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Determinants of live animals and animal products trade within the ECOWAS sub-region: A gravity model approach

Reuben J.*, A. D. Barau and M. O. Akintunde

Department of Agricultural Economics and Extension, Taraba State University Jalingo, Nigeria.

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The scope and direction of international agricultural trade among nations depend on a number of factors. This study, thus, sought to identify and evaluate the determinants of trade in live animals and animal products among member countries in the Economic Community of West African States (ECOWAS) sub-region. Panel data on values of bilateral merchandise imports of agricultural commodities (HS Codes 1-24) at 2-digits were obtained from the International Trade Centre (ITC) for the years 2001 to 2011. The data were analysed using descriptive statistics and gravity model. The value of all agricultural commodities imports within the region for the period stood at 4.56 billion US dollars, which accounted for 6.38% of the total value for all commodities imports in the region. Imports of live animals and animal products constituted 18.46% of all agricultural products imports for the period. The results also indicated that regional characteristics such as importer and exporter's Gross Domestic Products (GDPs), geographical distance, contiguity and usage of common official language did significantly affect the trade in live animals and animal products. Intra-ECOWAS imports of these products were consistent with the gravity theory and the trade pattern followed the Heckscher-Ohlin's theory of trade. The study therefore recommends that effort be made to improve on infrastructural facilities and harnessing of the resource endowments of member-countries to promote greater trade within the region.

Key words: Economic Community of West African States (ECOWAS), livestock trade, regional integration.

INTRODUCTION

External and internal motivation such as bilateral cordial relationship and specialization, respectively have been the major factors in the evolution and development of regional bodies in developing countries, especially bodies that are devoted to regional integration. After independence, African countries found the need (both political and economic) to associate with one another. This stemmed from the belief that for their economies to develop, certain obstacles had to be removed. Regional bodies were created to take advantage of relative resource endowments, economies of scale and comparative advantage in production and consumption within the integrated region (Ogunkola, 1998).

On individual basis, without integration, many West African countries would find it difficult to overcome the problems of poor resource endowment, lack of technical manpower and other socio-economic, political and environmental constraints. It is believed that regional integration would obviate these difficulties, which are the bane of isolated and poor economies in the sub-Saharan African (SSA) countries and pave the way for sustainable growth and development. Indeed, the treaty establishing common commercial policy towards third countries; and the African Economic Community (AEC), which was

*Corresponding author. E-mail: jonnyato4@yahoo.com.

signed in Abuja in 1991, perceived existing regional communities in the continent as building blocks thereby presuming the existence of a solid foundation on which it could build (ECOWAS, 2011). However, with over 40 regional bodies in the continent there is need for the evaluation of existing efforts at integration.

In West Africa, there are many regional bodies. Three of them can be identified as explicitly concerned with the promotion of intra-regional trade flows: the Economic Community of West African States (ECOWAS), Union Economique Monitaires l'Ouest Afrique (UEMOA) and Mano River Union (MARIUN). When ECOWAS was established in 1975, it aimed, among other things, at the gradual:

1) Elimination of custom duties and other charges of equivalent effect in respect of the importation and exportation of goods between member states;
2) Abolition of quantitative and administrative restrictions on trade among the member states;
3) Establishment of a common customs tariff; and
4) Abolition (as between the member states) of the obstacles inhibiting free movement of persons, goods, services and capital (ECOWAS, 2011).

These are laudable objectives, but the achievements have fallen far short especially in the area of trade liberalization. The Community has been trying to provide basic infrastructure such as good roads, reliable communication network, efficient transportation system and strong financial institutions, which, hopefully, will facilitate trading among member states.

There is no doubt that the Community, with 15 member states cutting across francophone and anglophone countries in the West African sub-region, has come a long way in trying to achieve set goals, not withstanding all the constraints. It has established institutions necessary not only for effective management of day-to-day activities of the Community, but also for increasing trade flows among member states. The West African Monetary Agency (WAMA), an autonomous body that grew out of the West African Clearing House (WACH), was established to facilitate multilateral payments in the sub-region and to provide means of overcoming the multiplicity of currencies in the region. The fund for Cooperation, Compensation and Development (FCCD) was established as the financial arm of the Community. Its major functions are to mobilize financial resources for the implementation of the Community's projects and to supervise payment of compensation to member states that might have incurred losses in revenue as a result of the implementation of the trade liberalization scheme (TLS).

Review of Conceptual and Methodological Issues

Gravity model has been used in international agricultural trade analysis for a long period of time now. This is because of its relevance in explaining the variables that determine international agricultural trade. Several empirical analyses in areas of agricultural policy, integration, border effects, economic sizes, trade potentials and other impedance of agricultural trade have been achieved using gravity model.

Ogunkola (1998) employed gravity model to analyse the trade potentials in the ECOWAS sub-region and found that the prospects for trade in the sub-region were indeed very great. In a similar study, Idsardi (2010) examined the determinants of agricultural export growth in South Africa using gravity model and found that various factors were shown to have significant impact on trade flows amongst which were economic market size, supply capacity and physical market size dominance.

Gravity model can also be augmented to analyse variables that cannot be measured. Dummy variables (qualitative variables) such as border effect, common language, regional integration, trade policy reform, just to mention a few, can be incorporated into gravity model for purposes of estimation (Hatab et al., 2010).

International agricultural trade is generally aimed at exchanging agricultural goods between or among countries that have agreement and understanding of each other to improve their economies. Agricultural trade is important to the poor in developing countries because most of the world's poor live in rural areas where agriculture is the key source of income and consumption (USAID, 2010). Agricultural trade provides a source of growth and agricultural growth stimulates growth in other sectors. Furthermore, the costs of supplying agricultural products are only partly determined by natural conditions like climate and soil but of greater importance could be per capita income, resources endowments, level of development, transportation costs and the size of a country's population. Therefore, identification and evaluation of the determinants of trade potentials within ECOWAS' nations, as concerns animal products, is considered an important research focus so as to contribute to the body of information available towards policy formulation and strengthening of the ECOWAS regional integration. Based on the above consideration, the specific objectives of the study were to:

1. Estimate the percentage volume, relative to all other agricultural products, and direction of trade in live animals and animal products among ECOWAS member countries, and
2. Assess the determinants of ECOWAS intra-trade in live animals and animal products during the period, 2001 to 2011.

Hypothesis of the study

The null hypothesis tested in this study was that ECOWAS regional characteristics did not influence trade

of live animals and animal products within the region.

MATERIALS AND METHODS

Study area

The study covered the entire ECOWAS. ECOWAS is the largest trade bloc in Africa. It was established on the 28 of May, 1975 in Lagos. Initially, it comprised sixteen West African countries. However, in 2000 Mauritania withdrew its membership from the ECOWAS thus reducing the number to fifteen member countries. Members of the trade bloc include: Benin Republic, Burkina Faso, Cape Verde, The Gambia, Ghana, Guinea, Guinea Bissau, Cote d'Ivoire, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. Agriculture (agrarian economy) accounts for at least 25% of the Gross Domestic Product (GDP) in all these countries and there is a combined estimated population of 280 million people as at 2010 with land area of about 5,112,913 km^2 (ECOWAS, 2011).

Sampling procedure

Data collected covered all the 15 ECOWAS member countries for purpose of analysing intra-ECOWAS agricultural trade on imports of live animals and animal products.

The panel data on the various agricultural commodities used comprised commodities on United Nations Harmonized System of classification (HS) codes 1-24. The choice of panel data was informed by the fact that it increases the efficiency of the estimators and significantly reduces the potential problem caused by the omission of variables. Secondly, panels can monitor unobservable trading partner-pairs' individual effects. The data were collected for the period of 11 years (2001 to 2011) giving 210 bilateral observations (that is 15 importing countries by 14 partner countries) for intra-ECOWAS trade.

The sub-categories of agricultural commodities were defined as follows: Section I (HS Codes 1-5): live animals and animal products; Section II (HS Codes 6-14): the vegetable products; Section III (HS Code 15): animal and vegetable fats and oils and other cleavage products; and Section IV (HS Codes 16-24): the prepared food stuff, beverages and tobacco.

Data collection

Panel data on values of bilateral merchandise imports of agricultural commodities (HS Codes 1-24) at 2-digits were obtained from Trademap (International Trade Centre-ITC) for the years 2001-2011. The choice of this period was to examine the effect of ECOWAS regional characteristics on trade after the birth of the present ECOWAS regional body following the withdrawal of Mauritania from the trade agreement in 2000. The data on GDP, per capita GDP, and the ratios between the nominal exchange rate and the official exchange rate of the countries concerned were obtained from the World Economic Outlook of the International Monetary Fund (IMF). Geographical distance between two partner-countries, population, countries' contiguity, infrastructure index and plausible use of common language were gathered from the database (Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)) of the French Research Centre in International Economics.

Data analysis

Objective (1) was achieved by the use of descriptive statistics such as percentages while objective (2) was achieved using gravity model. The software used in the analysis was Statistical Package for Social Science (SPSS) version 16, using ordinary least square estimator. A theoretical basis developed by Baier and Bergstrand (2002) underlies the gravity model. This model originated from the Newtonian Physics notion. Newton's gravity law in mechanics states that two bodies attract each other proportionately to the product of each body's mass (in kg) divided by the square of the distance between their respective centres of gravity (in metres).

Later on an Astronomer, Stewart and Sociologist Zipf (Zhang and Kristensen, 1995) transferred this law to the social sciences and attempted to apply it to spatial interactions, such as trips between cities, using the following specifications:

$$I_{ij} = G(Pop_i \ \ Pop_j) / D_{ij}^{\alpha} \quad (1)$$

where I_{ij} is trips between city i and city j; $pop_{i(j)}$ is population of city i(j); D_{ij} is distance between city i and city j; and G and α are the respective coefficients.

The gravity for trade is analogous to this law. The analogy is as follows: "the trade flow between two countries is proportional to the product of each country's 'economic mass', generally measured by GDP, each to the power of quantities to be determined, divided by the distance between the countries' respective 'economic centres of gravity', generally their capitals, raised to the power of another quantity to be determined" (Christie, 2002). This formulation can be generalised to:

$$M_{ij} = KY_i^{\beta} Y_j^{y} D_{ij}^{\delta} \quad (2)$$

where, M_{ij} is the flow of imports into country i from country j, k is constant, Y_i and Y_j are country i's and j's GDPs, D_{ij} is the geographical distance between the countries' capitals and β, y and δ are the respective coefficients. The linear form of the model is as follows:

$$Log(M_{ij}) = k + \beta \log(Y_j) + y \log(Y_j) + \delta \log(D_y) \quad (3)$$

Even though when estimated, this baseline model gives relatively good result, most estimates of gravity models add a certain number of dummy variables to equation (3) to test for specific effects. The gravity model has been applied to a wide variety of goods and factors of production moving across regional and national boundaries under different circumstances since the early 1940s (Oguledo and Macphee, 1994). Thus the functional form of the gravity model estimated in this study was as follows:

$$lnY_{ijt} = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + \beta_7 lnX_7 + \beta_8 lnX_8 + \beta_9 lnX_9 + \beta_{10} lnX_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \mu_{ijt} + v_{ijt} \quad (4)$$

In the above model (Equation 4):

1) Y_{ijt} indicates the amount of trade imports of country i from country j at time t. Although Elbadawi (1995) pointed out that, in principle, bilateral trade flows (exports or imports) would be influenced by the same factors, in this study imports were chosen rather than exports. The choice was informed by the fact that imports are better measured in the country of arrival because countries tend to monitor their imports more than their exports given that taxes are levied on the imports. Since the gravity model refers to the trade

volume, the study deflated the values of the annual imports, measured in US dollars, using the US Consumer Price Index (CPI).
2) X_1 and X_2 represent the GDPs in constant values (US dollar) of countries i and j, respectively. Given that the GDP is a variable that is indicative of the size of the economy, one expects $\beta_1 \geq 0$ and $\beta_2 \geq 0$ to confirm that the bigger the economy, the more significant trade becomes.
3) X_3 and X_4 represent the per capita GDPs in US dollars of countries i and j, respectively. Given that the per capita GDP is a variable that is indicative of the consumers' income level determining the purchasing power of the consumers in the respective countries, it is expected that $\beta_3 \geq 0$ *and* $\beta_4 \geq 0$, to confirm that the higher the income of consumers the more goods they can purchase, *ceteris paribus*.
4) X_5 and X_6 are variables that indicate the infrastructure index, which is constructed from three variables: the number of kilometers of roads and of railways and the number of telephone lines per capita. The index thus corresponds to the arithmetic mean of standardized variables. Considering that more developed infrastructure is likely to foster the movement of bilateral trade, it is also expected that $\beta_5 \geq 0$ and $\beta_6 \geq 0$
5) X_7 measures geographical distance between country i and country j in kilometres. The greater the distance between the two countries, the more transport costs tend to rise, consequently reducing the volume of trade; hence, it is expected that $\beta_7 < 0$
6) X_8 is a variable added to test Linder vs Hecksher-Olin theories that countries with similar characteristics trade more than dissimilar ones. The absolute difference values of the GDP per capita of country i and j was used. B_8 is expected to be negative when it obeys Linder's theory and positive if otherwise. Hecksher-Ohlin supported endowment factors as the major determinants in trade differences while Linder hypothesis identified taste differences, and the effect of development as the factors influencing trade.
7) X_9 is the real bilateral exchange rate between country i and country j at time t measured by the following formula: $TCR_{ijt} = (TCN_{i/\$}/TCN_{j/\$} \times (CPI_j / CPI_i)$, where TCN is the nominal exchange rate vis-à-vis the dollar and CPI is the price index, notably the GDP deflator. The negative impact of the real bilateral exchange rate will be reflected in $\beta_9 < 0$. This means that depreciation in value of the importing country's currency hinder imports and promotes exports
8) X_{10} is a tax variable introduced into the model to indicate the incentives for conducting unregistered trade. Its coefficient will thus reflect the impact of unrecorded trade on official bilateral trade. It was represented in the model by the percentage of tax paid on commodities imported. Accordingly, it is expected that the coefficient $\beta_{10} < 0$.
9) X_{11} is the dummy variable relating to whether the two trading countries border each other. It takes the value 1 if the two are neighbouring countries and 0 otherwise. For neighbouring countries, trade is expected to be intensive; this assumes that $\beta_{11} \geq 0$ and positive.
10) X_{12} is a variable added to assess contribution of usage of common language between the partner countries in trade. It is expected that $\beta_{12} \geq 0$ and positive.
11) μ_{ij} is the error term that is representative of the specific bilateral effect, and v_{ij} is the habitual symmetrical error term.

Except for the dummy variables all the other variables were expressed in natural logarithm. The estimated coefficients of these variables are directly interpreted as elasticities. On the other hand the elasticities of the qualitative variables were given as the exponential of the estimated coefficients.

Hypothesis testing

The specification for the test of significance for the null hypothesis of the study was as follows:

Null hypothesis

H_0: $\beta_1 = \beta_2 = \beta_n = 0$ (that regional characteristics did not significantly affect the trade of live animals and animal products in the region).

Alternative hypothesis

H_1: $\beta_1 = \beta_2 = \beta_n \neq 0$ (that regional characteristics did significantly affect the trade of live animals and animal products in the region). The hypothesis was tested using both the t-test the F-test for the statistical significance of the individual and combined variable effects on the dependent variable.

RESULTS AND DISCUSSION

Intra-ECOWAS imports of live animals and animal products

Total annual trade values of imports for the paired countries for all agricultural products and for the first products alone were computed as presented in Table 1. The value of all agricultural commodities imports within the region for the period of 2001 to 2011 stood at 4.56 billion US dollars, which accounted for 6.38% of the total value for all commodities imports in the region. The trade trends showed a tremendous increase from 3.92% in 2002 to 13.02% in 2008. After reaching this peak, it dropped to 9.52% in 2009 and later rose again to 12.45% in 2010. The highest trade values for the Section I products were observed in 2007 with corresponding percentage of 15.07%. The result indicated that the amount imported within the region varied with time. Assessment of the proportion of the Section I products (live animals and animal products) from the total agricultural products imports showed that Section I products accounted for 18.47%.

The percentages of each country's value for the total import values were analyzed and the findings are presented in Table 2. The results showed that Cote d'Ivoire alone accounted for more than half (52.39%) of the total all commodities imported within the region. Other countries like Mali, Senegal, Burkina Faso, Ghana and Nigeria accounted for 16.02, 8.45, 6.14, 5.42 and 4.20%, respectively. On the other hand, imports of agricultural products as a whole in the region seemed to spread across many countries. Burkina Faso and Mali had imports proportion of over 16% each while Cote d'Ivoire, Senegal, and Niger had over 13% each. The remaining countries like Nigeria, Togo, and Benin had the share of just slightly over 5% each while countries with least import trade proportion of less than 2% were Sierra Leone, Liberia, Guinea, Gambia, Cape Verde and Guinea Bissau.

With respect to the live animals and animal products imports, Cote d'Ivoire imported more than half (56.8%) of

Table 1. Value of intra-ECOWAS all agricultural live animals and animal products imports in thousand US dollars for the period 2001 to 2011.

Year	All commodities		All agricultural commodities		Section I Products (HS 1-5)	
	Total	%	Total	%	Total	%
2001	2,073,262	2.90	259,533	5.70	43,092	5.12
2002	1,522,408	2.13	178,537	3.92	15,575	1.85
2003	3,501,602	4.90	344,678	7.56	66,829	7.94
2004	3,318,687	4.65	356,741	7.83	42,071	5.00
2005	4,897,512	6.86	381,849	8.38	56,803	6.75
2006	4,472,975	6.26	407,137	8.94	102,464	12.18
2007	6,005,638	8.41	546,145	11.99	126,821	15.07
2008	31,566,971	44.21	593,465	13.02	116,506	13.84
2009	3,877,879	5.43	433,937	9.52	96,784	11.50
2010	6,247,203	8.75	567,459	12.45	90,471	10.75
2011	3,916,189	5.48	486,904	10.69	84,100	9.99
Total	71,400,326	100	4,556,385	100	841,516	100
%			6.38		18.47	

Source: Authors' computation using data extracted from ITC (Trademap) 2012.

Table 2. Value of Intra-ECOWAS all agricultural and live animal and animal products imports in thousand US by countries for the period 2001-2011.

Country	All commodities		All agricultural commodities		Section I products (HS 1-5)	
	Total	%	Total	%	Total	%
Benin	2270934	3.19	239227	5.25	44357	5.27
B/Faso	4380888	6.14	744122	16.33	24951	2.97
C/Verde	81671	0.11	4820	0.11	904	0.11
Cote d' Ivoire	37407642	52.39	668969	14.68	478004	56.8
Gambia	428354	0.6	20780	0.46	2446	0.29
Ghana	3868312	5.42	127580	2.8	20016	2.38
Guinea	957783	1.34	62584	1.37	918	0.11
G/Bissau	75415	0.11	22276	0.49	787	0.09
Liberia	1999764	2.8	64794	1.42	3186	0.38
Mali	6985998	16.02	729770	16.02	58589	6.96
Niger	2389332	3.35	617362	13.55	13148	1.56
Nigeria	2998489	4.2	289100	6.34	80108	9.52
Senegal	6033545	8.45	636936	13.98	57430	6.82
S/Leone	643953	0.9	55522	1.22	4390	0.52
Togo	878246	1.23	272543	5.98	52282	6.21
Total	71400326	100	4556385	100	841516	100
%			6.38		18.47	

Source: Authors' computation using data extracted from ITC (Trademap), 2012.

the total imports in the region. The percentages of other countries' imports of these products were 9.52%, 6.96%, 6.82%, 6.21% and 5.27% for Nigeria, Mali, Senegal, Togo and Benin, respectively. Other countries with a proportion of less than 2% of the imports included Cape Verde, Gambia, Guinea, Guinea Bissau, Liberia, Niger and Sierra Leone.

Determinants of ECOWAS trade in live animals and animal products

The OLS regression technique was employed for the analysis after testing several other estimators which did not give any superior results. To check for multicollinearity, simple correlation was run and the results

Table 3. Gravity regression results of determinants of trade in live animals and animal products within ECOWAS region.

Variable	Coefficient (B)	Std error	t-value	Exp $(\beta)^{-1}$
X_1	0.966	0.134	7.190***	
X_2	0.767	0.121	6.325***	
X_3	-0.263	-0.290	-0.907	
X_4	-0.001	0.211	-0.006	
X_5	0.036	0.356	0.100	
X_6	-0.084	0.134	-0.622	
X_7	-0.579	0.238	-2.433**	
X_8	0.189	0.217	0.872	
X_9	0.090	0.056	1.596	
X_{10}	0.356	0.197	1.774	
X_{11}	1.341	0.523	2.566**	2.82
X_{12}	0.596	0.316	1.886*	0.81
Constant	5.220	3.437	1.519	
R2	0.607			
F-Statistic	18.805***			
Number of observations	2288			
Relative bilateral trade	208			

Dependent Variable Y_{ij}; All variables except dummies are in natural logarithms form *, **, *** indicate significance at the 10, 5, and 1% levels, respectively. Source: Authors' estimation using SPSS 16 (2012).

indicated that the population and land lockedness variables had high correlation coefficients. In an attempt to use another software Stata Version 9, these same variables were automatically dropped by the package. Thus, these variables were dropped from the final equations estimated. The issue of zero values recorded was handled using three methods suggested in literature; namely; using (i) Tobit model, (ii) elimination of zero data and (iii) addition of a minimum constant value all through to the actual dependent variable data collected. The results indicated that regression by addition of a minimum constant value was more efficient and explained the variations better than the other methods. Thus, it was adopted for the analysis. The results of the gravity equations are presented in Table 3. The model fitted the data well and explained over 60% of the variations in trade of live animals and animal products discussed as follows:

1) The GDP of the importing countries (X_1) and that of exporting countries (X_2) were used as proxies for marketing sizes of these countries. The coefficients of the GDP in importing countries were high and statistically significant at 1% level of significance, with all the expected positive signs. The positive and statistically significant coefficients of the importing and exporting countries' GDPs for the augmented gravity model were consistent with the theory behind the conventional gravity model, suggesting that the size of the economies should enhance the amount of trade between trading partners. The result implied that a percent increase in GDP of the importing countries increased imports of live animals and animal products by 0.97% for the period under review.

2) The coefficients of the GDP of the exporting countries, which indicated the potentials for supply, were found to be positive and statistically significant at 1% level of significance. The result suggested that holding other variables constant, a percent increase in GDP of the exporting countries increased the supply of live animals and animal products by 0.77%. It, therefore, meant that GDP determined the pattern of trade in live animals and animal products in the region. This agreed with the findings of Hatab et al. (2010) which showed that GDP influenced most of the trade in agricultural products between Egypt and its partner nations.

3) The per capita GDP for importing countries (X_3), which proxied the consumer's income (purchasing power) showed negative sign and not statistically significant. The negative sign implied that as the income of consumers improved less of the products were demanded. The result thus suggested that the absorption effect was not as the result of the consumer's income but that of the economic or endowment size.

For the per capita GDP of the exporting countries (X_4), the coefficient estimated was negative and not statistically significant. The low value and non-significance of the coefficient for per capita GDP (income) of producing countries signified 'home market effects.' This suggested that an increase in income of the producing country increased the domestic consumption of the product thereby reducing the quantity to be exported to the partner countries. Thus, one can deduce from the results in Table 3 that, trade in live animals and

animal products in the ECOWAS region was determined more by the economic and resource endowment size than by the per capita GDP.

The coefficient of the infrastructure variable in importing countries (X_5) was positive but not statistically significant. On the other hand, the coefficient of the infrastructure variable for exporting countries (X_6) had negative sign and not statistically significant also. This meant that infrastructure variables in both importing and exporting countries did not explain variations in imports of live animals and animal products within ECOWAS region. This too could be explained by the nature of the trade involved. The bulk of it was in live animals trekking across borders, mostly using bush paths such that states of roads and other handling facilities were irrelevant to the trade at the level it was transacted.

The distance variable (X_7) coefficient had a negative sign and was significant at 5% level. The negative coefficient of this variable indicated that the distance between individual ECOWAS countries and their partner-countries affected ECOWAS imports negatively. A percent increase in distance (km) will reduce ECOWAS imports by 0.58%. The lower reduction in amount of live animals and animal products traded with increases in distance as compared to other sectors of agricultural products may not be unconnected with the fact that live animals transportation were more by movement of the animals across borders on foot and sometimes by trucks than by air. Nonetheless, distance invariably affected trade of live animals and animal products in the region.

The absolute values of the difference between per capita GDP (income) of importing and exporting countries (X_8) was added to the gravity equation of intra-ECOWAS trade to test for Linder vs Heckscher-Ohlin theories, that countries with similar characteristics trade more with each other. The coefficient of this variable was positive but not statistically significant for trade of live animals and animal products. This implied that the trade pattern followed the Heckscher-Ohlin's theory of trade but the effects were very minimal (not significant).

Real exchange rate (X_9) was added to the gravity equation to estimate the effects of currencies exchange between the importing countries and those exporting live animals and animal products in the region. The coefficient estimated had positive sign but not statistically significant. The non-significance of exchange rate of currency in the region could be as a result of common currency used by the French speaking countries in the region (UEMOA). This result implied that holding other variables constant, an appreciation of importing country's currency will increase imports of live animals and animal products by 0.09% but since it was not significant it meant the exchange rates were not major determinants of variations in trade of live animals and animal products in the region.

The coefficient of the tax (X_{10}) payable variable in the importing countries turned out, surprisingly, to be positive but not statistically significant. This implied that tax was not a major explanatory variable in importing countries to influence changes in the amount of trade in live animals and animal products. This could be as a result of efforts made by ECOWAS trade agreement to eliminate tariff and other fees payable for some imported consumable goods in the region.

One of the geographical variables that explained variations in imports of live animals and animal products was contiguity (X_{11})-that is, countries sharing common border. The coefficient for contiguity was high, positive as expected and statistically significant at 1% probability level. This result suggested that sharing common border enhanced trade of live animals and animal products in the region. As shown in Table 3, holding other variables constant, sharing common border increased trade of live animals and animal products by 2.82 (exp 1.341) times than observed in countries that did not share common border. Therefore, contiguity explained variations in trade of live animals and animal products to a very high level in the region.

The coefficient of the common official language variable (X_{12}) was positive as expected and significant at 10% level of significance. The result implied that use of common language by partner-countries increased trade in live animals and animal products by 0.82 (exp 0.596) times than countries that did not share common language in the region. This was possible because common language helped in quick bargaining of prices and passage of other vital information. Thus, usage of common language positively and significantly influenced trade in live animals and animal products in the region.

Test of hypothesis

The test was done to evaluate the significance of the impact of the regional characteristic on Intra-ECOWAS Trade in live animals and animal products.

Null hypothesis

H_0: $\beta_1 = \beta_2 = \beta_n = 0$ (that regional characteristics did not significantly affect the trade of live animals and animal products in the region).

Alternative hypothesis

H_1: $\beta_1 = \beta_2 = \beta_n \neq 0$ (that regional characteristics did significantly affect the trade of live animals and animal products).

The F-test indicated the overall contribution of all the independent variables in the model to explaining variations in trade. The F-statistics of 18.81 showed how significantly [1% level ($p = 0.0001$] the independent

variables combined explained the variations in the trade in live animals and animal products in the region.

Decision

Since the model was significant at 1%, it meant that not all variable coefficients (β's) were zero. Therefore, the null hypothesis was rejected and it was concluded that regional characteristics did significantly affect the trade of live animals and animal products in the ECOWAS region.

CONCLUSION AND RECOMMENDATIONS

In recognition of the importance of international agricultural trade in most African economies, this study attempted to identify and analyse the determinants of trade in live animals and animal products within the sub-region. From the results, intra-ECOWAS imports of the products were consistent with the gravity theory that trade between countries depended on the mass (economic size) and inversely proportional to the distance between them. The per capita GDP in both countries (importer and exporter) turned out to be insignificant factors in determining ECOWAS imports of live animals and animal products. This implied that ECOWAS trade pattern, with respect to the products under consideration, followed a GDP pattern. That is, it concentrated on the demand and import of quantity-based products and depended on overall market size, rather than on per capita GDP pattern which centers on the import of quality-based high value-added products which are sensitive to income levels.

Based on the findings of this study, the following recommendations are made:

1. Non-tariff barriers in the Union's member-countries must be effectively eliminated so as to enhance cross border trade especially in the areas of live animals and animal products.
2. It is imperative that efforts should be made by the member-countries to improve on infrastructural facilities so as to promote processing, storage and cost-effective transportation and marketing of more value-added products within the sub-region.
3. Efforts are needed on the part of the Union at harnessing more of the resource endowments of member-countries and re-formulation and harmonization of trade policies in member-nations to promote greater trade within the region.

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