Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 21, Issue 4, 2021
PRINT ISSN 2284-7995, E-ISSN 2285-3952

MACRO ECONOMIC VARIABLES AND NIGERIA AGRICULTURAL TRADE FLOWS: A GRAVITY MODEL ANALYSIS APPROACH

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Abstract

The study examined the influence of macro-economic variables on agricultural trade flows between Nigeria and her trading partners. Time series data covering the period between 1970 and 2019 were used in the study. Data were analysed using descriptive statistics and a gravity model. Results of the descriptive analysis revealed a declining trend in earnings from agricultural exports, while expenditure on agricultural imports increased significantly, resulting in a deficit balance of agricultural trade in Nigeria over the study period. Results of gravity model analysis showed that exchange rate, agricultural export tax, Nigeria's Gross Domestic Product (GDP) and Nigeria's population positively influenced agricultural trade flows, while the distance between Nigeria and United Kingdom negatively influenced agricultural trade flows. The study concluded that bilateral agricultural trade between Nigeria and her trading partners in the study is elastic to exchange rate, agricultural export tax, Nigeria GDP, Nigeria population, and distance between Nigeria and United Kingdom. Thus, effective and efficient monetary and fiscal policies to monitor exchange and export tax in the economy and improved bilateral trade agreements will ensure a friendly macro-economic environment that will stimulate mutual benefits from agricultural trade for both partners.

Key words**:** *gravity model, agricultural export earnings, exchange rate, inflation rate, agricultural export tax*

INTRODUCTION

Prior to independence, agricultural exports such as cocoa, palm oil, palm kernel, rubber, cotton and beni-seed constituted a significant proportion of Nigeria's export trade. Other non-oil export commodities are cattle, hides and skin, tin-ore and columbite [3].

However, the discovery oil and its subsequent boom in the early 1970s relegated agricultural exports and become the major source of revenue for the nation. The situation was seriously aggravated in the 1980s plunging the country into serious balance of trade and payment problems [9] and [10].

According to [1] and [14] fluctuations in income earned from production of agricultural export commodities comes from either an increase or a decrease in the prices of agricultural export commodities in international market or increase in producer prices because of currency devaluation. Changes in price/exchange can result in decline in future production of agricultural export commodities which will aggravate risks and uncertainty in international agricultural trade flows, which in turn will discourage agricultural trade.

[13] argued that instability in exchange rate will induce undesirable macroeconomic phenomena such as inflation and domestic trade protection which are both detrimental to agricultural trade flows.

In Sub-Saharan Africa, many countries embraced the Import Substitution Industrialization (ISI) strategy which involved substitution of expensive imports with locally produced cheap alternatives in order to achieve sustained economic growth. In Nigeria, agriculture is the mainstay of the economy, thus, ISI is expected to improve productive capacity of the agricultural sector, especially agricultural exports sub-sector. ISI stimulated increase in production and export volumes of agricultural commodities which led to appreciation in the value of naira relative to other currencies of Nigeria's trading partners [14].

In an effort to restructure the economy, the federal government of Nigeria introduced the Structural Adjustment Programme (SAP) in 1986. This programme was aimed at solving country's balance of trade and payment problems. However, SAP did not yield the desired results as the food import bills continue to soar [1].

One of the economic implications of SAP is the devaluation of the country currency under Bretton wood system as recommended by international financial organizations (International Monetary Fund (IMF) and World Bank (IBRD)). The devaluation is expected to stimulate economic growth and development, consequently, low profits from exports significantly reduced the performance of the export sector [2].

Conventionally, the gravity model first application to international trade flows analysis was cited by [12], is credited to the contemporary and independent work of [17] and [15]. In standard form, the gravity model as explained by [19], is specified the volume of bilateral trade between any two trading partners is an increasing function of their sizes of income and a decreasing function of the geographical distance between the trading partners.

[5] asserted that under apriori expectation, bilateral trade is positively associated with the income and negatively associated with the geographical distance between the two countries. Although, the gravity model have been presumed as a powerful tool in analyzing bilateral trade flows by various authors ([18], [16], [11], [20]) it was heavily criticized for being deficient in theoretical justification.

However, the works of [4] and [6] who derived gravity equation models from trade models of product differentiation and increasing returns to scale disapproved this assertion, [12] also showed that the gravity equation can be derived within Ricardian and Hecksher-Ohlin models framework. This affirms that the gravity model, provides a very important empirical analytical tool.

This study examines the determinants of agricultural trade flows between Nigeria and her trading partners, with the specific objectives of describing export destinations of agricultural export commodities and isolating the effects of macro-economic variables such as exchange rate, interest rate, inflation rate and export tax on agricultural trade flows.

MATERIALS AND METHODS

The data set for the study were obtained from secondary sources. Data on the values and volumes of agricultural export commodities, as well as gross domestic product (GDP) of both exporting and importing countries were obtained from Food and Agriculture Organization (FAO) Statistical Database (FAOSTAT), while data on variables such in exchange rate, inflation rate, geographical distances and population were obtained from the publications of the Central Bank of Nigeria (CBN) and the National Bureau of Statistics (NBS). The selected agricultural export commodities for this study are cocoa beans, palm oil, palm kernels and seed cotton. The analysis covered the period between 1970 and 2019.

Data were analyzed using both descriptive and inferential statistics. The descriptive statistics such as means, graphs and tables were used to describe trend in agricultural trade in Nigeria between 1970 and 2018. The inferential statistical tool employed in the study to isolate significant determinants of agricultural trade flows is the gravity model regression analysis. Prior to this, time series characteristics of the variables employed in the study were examined for unit root (non-stationary) using the Augmented Dickey Fuller (ADF) technique and are made stationary by differencing in order to avoid spurious regression associated with time series data.

In trade analysis, the mass of the bodies are represented by the gross domestic product (GDP) of the exporting and importing countries, while distance is measured as the shortest possible distance measured in kilometres between the two trading countries. In empirical studies, policy variables are added to assess and estimate deviations from the baseline trade flows. The model has a significant explanatory power in trade analysis [12] and [8].

In estimation, the gravity model is usually specified in natural logarithmic functional form, linking the bilateral trade flows of individual country pair to the product of their GDPs, per capita GDPs, population and the distance between them plus an error term to capture the random component in the data. In most applications, additional independent variables are also often included in the model to improve the fit [7].

In this study, the included variables are exchange rate, inflation rate and export tax. A language dummy for a country pair is assigned 1 if they share a common language and 0 otherwise. The selected agricultural export commodities for this study are cocoa, palm kernel, seed cotton, cashew nuts and ginger. The analysis covered the period between1970 to 2019.

The empirical form of the model that was used in this study is given as follows:

$$\ln Y = \ell_0 + \ell_1 \ln X_1 + \ell_2 \ln X_2 + \ell_3 \ln X_3 + \ell_4 \ln X_4 + \ell_5 \ln X_5 + \ell_6 \ln X_6 + \ell_7 \ln X_7 + \ell_8 \ln X_8 + \ell_9 \ln X_9 + \ell_{10} \ln X_{10} + \ell_{11} X_{11} \quad \text{......................................(1)}$$

where:

$\ln Y$ is the log of value agricultural exports from Nigeria.

$\ln X_1$ is the log of volume of agricultural exports from Nigeria

$\ln X_2$ is the log of value of agricultural imports from trading partners

$\ln X_3$ is the log of real exchange rate

$\ln X_4$ is the log of export tax levied on agricultural export commodities valued in Naira

$\ln X_5$ is the log of rate of inflation in the economy

$\ln X_6$ is the log of Gross Domestic Product (GDP) of Nigeria

$\ln X_7$ is the log of Gross Domestic Product (GDP) of Nigeria's trading partners

$\ln X_8$ is log of the population of Nigeria

$\ln X_9$ is the log of population of Nigeria's trading partners

$\ln X_{10}$ is the log of distance, measured in nautical miles between Nigeria and her trading partners

$\ln X_{11}$ is the log of language dummy (1 for the same language 0 otherwise)

ℓ_0 is the constant of the regression

ℓ_1----- ℓ_{11} are parameters to be estimated

The selected Nigeria's trading partners for this study are United States of America and United Kingdom.

RESULTS AND DISCUSSIONS

Trend in Agricultural Trade in Nigeria (1970-2019)

The trend in agricultural trade flows in Nigeria between 1970 and 2019 is presented in Table 1 and Figure 1. The table and figure reveals that the average values of agricultural exports decreased progressively from 1970-79 sub-period to 1990-99 sub-period, but rose significantly during the 2000-09 and 2010-19 sub-periods. The average value of agricultural exports for the period under study is $322,393.5.

Similarly, the average volume of agricultural imports rose significantly between 1970-79 and 2010-19 sub-period. The average value of agricultural imports for the period under study is $343,247.7.

Table 1. Trend in Agricultural Trade in Nigeria (1970-2019)

Sub-period	Average value of Agricultural Exports ($)	Average value of Agricultural Imports ($)	Average balance of Agricultural Trade ($)
1970-79	316,106.8	34,129.0	231,977.8
1980-89	244,311.1	174,694.3	69,616.8
1990-99	173,661.0	136,755.4	3,905.6
2000-09	353,174.9	383,979.7	-269,077
2010-19	547,193.6	1,002,617	-455,423.4
All period	**322,393.5**	**343,247.7**	**-1,130,000**

Source: Computed from FAOSTAT, NBS and CBN Statistical Bulletin, 2020.

However, average balance of agricultural trade decreased progressively over the period of the study, with a deficit balance of agricultural traded recorded during the 2000-

09 and 2010-19 sub-periods. The average agricultural balance of trade over the study period is $-1,130,000.

In summary, there was a declining trend in earnings from agricultural exports, while expenditure on agricultural imports increased significantly, resulting into a deficit balance of agricultural trade during the period of the study.

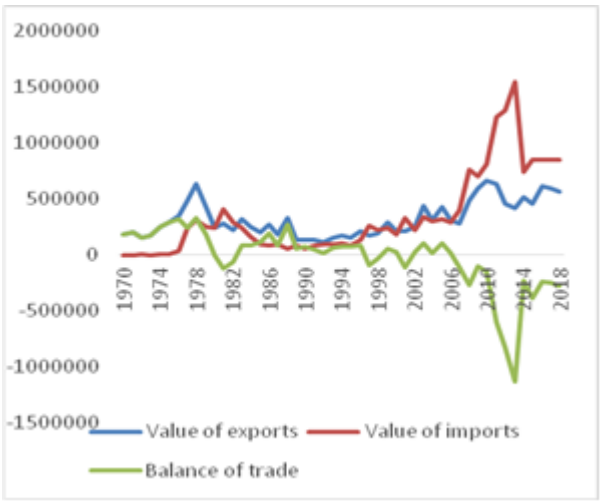

Fig. 1. Trend in Agricultural Trade in Nigeria (1970-2019)
Source: Author computation, 2020.

Result of Gravity Regression Analysis of the Determinants of Agricultural trade Flows between Nigeria and United States of America

The result of gravity regression analysis of the determinants of agricultural trade flows between Nigeria and United States of America is presented in Table 2. The coefficient of determination (R^2) is 0.74 and the F- statistic is 124.30 which is statistically significant at 1% level, showing that the model has a good fit.

Table 2 presents the result of gravity regression analysis for United States of America. The coefficients of log of exchange rate (X_3), Nigeria gross domestic product (GDP) (X_6) and log of export tax on agricultural export commodities (X_4) are significant at 1%, 1% and 5% level respectively. The result implies that bilateral agricultural trade flows between Nigeria and United States of America is highly elastic to exchange rate, Nigeria GDP and export tax on agricultural commodities.

This result implies that an increase in bilateral agricultural trade flows between Nigeria and United States of America would boost Nigeria's output capacity of agricultural export commodities, and would improve agricultural export earnings and revenue generated through export taxes on agricultural export commodities traded with the United States under an agricultural exports friendly exchange rate.

Table 2. Result of Gravity Regression Analysis of the Determinants of Agricultural Trade Flows between Nigeria and United States of America.
Dependent Variable = Ln Y

Variable	Coefficient	Standard Error	t-Statistics	Probability
lnX_1	6.646	4.406	1.508	0.144
lnX_2	-12.097	11.008	-1.099	0.282
lnX_3	30.267	8.119	3.727	0.001*
lnX_4	36.416	16.444	2.214	0.036**
lnX_5	-33.620	734.304	-0.046	0.936
lnX_6	11.024	4.734	2.326	0.028*
lnX_7	6.262	12.637	0.495	0.624
lnX_8	0.230	0.482	0.478	0.637
lnX_9	-25.864	45.024	-0.574	0.571
lnX_{10}	11.195	13.586	0.824	0.418
lnX_{11}	83.553	666.909	0.125	0.901
Constant	-11.525	4.848	-2.377	0.225
R^2 = 0.74				
F = 124.30*				

Source: Data Analysis, 2020
*Coefficient significant at 1% level.
**Coefficient significant at 5% level

Result of Gravity Regression Analysis of the Determinants of Agricultural trade Flows between Nigeria and United Kingdom.

The result of gravity regression analysis of the determinants of agricultural trade flows between Nigeria and United Kingdom is presented in Table 3.

The values of coefficient of determination (R^2) and F statistic are 0.63 and 121.40 respectively. The F-value is statistically significant at 1% level. This shows that the model has a good fit. The result of gravity regression analysis for United Kingdom reveals that the coefficients of log of exchange rate (X_3), log of Nigeria's GDP (X_6) and log of Nigeria's population (X_8) are positive and statistically significant at 1%, 5% and 1% level respectively This result exerts that bilateral agricultural trade between Nigeria and United Kingdom is positively elastic to exchange rate, Nigeria's GDP and Nigeria's population.

Conversely, the coefficient of log of distance between Nigeria and United Kingdom is negative and statistically significant at 1% level.

This result implies that expansion in market size of Nigeria and output capacity of agricultural export commodities are factors that would facilitate bilateral agricultural trade flows between Nigeria and the United Kingdom. However, distance between markets of both countries would impede bilateral agricultural trade flows. This might be due to high logistics and transportation cost incurred by exporters as a result of higher value of pound sterling relative to the naira.

Table 3. Result of Gravity Regression Analysis of the .Determinants of Agricultural Trade Flows between Nigeria and United Kingdom

Dependent Variable = Ln Y

Variable	Coefficient	Standard Error	t-Statistics	Probability
lnX_1	6.646	4.406	1.508	0.144
lnX_2	=12.67	50.119	-0.604	0.550
lnX_3	8.409	2.085	4.029	0.000*
lnX_4	-12.097	11.008	-1.099	0.282
lnX_5	-11.525	9.585	-1.202	0.318
lnX_6	4.341	1.734	2.503	0.028**
lnX_7	-0.046	0.248	-0.186	0.854
lnX_8	5.208	1.038	5.07	0.000*
lnX_9	12.340	9.204	1.341	0.190
lnX_{10}	-40.639	15.784	-2.574	0.052**
lnX_{11}	3.396	11.983	0.283	0.779
Constant	-10.545	7.840	-1.345	0.225
R^2 = 0.63				
F = 121.40*				

Source: Data Analysis, 2020

*Coefficient significant at 1% level.

**Coefficient significant at 5% level

CONCLUSIONS

This study examined the influence of macro-economic variables (exchange rate, inflation rate and export tax on agricultural export commodities) on agricultural trade flows between Nigeria and her trading partners.

The study concluded that bilateral agricultural trade between Nigeria and her trading partners in the study is elastic to exchange rate, agricultural export tax, Nigeria GDP, Nigeria population and distance between Nigeria and United Kingdom.

Based on the findings from the study, there is need for effective and efficient monetary and fiscal policies to monitor exchange and export tax in the economy in order to provide conducive macro-economic environment that will stimulate and promote agricultural trade flows. This will help to maximize earnings from agricultural exports.

There should also be improved bilateral trade agreement between Nigeria and her trading partners, this will ensure a friendly macro-economic environment that will stimulate mutual benefits from agricultural trade.

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