Analysis of Nigeria's Bilateral Agricultural Exports and Trade Potentials using a Structural Dynamic Gravity Model, 1970-2016

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Aims: This study analysed Nigeria's bilateral agricultural exports and agricultural export trade potentials with 51 other countries, who are its major trading partners.
Methodology: The study was based on panel data of trade with 51 countries over a 47 years period, from 1970-2016. The data were obtained from the United Nations Comtrade, the World Bank Open Data and the Centre for Prospective Studies and International Information (CEPII gravity dataset), The structural dynamic gravity model was analysed using the general method of moments, while the trade potential was determined using the speed of convergence methods.
Results: The average value of Nigeria's agricultural exports to its trading partners over the study period was $26.2 million (USD). Also, the highest averages were recorded with Turkey, Malaysia, Sweden, Sierra Leone, Cameroon, Saudi Arabia, India, Japan, Togo, and Israel. Ten factors were found to be significant in determining the country's agricultural exports in both the short-run and in the long-run. These include, the lags of agricultural exports, reciprocal and quasi-total trades, the gross domestic products (GDPs) of the trading pair, inflation rates, similarity in countries GDPs, free trade agreements, foreign currency reserve, common colonizer and common language. The study also found out that Nigeria has a convergent trade situation with 19 countries, and a divergent situation with 27 other Countries.
Conclusion: The identified priority markets for Nigeria's agricultural exports include United Kingdom, Norway, Bulgaria, Czech Republic, Germany, Belgium, Italy, Cyprus and Portugal. Other include Ireland, Netherland, Spain, Austria and Greece China, Israel, Saudi Arabia, Hong Kong, and the United States of America. The terms of agricultural trade with countries with convergent trade situations should be reviewed to resolve barriers or restrictions. 'Overtraded' markets with active trade relations should still be maintained, while value additions should be used to drive export diversification efforts.

Keywords: Agricultural Exports; Bilateral-Trade; Trade-Potentials; Priority-Markets

1. INTRODUCTION

The agricultural sector is very important to the economy of Nigeria. It remains the country's major employer of labour since the 1960s and is considered to hold the keys to eradicating extreme poverty and hunger, addressing the rising unemployment, food insecurity and nutrition challenges, with huge potentials as a major foreign exchange earner. The sector made significant contributions to the country's economy in the early 1960s, but started to

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show sign of decline from the 1970s, particularly in terms of its contribution to the country's total export over the study period. The consequences of this decline are the loss of market shares in the export of key tropical agricultural commodities (National Bureau of Statistics, 2016). The Federal Ministry of Agriculture and Rural Development (FMARD, 2012) attributed the decline to low productivity and poor market performance, while Oluwatoyese et al. (2016) attributed it to deterioration in terms of trade which weakened demand for Nigeria's agricultural exports. According to FMARD (2012), the major constraints militating against the expansion of Nigeria's agricultural export market include the limited awareness and understanding of key export markets (market knowledge that also include tariff regimes), and lack of quality market information to enable identification of market opportunities, coordination among market actors and transparency. However, the Organization for Economic Cooperation and Development (OECD, 2015) identified two major limiting factors among others to the expansion of Nigeria's agricultural export trade. One was the challenge of finding niches for export in which it can gain in both value addition and export diversification, and two, its underutilization of existing market access opportunities. Also, according to the OECD (2015), the Nigeria's National Trade Policy had correctly identified agriculture as one of the key economic sectors on which to focus export promotion efforts, however, it posited that this should also be accompanied with an analysis of the destination markets in other to understand what influences Nigeria's trade relations with the rest of the world. This study therefore, analysed Nigeria's bilateral agricultural exports and agricultural trade potentials using a structural dynamic gravity model based on panel data of bilateral agricultural trade with 51 countries from 1970-2016. Therefore, the objectives of this study using the stated model, is to find out whether trade determinants in the gravity literature are consistent with the trade patterns in Nigeria in both the short-run and in the long-run. In addition, it determined the trade status of Nigeria's traditional trading partners, and identified from amongst them potential markets for deepening Nigeria's agricultural export trade. The study also aims at bridging the knowledge gap in existing literature related to Nigeria's sectoral and bilateral trade analysis. It is expected that its findings will be helpful to policy and other decision-makers involved in the country's trade to know where to concentrate export promotions from its long list of diverse trading partners.

2. LITERATURE REVIEW

2.1 Theoretical Framework

The trade gravity equation is derived from the Newton Law of Universal Gravitation, and in its most basic form, is used to explain the bilateral trade flows between two countries, which is said to be direclty proportional to their sizes measured by their natonal products and inversely proportional to the distance between them. However, according to Paas (2000), and Zhang and Kristensen (2010), the first attempt to explain the theory behind the gravity model could be traced to the work of Linnemann (1966), who asserts that the gravity model is a reduced form from a four-equation partial equilibrium model of export supply and import demand, with the exclusion of prices from the model, considered to work only as an adjustment mechanism between supply and demand (Bergstrand, 1985). According to Baier and Bergstrand (2007), Anderson (1979) was considered to have offered the first theoretical foundation for the gravity model under the assumption of product differentiation by place of origin (based on Armington assumption or preferences) and Constant Elasticity of Substitution (CES) expenditures. Also, according to Yotov et al. (2016), several other researchers have been able to draw a strong theoretical foundation for the gravity model from several economic theories of international trade such as using a single economic model with monopolistic competition; a Heckscher-Ohlin framework; a Ricardian framework; entry of heterogeneous firms, selection into markets; a sectoral Ricardian model; a sectoral input-output linkages gravity model based on Eaton and Kortum, 2002 (cited in Caliendo and

Parro, 2015), and a dynamic framework with asset accumulation (Olivero and Yotov, 2012, Yotov *et al*., 2016, and Eaton *et al*., 2016). Importantly, irrespective of the approaches from which the gravity model is derived, they are all based on differing opportunity costs. Therefore, the gravity model is now theoretically founded, as several scholars have been able to derive it from different trade theories, thereby making it the most versatile tool in trade flows analysis.

2.2 Conceptual Framework

Analysis of Nigeria bilateral agricultural exports and potential trade is conceptualized as Figure 1 which explains the relationship between agricultural exports and a number of factors obtained from the characteristics of the trading pair and are thought to influence or determine the flow between them. These factors include gross domestic products, foreign exchange rate, foreign currency reserve, similarities in country size, relative factor endowment, inflation rate and membership of trade union. The total exportable agricultural commodities constitute the total potential supply from the origin country, which is equal to the total potential demand from the destination country. The trade potential is however subject to certain trade barriers represented by distance, common border, common language and common colonizer. The exports are also affected by other trade resistance factors not directly observable, which are country specific (or due to country pair effects) and constitute an export bias. The trade flows could also be affected by the presence or absence of trade arrangements between the exporting and importing countries represented by the free trade agreement. Other factors that are considered to likely affect the bilateral trade flows include persistence in trade, trade compatibility and partial adjustment to disequilibria, represented by lagged values of agricultural export, reciprocal trade and quasi-total trade respectively. The actual trade flow therefore is less than the potential trade flow because of the unrealized potentials, which is also due to the trade barriers. Some of these trade barriers are unobservable and create either an export bias or an import bias, which are inherent characteristics in either the exporter or the importer, between the exporter and importer and between the exporter and the rest of the world, as well as between the importer and the rest of the world.

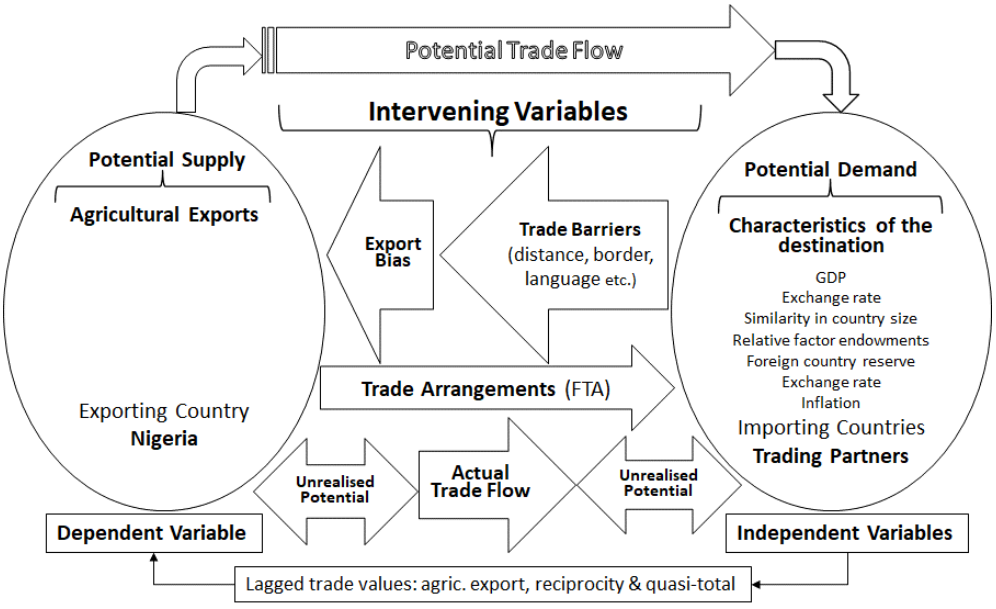

Figure 1: Conceptual framework for analysis of Nigeria agricultural exports and bilateral trade potential. Adapted from department of trade and industry (2004).

2.3 Review of Related Empirical Studies

According to Head and Mayer (2014), the two key features of trade data that mirrors the physical gravity equation is that exports rise proportionately with the economic size of the destination and imports rise in proportion to the size of the origin economy. Binh et al. (2013) applied the gravity model to analyse bilateral trade between Vietnam and 60 countries from 2000 to 2010 using both the pooled and random effects model estimation on panel data. Sebbagh et al. (2015) also used it to examine the determinants of trade flows among Arab Maghreb Union (AMU) group members from 1995 to 2011. Anderson and Yotov (2013) investigated the effects of free trade agreement on bilateral trade flows in a study that involved 40 countries and a rest of the world aggregate using an endowment general equilibrium model and found out that the effects were positive and statistically significant. However, there are concerns that the standard gravity model is static and biases the estimates of the gravity coefficients. Furthermore, according to Sohn (2005), most evidence that the gravity model works well comes from aggregate data and that very little work has been done with disaggregated data, and this also provides a strong rationale for doing so. Yotov et al. (2016) suggested the use of disaggregated data considering the heterogeneity of many policies across sectors, coupled with the availability of such data. Although, the gravity model has proven to be very important in the analysis of bilateral trade flows and has been widely used in the empirical literature to explain bilateral trade and export determinants (Hatab et al., 2010). There are very few studies known to the researchers that modelled bilateral trade flows between Nigeria and its trading partners, and far fewer studies that considered the agricultural sector. In addition, no study known to the researchers have considered the dynamic nature of trade flow data in analyzing Nigeria's bilateral trade. For instance, Sandrey et al. (2007) used the Global Trade Analysis Project (GTAP) computer model to assess the likely benefit of a full Free Trade Agreement (FTA) between Nigeria and the European Union (EU) by 2015. The GTAP simulation was based on the Computable General Equilibrium (CGE) application that is concentrated on tariff cuts, and neglected the inclusion of any non-tariff measures in the model. Akanni et al. (2009) analysed the effect of free trade policy of Nigeria on the average market prices of three traditional cash crop exports using trend and regression analysis techniques. The trade policy instruments analysed by the study which included exchange rate, tariffs/ duties and export quotas were not directly modelled. Ariyo (2013), analysed the impact of international trade on Nigerian economy from a historical perspective and before the advent of modern economic system. Reuben et al. (2013) conducted a study on the theoretical, analytical, and methodological issues on regional integration and bilateral trade in the ECOWAS sub-region based on evidence from literature on the gravity model of trade. Nwali and Arene (2015) conducted a study on effects of economic partnership agreements on agricultural trade between Nigeria and the European Union using smart simulation Computable Partial Equilibrium (CPE) Methodology; and Aliyu and Bawa (2015) assessed the determinants of the flow of Nigeria's exports using aggregated data from 1999 to 2012 based on a static model.

3. METHODOLOGY

3.1 Study Area

The study was carried out in Nigeria (Figure 2), which is located in West Africa. It lies on latitude 9.082º North and longitude 8.6753º East of the Greenwich Meridian. Nigeria is bounded to the West by the Republic of Benin, to the East by Chad and Cameroon Republic, to the North by Niger Republic and to the South by the Atlantic Ocean with a coastline that stretches to about 853 kilometers. It occupies a land area of 923,768 square kilometers, with 31.29% arable land and an estimated population of 182 million. Its major export commodities include cashew nuts, cocoa, cotton, coffee, palm oil and rubber. Others include kolanut, tea, sugarcane, gum Arabic, shea nut, ginger, garlic and sesame seed. Its 10 top countries in total export include India, United States of America, Spain, Netherland, France, Indonesia, South Africa, Canada, United Kingdom, and Italy. Crude and other oil products accounts for about 95% of its total export as at third quarter of 2017, while agricultural products accounts for less than one percent (National Bureau of Statistics, 2017).

Figure 2: Nigeria, Map no.4228, Rev.1 August 2014.
Source: The United Nations (Reproduced with permission)

3.2. Method of Data Collection

Secondary data consisting of annual time series covering a period of 47 years (1970-2016) on Nigeria's commodity trade with 51 countries were obtained from the United Nations Comtrade Database (UN Comtrade), and dataset covering the same period on exchange rate, population, foreign currency reserve, inflation and gross domestic product were obtained from the World Bank Open Data, while additional gravity data on geographic distance, common language and common history, regional trade agreement, currency union, and land area were obtained from the Centre for Prospective Studies and International Information (CEPII), Keith et al., 2015.

3.3. Measurement of variables

There were two equations (models) that were analysed. The first was the structural dynamic gravity model, and the second was the equations for estimating trade potentials. The variables used in these models, their measurements and a priori expectations where applicable are presented in Table 1.

Table 1. Description of variables and expected signs

Gravity variable	Description	a priori expectations
Dependent variable		
Agricultural exports	Total bilateral agricultural exports from Nigeria to its trading partners measured in current US dollars	
Independent variables		
Real Gross Domestic Product (GDP)	This is the total monetary value of goods and services produced in a country during one year. It is measured in current US dollars.	Positive
Real Effective Exchange Rate	This is the real (nominal) appreciation of the effective exchange rate between the exporter and the importer. It is used as a proxy for relative prices.	Negative
Relative factor endowments	This is a proxy variable measured by the differences in per capita GDPs of the trading pair of countries. The variable is defined as RELFACijt = [PCGDPjt – PCGDPit], where PCGDP is the per capita real GDP of the exporter and the importer respectively.	Positive
Similarity in country sizes	This a measure of the relative sizes of a pair of trading countries in terms of GDP and is defined as $SIMZ_{ijt} = 1 - \left(\frac{\text{GDP}_{it}}{\text{GDP}_{it} + \text{GDP}_{jt}}\right)^2 - \left(\frac{\text{GDP}_{jt}}{\text{GDP}_{jt} + \text{GDP}_{it}}\right)^2$	Positive
Foreign Currency Reserve	This is the total reserve minus gold that comprise of special drawing rights, reserve of International Monetary Fund (IMF) members held by the IMF, and holdings of foreign exchange under the control of monetary authorities measured in U.S. dollars.	Positive
Bilateral Distance	This is the population weighted bilateral distance (km) between the exporter and importer.	Negative
Common border	This is a dummy variable that takes the value of 1 if the exporter and importer share a common border,	Positive

	otherwise 0.	
Common Language	This is a dummy variable that takes the value of 1 if both exporter and importer share a common border, otherwise 0.	Positive
Common Colonizer	This is a dummy variable that takes the value of 1 if the exporter and the importer have a common colonizer post-1945	Positive
Inflation	This is the annual inflation rate of the exporting country.	Negative
Free Trade Agreements	This is a dummy variable that takes the value of 1 if the pair of trading countries share common membership of a regional trade agreement, otherwise 0	Positive
Lagged agricultural export	This is the lagged values of the bilateral agricultural exports which is expected to have a positive effect on agricultural exports from the origin or exporting country	Positive
Lagged reciprocal trade	This is the lagged value of the reciprocal trade values that accounts for trade compatibility between two trading countries, measured in current U.S dollars.	Positive
Lagged quasi-total trade	This is the lagged quasi-total export variable that accounts for partial adjustment to disequilibria in export trade. It is measured in current U.S dollars.	Positive
Trade potential variables		
Speed of convergence (SC)	This is the ratio of the average growth rate of potential trade to average growth rate of actual trade multiplied by 100 and subtracted from 100.	
Potential trade value	This is the maximum level of agricultural export trade given the current level of determinants of agricultural export trade and existing levels of export trade restrictions or bias. It is a predicted value from the gravity equation.	
Actual trade value	This is the observed value of agricultural exports measured in U.S. dollars.	
Time of convergence	This is the ratio of the difference between the potential and actual trade values denoted by ΔT, and the speed of convergence (SC).	

Source: Authors compilation, 2021

3.4. Model Specifications

3.4.1 The structural dynamic gravity model

The log-linearized standard gravity model following Harris *et al*. (2008), is given by:

$X_{ijt} = Y'_{ijt}\beta + \prod_i + P_j + \lambda_t + \mu_{ijt}$ …… (2.7)

Where:

- X_{ijt} is the dependent variable and represents the value of agricultural export flows from country i, Nigeria (exporter) to country j (importer) in time t
- Y'_{ijt} is the vector of structural explanatory variables that include:
  - Real gross domestic product of exporter and importer (GDP_{it} and GDP_{jt})
  - Real exchange rate between country i and country j ($REER_{ijt}$).
  - Differences in relative factor endowments, proxied by differences in per capita GDPs of the trading pair of country ($RELFAC_{ijt}$).
  - Similarity in relative size of trading countries in terms of GDP ($SIMZ_{ijt}$)
  - Target country foreign currency reserve ($FCURR_{jt}$).
  - Distance between the two trading countries in km ($DISTW_{ij}$)
  - Dummy variable for common border (CM_BDR_{ij})
  - Dummy variable for common language (CM_LANG_{ij})
  - Dummy variable for common colonizer (CM_COL_{ij})
  - Inflation rate of Nigeria ($INFL_{ij}$)
  - Dummy for free trade agreements (FTA_WTO)
- $\prod_i$ is the unobserved supply effect/ outward multilateral resistance term
- P_j is the unobserved demand effect/ inward multilateral resistance term
- λ_t is the unobserved time effect (business cycle effect)
- T is the time period
- β is the unknown parameter vector
- μ_{ijt} is the idiosyncratic error (disturbance term)

To obtain a structural dynamic gravity model that accounts for dynamic reciprocity and convergence to equilibrium, equation (2.7) was augmented with three additional variables to yield equation 2.9, expressed as:

$X_{ijt} = X_{ijt-1}\delta_1 + Y'_{ijt}\beta + X_{jit-1}\delta_2 + X_{ij*t-1}\delta_3 + \lambda_t + v_{ijt}$…… (2.9)

$v_{ijt} = \alpha_{ijt} + \mu_{ijt}$; $\alpha_{ijt} = \prod_i + P_j$

Where:

- X_{ijt-1} is the lagged dependent variable,
- X_{jit-1} is the lagged reciprocal interaction variable
- X_{ij*t-1} is the lagged quasi-total export variable
- $X_{ij*t} = \sum_j Y_{ijt}$ j=1,…j-1, j+1,…N, j≠ i
- α_{ijt} is individual specific effects for both exporter (country i) and importer (country j)
- N is the number of cross section units
- $\delta_1, \delta_2, \delta_3$ are parameters that relate to the dynamic components.

All non-Boolean variables were entered in natural logarithm form. The model was estimated using instrumental variables based on two-step system GMM and iterated GMM approaches with Windmeijer corrected standard errors (Kripfganz & Schwarz, 2015; Kripfganz, 2019).

According to Hansen *et al.* (1996), the iterated GMM estimator updates the weighting matrix and coefficient estimates until convergence, while Hansen & Lee (2018), posits that it removes the arbitrariness in the choice of the initial weighting matrix.

3.4.2. The speed of convergence method

The speed of convergence method (SC) is used to determine potential exports, and calculated from the equation:

$$SC = \left(\frac{Average\ growth\ rate\ of\ potential\ trade}{Average\ growth\ rate\ of\ actual\ trade}\ X\ 100\right) - 100 \quad \ldots\ldots\ldots\ldots\ldots \quad (3.1)$$

The SC result is compared with the difference between potential trade and actual trade values to determine whether there is a convergence or divergence in trade situation.
The difference between potential and actual trade value is expressed as:

$$\Delta T = \text{Potential Trade} - \text{Actual Trade} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.2)$$

If SC and ΔT are of unlike signs, the trade situation is convergent, but if they are of like signs, it is divergent. Countries with a convergence have high potentials for developing bilateral trade, while those with divergence have either reached their limit (overtrading) or faced with restrictive potential trade.
To determine an overtrade or restrictive potential trade situation, the decision rule is:
if $\Delta T < 0$: it is an overtrade, and if $\Delta T > 0$: it is restrictive potential trade
The time of convergence (t_c), computed from the ratio of ΔT and SC following Binh *et al*. (2013), is used to determine the most potential bilateral trade partners. And based on this, countries with smaller ratios were considered to have the most potentials for bilateral trade.
The time of convergence (t_c) is expressed as:

$$t_c = \frac{\Delta T}{SC} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3.3)$$

Where t_c, ΔT and SC are as defined.

4. RESULTS AND DISCUSSION

4.1. Summary of Nigeria's bilateral agricultural export trade

The summary of Nigeria's bilateral agricultural export trade over the study period, and with the selected trading partners is presented in Table 5. The result obtained shows that the average value of the country's bilateral agricultural exports to its trading partners was about $26.2 million (USD). Its top 10 all-time export markets include Turkey, Malaysia, Sweden, Sierra Leone, Cameroon, Saudi Arabia, India, Japan, Togo, and Israel. Other major destinations for its agricultural exports in Africa over the study period include Algeria, Benin, Burkina Faso, Congo, Cote d'Ivoire, Ghana, Niger republic and Morrocco.

4.2. Short-run GMM estimations of the dynamic gravity model

The dynamic gravity model was analysed with and without year dummies using the 2s-sGMM and the iGMM estimation techniques, and the results obtained are presented in Table 2. The 2s-sGMM and the iGMM estimations produced similar results. The year dummies improved the GMM estimators' performance particularly for the coefficients of the time-varying regressors. The post-estimation tests carried out included the Sargan-Hansen test of overidentification under the null hypothesis that all the included instruments are valid; the Arellano-Bond test for autocorrelation of the first differenced residuals under the null hypothesis of no higher order serial correlation of the residuals; and the model underidentification test under the null hypothesis that the excluded instruments are relevant. The results obtained shows that all the tests were valid. The significant variables at 10%, 5%

and 1% were also indicated in the table, and interpreted as elasticities, ceteris paribus. Furthermore, to interpret the effect of the dummy variables, their coefficients were transformed into elasticities following Baccheta et al. (2012), with the equation for these transformations given as:

$$\text{Elasticity} = \exp(a)^{-1}$$

Where (a) is the structural coefficient of the dummy variables.

Therefore, free trade agreement and common colonizer is associated with a 0.086% and 0.377% increase in agricultural exports respectively, while common language is associated with 0.27% decrease in the short-run, on average ceteris paribus. The effects of these variables on Nigeria's agricultural exports were inelastic in each case.

Table 2. Results of short-run GMM estimations of the dynamic gravity model

Variables	(2s-sGMM1) lexp1	(2s-sGMM2) lexp1	(iGMM1) lexp1	(iGMM2) lexp1
L.lexp1	0.554***	0.518***	0.553***	0.519***
	(0.0496)	(0.0512)	(0.0499)	(0.0498)
L.lrecpro	0.214***	0.177***	0.215***	0.177***
	(0.0293)	(0.0271)	(0.0293)	(0.0270)
L.lquasi	0.0357	0.0809**	0.0358	0.0805**
	(0.0397)	(0.0364)	(0.0403)	(0.0353)
lgdp_i	0.156*	0.783***	0.158*	0.786***
	(0.0943)	(0.159)	(0.0940)	(0.156)
lgdp_j	0.0403	0.137*	0.0397	0.133*
	(0.0668)	(0.0746)	(0.0679)	(0.0746)
lreer	-0.0977	-0.0530	-0.105	-0.0524
	(0.110)	(0.0718)	(0.121)	(0.0646)
lrelfac_ij	-0.109	0.0275	-0.110	0.0256
	(0.0932)	(0.0997)	(0.0942)	(0.0984)
lsimz_ij	0.363**	0.330*	0.364*	0.326**
	(0.160)	(0.170)	(0.163)	(0.164)
linfl_o	-0.691***	-0.864**	-0.691***	-0.867**
	(0.217)	(0.440)	(0.217)	(0.441)
fta_wto	1.289***	1.862***	1.286***	1.872***
	(0.470)	(0.486)	(0.474)	(0.486)
eu_d	-0.140	0.140	-0.143	0.153
	(0.287)	(0.260)	(0.290)	(0.243)
lfcurr	0.0512	0.120***	0.0515	0.118***
	(0.0472)	(0.0364)	(0.0471)	(0.0348)
cm_bdr	0.545	0.733	0.541	0.795
	(1.049)	(1.296)	(1.072)	(1.212)

cm_lang	-1.144***	-1.270***	-1.149***	-1.277***
	(0.355)	(0.353)	(0.366)	(0.342)
cm_col	0.867**	1.377***	0.863**	1.375***
	(0.399)	(0.392)	(0.399)	(0.392)
ldistw	0.287	-0.338	0.288	-0.328
	(0.202)	(0.272)	(0.203)	(0.275)
_cons	-2.407	-17.96***	-2.403	-17.99***
	(2.468)	(4.562)	(2.507)	(4.441)
No. of observations	846	846	846	846
No. of groups	48	48	48	48
No. of instruments	19	34	19	34
Year dummies/time trend included	No	Yes	No	Yes
F-statistics	$F_{16, 47}$=146.4 (0.000)	$F_{31, 47}$=116.3 (0.000)	$F_{16, 47}$=146.4 (0.000)	$F_{31, 47}$=116.3 (0.000)
Centered R2	0.6259	0.6673	0.6259	0.6673
Uncentered R2	0.9557	0.9606	0.9557	0.9606
Arellano-Bond stats.				
AR (1)	z = -3.9150 (0.001)	z = -4.0235 (0.0001)	z = -3.9177 (0.0001)	z = -4.0066 (0.0001)
AR (2)	z =-1.1877 (0.2349)	z =-1.5762 (0.1150)	z = -1.1883 (0.2347)	z = -1.5694 (0.1165)
AR (3)	z = 0.5359 (0.5920)	z = 0.7841 (0.4330)	z =0.5357 (0.5922)	z =0.7898 (0.4296)
Sargan-Hansen stats.				
Optimal weighing matrix (1)	2s-wm: x_2^2=1.2009 (0.5486)	2s-wm: x_2^2=3.3820 (0.1843)	10s-wm: x_2^2=1.1990 (0.5491)	9s-wm: x_2^2=3.3834 (0.1842)
Optimal weighing matrix (2)	3s-wm: x_3^2=1.2066 (0.5470)	3s-wm: x_3^2=3.4858 (0.1750)	10s-wm: x_2^2=1.1990 (0.5491)	9s-wm: x_2^2=3.3834 (0.1842)
Underidentification test (Kleibergen-Paap rk LM statistics)	$x_2^2 = 14.190$ (0.0027)	$x_3^2 = 27.399$ (0.0000)	$x_2^2 = 14.190$ (0.0027)	$x_3^2 = 27.399$ (0.0000)
Number of iterations	0	0	10	9
MMSC-AIC		-0.6180		-0.6166
MMSC-BIC		-4.3604		-4.3590

Significance at: *10%, **5% and ***1%.
Standard errors for the gravity variables are in parentheses
The p-values for the F-statistics are in parenthesis
Note: all the time varying variables are in log form except fta_wto and eu_d which are dummy variables. Also, all time-invariant variables are dummies except population weighted distance (ldistw) which is in log form. The estimators were abbreviated as follows: “2s-

sGMM1" and "2s-sGMM2" refers to the two-step system GMM estimation without and with year dummies respectively. "iGMM1" and "iGMM2" refers to iterated GMM estimations without and with year dummies respectively. The standard errors of the variables are Windmeijer corrected and hence robust to serial correlation and heteroskedasticity and are reported in parenthesis. The Sargan-Hansen statistics (1) and (2) for the 2s-sGMM1 and 2 were computed from the 2/3-step weighting matrixes, while for iGMM1 and 2, they are computed from the 40/41-step and 10/11-step weighting matrixes respectively. The p-values of the Arellano-Bond statistics for autocorrelation test of the first differenced residuals, Sargan-Hansen statistics for test of overidentifying restrictions and the underidentication test statistics are reported in parenthesis. The reported GMM estimates in Table 2 are short-run estimates

Source: Author's computation, 2021.

4.3. Long-run coefficients of the GMM estimations

The long-run GMM coefficients were generated from the significant short-run coefficients estimated from the structural dynamic gravity model using the 2s-sGMM estimator. The long-run effects of the kth parameter were computed as:

$$\beta_k \div [1 - \Phi]$$

Where β_k is the significant short-run coefficient of the kth parameter, and ϕ is the lag of the dependent variable, agricultural exports (lexp1).

The results of these analyses are presented in Table 3 and shows that all the variables that were significant in the short-run at either 10%, 5% or 1% were also found to be significant in the long-run, ceteris paribus, with larger effects in the long-run than in the short-run.

Table3. Results of long-run GMM estimations of significant short-run coefficients

Variables	**(2s-sGMM2)**	
Lexp1	**Short-run**	**Long-run**
L.lexp1	0.518***	1.074***
	(0.0512)	(0.2202)
L.lrecpro	0.177***	0.367***
	(0.0271)	(0.0588)
L.lquasi	0.081**	0.167**
	(0.0364)	(0.0708)
lgdp_i	0.783***	1.624***
	(0.159)	(0.3447)
lgdp_j	0.137*	0.284*
	(0.0746)	(0.1506)
lsimz_ij	0.330*	0.684*
	(0.170)	(0.3517)
linfl_o	-0.864**	-1.792*
	(0.440)	(0.9464)

fta_wto	1.862***	3.861***
	(0.486)	(1.1323)
Lfcurr	0.120***	0.248***
	(0.0364)	(0.0697)
cm_lang	-1.270***	-2.634**
	(0.353)	(0.7749)
cm_col	1.377***	2.856***
	(0.392)	(0.8063)

*Significance at: *10%, **5% and ***1%.*
The standard errors are reported in parenthesis.
Source: Author's computation, 2021.

Furthermore, the country's agricultural export on one hand, exhibited an elastic relationship with lagged agricultural export, GDP of the exporter, FTA, inflation, common language and common colonizer, while on the other hand, it exhibited an inelastic relationship with the lagged values of reciprocal and quasi-total trade, foreign currency reserve, GDP of the importer, and relative country sizes. Lastly, the result of the hypothesis test of the significance of the export determinants is presented in Table 4. The null hypothesis of this test is that there is no significant relationship between the identified export determinants and the Nigeria's agricultural exports. The null hypothesis is stated as,

H_0: $\beta_k = 0$, where β_k is the k[th] parameter of the estimates.

The result obtained shows that there is a significant relationship between the listed variables and the country's agricultural exports.

Table 4. Result of hypothesis test of the agricultural export determinants

Variables	**chi2**	**df**	***p*-value**	
Lagged agricultural export	102.310***	1	.000	#
Lagged reciprocal trade	42.830***	1	.000	#
Lagged quasi trade	4.940**	1	.026	#
GDP of exporter	24.130***	1	.000	#
GDP of importer	3.370*	1	.066	#
Similarity in country size	3.770*	1	.052	#
Inflation rate of exporter	3.860**	1	.049	#
WTO free trade agreement	14.680***	1	.000	#
Foreign Currency Reserve	10.830***	1	.001	#
Common Language	12.920***	1	.000	#
Common Colonizer	12.340***	1	.000	#
All	**1116.650**	**11**	**.000**	

*Note: # denotes unadjusted p-values significance level: *10%, **5%, ***1%,*
Source: Author's computation, 2021.

The result of this study is consistent with the findings by Haris et al. (2008) on the effect of

GDPs of both importer and exporter, and lagged values of the dependent variables, reciprocal trade and quasi-total trade on current export, but differs with their findings on the effect of similarity in country size, foreign currency reserve and common language. The study was also consistent with the findings by Tripathi and Leitão (2013), and Cho and Zheng (2017) on the effects of lagged trade values as well as GDPs on current export trade, and inconsistent with the findings of Cho and Zheng (2017) on the effect of membership of the World Trade Organization (FTA_WTO), which was found to have an effect on Nigeria's agricultural trade flow. This is also consistent with Olivero and Yotov (2012), who found a strong positive effect of FTA on export both in the short-run and long-run. In addition, Gurevich and Herman (2018) also found that having colonial ties have a positive effect on export trade, while its findings on the effect of common language was inconsistent with the findings of this study.

4.4. Estimation of agricultural export trade potentials

The result of the computation of Nigeria's agricultural trade potentials presented in Table 5 shows that 17 out of 51 countries have a convergence trade situation with Nigeria, which is indicative of opportunities for growth in agricultural export trade. In addition, it had divergent trade situation with 29 countries, while the trade situation with 5 other countries were indeterminate. The analysis also showed that the overtrade situation with Austria and Greece was restrictive because the measure, $\Delta T > 0$ in each case. Therefore, only 27 countries out of the 51 in the analysis had an overtrade situation with Nigeria, while 19 in all are potential export markets for the country's agricultural commodities. Lastly, countries with larger magnitude of speed of convergence (SC) and smaller magnitude of trade difference (ΔT), or smaller time of convergence, are indicative of countries with the most trade potentials for agricultural export from Nigeria.

Table 5: Estimation of Nigeria's Agricultural Trade Potentials with 51 other Countries

Exporting country	Actual trade values	Potential trade values	Growth rate of…		Speed of convergence (SC)	Trade difference (ΔT)	Trade Potential status
			Potential trade	Actual trade			
Belgium-Luxembourg	7.33E+06	8.53E+06	1.15E+00	2.57E+04	-1.00E+02	1.21E+06	1
Bulgaria	3.56E+05	5.46E+05	1.16E+00	1.55E+02	-9.93E+01	1.91E+05	1*
China	4.49E+05	5.32E+05	1.34E+00	8.99E+03	-1.00E+02	8.33E+04	1*
Cyprus	2.40E+06	4.80E+06	6.52E-01	8.24E+00	-9.21E+01	2.40E+06	1
Czech Rep	9.79E+05	1.30E+06	3.21E-01	1.60E+00	-7.99E+01	3.21E+05	1
Germany	4.18E+06	3.80E+06	1.31E+00	8.18E-01	5.97E+01	-3.86E+05	1
Hong Kong SAR	8.05E+05	1.75E+06	9.97E+00	5.06E+01	-8.03E+01	9.46E+05	1
Ireland	1.79E+06	6.33E+06	2.36E+02	1.32E+03	-8.21E+01	4.54E+06	1
Israel	2.77E+07**	3.31E+07	8.70E+00	1.65E+03	-9.95E+01	5.40E+06	1
Italy	1.78E+06	3.30E+06	4.28E+00	1.62E+03	-9.97E+01	1.52E+06	1
Netherlands	1.38E+06	7.75E+06	2.32E+01	2.09E+04	-9.99E+01	6.37E+06	1
Norway	2.56E+06	2.68E+06	9.18E-01	6.65E+00	-8.62E+01	1.25E+05	1*
Portugal	1.37E+06	2.98E+06	3.17E+00	6.93E+00	-5.42E+01	1.61E+06	1
Saudi Arabia	4.55E+07**	5.85E+07	2.74E+00	7.23E+04	-1.00E+02	1.30E+07	1
Spain	2.35E+06	6.38E+06	1.26E+00	2.05E+00	-3.85E+01	4.03E+06	1
USA	1.55E+05	2.37E+05	8.10E-01	1.17E+02	-9.93E+01	8.29E+04	1*
United Kingdom	3.25E+06	3.32E+06	1.22E+00	5.50E+00	-7.78E+01	6.85E+04	1*
Algeria	5.37E+06	4.81E+06	1.85E+00	3.14E+00	-4.12E+01	-5.56E+05	0
Australia	2.07E+06	8.21E+05	3.48E-01	9.39E-01	-6.29E+01	-1.25E+06	0
Austria	3.31E+05	1.47E+06	1.77E+00	1.05E+00	6.86E+01	1.13E+06	0
Bangladesh	8.09E+06	.	.	2.09E+02			0
Benin Rep	8.02E+06	4.67E+05	6.60E-01	1.01E+05	-1.00E+02	-7.55E+06	0

Brazil	6.62E+05	6.57E+05	4.38E-01	1.03E+05	-1.00E+02	-5.27E+03	0
Burkina Faso	9.96E+06	.	.	5.29E+03			0
Cameroon	5.62E+07**	1.86E+06	3.77E+00	3.47E+05	-1.00E+02	-5.43E+07	0
Canada	3.95E+05	2.51E+05	4.31E+01	6.05E+03	-9.93E+01	-1.43E+05	0
Congo	1.20E+06	7.75E+04	1.71E+01	1.74E+03	-9.90E+01	-1.12E+06	0
Côte d'Ivoire	3.21E+06	7.12E+05	7.48E+01	9.43E+03	-9.92E+01	-2.49E+06	0
Denmark	5.16E+07	3.95E+07	1.85E+00	1.62E+01	-8.86E+01	-1.21E+07	0
Finland	7.32E+07	7.76E+06	2.40E+00	2.79E+06	-1.00E+02	-6.54E+07	0
France	8.65E+07	6.00E+07	1.59E+00	6.78E+00	-7.66E+01	-2.65E+07	0
Gambia	1.60E+07	6.57E+04	2.70E+00	4.35E+04	-1.00E+02	-1.59E+07	0
Ghana	1.08E+06	4.55E+05	1.94E+00	7.97E+00	-7.56E+01	-6.23E+05	0
Greece	2.30E+06	2.69E+06	.	-7.23E-01		3.89E+05	0
Hungary	6.06E+06	4.36E+06	2.20E+00	2.10E+01	-8.95E+01	-1.70E+06	0
Iceland	9.21E+06	3.12E+06	7.60E-01	1.79E+00	-5.76E+01	-6.09E+06	0
India	4.53E+07**	5.06E+06	3.25E+00	3.42E+01	-9.05E+01	-4.02E+07	0
Japan	4.29E+07**	1.49E+07	8.37E+01	4.78E+04	-9.98E+01	-2.80E+07	0
Lebanon	3.27E+06	1.03E+06	1.05E+02	2.32E+04	-9.95E+01	-2.23E+06	0
Malaysia	1.56E+08**	1.16E+08	2.13E+00	2.25E+01	-9.06E+01	-4.00E+07	0
Morocco	1.12E+06	4.85E+05	7.90E-01	6.19E+01	-9.87E+01	-6.34E+05	0
New Zealand	7.13E+05	3.75E+05	1.84E+01	1.25E+03	-9.85E+01	-3.38E+05	0
Niger	1.40E+07	1.85E+03	8.52E-01	9.23E+04	-1.00E+02	-1.40E+07	0
Poland	1.79E+07	7.10E+06	4.13E-01	2.38E+06	-1.00E+02	-1.08E+07	0
Russian Federation	4.98E+05	1.68E+05	7.90E+00	7.23E+03	-9.99E+01	-3.30E+05	0
Singapore	4.05E+07	1.93E+07	1.75E+00	1.95E+01	-9.10E+01	-2.12E+07	0
Sierra Leone	6.25E+07**	2.09E+05	.	1.47E+01		-6.23E+07	
Sweden	8.53E+07**	2.89E+07	2.76E+00	3.95E+01	-9.30E+01	-5.64E+07	0
Switzerland	4.68E+06	3.62E+06	6.58E+02	4.23E+04	-9.84E+01	-1.06E+06	0
Togo	4.10E+07**	.	.	8.33E+00			
Turkey	2.03E+08**	9.84E+07	2.11E+00	2.57E+01	-9.18E+01	-1.05E+08	0
Total	2.62E+07	1.80E+07					

Source: Author's computation, 2021.
*Note: Trade potential status: [1]=convergence; [0]=divergence and, [empty]=indeterminate. *Score denotes countries with the most potential for Nigeria's agricultural exports.*
***Top10 agricultural export markets for Nigeria.*

4.5. Priority markets for Nigeria's agricultural exports

The result presented in Table 6 identified 19 countries with potentials for agricultural exports from Nigeria. In addition, 5 of these countries are rated top ten economies at enabling trade across borders, and they include Netherland, Hong Kong SAR, Austria, United Kingdom and Germany (Willige, 2016). Also, there are indications that countries from Asia and the Pacific that includes China, Israel and Hong Kong identified in our study as potential agricultural export destinations for Nigeria are beginning to show more prospects for growth in agro-exports necessitated by the emergence of new and stricter standards for agricultural imports in European and North American countries (UNESCAP, 2011).

Table 6: List of Potential Export Markets for Nigeria's Agricultural Commodities

No.	Country	Time of Convergence
	Europe	
1	United Kingdom	-1.14E-03
2	Norway	-6.89E-04
3	Bulgaria	-5.21E-04
4	Czech Rep	-2.49E-04
5	Germany	-1.55E-04
6	Belgium-Luxembourg	-8.29E-05
7	Italy	-6.57E-05
8	Cyprus	-3.84E-05
9	Portugal	-3.36E-05
10	Ireland	-1.81E-05
11	Netherlands	-1.57E-05
12	Spain	-9.55E-06
13	Austria	-7.69E-06
14	Greece	-7.69E-06
	Asia/ Midde East	
15	China	-1.20E-03
16	Hong Kong SAR	-8.49E-05
17	Israel	-1.84E-05
18	Saudi Arabia	-7.69E-06
	North/ South America	
19	USA	-9.93E+01

Source: Author's computation, 2021.

4. CONCLUSION

The significant factors to Nigeria's agricultural exports in both the short-run & long-run include lagged exports, lagged quasi trade, lagged reciprocal trade, GDPs, inflation rate, similarity in country sizes, foreign currency reserve, membership of the world trade organization, common colonizer (shared experience) & common language (proxy for information cost). According to Haris et al. (2008), lagged trade values represent a combination of factors that include amongst others, relative factor endowment, level of development, historical and political ties, transport cost, preferred trade partner and trade partner effects. The study found out that Nigeria does not share a common language with over 70% of its trading partners. Also, there was an observed pattern of trade with geographic distant countries, with an average distance of 15,427.93km from Nigeria. The

observed preference for trade with distant countries is attributed to the trade persistent factor as trade relations with most of these countries were established during the colonial era. There is therefore the need to create or explore new export market opportunities for Nigeria's agricultural commodities. Factors to consider include countries with shared experience with Nigeria or that are part of a common trade treaty. Also, the right policy mix that will sustain economic growth and manage inflation levels in the country should be adopted, as this has been shown to affect the country's agricultural export trade. Inflation has a negative effect on price competitiveness of agricultural commodities originating from Nigeria, while foreign currency reserve serves as a backup funds, and is used to keep a fixed rate value, maintain export prices and provide confidence for investors.

Nigeria has a convergent trade situation with 19 countries, and a divergent situation with 27 Countries. Trade divergence is an overtrade situation, while convergence is indicative of export market opportunities. Therefore, the bilateral relationship with the 19 countries should be reviewed with the aim of identifying and negotiating removal of barriers or restrictions to agricultural trade with Nigeria. Also, trade divergence should be treated as an export market concentration and dependence issue that signals the need to increase the number of trading partners and to diversify the country's agricultural export base (UNCTAD, 2019). Deliberate policies that are aimed at achieving value addition in agricultural exports should be formulated as it is critical to agricultural export diversification both in terms of products and destinations. This should begin with a proper identification of constraints and conditions for diversification and value addition, and measures should be product specific.

The identification of potential export destinations for agricultural commodities of Nigeria origin does not in any way suggest the abandonment of any existing trade relations, especially for countries with divergent trade situation with Nigeria, which is usually the case when potential trade is less than actual trade. According to UNCTAD (2019), this should be considered an export market concentration and dependence issue that signals the need to increase the number of trading partners and to diversify the country's agricultural exports. One way to begin this, is to review or ratify Nigeria's existing trade agreements. Nigeria has 31 bilateral investment agreements out of which only 15 are in force. It also has a double tax treaty with 13 countries, and is a signatory to 21 investment related instruments, and 9 memoranda of understandings. In addition, it has a signed Trade and Investment Framework Agreement with the United States of America (Salawu et al., 2020). These are all opportunities for improving the country's agricultural export trade. Lastly, trade potential does not automatically translate to actual market, but are indicative of direction of export growth opportunities barring any trade restrictions or other rigidities.

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