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AGRIBUSINESS

Nigeria's cocoa exports: a gravity model approach

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ABSTRACT: *What are the major factors affecting Nigeria's cocoa export flows? In answering this question, the authors suggest a commodity-specific gravity model with three different analytical approaches, (the Heckman Sample Selection Model, the Generalised Least Square, and the Poisson Pseudo Maximum Likelihood), based on a period of 24 years of panel data for Nigeria and it's 36 importing partners to estimate the models. The results showed that GDP, exchange rate policy, WTO, EU, and colonial link are positively associated with the Nigerian cocoa export flows. Further, the negative impact of the GDP per capita, landlocked, distance, AU, and ECOWAS are observed. The need for the expansion of exports to the trading partners, especially the EU members (Netherlands, Germany, France, United Kingdom, Belgium, Spain, etc.), Canada, Malaysia, and the USA is particularly highlighted. These results are important for the formulation of future trade policy that could boost up the Nigerian cocoa exports. This would eventually contribute to the diversification of the Nigerian exports and also enhance the country's foreign earnings.*
Key words: *cocoa exports, Heckman section model, Generalized least square (GLS), Poisson pseudo-maximum-likelihood (PPML), panel data.*

Exportações de cacau da Nigéria: uma abordagem do modelo gravitacional

RESUMO: *Quais são os principais fatores que afetam os fluxos de exportação de cacau da Nigéria? Ao responder a esta pergunta, os autores sugerem um modelo de gravidade específica de mercadoria com três abordagens analíticas diferentes (o Modelo de Seleção de Amostras de Heckman, o Mínimo Quadrado Generalizado e a Pseudo Máxima Verossimilhança de Poisson), com base em um período de 24 anos de dados em painel para a Nigéria e seus parceiros importadores para estimar os modelos. Os resultados mostram que o PIB, a política cambial, a OMC, a UE e a ligação colonial estão positivamente associados aos fluxos de exportação de cacau da Nigéria. Além disso, é observado o impacto negativo do PIB per capita, sem litoral, distância, UA e CEDEAO. Destaca-se a necessidade de ampliação das exportações para os parceiros comerciais, especialmente os membros da UE (Holanda, Alemanha, França, Reino Unido, Bélgica, Espanha, etc.), Canadá, Malásia e Estados Unidos. Esses resultados são importantes para a formulação de uma política comercial futura que possa impulsionar as exportações de cacau nigeriano. Isso acabaria por contribuir para a diversificação das exportações nigerianas e também aumentar as receitas externas do país.*
Palavras-chave: *exportações de cacau nigeriano, modelo de seção de Heckman, mínimo quadrado generalizado (GLS), Poisson pseudo-máxima verossimilhança (PPML), dados em painel.*

INTRODUCTION

Nigeria is an agrarian country where agricultural activities are the primary source of economic survivals and livelihoods. Although, the country's agricultural Gross Domestic Product (GDP) and employment have substantially fallen from 37% and 47% in 2002 to 22% and 36% in 2019, the values are of huge significance to date (WORLD BANK, 2020). Among all the major agricultural products, cocoa is the single commodity contributing significantly to the agricultural revenue. Cocoa is such an important agricultural product that has occupied a central place in the economic policy processes (OSABOHIEN et al., 2019). Cocoa is a leading commodity of foreign exchange from non-oil exports (FAMUYIWA et al., 2014). In 2018, the country exported 321.99 thousand tons of cocoa worth $ 657.61 million to the global market (FAOSTAT, 2020).

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The sector is encountering a plethora of challenges and problems including the climate change, small farm holding, technological modernization, access to finance, and pest and diseases (UWAGBOE et al., 2017). Nigeria is the second-largest producer and exporter of cocoa in the 1960s and accounted for more than 15% of the global cocoa output (VERTER, 2016). At that time, the agricultural exports accounted for over 75% of total annual merchandise exports. Nevertheless, these problems dated back to a decade after the country got its independence with a growing lack of food supply, increasing food prices, and decreasing foreign exchange earnings from agricultural exports, and increasing food import bills. The condition further deteriorated due to the adverse effects of the civil war, government policies (fiscal and monetary), frequent change of government (from a military regime to democracy and from one political party to another), corruption (FAGBADEBO, 2020), terrorism, and severe droughts. The issue of "oil boom" created both opportunities and distortions in the economy and increased the degree of movement of labour from agriculture to non-agriculture (OSABUOHIEN, 2014).

Given the significance of agriculture in general and cocoa in particular to the Nigerian economy, the Federal Republic of Nigeria (FRN) makes it her top mission to diversify its economy and proactively decrease its vulnerability, after the country has slipped into recession in 2016 (MBNP, 2017). The FRN has suffered recently with the drop in the price of crude oil in the international market. Therefore, the country embarked on several agricultural promotion measures required to revive the economy and stop the decreasing tide (ADELEYE et al., 2020). It contains an economic policy document, called the Economic Recovery and Growth Plan (ERGP) in 2017. The document emphasises the needs to boost cocoa production and exports. Therefore, the government has again paid its attention to cocoa cultivation and it still has the available land and climate to boost the output of cocoa, increase the volume of export as well as helping the economy recover (NEPC, 2017).

Foreign trade is a significant determinant of the economic growth in developing countries including Nigeria (ATIF et al., 2016; ALI et al., 2020). Agricultural exports are likely to have a positive impact on the economy of a developing nation (SHAFIULLAH et al., 2017). The income generation from cocoa export might contribute to the growth of the Nigerian economy and reduce its over-dependence on the exports of oil.

To the best of the authors' knowledge, there is no significant research on Nigeria's cocoa exports using the gravity model. However, a limited number of studies are reported regarding the Nigerian trade (ALIYU & BAWA, 2015; OLADIPUPO & ADEDOYIN, 2019), cocoa exports competitiveness (NWACHUKWU et al., 2010) and political economy of cocoa (OLAIYA, 2016). It is thus apparent that there is a dearth of literature on the determinants of the Nigerian exports of cocoa.

Therefore, this study analyzed the major factors affecting the Nigerian agricultural export performance in the international market, with a reference to identifying the main factors influencing Nigerian cocoa export performance by an application of the panel data gravity model. Hence, the study contributed to the existing literature in several ways. First, it would fill the research gap on the determinants of the Nigerian cocoa exports by covering a total of 36 countries for a period of 24 years of panel data. The authors take into consideration the availability of data before selecting the period of the study. Second, our study is unique from previous studies in the sense that, it applies the gravity model by integrating numerous methods including, the Heckman selection models, the Generalized Least Square (GLS), and the Poisson Pseudo Maximum Likelihood (PPML). These methods were mainly applied independently in the existing literature. Third, the study would enrich the current literature on the commodity-specific gravity model of agricultural exports. Presently, there are some studies on the export determinants of product/agricultural commodities such as coffee (NSABIMANA & TIRKASO, 2019), rice (BUI & CHEN, 2015; KEA et al., 2019), coffee and rice (NGUYEN, 2020), soybeans (BOEREMA et al., 2016), wine (CASTILLO et al., 2016), poultry (ZHOU et al., 2019), meat (SHAHRIAR et al., 2019a), leather and textile (JORDAAN & EITA, 2012; RAHMAN et al., 2019), creative goods (DONG & TRUONG, 2019), and forest products (NASRULLAH et al., 2020). Lastly, this study provided new insights and allowed us to derive some policy implications about the development and sustainability of cocoa export in Nigeria.

The shape of the Nigerian cocoa market

Figure 1 illustrates the ranking of export destinations based on Nigeria's average export values of cocoa between 1995 and 2018. Nigeria's top ten cocoa export destinations are as follows: Netherlands (36.74%), Germany (13.34%), France (6.66%), United Kingdom (6.15%), Belgium (5.89%), Spain

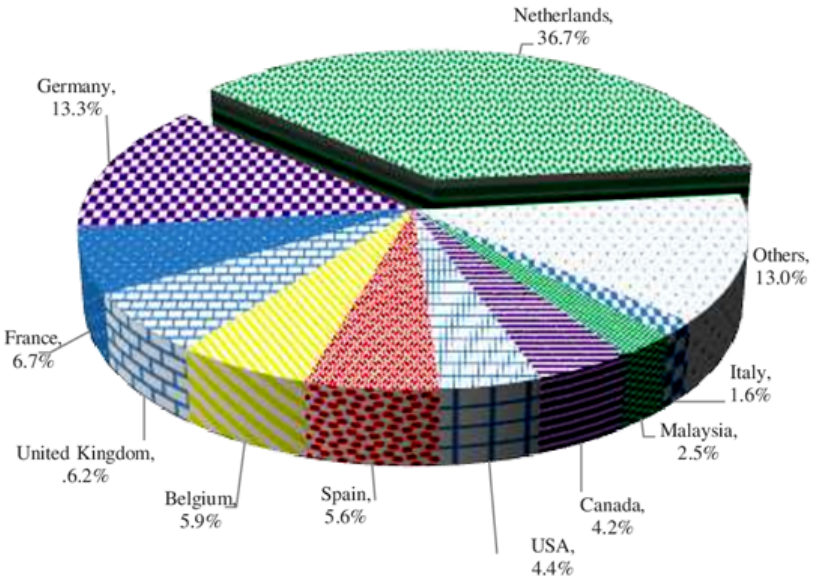

Figure 1 - Top 10 destination in percentage of the Nigeria`s cocoa markets.

Source: Authors´ own estimate based on extracted data from UNCTAD (2020).

(5.64%), USA (4.35%), Canada (4.15%), Malaysia (2.48%), and Italy (1.58%). The figure also shows that the export flow of Nigerian cocoa to those ten countries accounted for approximately 87% of Nigeria's total cocoa export flow to the global market. Similarly, during the study period, Nigeria accounted for cocoa import shares of Netherlands (8.28), Germany (8.39%), France (5.72%), United Kingdom (9.64%), Belgium (8.54%), Spain (9.21%), USA (1.36%), Canada (5.17%), Malaysia (1.78%), and Italy (3.13%) (UNCTAD, 2020).

The European Union (EU) is the most significant market for Nigeria's cocoa exports. Netherlands, Germany, France, United Kingdom, and Belgium are the major destinations of Nigeria's cocoa in Europe. Figure 2 shows that the export flows from Nigeria to these five countries between 1995 and 2018 reached the amount of $ 329 million annually, which accounted for about 69% of total Nigeria's cocoa market share.

The state of the cocoa economy at a global scale

The cocoa bean is one of the major cash crops in Africa, produced mostly for export purposes and the region accounts for more than 75% of the global cocoa (production and exports) which makes the regions a global phenomenon (WESSEL & QUIST-WESSEL, 2015; ICCO, 2017). Figure 3 shows that the Ivory Coast and Ghana are the two largest producers and exporters of cocoa. In 2017, the production of these countries' reached 2.03 million tons and 893.60 thousand tons respectively. Indonesia and Nigeria which occupied third and fourth positions exported 659.78 and 324.39 thousand tons of cocoa respectively. Four countries out of the top five producers are from Africa. Similarly, three out of the five largest producers are from the same region in Africa; i.e. West Africa, revealing that this region is the most important baskets of the global cocoa market. Cameroon is the largest producer in Central Africa and fifth in the world, however, Cameroon ranked seventh among the largest exporters. The country exported 260.01 thousand tons of cocoa Figure 3).

LITERATURE REVIEW

The gravity models

The gravity model is one of the most popular empirical tools for analysis in international trade studies (MA´TYA´S, 1998; ANDERSON & Wincoop, 2003). Tinbergen became the first person to propose the use of the gravity equation in international trade studies (TINBERGEN, 1962), while

Figure 2 - Nigeria`s average cocoa exports flow in thousand USD, 1995-2018.

Source: Authors`s own estimates based on extracted data from UNCTAD (2020).

ANDERSON (1979) comprehensively examined the model with the expectations that bilateral trade between two countries is positively determined by each country's GDP, and negatively by their distance apart. The gravity model for cocoa exports in linear form can be mathematically expressed as follows:

$$ln\,(X_{ij}) = \beta_0 + \beta_1\, ln(Y_i) + \beta_2\, ln(Y_j) + \beta_3\, ln(Dis_{ij}) \quad (1)$$

Where, "*Xij*" denotes the value of cocoa exports from Nigeria to its trading partners. "*Yi*" is the GDP of Nigeria and "*Yj*" denotes the GDP of Nigerian trading partner. "Dis_{ij}" stands for the distance between Nigeria and trading partner. "j" = 1. . ..36 is for trading partners and t = 1995. . ..2018 annual series. "ln" stands for a natural log.

Several researchers used the gravity model in different forms. For example, the gravity model was derived for the first time by ANDERSON (1979) through the application of the product differentiation model, which adopts constant elasticity of replacement (CER) desired functions for all countries or identical Cobb–Douglas and weakly separable utility functions among traded and non-traded goods. Anderson analyses at the cumulative level, HELPMAN & KRUGMAN (1987) justify the gravity model by differentiated product market and assuming increasing returns to scale. Based on 18 industrial countries, HELPMAN & KRUGMAN also recognized a linkage between the gravity model and the monopolistic competition model.

BERGSTRAND (1989); BERGSTRAND (1990) previously examined the microeconomic foundations of trade through monopolistic competition models. He claimed that a gravity model is a summarized form of a general equilibrium of demand and supply systems. DEARDORFF (1998) develops it from a Heckscher–Ohlin (H-O) viewpoint, and showed that this model was reliable with a large number of trade models such as the Ricardian model, H-O model, increasing returns to scales, and so on. MA´TYA´S (1998) suggested incorporating the trading bloc dummy variable(s), and time precise effects into the specification of the gravity models without dealing with the issue of trading potentials. EGGER (2002) proposed ideas into the difficulties related to the in-sample forecast of trade potentials based on panel data and into the selection of the adequate estimation method.

Excluding multilateral resistance factors in the prior gravity model, ANDERSON & Wincoop (2003) argued that the estimation could lead to biased inferences. The authors developed an improved gravity model by adding multiple resistance factors and applied it to resolve the famous "border puzzle." HELPMAN et al. (2008) derive the improved gravity equation of ANDERSON & Wincoop (2003) in two ways to address the lack of trade "Zeros trade" flows problem. First, it accounts for asymmetries between the volume of exports from i to j and the volume of exports from j to i. Second, it accounts for fixed trade and firm heterogeneity costs; and therefore, forecasts an extensive margin for trade flows. CHANEY (2008) argued that when the cost of transportation changes, not only does each exporter change the size of its exports (the intensive margin), but the set of exporters changes as well (the extensive margin). He also introduced firm heterogeneity in a simple model of international trade. Several prior studies showed how the gravity model has developed itself as a "workhorse" for the study of international trade (HEAD & MAYER, 2014; SHEPHERD, 2019). YOTOV et al. (2016) introduced the structural gravity model as an advanced guide to trade policy analysis, though CHANEY (2018) provided an in-depth description of the gravity equation in international

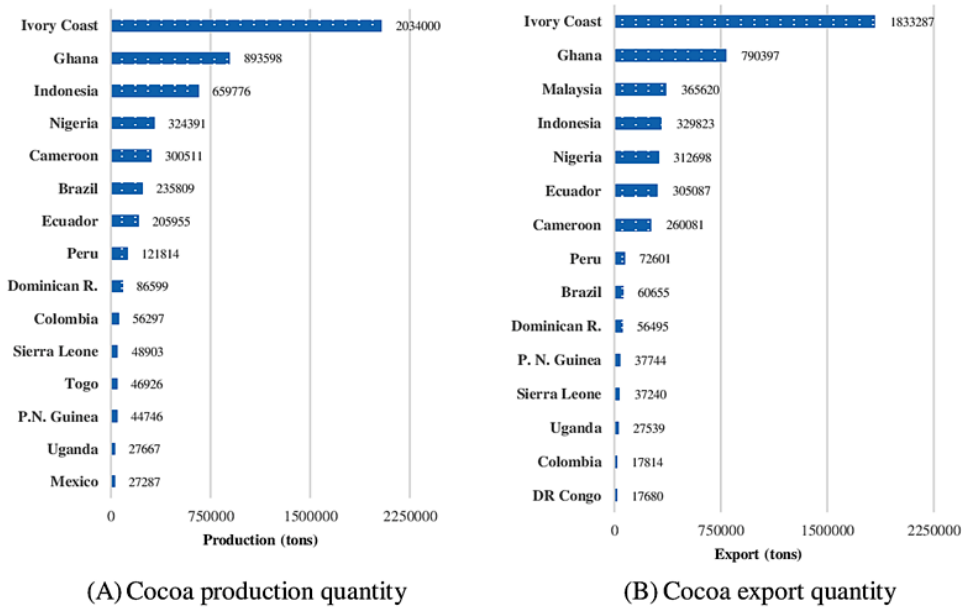

Figure 3 - The world`s top cocoa producers and exporters in 2017.

Source: Author`s own estimates based on extracted data from FAOSTAT (2020). Note: The export quantity consist of the total of four different kinds of cocoa (cocoa bean, cocoa butter, cocoa paste and cocoa powder), "Dominica R." = Dominica Republic, "P.N. Guinea" = Papua New Guinea, "USA" = United States.

trade. SHAHRIAR et al. (2019b) explained the theoretical dimensions of the trade gravity model.

Several studies used the commodity-specific to determine trade flows. Only a few studies used the Heckman model, GLS and PPML in a single study. For instance, KEA et al. (2019) using these approaches study the dynamic panel for the Cambodian rice exports between 1996 and 2018. The results disclose that the historical ties, exchange rate policy, and the agricultural land reform promote the Cambodian rice export. The study suggested that as a macroeconomic issue and resistance factor, the economic recession hinders the export flows, and needs more exceptional considerations. In the same direction, SHAHRIAR et al. (2019a) have provided a case study of the Chinese meat industry for the period 1996-2016 and revealed that GDP, exchange rate, common language, and country land area affect the Chinese pork export flows. Similarly, the Belt and Road Initiative and the WTO membership, common border are positively associated with pork export flows. The study concluded that the Chinese government could enhance the pork export system with its bordering countries.

BRAHA et al. (2017) used the gravity model with the PPML panel data and reported that agricultural export flow grows with increasing economic size, indicating a higher impact of importer's absorbing potential compared to Albania's productive potential. Also, the bilateral distance, common border, and common language have a negative impact on export flows. Albania has a vast potential to become a competitive player in international markets if supportive measures are fixed in increasing the productivity of labour-intensive agricultural sectors. DADAKAS et al. (2020) explored the UAE's trade potential and indicated that the economic size of the UAE and its trading partner, common language and colonial link stimulate the country's export. Whereas, distance has proven to be an obstacle for UAE's trade. Similarly, HOANG et al. (2020) also applied the PPML to study the factors affecting trade between Taiwan and ASEAN countries from 2000-2017.

In the Nigerian context, ALIYU & BAWA (2015) investigated the factors affecting Nigeria's trade flow for the period of 1999-2012. Using the fixed effects and random effects, the results showed that market size and price index of destination countries

positively drive trade flows in Nigeria. The results confirmed that Nigeria's exports follow the Linder hypothesis. Using the fixed effects, OLADIPUPO & ADEDOYIN (2019) study the factors affecting the bilateral trade flows of Nigeria for a panel data of 16 trading partners between 2000 and 2016. No study is thus available on the determinants of Nigeria's cocoa export using the gravity model. Therefore, we aimed to fill this gap in the current literature.

In light of the above discussions, it is clear that the previous studies provided the theoretical and empirical basis for the gravity model that are in line with some analytical approaches such as the Ricardian model, H-O model, monopolistic competition, and the "new trade" theory.

The generalised gravity model of the Nigerian cocoa exports

In this study, the gravity model of Nigerian cocoa exports can be expressed as follows:

$$\begin{aligned} lnCocoaExp_{ijt} &= \alpha + \beta_1 ln(GDP_{it}.GDP_{jt}) + \beta_2 ln(pcGDP_{it}.pcGDP_{jt}) \\ &+ \beta_3 ln(dpcGDP_{it}.dpcGDP_{jt}) + \beta_4 ln(Dis_{ij}) + \beta_5 ln(Exc_{ij}) \\ &+ \gamma_1(landlocked_j) + \gamma_2(border_{ij}) + \gamma_3(language_{ij}) + \gamma_4(WTO_{jt}) \\ &+ \gamma_5(EU_{jt}) + \gamma_6(AU_{jt}) + \varepsilon_{ijt} \end{aligned} \quad (2)$$

Where as, the ln(.) denotes the logarithm form. α indicates the intercept, whereas, β_s,γ_s are the estimated coefficients and ε_{ijt} denotes the stochastic error term.

Lack of trade or zero trade problem

The lack of trade problems occurs in some periods of time when some pair of countries did not trade with each other for some reason. In the absence of trade between i and j countries, the gravity equation becomes problematic as the trade value of [log (0) is undefined]. Therefore, in order to overcome this problem we employed the most common approaches used in gravity literature; the PPML method suggested by (SANTOS SILVA & TENREYRO, 2006; SANTOS SILVA & TENREYRO, 2010) and the Heckman Selection model (HECKMAN, 1979). Though, some researchers such as BURGER et al. (2009) and MARTÍNEZ-ZARZOSO (2011) criticized the PPML estimator suggesting that results are biased in the presence of zero trade when combined with heteroscedasticity and can lead to inconsistent of the estimates. However, some researchers such as MARTIN & PHAM (2020) and SANTOS SILVA & TENREYRO (2011) recommended that the PPML estimator is not biased by extra zeros and it is consistent when high variability exists in the data set.

The PPML allows the estimation of a gravity model which includes zeros and the dependent variable will not take log form (SANTOS SILVA & TENREYRO, 2006). In the case of Nigerian cocoa, the PPML model can be written as follows:

$$\begin{aligned} CocoaExp_{ijt} &= \alpha + \beta_1 ln(GDP_{it}.GDP_{jt}) + \beta_2 ln(pcGDP_{it}.pcGDP_{jt}) \\ &+ \beta_3 ln(dpcGDP_{it}.dpcGDP_{jt}) + \beta_4 ln(Dis_{ij}) + \beta_5 ln(Exc_{ij}) \\ &+ \gamma_1(landlocked_j) + \gamma_2(border_{ij}) + \gamma_3(language_{ij}) + \gamma_4(WTO_{jt}) \\ &+ \gamma_5(EU_{jt}) + \gamma_6(AU_{jt}) + \varepsilon_{ijt} \end{aligned}$$

The Heckman selection model comprises two different equations, namely, sample selection (eq. 4, 5) and outcome (eq. 6). The sample selection for Nigerian cocoa export can be written as follows:

$$t^*_{ijt} = \eta' Z_{ijt} + \mu_{ijt} \quad (4)$$

Whereas, t^*_{ijt} denotes latent variable and it is not observed but we do observe if countries trade or not, such that $t^*_{ijt} = 1$ if $t^*_{ijt} > 0$ and $t^*_{ijt} = 1$ if $t^*_{ijt} = 0$ and Z_{ijt} denotes a vector variable that affects t^*_{ijt} . μ_{ijt} denotes the error term. However, there are some variables that are not in the model but they might affect the t^*_{ijt} in this study. In addition to the other independent variables, the study has also added some dummies to find out the impact of the landlocked country, common language, common border, and the WTO, AU, and EU membership on cocoa exports. Thus, we expect their coefficients to have different signs (Table 2). The details of the equation (4) can be written as follows:

Selection Equation:

$$\begin{aligned} t^*_{ijt} &= \eta_0 + \eta_1 \ln(GDP_{it}.GDP_{jt}) + \eta_2 \ln(pcGDP_{it}.pcGDP_{jt}) \\ &+ \eta_3 \ln(\text{dpc}GDP_{it}.dpcGDP_{jt}) + \eta_4 \ln(Dis_{ij}) + \eta_5 \ln(Exc_{ij}) \\ &+ \eta_6(landlocked_j) + \eta_7(border_{ij}) + \eta_8(language_{ij}) + \eta_9(WTO_{jt}) \\ &+ \gamma\eta_{10}(EU_{jt}) + \eta_{11}(AU_{jt}) + \mu_{ijt} \end{aligned} \quad (5)$$

Outcome Equation:

$$\begin{aligned} t^*_{ijt} &= \eta_0 + \eta_1 \ln(GDP_{it}.GDP_{jt}) + \eta_2 \ln(pcGDP_{it}.pcGDP_{jt}) \\ &+ \eta_3 \ln(\text{dpc}GDP_{it}.dpcGDP_{jt}) + \eta_4 \ln(Dis_{ij}) + \eta_5 \ln(Exc_{ij}) \\ &+ \eta_6(landlocked_j) + \eta_7(border_{ij}) + \eta_8(language_{ij}) + \eta_9(WTO_{jt}) \\ &+ \gamma\eta_{10}(EU_{jt}) + \eta_{11}(AU_{jt}) + \eta_{12}(Ecowas_{jt}) + \eta_{13}(colony_{ij}) \\ &+ \eta_{14}(asia_j) + \mu_{ijt} \end{aligned} \quad (6)$$

The selection of the independent variables is a difficult task in econometrics. According to AMEMIYA (1980), the selection of regression analysts should be based on economic-theory considerations along with statistical reasoning. The omitted variables might lead to biased conclusions in the estimations of the model (WOOLDRIDGE, 2002).

There are two main sources of misspecifications of the model which include: (1) invalid assumptions on the distribution term and (2) incorrect functional form. Consequently, the selection of regressors should be taken into consideration and the correct specification of the model, function form (BERA & JARQUE, 1982). Based on the above guidelines and instructions, we relied on the trade theories and prior empirical studies in selecting the relevant variables for the specification of the empirical gravity model of the Nigerian cocoa exports. In this study, we employed three different methods of estimation to confirm the robustness of the findings. Thus, the models we use could solve the problems of hetroscedasticity, multi-collinearity, and serially correlated errors (SANTOS SILVA & TENREYRO, 2006; HAQ et al., 2013).

Sampling size and data sources

One of the main benefits of the panel data is to get rid of some biases and disadvantages arising out of the time series and cross-sectional estimations (BALTAGI et al., 2018; SHEPHERD, 2019). Following the literature, we applied the panel data models to estimate the gravity equations of the Nigerian cocoa exports. The sample of this study comprised Nigeria and its 36 cocoa importing partners over 24 years, covering from 1995 to 2018. These 36 countries are selected based on Nigeria's annual average cocoa export value. During the period, the export value of Nigeria's cocoa to those 36 destinations accounted for 95.45% of the total cocoa exported value of Nigeria. Therefore, the dataset of this study consist of a total observation of 864 (N = 36 x T = 24). The list of the countries engaged in cocoa trade with Nigeria included in the sample is shown in table 1. The data sources are mentioned in table 2 and 3 shows the descriptive statistics of the variables.

RESULTS AND DISCUSSION

Table 4 and 5 show the results estimated from the Heckman selection models, GLS, and PPML models respectively. In general, the three models are almost similar in terms of variables signs, coefficients, and statistical significance at conventional levels. In addition, to confirm the appropriateness of our baseline model (random effect/GLS), we have conducted a Hausman test. The result showed a p-value of 0.071 which indicated that we accept our null hypothesis that is the GLS is the appropriate model. These two tables showed the factors affecting Nigeria's cocoa exports. They are the GDP, per capita GDP, distance, exchange rate, landlocked of partner country j, common border, common language, WTO, EU, AU, ECOWAS membership of partner country j, Asia and colonial link. Among these variables, we found eight key variables to be highly significant at a 1% level of significance, the variables include; (GDP_{it}.GDP_{jt}), distance, exchange rate, landlocked, common border, WTO, EU, and AU membership. The coefficients of (GDP_{it}.GDP_{jt}), exchange rate, WTO, EU, and border are positive whereas, the signs of distance and landlocked are negative.

The positive sign of GDP_{it}.GDP_{jt}, indicates that Nigeria has the potential to trade more of its cocoa with wealthier countries. This implied that holding other variables constant, a 1% increase in GDP_{it}.GDP_{jt}, result in roughly a 0.33% increase in export volume. This finding is in line with prior studies such as ANH THU et al. (2019); LIU et al. (2020).

Although, the per capita income of Nigeria and its cocoa importing partners ($pcGDP_{it}$.$pcGDP_{jt}$) maintain it negative sign in all the models; however, we reported per capita income to be significant in GLS and PPML models with different significance levels 5% and 10% respectively. The negative sign

Table 1 - Sample economies and countries used in the study.

Continents	Economies/Country	#country
Africa	Algeria, Benin, Cameroon, Ivory Coast, Gabon, Ghana Kenya, Niger, South Africa.	9
America	Barbados, Canada, United States of America (USA)	3
Asia & Pacific	Armenia, China (mainland), India, Indonesia, Malaysia, Japan, Russian Federation, Singapore, Turkey, Viet Nam	10
Europe	Austria, Belgium, Bulgaria, Czechia, Estonia, France, Germany, Italy, Netherlands, Poland, Spain, Switzerland, Ukraine, United Kingdom	14
	Total number of countries used in this study	36

Source: Authors' own elaboration. Note: "No. of Country" = Number of country.

Table 2 - Detail description of data sources, unit and expected sign of the variables.

Variables	Description	Unit	Source of Data	Expected Sign
$CocoaExp_{ijt}$ /$ln(cocoaExp_{ijt})$	Bilateral cocoa exports	Thousand USD	UNCTAD	
$ln(GDP_{it}.GDP_{jt})$	Aggregate income of Nigeria and its partners	Million USD	WDI	+
$ln(pcGDP_{it}.pcGDP_{jt})$	Per capita GDP of Nigeria and its partners	USD	WDI	+
$ln(dpcGDP_{ijt})$	Difference of per capita	USD	Author's own calculation	+/−
$ln(Exc_{ijt})$	Bilateral exchange rate	Naira ₦/j's currency	UNCTAD	+/−
$ln(Distance_{ij})$	Distance between Abuja and j's capital city	Kilometres	Distance calculator	−
$landlocked_j$	Landlocked country j	0/1 Dummy	CEPII Database	−
$border_{ij}$	Common border with Nigeria	0/1 Dummy	CEPII Database	+/−
$language_{ij}$	Share same official language with Nigeria	0/1 Dummy	CEPII Database	+/−
EUm_j	EU membership	0/1 Dummy	www.europa.eu	+
Aum_j	AU membership	0/1 Dummy	www.au.int	+/−
$WTOm_j$	WTO membership	0/1 Dummy	www.wto.org	+
$Ecowas_j$	Regional trade agreement	0/1 Dummy	www.ecowas.int	−
$asia_j$	Geographical location	0/1 Dummy	CEPII Database	+/−

Source: Authors' own elaboration.

showed that the Nigerian cocoa export follows the Linder hypothesis. Similarly, SHAHRIAR et al. (2019a) also reported a negative coefficient of per capita GDP for China and its meat importing countries. In contrast, RASOULINEZHAD et al. (2020) revealed that Russia's export pattern with the East Asian region did not follow the Linder hypothesis, in other words, it follows the Heckscher–

Table 3 - Descriptive statistics of the variables used in the study.

Variables	Mean	Standard Deviation	Minimum	Maximum	Observations
$CocoaExp_{ijt}$	17,574.5100	49,814.5400	0.002	666,116.40	634
$ln(GDP_{it}.GDP_{jt})$	51.8503	2.5900	45.6163	57.5607	864
$ln(pcGDP_{it}.pcGDP_{jt})$	23.3995	2.6308	14.0844	31.2749	864
$ln(dpcGDP_{ijt})$	11.6662	1.3788	3.3584	13.3832	604
$ln(Exc_{ijt})$	2.1367	3.1026	-5.1916	7.2000	864
$ln(Distance_{ij})$	8.3747	0.8187	6.4102	9.4707	864
$landlocked_j$	0.1389	0.3460	0.0000	1.0000	864
$border_{ij}$	0.0833	0.2765	0.0000	1.0000	864
$language_{ij}$	0.2778	0.4482	0.0000	1.0000	864
$WTOm_j$	0.7789	0.4152	0.0000	1.0000	864
EUm_{jt}	0.3137	0.4642	0.0000	1.0000	864
Aum_{jt}	0.2500	0.4333	0.0000	1.0000	864
$Ecowas_j$	0.1111	0.3145	0.0000	1.0000	864
$asia_j$	0.2778	0.4481	0.0000	1.0000	864
$colony_{ij}$	0.2779	0.4482	0.0000	1.0000	864

Source: Authors' own elaboration.

Table 4 - The estimated coefficients from Heckman selection models.

Variables	Main				Selection			
	Coefficient		Std. Dev.	P|>|z	Coefficient		Std. Dev.	P|>|z
$\ln(GDP_{it}.GDP_{jt})$	0.3172	***	0.0712	0.0000	0.3689	***	0.0748	0.0000
$\ln(pcGDP_{it}.pcGDP_{jt})$	-0.1569		0.0992	0.1140	-0.9083		0.0607	0.1340
$\ln(dpcGDP_{ijt})$	-0.0428		0.0976	0.6610	-0.0380		0.0829	0.6470
$\ln(Exc_{ijt})$	0.1861	**	0.0822	0.0240	0.2253	***	0.0520	0.0000
$\ln(Distance_{ij})$	-0.1553		0.3373	0.6450	-0.5758		0.3949	0.1450
$landlocked_{j}$	-2.1566	***	0.3775	0.0000	-0.8827	***	0.3282	0.0070
$border_{ij}$	-1.6477	*	0.9132	0.0710	4.3685	***	0.8594	0.0000
$language_{ij}$	0.0024		0.2673	0.9930	0.0899		0.3656	0.8060
$WTOm_{j}$	1.3315	***	0.3311	0.0000	0.7830	**	0.3263	0.0160
EUm_{jt}	0.6714	**	0.2739	0.0140	0.1297		0.2409	0.5900
Aum_{jt}	-2.3323	***	0.4987	0.0000	-1.0397	**	0.4881	0.0330
$Ecowas_{j}$					-1.9477	***	0.6857	0.0050
$asia_{j}$					-1.7293	***	0.3327	0.0000
$colony_{ij}$					1.2733	***	0.4767	0.0080
constant	-5.1387		3.7712	0.1730	-10.4014	**	4.2168	0.0140
athrho					-0.0665		1.1723	0.6990
insigma					0.6919	***	0.0318	0.0000
log-likelihood	-1243.501							
No. of observations	605							
wald chi	391.58							
Pro > *chi*	0.0000***							

Source: Authors' own estimations. Note: ***, **, and * indicates significant at 1%, 5% and 10% respectively.

Ohlin hypothesis. Besides, the negative sign can be attributed to the rapid economic growth in Nigeria as well as the accelerated increase in population which reached nearly 20% increases in the last decade. This indicated that the 1% increase per capita of i and j countries cause cocoa exports to decrease by 0.31%. It also points out that the Nigerian cocoa export patterns follow a GDP pattern, focusing on the production and export of quantity-based products and reliant on total market size, rather than a per capita GDP pattern addressing the export of quality-based high value-added products which can be easily affected to the levels of income. In the traditional gravity model GDP usually signifies income.

The distance ($Distance_{it}$) between Nigeria's capital and its trading partner's capital is taken as a proxy for trade costs. In our PPML and GLS models distance was significant at 1% and 10% with negative coefficients respectively whereas, in the Heckman model is insignificance also with negative coefficients. This showed that the distance between Abuja to the capitals of importing countries decreases cocoa trade flows by 1.29%. BRAHA et al. (2017) disclose a similar result for Albania and its trading partners. LIU et al. (2020) and NASRULLAH et al. (2020) reported that China's exports are hindered by both institutional and cultural distance. Additionally, our result is in line with the classical findings of the gravity model.

Furthermore, the coefficients of the bilateral exchange rate (Exc_{ijt}) between ''Naira'' and importing countries' currency are positively significant at 1% and 5% only in the Heckman models. In other words, a depreciation of the Nigerian currency (₦) results in a nearly 0.21% increase in cocoa export flows. The result is in line with several prior studies conducted by IRSHAD et al. (2018) and JORDAAN & EITA (2012). At the same time, IGUE & OGUNLEYE (2014) proposed that a decrease in the price of the Nigerian currency "Naira" has a positive effect on the trade balance in the long run. They also reported that a 1% reduction in the value of "Naira" would improve trade balance by 1.16%. Since the collapse of the Bretton Woods system of fixed exchange rates

Table 5 - The estimated coefficients from GLS and PPML models.

Variables	GLS				PPML			
	Coefficient		Std. Dev.	P>|z	Coefficient		Std. Dev.	P>|z
$ln(GDP_{it}.GDP_{jt})$	0.4831	***	0.1750	0.006	0.1564	***	0.0383	0.000
$ln(pcGDP_{it}.pcGDP_{jt})$	-0.3601	**	0.1610	0.025	-0.2661	*	0.1439	0.064
$ln(dpcGDP_{ijt})$	0.1306		0.1243	0.293	-0.1110		0.1547	0.473
$ln(Exc_{ijt})$	0.0326		0.7943	0.850	0.2526		0.2269	0.266
$ln(Distance_{ij})$	-1.3623	*	0.7943	0.086	-1.2212	***	0.3721	0.001
$landlocked_{j}$	-2.7482	**	1.1324	0.015	-2.8894	***	0.3100	0.000
$border_{ij}$	-3.0437		2.3681	0.199	2.1470	*	1.2707	0.091
$language_{ij}$	-0.6315		0.7904	0.428	-0.5016	*	0.2589	0.053
$WTOm_{j}$	1.7006	***	0.4836	0.000	2.0116	***	0.4515	0.000
EUm_{jt}	1.7115	***	0.4330	0.000	1.8116	***	0.3854	0.000
Aum_{jt}	-3.8838	***	1.3384	0.004	-0.6157		0.7239	0.395
$constant$	0.6826		9.1838	0.941	-17.7098	***	5.0534	0.000
R^2	0.6599				0.2479			
No. of observations	499				499			
log-likelihood					7545392.4			

Source: Authors' own estimations. Note: ***, **, and * indicates significant at 1%, 5% and 10% respectively.

in the early 1970s, the high degree of volatility and uncertainty of exchange rate movements. Several prior studies have generated theoretical and empirical evidence to determine the effect of exchange rate vitality on Nigerian exports (ONAFOWORA & OWOYE, 2008; ALIYU, 2010). Moreover, ADDAI et al. (2020) explored the international cocoa exports and exchange rate regimes and claimed that the profits gained from the cocoa exports had been wiped out by the inflexibility of the exchange rate. The analysts also suggested adopting a more flexible exchange rate policy on the part of the cocoa-producing countries.

Additionally, a landlocked ($Landlocked_{j}$) situation as a variable is reported to be highly significant at 1% in the PPML, Heckman selection, and main models and at 5% in the GLS model all with negative coefficients. This shows that landlocked decreases Nigerian cocoa exports by nearly 2.42%. PAUDEL & COORAY (2018) disclose that the export performance of landlocked developing nations is low due to the inherent additional costs related to being a landlocked country. A nation's comparative benefit in trade is affected by its trade costs and trade composition (MILNER & MCGOWAN, 2013).

Border ($border_{ij}$) form local business systems and patterns of agglomeration, which in turn shape economic activities. However, our border dummy turns out to be significant in the Heckman models with positive and negative coefficients (-1.6477, 10% and 4.3685, 1%). The findings suggested that a shared and common border could promote the exports of cocoa products by 4.36% or decrease the flow by 1.64%. The explanation behind the argument is that Nigeria shares borders with four countries Benin, Cameroon, Chad, and Niger; however, Cameroon and Chad also share a common border. Considering the fact that Cameroon is also among the top four exporters of cocoa from Africa after Ivory Coast, Ghana, and Nigeria, this creates competition in cocoa exports between Nigeria and Cameroon along Chad's borders. A common language ($language_{ij}$) is significant only at 10% in the PPML model with a negative coefficient. This indicated that sharing a common language with an importing partner decrease export by 0.50%. The result contradicted prior studies that report language as a tool for networks, communications, and promotes export (ATIF et al., 2016; CASTILLO et al., 2016).

The $WTOm_{jt}$ membership is highly significant at 1% in all models except in the selection model at 5% with positive coefficients. Nigerian has been active in the world cocoa market which makes it a key exporting nation in the world. Results in Tables 4 and 5 show that WTO promotes exports of Nigerian cocoa by 1.46%. This implies that WTO membership did influence cocoa exports from Nigeria. The

previous studies of gravity analysis of Bangladesh textile exports carried out by RAHMAN et al. (2019) and Cambodian export performance conducted by SOENG & CUYVERS (2017) also provide empirical evidence to support the significance of WTO membership in export.

The results further showed that the EU is the biggest destination for the Nigerian cocoa. The EUm_{jt} dummy variable is highly significant at 1% with positive coefficients in the GLS and PPML models and 5% in the Heckman main model. The result is consistent with the finding of KEA et al. (2019) who reported a positive effect of the EU membership on the Cambodian rice trade. According to COULIBALY & ERBAO, (2019) cocoa production in Africa in general and West Africa in particular was initially meant to satisfy the European market demand. The AU is strongly significant at 1% in Heckman and GLS model with negative coefficients but insignificant in PPML. This indicated that AU has an inverse effect on the Nigerian export. This might be due to the fact that many African countries, such as the Ivory Coast, Ghana, Cameroon, Tanzania, Togo, Democratic Republic of Congo, and Uganda, are among major producers of cocoa and had the negative impacts on the cocoa export in Nigeria.

Similarly, three variables were added to the selection equation eq.6: $Ecowas_j$, $asia_j$ and common colony ($colony_{ij}$). The ECOWAS membership is significant at 1% but with a negative coefficient. In other words, its decrease cocoa export flows by 1.95%. We expected this result because West Africa is the most important region in the world in terms of cocoa production (WESSEL & QUIST-WESSEL, 2015). Ivory Coast and Ghana are the two biggest producers and exporters, but Nigeria is the fourth largest producer and 5th largest exporter. Moreover, countries like Togo and Sierra Leone are also cocoa-producing countries. Similarly, as pointed out in the previous literature that export between ECOWAS members may be a bad idea and the failure of ECOWAS countries to boost bilateral trade among it 15 member states is contributed by the restrictive trade policies and weak institutions (ASSANE & CHIANG, 2014).

The geographical dummy ($asia_j$) is negative (-1.73) but strongly significant at 1%. This indicated that the Nigerian cocoa trade decrease by 1.73% with the Asian countries. BUI & CHEN (2015) reported a similar result between Vietnam and its rice importing partners. Conversely, a common colony is significant at 1%, meaning that Nigeria would share the same colonial heritage and economic practices with its importing country. As a result, the export value will increase by 1.27%. Prior studies such as ATIF et al. (2016) and JOMIT (2015) also find similar results.

CONCLUSION

This paper has attempted to identify the major factors affecting Nigerian cocoa exports using the gravity model. In line with the theoretical and empirical studies, the study is based on the application of the three different analytical approaches including the Heckman selection models, GLS and PPML. The authors run these models to overcome the problems of the multi-collinearity, serial correlation, heteroscedasticity, zero trade, for comparative purpose. The analysis is based on a panel dataset from 1995 to 2018 (24 years) for a total of 36 selected largest cocoa importing partners. The study is a novel research in the sense that Nigeria's main trading partners are covered in the sampling framework. Also, a commodity-specific gravity modelling is attempted for Nigeria's cocoa export sector and we aimed to fill a gap on the Nigerian agricultural trade.

The study generated a number of interesting findings and insights. First, The EU countries Netherland, Germany, France, etc., and the USA, Canada, and Malaysia are the most important market for Nigerian cocoa exports. Second, the GDP, WTO, EU, and common colony are the positive determinants of Nigerian cocoa export flows. Also, the positive impact of exchange rate policy is observed. Third, the per capita GDP (pcGDP), distance, landlocked, AU, ECOWAS, and Asia are the negative factors associated with the Nigerian cocoa export flows.

We are now in a position to offer a few recommendations for the development of the Nigerian cocoa exports. First, the FRN would continue to build up strong bilateral relations with the current cocoa trading partners by employing trade promotion policies and other trade promotion tools such as bilateral trading agreements. Second, the FRN could facilitate its cocoa exports by giving less attention to AU and ECOWAS countries. Third, a suitable and gradual devaluation of 'Naira' couple with an export policy that encourages cocoa production is required to improve cocoa export revenue. Fourth, future researchers may examine other agricultural products of Nigeria to extend the current results. The researchers could also include both agricultural-commodities imports and export equations altogether in a single study. Further research efforts can focus on a comparison of the methodology presented in this article with SFA results that uses the maximum possible value of trade

rather than average values to infer on the inefficiency and the trade potential of the country.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

AUTHORS' CONTRIBUTIONS

All authors contributed equally for the conception and writing of the manuscript. All authors critically revised the manuscript and approved of the final version.

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Erratum

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