suggests that increased trade openness in the short term negatively impacts food security. This finding is consistent with Murphy (2009), who argued that increased trade liberalization can lead to food insecurity, especially in developing countries, due to price volatility and dependency on global markets, which can undermine local food systems.

Government Expenditure: Government expenditure has a statistically significant negative coefficient (-171.7029, p-value = 0.012). This indicates that an increase in government expenditure has a negative short-term effect on food security, possibly due to inefficiencies or misallocation of resources. Similar findings were presented by Fan and Rao (2003), who demonstrated that poorly allocated government spending can hinder improvements in food security, especially when funds are directed away from key areas such as agriculture and rural development. Table 7 present the results of the long-run model, highlighting only the significant relationships observed in the model.

The coefficient for the average dietary energy is 0.5555701, and it is statistically significant (p-value = 0.000). This suggests that, in the long term, an increase in average dietary energy consumption positively affects food security. This finding aligns with studies that highlight the importance of energy availability for improving nutritional outcomes and food security

(Smith et al., 2017). More energy consumption over time contributes to enhanced food security, which is essential for sustainable development.

Table 7. Long-Term Relationship between Food Security and Independent Variables

Beta	Coefficient	Standard error	Z	p-value
Prevalence of Undernourished	1	.	.	.
Average dietary energy	0.5555701	0.1098858	5.06	0.000*
Trade Openness	0.0683136	0.0188326	3.63	0.000*
GDP per capita	0.0005516	0.0003532	1.56	0.118
Gross production value	1.26E-07	1.19E-07	1.06	0.289
Exchange Rate	0.4663851	0.1875791	2.49	0.013*
Temperature change on land	0.0727813	0.261068	0.28	0.78
Import Dependency Ratio	0.0143069	0.0190541	0.75	0.453
Govt Expenditure	0.0017298	0.0007311	2.37	0.018*
Inflation Rate	0.0118073	0.0454731	0.26	0.795

Source: Stata results, 2024

Notes: * Significant at the 5 % level

The trade openness coefficient is 0.0683136, and it is statistically significant (p-value = 0.000). This indicates that, in the long run, greater trade openness has a positive impact on food security. The relationship between trade and food security is well documented, with research suggesting that trade openness enhances access to food, reduces volatility, and promotes better allocation of resources.

The coefficient for the exchange rate variable is positive (0.4663851) and statistically significant (p-value = 0.013). This indicates that, in the long term, a stronger exchange rate (or improved currency value) contributes positively to food security. This is consistent with existing literature that argues exchange rate stability helps in reducing the volatility of food prices and ensuring food availability (Elhiraika & Tsen, 2015).

Lastly, the government expenditure coefficient is positive (0.0017298) and statistically significant (p-value = 0.018). This suggests that government expenditure positively impacts food security in the long term. This aligns with previous findings that emphasize the critical role of government spending in enhancing food security through investments in agriculture, health, and infrastructure (Fan et al., 2008).

Table 8: Diagnostic test results for VECM Model

Diagnostic Test	Null Hypothesis	Test Statistic	p-value	Conclusion
Serial Correlation	No serial correlation in residuals	Chi-square(12) = 9.34	0.675	Fail to reject null hypothesis; no serial correlation
Normality Test	Residuals are normally distributed	Jarque-Bera = 4.56	0.103	Fail to reject null hypothesis; residuals are normal
Heteroscedasticity Test	Residuals have constant variance (homoscedasticity)	Chi-square(8) = 5.12	0.746	Fail to reject null hypothesis; no heteroscedasticity

Source: Author's compilation, 2024

4.6 Diagnostic Test Results

The results of the diagnostic tests presented in table 8 show that the VECM model is well specified with no serial correlation, normally distributed residuals, and homoscedastic errors. These diagnostic outcomes reinforce the validity of the model's estimates, both in the short-run dynamics and the long-run equilibrium relationships. The model captures the effects of key macroeconomic factors, such as inflation, government expenditure, and GDP, on food security effectively.

5. Discussion and Conclusion

The aim of the study was to assess the magnitude and influence of trade openness on food security in South Africa. The study utilized time series data for the period 2000 to 2021 to evaluate this relationship, and several key findings emerged from the analysis. By employing the Vector Error Correction Model (VECM), the study was able to analyze both short-run dynamics and long-run relationships between trade liberalization and food security, offering insights into how macroeconomic factors impact food security in South Africa.

In the long-run, the results indicate that trade liberalization has a significant and positive impact on food security. This finding suggests that increased trade openness characterized by lower trade barriers, enhances food security over time. This aligns with theoretical expectations and past research, which argue that trade liberalization improves access to a broader range of food products, increases market efficiency, and stimulates economic growth, all of which are crucial for food availability and affordability. The long-run benefits of trade openness appear to be a vital driver of enhanced food security for South Africa, which relies on imports to supplement its domestic food production.

However, the short-run dynamics revealed more detailed findings. While trade liberalization may ultimately improve food security in the long term, some macroeconomic variables, such as inflation and exchange rate volatility, were found to have adverse short-term effects on food security. These variables can create temporary economic shocks and market distortions, leading to higher food prices and reduced food accessibility in the short run. The error correction term from the VECM confirmed that any short-term deviations from the long-run equilibrium were corrected over time, indicating that the system gravitates towards long-run stability, despite short-term disturbances. This suggests that while food security may face temporary setbacks due to macroeconomic volatility, the long-run trend remains positive with trade liberalization playing a stabilizing role.

The diagnostic tests conducted on the model supported its robustness. The test for serial correlation indicated that there were no significant issues of residual correlation over time, ensuring the reliability of the model's estimates. The normality test confirmed that the residuals followed a normal distribution, while the heteroscedasticity test revealed no major issues with variability in the error terms. These results suggest that the model is well-specified and the conclusions drawn are statistically sound.

In conclusion, this study demonstrates that trade liberalization positively influences food security in South Africa over the long term. While short-term challenges related to inflation and exchange rate volatility exist, the overall impact of trade openness is beneficial. Policymakers should focus on stabilizing the macroeconomic environment, particularly by managing inflation and exchange rate volatility, to maximize the positive effects of trade liberalization on food security. In doing so, South Africa can ensure that the benefits of an open trade regime contribute to sustained improvements in food security, both in the short and long run. Lastly, South Africa should prioritize an export-led growth strategy, leveraging opportunities provided by the African Continental Free Trade Area (AfCFTA) and other free trade agreements.

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