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ORIGINAL ARTICLE

Navigating the Global Cashew Market: Determinants and Elasticities of Ghana's Exports

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K E Y W O R D S

ARDL model;
Cashew nuts;
Export;
Ghana;
Macroeconomic factors;
Unit roots

A B S T R A C T

Given the reported changes in the volume of cashew nut exports in the global market, including shifts in consumer demand, competition among producers, and changes in trade policies, it is crucial to understand the determinants influencing export volume, particularly for an exporting country like Ghana. This study examined the determinants and the price and income elasticities of cashew nut exports from Ghana. Utilizing secondary data from relevant databases over a thirty-year period (1992-2021), the study employed the Autoregressive Distributed Lag (ARDL) model for analysis. The cointegration results confirmed a long-run relationship between the volume of cashew nuts exported and factors such as the real exchange rate, the real GDP per capita of major trading partners, the international price of cashew nuts, the international price of shea nuts, and Ghana's real GDP per capita. The error correction model indicated that any short-run disequilibrium was corrected at a speed of 91.39% in the long run. The ARDL regression results revealed that the volume of cashew nut exports experienced significant negative price effects due to both the international price of cashew nuts and the real exchange rate, while exhibiting positive income effects related to the real GDP per capita of trading partners and Ghana. The effects of these macroeconomic variables were found to be elastic in nature, suggesting that cashew nuts are considered a luxury food item. These findings have important implications for enhancing export trade for products from developing economies like Ghana's cashew nuts. Recommendations include implementing mechanisms to stabilize exchange rates, conducting regular market research to understand price sensitivities across target markets, and tailoring pricing strategies to diverse consumer preferences and purchasing power. Additionally, measures to stimulate and sustain economic growth are crucial for enhancing export trade.

Introduction

Exports play a pivotal role in the economic development of various nations, contributing to the balance of payments and serving as crucial sources of foreign exchange earnings (Newman, 2021). Historically, Ghana's economic growth has been driven by commodities such as cocoa, gold, timber, diamonds, and palm oil. Recognizing the importance of expanding its export base, Ghana has focused on non-traditional export commodities, which have significantly bolstered the economy. This export diversification has led to the promotion of non-traditional agricultural products, including cashew

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nuts, shea nuts, mangoes, pineapples, and bananas (Ayambila *et al.*, 2023). Among these, cashew nuts are valuable for their nutritious kernels, similar to other nut crops like walnuts (Chatrabnous *et al.*, 2018; Pakrah *et al.*, 2021; Sarikhani *et al.*, 2021). Ghana's international trade policy emphasizes enhancing exports, reducing imports, and promoting locally made products (MoTI, 2012). According to the Ghana Export Promotion Authority (2021), cashew nut exports were the highest earners in the agricultural sub-sector in 2021, experiencing a performance increase of 14.35% over 2020 and contributing approximately 60.38% (US$476.01 million) of total export earnings for non-traditional agricultural products.

Ghana's cashew production primarily targets specialized niche markets for export, although some nuts are processed for local consumption (Danso-Abbeam *et al.*, 2021). Over the past three decades, the volume of cashew nut exports has fluctuated due to shifts in consumer demand, competition from other producers, and changes in trade policies (Boafo & Lyons, 2021). However, the determinants driving changes in the export volume of cashew nuts have not been extensively investigated, particularly for a country like Ghana. Previous studies have explored the exports of various agricultural commodities. For example, Boansi *et al.* (2014) examined the determinants of agricultural export trade, focusing on Ghana's fresh pineapple exports. Siaw *et al.* (2018) investigated the correlation between agricultural exports (cocoa, pineapple, and banana) and economic growth. Additionally, Ayambila *et al.* (2023) analyzed the determinants of growth in Ghana's non-traditional agricultural exports, including cashew nuts. Lastly, Abdul-Karim and Damba (2024) assessed the impact of cocoa beans and cashew nuts on Ghana's economic growth. While existing literature provides insights into the dynamics of Ghana's traditional and non-traditional agricultural exports, research specifically analyzing the key determinants of cashew nut exports remains limited. This study aims to fill this knowledge gap by exploring the short-run and long-run relationships affecting Ghana's cashew nut exports. The specific objectives are: (i) to investigate the key determinants of Ghana's cashew nut exports; and (ii) to estimate the price and income elasticities related to these exports.

It is widely acknowledged that countries strive to maximize exports rather than imports to foster economic development (Schumacher, 2020). A robust economy typically translates to improved welfare for its citizens. Consequently, Ghana has formulated and pursued strategic policies aimed at development through an export-led approach. The findings of this study are particularly relevant for policymakers and industry stakeholders, providing insights for devising effective strategies to enhance cashew nut export performance in Ghana. The results will also serve as a benchmark for researchers in the field of agricultural commodity trade and development, especially within the nut industry (Vahdati *et al.*, 2021).

The literature review indicates that various estimation techniques have been employed by different studies to assess long-run and short-run associations between agricultural export performance and macroeconomic variables (Vahdati *et al.*, 2019). These techniques include simulation methods for cointegration and error correction models (Okyere & Jilu, 2020), the Autoregressive Distributed Lag (ARDL) method (Siaw *et al.*, 2018; Ayambila *et al.*, 2023), Non-Linear Autoregressive Distributed Lag (NARDL) methods (Abdul-Karim & Damba, 2024), and Ordinary Least Squares (OLS) methods (Boansi *et al.*, 2014; Chimhore & Chivasa, 2021). Additionally, these authors have employed both small and large sample sizes depending on their study context. The ARDL model is particularly recommended for studies that investigate long-run and short-run relationships with small sample sizes (Asratie & McMillan, 2021; Kripfganz & Schneider, 2023). In this study, the ARDL modeling technique for cointegration and error correction model (ECM) estimations is deemed relevant for analyzing long-run

and short-run relationships between cashew nut exports and macroeconomic variables. This approach is preferred as it provides robust results with a limited number of observations across various variables, in line with the error correction model (Latif *et al.*, 2015; Lin & Wang, 2020).

The remaining sections of the article are structured as follows: methodology, empirical results, discussion of results, and conclusions and policy implications.

Materials and Methods

Data sources

Annual time series data spanning from 1992 to 2021 was used to address the objectives. The variables used comprised the volume of cashew nut exported (MT), the international price of cashew nut (in USD per MT), the international price of shea nut (in USD per MT), per capita real GDP of major trading partners (in constant 2015 in USD), real exchange rate (GHS/USD), and Ghana's per capita real GDP (in constant 2015 in USD). The average real GDP per capita of importing countries was obtained from Ghana's ten major trading partners for cashew nuts, namely, the United States of America, Netherlands, Vietnam, India, China, France, Germany, Canada, Spain, and Singapore, as reported by the Ghana Export Promotion Authority. The international prices of cashew nuts and shea nut exports were sourced from the Ghana Export Promotion Authority. The real exchange rate was sourced from the Bank of Ghana website and the International Monetary Fund database. Lastly, the trading partners' per capita real GDP and Ghana's per capita real GDP figures were accessed from the World Bank's World Development indicators. The variables were transformed to their natural logarithms to facilitate analysis and direct interpretation of elasticities, (Stenberg *et al*., 2018).

Examination of the determinants of export of Ghana's cashew nut

For the econometric analysis, the study first examines the presence of unit roots of the variables. The null hypothesis was that a variable exhibited a unit root, and the alternative was that the variable exhibited stationary traits. This holds considerable importance as it served to prevent spurious models caused by trending variables because incorporating non-stationary variables in time series analysis led to misleading interpretations of the findings (Muthamia and Muturi, 2015). The study utilized the widely used Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests to check for the presence of the unit roots, but the study concentrated on the ADF because it addresses the issue of serial autocorrelation. The unit roots tests conducted suggested that all the variables were not integrated in the same order, hence the autoregressive-distributed lag (ARDL) bounds approach was employed to examine the determinants of export for cashew nuts. The ARDL modeling approach is suitable for analyzing variables with integration order level I(0), first difference I(1), or a mix of both (Pesaran *et al*., 2001). The ARDL modeling technique is efficient, offering unbiased estimates and overcoming the limitations of constraining cointegration steps to variables of the same integration order (Johansen & Juselius, 2009). Furthermore, it has proven efficacy in handling small sample sizes.

ARDL bounds test for cointegration

The study employed the ARDL Bounds test to examine the long-run relationship between the volume of cashew nuts exported, real exchange rate, major trading partners' per capita real GDP, the international price of cashew nuts and shea nuts, and Ghana's real GDP per capita. The ARDL bounds approach based on an error correction model (unrestricted) was specified as:

$$\Delta LnEXPTC_t = \lambda_0 + \sum_{i=1}^{P} \lambda_1 \Delta LnEXPTC_{t-i} + \sum_{i=0}^{q_3} \lambda_4 \Delta LnIPC_{t-i} + \sum_{i=0}^{q_1} \lambda_2 \Delta LnRER_{t-i} + \sum_{i=0}^{q_2} \lambda_3 \Delta LnF\_RGDPC_{t-i} +$$

$$+\sum_{i=0}^{q_4}\lambda_5\,\Delta LnIPS_{t-i}+$$
$$\sum_{i=0}^{q_5}\lambda_6\,\Delta LnG\_RGDPC_{t-i}+$$
$$\delta_1 LnEXPTC_{t-1}+\delta_2 LnIPC_{t-i}+$$
$$\delta_3 LnRER_{t-i}+\delta_4 LnF\_RGDPC_{t-i}+$$
$$+\delta_5 LnIPS_{t-i}+\delta_6 LnG\_RGDPC_{t-i}+\varepsilon_{1t} \quad (2)$$

From the Eqn. (2), Δ represents the first difference operator, λ_0 is the constant term, p, $q_1,..,q_5$ represents the lag length, and ε_t is the stochastic error term. $EXPTC_t$ is volume of cashew exports from Ghana in year *t* (MT), RER_t is real exchange rate (GHS/US$), F_RGDPC_t is real per capita income of major trading partners (USD), IPC_t is the international price of cashew nuts (USD/Mt), IPS_t is the international price of shea nuts (USD/Mt), and G_RGDPC_t is Ghana's real GDP per capita. The determination of the bounds for the long-run relationship using ARDL is based on the F-value or t-values. The null hypothesis of no cointegration, that is, $H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = 0$, is tested against the alternative hypothesis of cointegration, that is, $H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq \delta_6 \neq 0$.

The ARDL bounds test was applied to the equation (3) for the long-run effects:

$$LnEXPTC_t = \delta_0 + \sum_{i=1}^{P}\delta_1\,LnEXPTC_t +$$
$$\sum_{i=0}^{q_3}\delta_2\,LnIPC_t + \sum_{i=0}^{q_1}\delta_3\,LnRER_t +$$
$$\sum_{i=0}^{q_2}\delta_4\,LnF\_RGDPC_t + +\sum_{i=0}^{q_4}\delta_5\,LnIPS_t +$$
$$\sum_{i=0}^{q_5}\delta_6\,LnG\_RGDPC_t + \varepsilon_{2t} \quad (3)$$

Establishing the long-run relationship hinges on the estimated value for the F-statistic. If the estimated value for the F-statistic exceeds the critical values from the tables, then it confirms the existence of a long-run relationship.

The selection of time lags (represented by p and q's) is done specifically on the Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC) when using the ARDL model. The purpose of these criteria is to aid in identifying the optimal number of lags that should be included in the model. For annual data, it has been recommended to use a maximum lag of 1 or 2 lags in order not to lose too many degrees of freedom and address autocorrelation that may arise as a result of random errors (Wooldridge *et al*., 2016). The model can be estimated using the Ordinary Least Squares approach after the ideal lag order has been determined (Pesaran *et al*., 2001). The appropriate lag length was determined based on the AIC criteria.

Error correction model (ECM)

The error correction model was estimated after confirming cointegration and the long-run relationship estimation. This model signifies the pace at which long-run equilibrium restoration occurs and is expressed by equation (4).

$$\Delta LnEXPTC_t =$$
$$\lambda_0 + \sum_{i=1}^{P}\lambda_1\,\Delta LnEXPTC_{t-i} +$$
$$\sum_{i=0}^{q_3}\lambda_2\,\Delta LnIPC_{t-i} + \sum_{i=0}^{q_1}\lambda_3\,\Delta LnRER_{t-i} +$$
$$\sum_{i=0}^{q_2}\lambda_4\Delta LnF\_RGDPC_{t-i} +$$
$$+\sum_{i=0}^{q_4}\lambda_5\,\Delta LnIPS_{t-i} +$$
$$\sum_{i=0}^{5}\lambda_5\,\Delta LnG\_RGDPC_{t-i} + \rho ECT_t + \varepsilon_{3t} \quad (4)$$

where Δ represents the first difference, ECT_t represents the error correction term, and ρ is the coefficient of the error correction term for short-run dynamics. The coefficient of the error correction term shows the time period taken for (any) long-run disequilibrium to be restored to a steady state (Menegaki, 2019; Esaku, 2021; Abdul-Karim & Damba, 2024). A negative coefficient of the error correction term indicates that the dependent variable is adjusting back (converging) towards its long-run equilibrium after a deviation, while a positive error correction term value suggests that the dependent variable is moving further away (diverging) from its long-run equilibrium after a deviation (Kripfganz & Schneider, 2023).

Diagnostic tests

Appropriate diagnostic and statistical tests for series regression analysis have been applied to obtain a fitted model. The post-estimation model diagnosis was conducted using the following tests: Jarque-Bera

test to check for normality, Breusch-Pagan Godfrey test to check for heteroscedasticity, and the Breusch Godfrey LM test and correlogram statistics to check for serial correlation. The cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals squared (CUSUMSQ) tests were also conducted to check the estimated model's stability. The CUSUM and CUSUMSQ were used to plot the residual of the error correction model. If the statistics in the plot fall within critical bounds at a 5% significant value, then the results suggest that the coefficient of the ARDL model is stable (Pesaran *et al*., 2001; Topić-Pavković *et al*., 2023).

Results

Descriptive statistics

The summary statistics of the variables included in the regression analysis are presented in Table 1. The volume of cashew nuts exported was 97,068.35 MT on average with a coefficient of variation of 1.172. The major trading partners' and Ghana's real per capita GDPs exhibited mean average incomes of USD 28,044 and USD 1,334 with coefficients of variation of 6.8798 and 0.2864, respectively. For the international prices of cashew nut and shea nut, their mean values were USD 633.30 and USD 291.25 per metric tonne, with coefficients of variation of 0.4446 and 0.4695, respectively. The average real exchange rate was 1.77 GHS/USD with a coefficient of variation of 1.030.

Table 1. Summary Statistics.

Variable	Mean	Maximum	Minimum	Std. Dev.	CV
Volume of cashew nut exported (MT)	97068.35	325407.48	51.00	113758.55	1.1719
International price of cashew nut (USD/MT)	633.30	1457.84	212.30	281.626	0.4446
Real exchange rate (GHS/USD)	1.77	5.81	0.04	1.822	1.0305
Trading partners' GDP per capita (USD)	28044.43	34500.00	20898.91	4076.32	6.8798
International price of shea nut (USD/MT)	291.25	558.42	22.93	136.758	0.4695
Ghana's GDP per capita (USD)	1334.25	2014.71	886.65	382.096	0.2864

Note: Coefficient of Variation (CV) is calculated as CV = σ/X where σ is the estimated standard deviation and X is the estimated mean.
Source: Authors' estimation using STATA 17

The coefficient of variation of the volume of cashew exported was very high (1.172), suggesting highly volatile (unstable) export trade. The international prices for cashew and shea nuts, and the exchange rate in real terms were unstable with coefficients of variation of 0.444, 0.470, and 1.031, respectively. These implied that the volume of cashew nuts exported was relatively volatile compared to the international prices of cashew and shea nuts, and the exchange rate in real terms. The results are similar to those of Obeng (2017), whose estimated coefficient of variation results showed that the value of non-traditional exports was relatively more volatile than the effective real exchange rate. The obvious differences in the average real per capita GDPs between the major trading partners (USD 28,044) and Ghana (USD 1,334) suggested a more likely drift of export of cashew nuts to the higher income economies from Ghana. The differences in per capita incomes reflect the differences in the purchasing power of consumers in the two markets, which directly influences the export demand for cashew nuts. Though Ghana's real per capita GDP is very small, it is relatively stable (with COV of 0.286) and predictable compared to the high estimated COV (6.880) for the real per capita GDP of the major

trading partners.

Result of unit root analysis

The results for stationarity (order of integration) of the variables are presented in Table 2. The results indicate that the real exchange rate and international price of shea nuts are integrated at their levels, I(0), while the volume of cashew nuts exported, the international price of cashew nuts, major trading partners' per capita real GDP, and Ghana's per capita real GDP are stationary after their first difference, I(1). These indicated a mix of variables for the regression analysis, where some were integrated at their level values, I(0), while others were integrated after their first difference, I(1).

Table 2. Augmented Dickey-Fuller and Phillips Perron Test Results

Variables	ADF TEST		PP TEST	
	LevelI (0)	First difference I (1)	Level I (0)	First difference I (1)
Ln (volume of cashew nut)	-2.019	-7.556***	-2.169	-8.446***
Ln (international price of cashew nut)	-2.106	-7.400***	-1.980	-8.067***
Ln (real exchange rate)	-3.155**	-3.761***	-2.994**	-3.691**
Ln (trading partners' RGDPC)	-1.436	-5.684***	-1.920	-5.725***
Ln (international price of shea nut)	-5.491***	-8.441***	-5.196***	-10.997***
Ln (Ghana's RGDPC)	0.750	-3.505**	0.525	-3.474**

Note: *** and ** indicate 1% and 5% significance levels, respectively. Source: Authors' estimations, STATA 17

ARDL bounds test and estimated cointegration relationship

Before performing the bounds test for cointegration, the optimal lag selection was evaluated to find the appropriate lag length based on the vector autoregressive model (VAR) framework. The Akaike Information Criterion (AIC) was selected using a maximum lag of 1 (automatic selection) for the model selection (ARDL: 1,1,0,0,1,0). That is, one (1) lag period for the volume of cashew nuts, international prices of cashew nuts and shea nuts, and zero (0) lag for the real value of the exchange rate, trading partners' real GDPC, and Ghana's per capita real GDP, respectively. As shown in Table 3, the Akaike Information Criterion was selected for this research due to its lowest value (negative 7.119) compared to other estimated criteria in Lag 1.

Table 3. Lag-order Selection Criteria.

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	6.59162		3.9e-08	-0.04225	0.04501	0.24321
1	141.675	270.17	3.5e-11*	-0.71196*	-6.50872*	-5.12132*
2	177.291	71.232*	5.3e-11	-7.09219	-5.95766	-3.38105

Note: *optimal lag. Source: Authors' estimation, STATA 17

After selecting an appropriate lag length, the ARDL bound test was estimated. The results are presented in Table 4. The estimated F-value (6.806) was greater than the upper bound value of 4.68 at the 1% significance level, suggesting the existence of a cointegration (long-run) relationship. Hence, the null hypothesis was rejected and concluded that the volume of Ghana's cashew nuts exports and the independent variables exhibited a long-run co-integrated relationship.

Table 4. ARDL bounds test result for cointegration.

Test Statistic	Value	Level of significance	Lower bound I (0)	Upper bound I (1)	Decision
F-statistic	6.806	10%	2.26	3.35	Existence of long-run relationship
K	5	5%	2.62	3.79	
		1%	3.41	4.68	

Source: Authors' estimation, STATA 17

With the existence of cointegration verified, the determinants of the export of cashew nuts were analyzed. The results are presented in Table 5. In the long run, the volume of cashew nuts exported was significantly influenced by the real exchange rate, trading partners' per capita real GDP, the international price of cashew nuts, and Ghana's per capita real GDP. The coefficient of the international price of cashew nut was negative and significant statistically at the 10% level, with an estimated long-run elasticity of 1.042%. The coefficient of trading partners' real GDP per capita was positive and significant at 1%, with an estimated elasticity of 17.162% in the long-run. The negative and significant coefficient for the real exchange rate suggested an estimated long-run elasticity of approximately 1.543%. The coefficient of Ghana's real GDP per capita was positive and significant at the 1% level, and its estimated long-run elasticity is about 7.40%.

Table 5. Estimated Long-Run Coefficients using the ARDL Approach. Dependent variable: Ln (volume of cashew nut exported).

Variable	Coefficient (1,1,0,0,1,0)	Std. Error	t-value	Prob.
Ln (international price of cashew nut)	-1.04177*	0.4865	-2.1415	0.0447
Ln (real exchange rate)	-1.5433**	0.5920	-2.6069	0.0167
Ln (trading partners' real GDPC)	17.1622***	5.8048	2.9566	0.0078
Ln (international price of shea nut)	-0.0594	0.4778	-0.1244	0.9023
Ln (Ghana's RGDPC)	7.3991***	2.0256	3.6528	0.0016
Constant	-193.6795	53.2124	-3.6397	0.0016

R-squared	0.6993	Heteroscedasticity	0.4110
Adjusted R-squared	0.5791	Normality	0.2038
Breusch-Godfrey LM test	0.0000	Correlogram statistic	0.4755

Note: ***, **, and * indicate 1%, 5% and 10% significance levels respectively.

Results of the error correction model

The results for the estimated error correction model are presented in Table 6. The error correction term (ECT), which ascertained the speed of adjustment of the volume exported to the long-run equilibrium level had a coefficient of negative 0.9139, which is significant statistically at the 1% level. The coefficient of the first difference of the real exchange rate was negative and statistically significant at the 5% level, and its estimated short-run elasticity is 1.410%. Similarly, like the long-run effect, the trading partners' per capita real GDP influence on the export of cashew nuts in the short-run was positive and significant, and its estimated short-run elasticity is 15.684%. Also, the effect of the per capita GDP of Ghana on the volume of cashew nuts exported was positive and significant, with an estimated short-run elasticity of 6.7619. The effects of the international prices of cashew and shea nuts were insignificant in the short-run.

Table 6. Results of the ARDL Error Correction Model. Dependent variable: ΔLn (Volume of cashew nut exported)

Variable	Coefficient	Std. Error	t-value	Prob.
ΔLn (international price of cashew nut)	0.2493	0.4177	0.60	0.557
ΔLn (real exchange rate)	-1.4104**	0.5086	-2.27	0.012
ΔLn (trading partners' real GDPC)	15.6844***	5.4518	2.88	0.009
ΔLn (international price of shea nut)	-0.4865	0.3967	-1.23	0.234
ΔLn (Ghana's real GDPC)	6.7619***	2.0078	3.37	0.003
ECT (-1)	-0.9139***	0.1596	-5.73	0.0000
Constant	-193.6795***	53.2124	-3.64	0.0016

R-squared	0.6993	Heteroscedasticity	0.4110
Adjusted R-squared	0.5791	Normality	0.2038
Breusch-Godfrey LM test	0.0000	Correlogram statistics	0.4755

Note: *** and ** indicate 1% and 5% significance levels, respectively. Source: Author's estimation, STATA 17

Diagnostic test results

The results of the diagnostic tests were conducted to check the efficiency and consistency of the ARDL (1,1,0,0,1,0) model are presented in Table 7. The estimated chi-square value for the Breusch-Godfrey test was significant at the 1% level, indicating no consistent serial correlation in the estimated cointegration model. The results of correlogram statistics suggested no autocorrelation in the ARDL model because the Ljung-Box-statistic remains statistically insignificant at 1% and 5% significance levels. In addition, the estimated probability value of the Chi-square, 41.1%, exceeded the critical value at the 5% threshold, using the Breusch-Pagan-Godfrey heteroscedasticity test, which suggested the absence of heteroscedasticity problem in the estimated model. The normality test, based on the skewness and kurtosis, with an estimated probability value of the chi-square of 20.4 was greater than a 5% level of significance, hence the estimated model complied with the normal distribution assumptions and therefore was a suitable model.

Table 7. Diagnostic test results.

Test	Test method	Prob. > Chi-Square & Prob.>Q
Normality	Skewness & Kurtosis	0.2038
Heteroscedasticity	Breusch-Pagan-Godfrey	0.4110
Serial correlation	Breusch Godfrey LM	0.0000
Serial correlation	Correlogram (Prob>Q)	0.4755

Source: Authors' estimations, STATA 17

Stability test

To check stability in the long-run model, the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares tests (CUSUMSQ) were plotted and results are presented in Figs. 1 and 2. The results showed that the estimated model was stable as both CUSUM and CUSUMSQ fall within the 5% significance level for the critical boundary. The findings suggested that, generally, there was a long-run relationship and stability among the variables over the study period of 1992−2021.

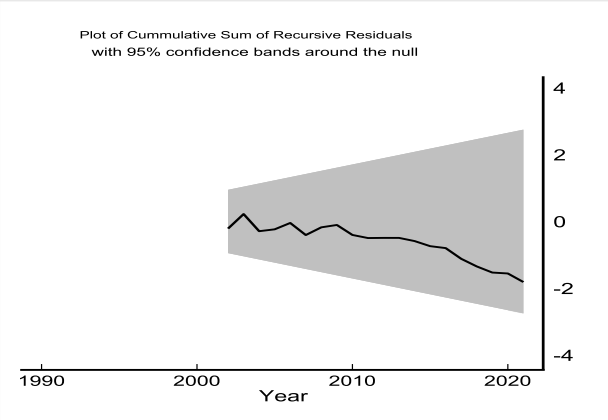

Fig. 1. Stability test (CUSUM).
Source: Authors' estimation, STATA 17

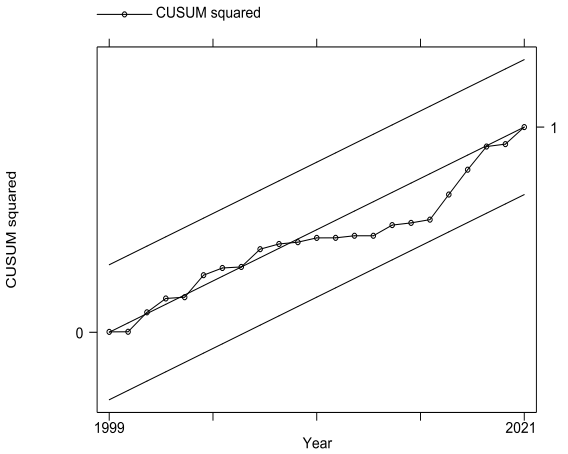

Fig. 2. Stability test (CUSUMSQ)
Source: Authors' estimation, STATA 17

Discussion

The ARDL regression results indicated that the volume of cashew nuts exported had negative price effects where it was negatively and significantly influenced by the international price of cashew nuts and the real value of the exchange rate, and positive income effects, where it was positively and significantly influenced by the trading partners' per capita real GDP and Ghana's per capita real GDP. The effects of the real exchange rate and the real per capita GDPs for the trading partners and Ghana were significant in both the long-run and short-run, while the international price effect was significant only in the long-run. The effects of these macroeconomic variables were elastic in nature. The negative own price effect (with an elasticity of 1.042%) conformed, cautiously, with the apriori expectation and is consistent with Mold & Prizzon (2015), whose study concluded that higher commodity prices negatively influence export performance in sub-Saharan African countries.

The real value of the exchange rate had similar effects on the export of cashew nuts in both the long-run and short-run. The negative and significant coefficient for the real exchange rate suggested that a 1% increase in the real exchange rate (i.e. depreciation of Ghana's currency) led to approximately 1.543% decrease in the volume of cashew nuts exported from Ghana, in the long-run. In comparison, in the short-run the declining effect was approximately 1.410%. The negative effect of the real value of the exchange rate is contrary to a priori expectation though, since given the international price of cashew nuts, the depreciation of Ghana's currency should have encouraged more exports from exporters of the nuts. This result, however, means that a higher real exchange rate has adverse effect on the export growth of Ghana's cashew nuts. Ayambila *et al.* (2023) in a study that employed autoregressive-distributed lag (ARDL) found that exchange rates negatively and significantly affected non-traditional agricultural export growth in Ghana. Similarly, Babapour *et al.* (2021) reported a negative relationship between the real exchange rate and the agricultural exports in Iran. These suggested that the effect of the real exchange rate on the export of agricultural products from emerging economies like Ghana tends to be negative.

Since the negative effect of the real exchange rate is contrary to a priori expectation, the implication of this finding is debatable. In line with Marshall-Lerner (M-L) condition, after depreciation of a domestic currency, commodities and services become relatively cheaper and more competitive than the products of other countries in the international market, and, as a result, the exports increase and therefore trade balance improves (Thuy and Thuy, 2019; Cambazoğlu and

Güneş, 2016). Hence, most studies have reported that the depreciation of domestic currency does improve the trade balance (net export) or export: Cambazoğlu and Güneş (2016) in the case of Turkey exports, Hassan *et al*. (2022) in the case of Canadian exports; Kumar *et al*. (2024) in the study of agricultural exports in India. However, Bahmani *et al*. (2013) in their reviewed study performed significance tests on the reported results and found that in half of the cases where the M-L condition appears to hold are not significant, while their empirical tests on a set of 29 countries, failed to prove the M-L Condition. Hence, they noted that the findings of studies that support the Marshall-Lerner condition and rely on it are much weaker than commonly thought. The finding in the present study is consistent with a note by Eshetu (2024) that many authors argue that currency devaluation (depreciation) is less likely to promote exports in small supply-constrained agrarian economies. Eshetu (2024) reported that the official exchange rate negatively and significantly influenced the exports of sesame and coffee from Ethiopia. Also, Thuy and Thuy (2019) reported that the depreciation of the domestic currency affects exports in Vietnam negatively in the short run, but positively in the long run. Moreover, Bostan *et al*. (2018) reported a negative and significant association between exchange rate devaluation and Romanian exports, based on which they concluded that exports no longer have a competitiveness influenced by the exchange rate. Javed *et al*. (2020) in their study also showed that the exchange rate of Pakistan has a negative and significant effect on basmati rice export, but exchange rate of the trading partner has a positive and significant effect on basmati rice export of Pakistan to its trading partner.

The income (proxied by per capita real GDP) effects of both trading partners (import countries) and Ghana (export country) were positive and significant, with each respective effect in the long and short runs, being similar. When the real per capita income of the trading partners increased by 1%, the export of cashew nuts to those countries from Ghana increased by about 17.162% in the long-run and 15.684% in the short-run which, based on the t-test for the difference between two means, were statistically similar. This finding is consistent with the findings reported in the literature which showed that gross domestic product is positively and significantly associated with export volume. This is because a country's ability to export would expand if its domestic output increased. Guided by the principles of the gravity theory, most estimated models assume that the domestic product of the exporting country positively affects the volume of exports to partner countries. For example, the finding is consistent with Mwansakilwa (2013), who found a positive connection between the per capita real GDP of the United Kingdom, Germany, and the Netherlands and flowers export volume from Zambia. Similarly, Shane *et al.* (2008) identified a positive effect of the real income of importing countries on the quantity of agricultural exports from the United States. Lastly, the results indicated that as Ghana's real GDP per capita increased by 1%, the volume of cashew nuts exported increased, ceteris paribus, by 7.399% in the long-run and 6.762% in the short-run and the magnitude of elasticities were statistically similar. The income effects of the trading partners were statistically higher than Ghana's income effects. The estimated income elasticities suggested that cashew nut is a luxury food item. Dastjerdi *et al.* (2021), have similarly found a positive association between GDP and the export of pistachio from Iran. Similarly, Dalango (2020) reported a positive association between GDP per capita and the performance of exports in Ethiopia. The finding was also in line with the results reported by Babapour *et al*., (2021), and Gebremariam & Ying (2022), who revealed a positive relationship between GDP and export of agricultural products, and real GDP and export performance in Iran and Ethiopia, respectively. With an estimated elasticity of 2.82%, Gebremariam & Ying (2022) considered the real GDP as a major determinant of export performance in the

long run. Eshetu (2024) showed that the GDPs of Ethiopia, and partner countries are positively and significantly related to the export volume of Ethiopian sesame. For the exports of coffee, Eshetu (2024) found that the coefficient of Ethiopian GDP was positive and significant. Bekele and Mersha (2019) have similarly estimated the positive and significant effects of the GPDs of Ethiopia and partner countries on the export of Ethiopian coffee, with elasticities of 1.56 and 0.26%, respectively. Hutchinson (2005), using the standard gravity model, found that the US income and foreign income have positive effects on US exports, but the effect of the foreign income was less than one (0.87%). Kumar *et al*. (2024) also found a significant and positive effect of the GDP on agricultural exports in India.

The estimated speed of adjustment, given by the coefficient of the error term in the ECM, signified convergence to a long-run equilibrium at a high adjustment speed of 91.39% after a short-run shock, taking about 1 year and 1.1 months for the volume of cashew nut exported to adjust from a disequilibrium state to a steady state, along its long-run pathway.

Conclusions and policy implications

The study examined the determinants of the export of cashew nuts, analyzing how sensitive the export of cashew nuts is to price changes using the ARDL regression technique. The ARDL bound test revealed evidence of cointegration between cashew nuts export volume and the macroeconomic variables included. The ARDL regression results indicated that the volume of cashew nuts exported experienced negative price effects (own export price effect and real exchange rate) and positive income effects (real per capita GDPs for the trading partners and Ghana). Effects of these macroeconomic variables were elastic and the income effects suggested that cashew nut is a luxury food item. The coefficient of error correction term meant that the volume of cashew nuts exported converged to a long-run equilibrium at a high adjustment speed of 91.39% after a short-run shock, taking about a year and a month to adjust.

The study presents some recommendations aimed at enhancing the export market for products from developing economies like Ghana's cashew nuts. The study found that the price effects were negative for the export volume of cashew nuts. Implementing mechanisms to stabilize exchange rates is suggested to create an enabling environment for trade between Ghana and its trading partners in the cashew nuts industry. Measures to improve and maintain market predictability and attract buyers are recommended. Regular conduct of market research by trade promoters to understand price sensitivities across target markets and tailored pricing strategies according to diverse consumer preferences and purchasing power are crucial. Similarly, measures to stimulate and sustain economic (GDP) growth are important for improving the export performance of the industry.

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Conflict of interest

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