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Factors influencing export performance of Ginger (*Zinbiger officinale*) in Nigeria

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Abstract

This study evaluated factors influencing export performance of ginger (*Zinbiger officinale*) in Nigeria. Specifically, the research study was designed to achieve the following objectives: examine the short run equilibrium relationships between test variables; evaluate the long run equilibrium relationships between test variables; and determine the linear – interdependence between factors influencing export of ginger. The test variables under considerations were export quantity of ginger (*Zinbiger officinale*), exchange rate, interest rate, ratio of producer price to domestic price, and ratio of producer price to export price. Data were of secondary sources covering 1995 -2020.The statistical and econometrics tools used to achieve the stated objectives were: Augmented Dickey Fuller (ADF), Phillips-Perron (PP), Johansen Co-Integrating Test and Vector Error Correction Model (VECM). The results of Augmented Dickey-Fuller (ADF) unit root test shows that all test variables were non-stationary at level. All test variables were statistically significant at first difference at 5% level of probability. Phillip-Perron (PP) unit root test shows that all test variables were stationary at first difference and were statistically significant. Johansens co-integration test revealed the presence of co-integration among variables and long-term relationships among variables. Vector Error Correction Model (VECM) shows that exchange rate (EXR), interest rate (INR), had negative coefficients and was statistically significant in influencing export performance of ginger (*Zinbiger officinale*) in Nigeria in the short run. Ratio of producer price to domestic price (PP), producer price to export price (PX), quantity of ginger exported (Y) had positive coefficients and were statistically significant in influencing export performance of ginger (*Zinbiger officinale*) in Nigeria in the short run. In the long run, exchange rate (EXR), interest rate (INR), ratio of producer price to domestic price (PP), ratio of producer price to export price (PX) were statistically significant in influencing export performance of ginger (*Zinbiger officinale*) in Nigeria. The coefficients of error correction model (ECM) was negative, this measures the speed of adjustment towards the long run equilibrium. The coefficients of multiple determinations (R^2) was 0.6710. This confirmed presence of goodness of fit. The F-statistics of 43.06 was significant at 1% level of significance. This confirmed the explanatory power of the entire model. The RESET value of VECM was 1.510 ($P < 0.01$) shows no evidence of misspecification of functional form. The research study recommends policy formulations and implementations that will stabilize exchange rate. Interest rate should be single digit. Export market should be developed along the ginger (*Zinbiger officinale*) value chains and other crops to expand export market base and earn foreign exchange.

Keywords

Export Performance of Ginger, Augmented Dickey Fuller (ADF), Vector Error, Correction Model (VECM), Nigeria

Introduction

Ginger (*Zingiber officinale*) is an important cash crop in Nigeria. Ginger is among the top ten most cultivated crops in Nigeria. It has the potentials to attract foreign exchange to Nigeria because of its rich health benefits, due to its medicinal purpose (Abah, Mbanasor and Agwu, 2018). The top thriving quality exports crop produce in Nigeria include: sesame, cocoa, groundnuts, gum Arabic, cotton, ginger, mangoes, rubber, coffee and pineapples (Nwachukwu, 2014). Ginger can be consumed its fresh form or in dried, powdered forms such as delicacy, spice or medicine. Ginger is known to be used for ailments such as high blood pressure, diarrhea, nausea, diabetics, high cholesterol and inflammation. Ginger can earn income in the domestic and foreign markets. Trade is very important for growth and development of a Nation. Ginger is also used for making ginger juices and tea. The dried ginger can be used for food processing industries and food flavoring (Ihuoma and Micah, 2018). Industries using ginger includes: food processing, pharmaceuticals, confectionary, and beverages industries. The top producing states of Ginger in Nigeria are: Kaduna, Niger, Nasarawa, Bauchi, and Benue. Nigeria produces about 110,000 tonnes of ginger annually and 10% is consumed locally and 90% is exported. One hectare of land requires about 2,500 Kg of ginger setts and can yields 20 tonnes per hectare with a revenue of ₦12 million for domestic sale and upwards of $50,000 in the international markets. Ginger from Nigeria is becoming increasingly demanded because of it pungency and oil. The prices of ginger for export also vary from one harvesting season to the next but are usually between $2,250 and $2,600 per tonne. There is viable and growing market of ginger in Europe because ginger cannot be grown or produced in Europe. About 73% of European import of ginger is from developing countries. European imports about 92,000 tonnes of ginger from developing countries in 2016. Dried ginger is preferable for export. The World production of Ginger in 2009 was 1.6 million metric tonnes (Mmasa and Mhagama, 2017). The global production of ginger was approximated to be 2.1 million tonnes in 2013.The major importing European countries were Netherlands, United Kingdom, Germany, France, Italy, Denmark, Belgium, Switzerland, and Greece. Other viable international markets include: Saudi Arabia, United States and Russia. The top Ginger producing Nations include: India, China, Nepal, Indonesia and Nigeria. India is the largest producer and consumer of ginger in the world (Mmasa and Mhagama, 2017). Ginger is also used for livestock feed (Verma *et al*, 2004). The medicinal value of Ginger makes it a viable health supplements and this ensures increased demand in the long term and makes it a viable investment option. The import markets for spices including ginger are concentrated with European Union (EU) and United States (US), purchasing more than half of the total worlds export (Jaffee, 2004; ITC, 2001). Nigeria exports of agricultural commodities are in their unprocessed state to its trading partners for further processing (Joseph, Oswald and Charles, 2014). The role of exchange rate in foreign transactions has been the major concerns of analysts, policymakers and economists. Exchange rate plays a crucial role in export growth as well as growth and development of a Nation (Nweke, Eze and Atuma, 2020). If any country's currency appreciated due to depreciation of foreign exchange rate, the volume of export of that country decreases due to decreases in foreign demand for export products which is occasioned by high prices of the export products in the country (Khaled, 2016).Nigeria have an advantage over major agricultural producers in terms of proximity to markets in Europe by air or sea and fertile land (Sasore, 2004).The foreign exchange earned from export of agricultural produce depend on export volume and export prices (Nweke,Eze and Atuma, 2020). The import volume, export volume, import prices, export, domestic products, growth and development of a Nation depend on exchange rate. Nigeria implements exchange rate and trade policies in an attempt to promote international trade and benefit from gain of foreign trade (Lawrence and Mohammed, 2015). Dania and Ogedemgbe (2019) revealed negative and significant relationships between exchange rate volatility, interest rate, and foreign direct investment on non-oil export performance in Nigeria. Ngondo and Khobai (2018) indicated that real interest rate and investment had positive and insignificant impact on export, while exchange rate had negative and significant influence on export in South Africa. Osabohien *et al* (2019) observed that agricultural export had negative but significant influence on economic growth in Nigeria. Many studies depict a positive relationship between total export and economic growth (Gilbert, Linyong and Divine, 2013). Export of agricultural commodities provides foreign exchange which in needed to purchase imports, that has beneficial effects on economic growth. Export of agricultural produce plays an important role in economic growth of many developing countries (Gilbert, Linyong and Divine,2013). Agricultural exports will continue to be the major important source of foreign exchange for many sub-Saharan countries (Gilbert, Linyong and Divine, 2013).

Objectives of the Study

The research study evaluated factors influencing export performance of ginger (*Zinbiger officinale*) in Nigeria. Specifically, the research was designed to achieve the following objectives:

(i) examine the short run equilibrium relationships between export quantities of ginger, exchange rate, interest rate, ratio of producer price to export price, and ratio of export price to producer price,

(ii) evaluate the long run equilibrium relationships between export quantities of ginger, exchange rate, interest rate, ratio of producer price to export price, ratio of export price to producer price, and

(iii) determine the linear interdependence between variables influencing export of ginger.

Methodology

The research study was conducted in Nigeria sub-Saharan Africa. Data used were from secondary sources. Data were obtained from Central Bank of Nigeria data base, Bureau of Statistics of Nigeria, research bulletins, journal articles, and Ministry of Agriculture of Nigeria publications. Data covered period of twenty-five years from 1995 to 2020.Data collected total export of ginger in tonnes, exchange rate of Nigeria, interest rate, ratio of producer price to domestic prices, ratio of export price

to producer prices. The following econometrics tools were used to achieve the stated objectives:

Two-unit root tests are better to examine time series. The unit root test is conducted to examine primarily the level of integration among factors under consideration. Unit root test is conducted through the application of Augmented Dickey-Fuller. Dickey and Fuller (1979, 1981) constructed method for testing formally non-stationary. The second unit root test was constructed using Phillips-Perron. Time series data exhibit volatility and trends which could result in non-stationary problem.

Augmented Dickey-Fuller (ADF) and Phillip-Person (PP) Unit Root Tests

Stationarity in stochastic time series can be describe: Firstly, the variable has a constant mean over time. Secondly, variance is constant over time. Thirdly, correlation value is constant and depends on the difference between the time periods. The error term is unlikely to white noise with no random walk. A non-stationary time series data may become stationary after differentiating a number of times.

Augmented Dickey-Fuller model is stated thus:

$$\Delta Y_t = \pi Y_{t-1} + \sum_{j=1}^{P} \gamma_J \, \Delta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

Y_t = Time Series to be Tested

ε_t = White Noise Error Term.

Phillip-Perron Unit Root Test Model is stated thus:

$$Y_t = a_0 + \ a_1 Y_{t-1} + a_2 t + \mu_1 D_P + \mu_2 D_L + \sum_{i=1}^{K} \beta_i \, \Delta Y_{t-i} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where,

D_P = Pulse Dummy (When $t = t + 1, D_P = 1, 0, \text{Otherwise}$)

D_L = Level Dummy (D_L = 1, when $\mathrm{t} > \mathrm{t}, 0, , \text{Otherwise}$)

Johansen Co-Integrating Test

Co-integrating is the statistical implication of the existence of long run equilibrium relationships between the variables. The variables are non-stationary at their level form but stationary after difference. Johansen co-integrating test gives two statistics. First, the value of Likelihood ratio test which is based on the maximum Eigen-value. Secondly, it is based on the trace statistics of the stochastic matrix. If the Likelihood ratio is greater than the critical value, the hypothesis of co-integration is accepted.:

The null hypothesis for Likelihood Ratio (LR_l) test based on Eigen Values is as follows

$$LR_\lambda = T \sum_{i=r+l}^{n} \left\{ \left(ln(1 - \lambda_i^*) \right) - \left(ln\left(1 - \hat{\lambda}_i\right) \right) \right\} \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where,

$\hat{\lambda}_i$ =Eigen-Value of the Unrestricted Model

λ_i^* = Eigen-Value of the Restricted Model

T = Total Number of Observations

n =Number of Endogenous Variables

If $LR_l > C^2$, the critical value for an $n - r$ degree of freedom where n is a number of endogenous variables and r is a number of co-integration relations of unrestricted model, then the null hypothesis is rejected.

Vector Error Correction Model (VECM)

Vector Error Correction Model is a multiple time series models that estimate the speed at which a dependent variable returns to equilibrium relationship after a change in an independent variable. VECM is interested both the short run and long term equilibrium relationships. A negative error correction coefficient gives sufficient evidence of the presence of a short run equilibrium relationship. The size of the error correction coefficient gives the speed of adjustment towards equilibrium. If two variables are con-integrated at the first difference order, their relationship can be expressed as Vector Error Correction Model by taking past disequilibrium as explanatory variables for the dynamic behavior of current variables. Vector Error Correction Model (VECM) corrects the equilibrium error in one period by the next period.

The Vector Error Correction Model (VECM) can be presented as:

$$\Delta Y_t = a_0 + \ a_1 \Delta X_t + a_2 \mu_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where, $\Delta Y_t = \ Y_t - Y_{t-1}$

$a_1 \ and \ a_2 =$ Dynamic Adjustment Coefficients ,

$\mu_{t-1} =$ Lag of Residual Representing Short Run Disequilibrium Adjustment of the Estimates of the Long Run Equilibrium Error

ε_t= Random Error Term.

$a_0 =$ Constant Term

Model Specification

The determinants of export performance of ginger (*Zinbiger officinale*), the following model was formulated and estimated:

$$Ln\,Y = \beta_0 + \beta_1 LnX_{1t} + \beta_2 LnX_{2t} + \beta_3 LnX_{3t} + \beta_4 LnX_{4t} + \beta_5 \mu_{t-1} + \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots (5)$$

Where,

$Y =$ Total Export of Ginger (Tonnes)

$X_{1t} =$ Exchange Rate (%)

$X_{2t} =$ Interest Rate (%)

$X_{3t} =$ Ratio of Producer Price to Domestic Price (Units)

$X_{4t} =$ Ratio of Export Price to Producer Price (Units)

$\mu_{t-1} =$ Lag of the Residual Term Representing Short Run Disequilibrium Adjustments of the Estimates of the Long Run Equilibrium Error

$\beta_5 =$ Coefficient of the Error Correction Term

$\varepsilon_{it} =$ Stochastic Error Term

Table 1. Units of Measurement and Apriori Expectations of Explanatory Variables Included in The Model.

Variable	Code	Units of Measurement	Apriori Expectations
Exchange Rate	X_{1t}	Percentage	-
Interest Rate	X_{2t}	Percentage	-
Ratio of Producer Price to Domestic Price	X_{3t}	Units (Continuous)	+
Ratio of Export Price to Producer Price	X_{4t}	Units (Continuous)	+

Source: Author (2020)

Results and Discussion

Unit Root Tests of Stationarity

The test variables for determining factors influencing export performance of ginger (*Zinbiger officinale*) in Nigeria were subjected to stationarity and co-integration tests. The ADF (Augmented Dickey-Fuller) and PP (Phillip-Perron) unit root tests were used for determining the order of integration of the variables under consideration, the results were presented for the export crop in Table 2. As can be observed in Table 2, the test variables for determining the ginger (*Zinbiger officinale*) export performance using Augmented Dickey-Fuller (ADF) were non-stationarity in their level form. This implies using Augmented Dickey-Fuller (ADF), none of the variables could reject the null-hypothesis of non-stationarity at their level form. After differencing, the Augmented Dickey-Fuller (ADF) estimates for the test variables became stationary, this implies that the test variables became significant at 5% level of probabilities at first difference of order one (1(1)). This implies that using Augmented Dickey-Fuller (ADF), the test variables could reject the null-hypothesis of non-stationarity at all levels. The test variables for export performance of ginger (*Zinbiger officinale*) were further subjected to Phillip-Perron (PP) unit root test. Phillip-Perron (PP) unit root test is a non-parametric test, but it was found to give a more superior result that correct for serial correlation and heteroscadasticity. The problem usually encountered with macroeconomic data in Africa which shows the presence of regime shifts is better solved using Phillip-Perron (PP) unit root test. When Phillip-Perron (PP) unit root test was applied to tests variables, only two variables attained stationarity at level form. After differencing once, the test variables attained stationarity or the test variables are integrated of order one. Stationarity of test variables were confirmed when the test statistics are greater than the critical values in absolute terms. This implies that all test variables became stationarity in difference based on the Phillip-Perron (PP) unit root test. This means that the null hypothesis on non-stationarity of test variables was rejected. This result is in line with findings of Nwachukwu (2014), Dawson (2005) and Aurangzeb (2006).

Table 2. Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Units Root Tests for Integration of Ginger (*Zinbiger officinale)*.

Variables	ADF at Level $[\mathbf{1(0)}]$	ADF at 1st Difference $[\mathbf{1(1)}]$	PP at Level $[\mathbf{1(0)}]$	PP at 1st Difference $[\mathbf{1(1)}]$
Ln Y	-2.420	-3.920**	-3.210*	-3.320*
LnX_1(EXR)	-2.310	-3.803**	-3.920**	-4.960***
LnX_2(INR)	- 1.920	-3.701**	-3.010	-3.651**
LnX_3(PP)	-2.160	-3.771**	-2.196	-3.823**
LnX_4(PX)	- 2.090	-3.609**	-1.161	-3.761**

Source: Computed Using STATA

NB-Critical Values of ADF at 1% (***), 5% (***), and 10%(*) are -4.38, -3.60, and -3.24

The PP Test Critical Values at 1% (***), 5% (**) and 10% (*) are -4.106, -3.510 and -3.182 respectively.

Results of Johansen's Co-Integration Test

The results of Johansen's Co-Integration test of data for ginger (*Zinbiger officinale*) in Nigeria was presented in Table 3. The results of Johansen's co-integration test indicate the presence of co-integration and it is a pre-condition for the specification of an error correction model. The Johansen's co-integration test was conducted to establish whether there were any long run equilibrium relationships and co-integration equations existed among variables. Further analysis was carried out on the series properties of the variables at first difference 1(1) using Johansen's co-integration test. The results show that one co-integration equation exists among the variables. The trace statistics and maximum Eigen-values are the most important statistics used in co-integration test. The decision rule shows that the trace statistics of 19.76 was greater than the critical value of 15.48 at 5% level of significance. Non-rejection of co-integration among test variables rules out the rejection of non-causality. The trace statistics shows that at least one co-integration equation existed at 5% level of probability. The null-hypothesis that there are no co-integration relationships among variables was rejected. This implies that there are long run equilibrium relationships between test variables under consideration. This result is in line with findings of Aro-Gordon (2017), Gilbert, Linyong and Divine (2013), Nweke, Eze and Atuma (2020).

Table 3. Results of Johansen Co-Integration Test (Trace Statistics).

Level	Eigen-Value	Trace Statistics	Critical Value at 5%	P-Values
$H_0: \gamma = 0 (None)^*$	0.30651	19.76	15.48	0.0004
$H_0: \gamma = 1 (At\ Most\ 1)^*$	0.26722	08.79	03.84	0.0087
At Most 2	0.14635	10.67	12.53	0.1563
At Most 3	0.11537	21.57	24.31	0.2714
At Most 4	0.05615	28.92	39.89	0.5410

*Denotes Rejection of the Hypothesis at the 0.05 Level.

Vector Error Correction Model (VECM)

The results of vector error correction model are presented in Table 4.Having fulfilled the necessary conditions which necessitates the applications of Augmented Dickey-Fuller (ADF), Phillip-Perron (PP) unit root tests and Johansen's co-integration test, the application of vector error correction model (VECM) was necessary because of the existence of co-integration among the test variables. The parameters in the short run were indicated by the variables in difference and the parameters of the long run were represented by the variables at levels. From the result presented in Table 4, the coefficient of exchange rate (0.9108) was negative and significant at 1% level of significant in influencing the export performance of ginger (*Zinbiger officinale*) in Nigeria in the long run. The coefficient of interest rate (-1.0671) was negative and significant at 5% level of significant in influencing the export performance of ginger (*Zinbiger officinale*) in Nigeria in the long run. These are in line with apriori expectations presented in Table 1. This implies that ginger export supply decreases as the interest rates increases. The coefficient for ratio of export price of ginger to producer price was negative (-1.085) and significant at 5% level of significant. The negative coefficient of ratio of export price to producer price of ginger implies that ginger export supply decreases as the cost of exporting the ginger increases. The ratio of export price to producer price is the price of ginger paid producer of ginger which represents cost to exporter. This result is in line with findings of Nwachukwu (2014), Aro-Gordon (2017), Nweke, Eze and Atuma (2020), Dawson (2005) and Aurangzeb (2006).

In the short run, ginger export responded positively to changes in the one-year lag of, ratio of producer price of ginger to domestic price, ratio of export price of ginger to producer price, and quantity of ginger exported. This means that price ratios, and quantity exported enhanced export of ginger supplied. The interest rate negatively influence export supply of ginger in the short run. This is line with apriori expectations of Table 1.The negative effects of exchange rate movements on their outputs are anticipated to be removed by exporter as this in most situations determines profit. Non-price, price and combinations of both can be employed on to determine their exporting and this depend on market power and the competitive strength of the exporting nations (Wisdom and Granskog, 2003). The statistical and significant response of the price ratios to export price of ginger is inelastic in the short run. A one unit increase (decrease) in export of ginger (*Zinbiger officinale*) leads to 0.71 and 0.91 increase (decrease) in the cost of production and export of ginger (*Zinbiger officinale*) respectively. The error correction coefficient of -0.659 for ginger (*Zinbiger officinale*) measures the speed of adjustment towards the long run equilibrium and the coefficient carries the expected negative sign. The coefficient of multiple determinations (R^2) of ginger supply was 0.6710. This implies that 67.10% of the variations in export performance of ginger (*Zinbiger officinale*) were explained by the predictor variables included in the model. The adjusted R^2 was 0.6101.This confirmed goodness of fit. The F-statistics of 43.06 was significant at 1% level of significant. This confirmed the explanatory power of the entire model. The Breusch-Godfrey Langrange Multiplier (LM) test is a general test which is significantly different from zero. The significant value of LM at 1% probability level was 1.410, this implies that the null-hypothesis of serial correlation was rejected. This is in line with Gbetnkom and Khan (2002), Nwachukwu (2014). The RESET test was employed to help check for correct regression specification. The statistics for ginger was 1.510 and

was significant at 1% probability level, this shows no evidence of misspecifications of functional form.

Table 4. Estimates of the Determinants of Ginger (*Zinbiger officinale*).

Variables	**Estimates (Long Run)**
Intercepts	32.001* (1.96)
$Ln\ EXR_1$	-0.9108*** (3.51)
$Ln\ INR_1$	-1.0671** (2.76)
$Ln\ PP_1$	0.8652** (2.47)
$Ln\ PX_1$	-1.085** (2.86)
	Short Run
Intercepts	8.061 (0.721)
Ln EXR_{t-1}	-0.9615** (2.61)
Ln INR_{t-1}	-1.108 ** (2.41)
$Ln\ PP_{t-1}$	0.7109* (1.96)
$Ln\ PX_{t-1}$	0.9107** (2.10)
$Ln\ Y_{t-1}$	1.8109** (2.211)
ECM_{t-1}	-0.659** (2.718)
R^2	0.6710
$Adjusted\ R^2$	0.6101
$F-Statistics$	43.06***
LM	1.410***
RESET	1.510***

***, ***, * - Significant at 1%, 5% and 10% Probability Levels*
Figures in Parentheses are t-Test Values

Linear Interdependency among Variables in the Short Run

The linear equation between variables is stated thus:

$$\boldsymbol{Ln}\ Y = 8.061 - 0.9615EXR - 1.108\ INR + 0.7109Ln\ PP + 0.9107Ln\ PX + 1.8109\ LnY_{t-1} \quad \ldots\ldots (6)$$
$$(2.61) \qquad (2.41) \qquad (1.96) \qquad (2.10) \qquad (2.21)$$

The linear interdependency as presented in equation (6) shows negative coefficients between exchange rate, interest rate and export quantities of ginger (*Zinbiger officinale*) in Nigeria. Figures in parentheses are t-values respectively. This is in line with findings of Pesaran, Shin and Smith (2001).

Conclusion

The research study investigated export performance of ginger (*Zinbiger officinale*) in Nigeria. Ginger is a cash crop that has potentials to attract foreign exchange to Nigeria. Ginger is a spicy crop that has health benefits due to its medicinal purpose. The test-variables under considerations were exchange rate, interest rate, ratio of producer price to domestic price, and ratio of export price to producer price. The statistical and econometric tools employed were Augmented Dickey-Fuller (ADF), Phillip-Perron (PP), both tools were for unit root tests. Other econometric tools include Johansen's Co-Integration and Vector Error Correction Model (VECM). The tests variables were at stationarity and significant at first difference using Augmented Dickey-Fuller (ADF) unit root test. Two test variables which include export quantity of ginger (*Zinbiger officinale*) and exchange rate were stationary at level using Phillip-Perron (PP) unit root test. All test variables were stationary and significant at first difference using Phillip-Perron (PP) unit root test. Johansens Co-Integration test revealed that co-integration equation exists among the variables. The test statistics of 08.79 at first difference was greater than the critical value of 3.84 at 5% level of significance. This implies that there exist long run relationships among the variables. Vector Error Correction Model was employed because of the existence of co-integration among test variables. The parameters of the variables in the short run were at difference and the parameters of the variables in the long run were examined at levels. Exchange rate and interest rate had negative coefficients but were statistically significant in influencing the export performance of ginger (*Zinbiger officinale*) in Nigeria in the long run. Ratios of producer price to domestic price and producer price to export price had positive coefficients, and were statistically significant in influencing export performance of ginger (*Zinbiger officinale*) at 5% level of probability. In the short run exchange rate, interest rates had negative coefficients and were statistically significant in influencing export performance of ginger (*Zinbiger officinale*) in Nigeria in the short run. Ratios of producer price to domestic price and producer price to export prices had positive coefficients and were statistically significant in influencing export performance of ginger (*Zinbiger officinale*) in Nigeria in the short run. The coefficient of error correction model was negative at – 0.659. This measures the speed of adjustment towards long run equilibrium. The coefficient of multiple determinations (R^2) of 0.6710 implies that 67.10% of export performances of ginger (*Zinbiger officinale*) in Nigeria were explained by the test variables included in the model. This implies goodness of fit. The F-statistics of 43.06 was statistically significant at 1% level of probability. This confirmed the explanatory power of the entire model. The statistically significant value of Breusch-Godfrey Langrange Multiplier (LM) test at 1% probability level implies that the null-hypothesis of serial correlation was rejected. The statistically significant of RESET value of 1.510 at 1% probability implies that no evidence of misspecification of functional form.

Recommendations

Based on the findings of this research study, the following policy recommendations were made:

- Macroeconomic policies that will stabilize exchange rate should be formulated and implemented by government.
- Policies that will promote single digit interest rate should be formulated by governments.
- Production inputs such as fertilizers input, chemical inputs, land input should be made available for ginger farmers at right time.
- Credit facilities at low interest rates should be made available to ginger farmers.
- Ginger farmers should be encouraged to form or join cooperative organizations.
- Feeder road infrastructures should be constructed for easy movement of ginger produce from producing areas to nearby markets.
- Favourable prices of ginger produce should be given to farmers for profitability of the enterprise.

Compliance with Ethical Standards

Conflict of interest

The authors declared that for this research article, they have no actual, potential or perceived conflict of interest.

Author contribution

The contribution of the authors to the present study is equal.

All the authors read and approved the final manuscript. All the authors verify that the Text, Figures, and Tables are original and that they have not been published before.

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Not applicable.

References

Abah, D.A., Mbanasor, J.A., Agwu, M.N. (2018). Analysis of the Factors Influencing Choice of Marketing Outlets by Ginger Producers in Kaduna State, Nigeria. *Journal of Agriculture and Food Environment* 5(3): 38 – 47.

Aro-Gordon, S. (2017). Econometrics Analysis of Exchange Rate and Export Performance in a Developing Economy. Asian Economic and Financial Review 7 (4): 334 – 348.

Aurangzeb, A. (2006). Export, Productivity and Economic Growth in Pakistan: A Time Series Analysis. The Lahore Journal of Economics 11 (1): 1 – 18.

Dania, E.N., Ogedemgbe, F.A. (2019). Impact of Exchange Rate Volatility on Non-Oil Export Performance in Nigeria. Open Journal of Economics and Commerce 2 (1): 32 – 39

Dawson, P.J. (2005). Agricultural Exports and Economic Growth in Less Developed Countries. Agricultural Economics 33: 145 – 152

Gbetnkom, D., Khan, S.A. (2002). Determinants of Agricultural Exports: The Case of Cameroon. AERC Research Paper 120, AERC, Nairobi, Kenya.

Gilbert, N.A., Linyong, S.G., Divine, G. M. (2013). Impact of Agricultural Export on Economic Growth in Cameroon: Case of Banana, Coffee and Cocoa. International Journal of Business and Management Review 1 (1): 44 – 71.

Ihuoma, A.A., Micah, D. (2018). Impact of Ginger Production on Poverty Alleviation in Kaduna State, Nigeria. IOSR Journal of Economic and Finance 3 (2): 37 – 44.

ITC (2001). Product File: Spices and Culinary Herbs. UNCTAD Discussion Documents Brussels Pp 2 – 11.

Jaffee, S. (2004). Delivering and Taking the Heat: Indian Spices and Evolving Product and Process Standards. Agricultural and Rural Development Discussion Paper, World Bank. Washington DC .

Joseph, D.N., Oswald, T., Chalse, A.A. (2014). The Impact of Exchange Rate Movement on Exports: Empirical Evidence from Ghana. International Journal of Academic Research in Accounting, Finance and Management Sciences 4 (3): 41 – 48.

Khaled, A. (2016). How Exchange Rate Influence a Country's Import and Export. International Journal of Scientific and Engineering Research 7 (5): 131 – 139.

Lawrence, E.I., Mohammed, I. (2015). The Impact of Exchange Rate on Nigeria Non-Oil Exports. International Journal of Academic Research in Accounting, Finance and Management 5(1): 190 – 198.

Mmasa J.J., Mhagama, J.K. (2017). Social –Economic Factors Influencing Ginger (Zinbiger officinale) Productivity among Smallholders Growers in Tanzania-Case of Same District. Journal of Economic and Sustainable Development 8 (8): 12 – 29.

Ngondo, M., Khobai, H. (2018). The Impact of Exchange Rate on Export in South Africa. The ARDL Bounds Test Approach. Munich Personal RePEc Archive (MPRA), Paper No. 85079, 1 -22.

Nwachukwu, I.N. (2014). Dynamics of Agricultural Exports in Sub-Saharan Africa: An Empirical Study of Rubber and Cocoa from Nigeria. International Journal of Food and Agricultural Economics 2 (3): 91 – 104.

Nweke, A.M., Eze, O.M., Atuma, E. (2020). Analysis of the Effect of Exchange Rate Depreciation on Export Performance in Nigeria. IORS Journal of Business and Management 22 (6): 48 – 60.

Osabohien, R, Akinpelumi, D Matthew, O., Okafor, V., Iku, E., Olawande, T., Okorie, U. (2019). Agricultural Exports and Economic Growth in Nigeria: An Econometric Analysis. International Conference on Energy and Sustainable Environment IOP Conference Series: Earth and Environmental Science 331: 1 – 10.

Pesaran, H.M., Shin, Y., Smith, R.J. (2001). Bound Testing Approaches to the Analysis of Long Run Relationships. Working Paper, University of Cambridge, Discussion Paper Version.

Sasore, G.M. (2004). Nigeria's Export Trade of Agricultural Commodities: Quality Control and Standards. A Paper Presented at Nigeria National Crop Outlook Conference held at Durbar Hotel Kano, 26th – 27th May.

Verma, S.K., Sighn, O., Jain, M., Borchia, P. (2004). Protective Effect of Ginger (*Zinbiger officinale Rose*). Journal of Experimental Biology 4 : 736 – 738.