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A Comparative Analysis of the Effect of Aflatoxin Standards of Sub-Saharan African Countries Cocoa Export Trading Partners' on Sub-Saharan African Countries Primary and Processed Cocoa Export Trade

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Assessment of the effect of aflatoxin standard of the EU trading partners on bilateral trade values of sub-Saharan African countries primary cocoa export to EU trading partners and sub-Saharan African countries processed cocoa export to EU trading partners from 2001 to 2010 was conducted. The bilateral trade values of sub-Saharan African countries primary cocoa export and processed cocoa export to EU trading partners from 2001 to 2010 was obtained from COMTRADE 2012. Gravity models were utilized to capture the bilateral trade values data for sub-Saharan African countries primary cocoa export and processed cocoa export to EU trading partners from 2001 to 2010 for 11 sub-Saharan African countries primary cocoa and processed cocoa exporters and their nine EU trading partners. The gravity models were estimated utilizing the Tobit model. A comparative analysis of the effect of aflatoxin standards on the bilateral trade values of sub-Saharan African primary cocoa export and processed cocoa exports to EU trading partners was conducted by utilizing descriptive analysis for analyzing the coefficients of aflatoxin standard for primary cocoa export and processed cocoa exports. The result showed that the coefficient of the aflatoxin standard for sub-Saharan African countries primary cocoa export to EU trading partners was 0.9 and the coefficients of aflatoxin standard for the gravity model for sub-Saharan African countries processed cocoa export to the EU trading partners were cocoa butter 0.2057 and cocoa powder 0.666. This implied that, aflatoxin standard of the EU trading partners export market had a lesser market access restriction effect on sub-Saharan African countries processed cocoa exports than that of sub-Saharan African primary cocoa export and that the aflatoxin standard of the EU trading partners export market had a lesser market access restriction effect on sub-Saharan African cocoa butter exports than that of sub-Saharan African countries cocoa powder export in the given period.

Keywords: aflatoxin, sub-Saharan, cocoa, African, primary, processed, countries and export

Introduction

Aflatoxins are the most known mycotoxins to contaminate crop produce and processed crop forms. In developing countries food crops are susceptible to fungal infections which result in mycotoxin contamination

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due to poor agronomic and post harvest practice. Aflatoxins are the most widely studied and dangerous mycotoxins (Okello et al., 2010).

Developing countries suffer most from impact of enforcement of regulation by European and international agencies, particularly from the former which is a major importer of agricultural commodities from developing countries. The economic losses does not arise from crop losses but also from costs associated with regulation compliance (CRA, 2011), for instance Bankole and Adebanjo (2003) reported that as a result, exports of agricultural products particularly from developing countries had dropped considerably resulting in major economic losses to producing countries. Losses from rejected shipments and lower prices for inferior quality can devastate developing country export markets (Bhat & Vasathi, 2003).

Analysis of a time series data of major sub-Saharan African countries export trade values from 2001 to 2010 obtained from United Nations international trade statistics database 2012 (COMTRADE, 2012) showed that sub-Saharan African countries cocoa exports had a major average share of 18.35% in annual gross trade values for sub-Saharan African countries agricultural exports from 2001 to 2010 and were the most important sub-Saharan African countries exports in the period. This is shown in Table 1. EU trading partners had the major average annual share of 70.41% in the world annual total export of sub-Saharan African cocoa from 2001 to 2010, shown in Table 2.

In this study average growth rate analysis of a time series data of sub-Saharan African countries primary and processed cocoa annual export outputs from 2001 to 2010 in Table 3, shows decline in sub-Saharan African countries, cocoa beans average annual outputs from 262.59% in 2001-2005 to 24.15% in 2006-2010, cocoa paste average annual outputs from 390.4% in 2001-2005 to -10.56% in 2006-2010, cocoa butter average annual outputs from 390.52% in 2001-2005 to -13.20% in 2006-2010, and cocoa powder average annual outputs from 2959.36% in 2001-2005 to -6.68% in 2006-2010.

Analysis of the performance of sub-Saharan African countries processed and primary cocoa exports in the period 2001 to 2010 showed that in the period 2001 to 2005 sub-Saharan African countries cocoa beans export achieved a three-digit annual average growth rate and processed cocoa products which include cocoa paste; cocoa butter achieved significantly higher three digits growth rates than that of cocoa beans exports while cocoa powder a processed cocoa export products achieved a dramatic, higher four digits average growth rate in the period. Table 3 shows that significantly higher annual average growth rates were recorded for processed cocoa exports than primary cocoa exports in the given period and this indicates that processed cocoa exports achieved higher market access in sub-Saharan African cocoa export trading partners' export markets than primary cocoa export in the given period.

One of the major causes of processed cocoa exports achieving significantly higher average growth rates than primary cocoa exports in the period has been attributed to a lesser market access restriction by stringent aflatoxin standards for processed cocoa exports than primary cocoa exports in the export markets of sub-Saharan African countries trading partners. The annual average growth rates in 2001-2005 period for primary cocoa export of cocoa beans is 262.59% and for processed cocoa exports which include cocoa paste, cocoa butter, and cocoa powder are 390.44%, 390.5%, and 2959% respectively. There was dramatic decline of the processed cocoa exports industry in the period 2006-2010, which recorded negative annual average growth rates of -10%, -13%, and -6% for cocoa paste, cocoa butter, and cocoa powder respectively. While the annual average growth rate of primary cocoa export declined to a two-digit annual average growth rate of 24%, the

dramatic decline of the cocoa export industry in this period was due to wars experienced in Cote d'ivoire and Democratic Republic of Congo, which are major exporters of primary and processed cocoa exports. The negative average growth rates of processed cocoa exports in the period 2006-2010 was due to closure of cocoa processing firms in the two African countries which are among the major sub-Saharan African countries primary and processed cocoa exporters.

Table 1

Shares of Major Agricultural Exports in Annual Total Trade Values of Sub-Saharan African Countries' Agricultural Exports 2001-2010

	2001 % shares	2002 % shares	2003 % shares	2004 % shares	2005 % shares	2006 % shares	2007 % shares	2008 % shares	2009 % shares	2010 % shares	Average % shares
Cocoa	14.517	3.57	24.3	23.945	19.869	19.519	20.52	21.613	24.450	11.172	18.354
Coffee	9.198	18.991	19.5	12.00	12.825	13.02	13.78	11.3	6.661	0.121	11.739
Groundnut	0.015	0.028	0.0318	28.391	-0.58	-0.772	0.022	0.02	0.014	0.0146	0.022
Banana	1.138	0.604	1.097	1.190	1.102	1.606	1.049	0.8	7.90	0.5121	1.699
Tea	6.020	3.532	4.380	4.1478	4.403	4.541	0.0452	4.63	5.070	1.5	3.826
Tobacco	11.50	9.525	4.79	7.450	6.697	7.769	7.262	7.724	8.794	10.834	8.228
Rubber	2.860	3.399	3.480	3.953	3.8	4.396	5.495	6.708	3.9	5.488	4.347
Cotton	10.204	12.275	11.718	13.965	9.72	7.285	6.450	5.5	4.493	7.976	8.450
Sugar	7.857	10.38	7.35	18.164	7.396	7.458	6.271	3.976	4.76	5.154	8.0766

Source: Author's computation from COMTRADE 2012.

Table 2

Shares of Major Trading Partners in Annual Total Trade Values of Sub-Saharan African Countries Cocoa World Exports, 2002-2010 (%)

Countries	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average
China	2.8431	0.26	0.5	0.9	0.97	1.238	1.6	0.589	0.46	1.039
EU	80.181	76.064	69.611	74.087	66.565	68.597	67.467	68815	62.344	70.41
Japan	8.642	1.944	1.895	1.637	2.173	2.029	0.496	1.444	0.692	2.328
USA	4.355	10.897	12.965	18.568	14.056	11.204	12.246	8.753	11.778	11.646
India	0.0168	0.0031	0.0394	0.18	0.316	0.30	0.25	0.13	0.034	0.14

Source: Author's computation from COMTRADE 2012.

Table 3

Average Growth Rate Analysis of Sub-Saharan African Countries Primary and Processed Cocoa Export Outputs, 2001-2010

Export	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Average 2001-2005	Average 2006-2010
Cocoa beans	268.44	-0.800	1,043.44	14.77	-12.86	11.81	5.82	25.91	18.22	59	262.59	24.152
Cocoa paste	-77.62	2,058.4	-50.66	0.007	22.08	16.29	9.29	12.78	-91.17	0	390.44	-10.562
Cocoa butter	1,187.59	98.41	13,603	4.04	15.17	5.87	56.10	13.20	18.58	-54.94	390.52	-13.202
Cocoa powder	35.41	97.24	14,911.39	-25.38	-27.87	-4.6	39.96	2.29	24.94	-96	2,959.362	-6.682

Source: Author's computation from COMTRADE 2012.

The focus of this study is comparative analysis of the effect of aflatoxin standard of sub-Saharan African countries trading partners' on sub-Saharan African countries primary and processed cocoa export trade. The specific objectives are, analysis of the effect of stringent aflatoxin standard of sub-Saharan African countries trading partners' on sub-Saharan African countries primary cocoa export trade, analysis of the effect of stringent aflatoxin standard of sub-Saharan African countries trading partners' on sub-Saharan African countries processed cocoa export trade, and comparative analysis of the effect of stringent aflatoxin standard of sub-Saharan African countries trading partners' on sub-Saharan African countries primary and processed cocoa export trade.

There is lack of adequate knowledge on comparative analysis of the effect of stringent aflatoxin standard of sub-Saharan African countries trading partners' on sub-Saharan African countries primary and processed cocoa export trade. This study will contribute to the knowledge of comparative analysis of the effect of stringent aflatoxin standard of sub-Saharan African countries trading partners' on sub-Saharan African countries primary and processed cocoa export trade. This study is also policy relevant; it would enable policy makers of sub-Saharan African countries to proffer policies that will enhance sub-Saharan African countries cocoa exports to gain ease of market access to the export market of trading partners.

Literature Review

Theoretical Review

The immediate effect of a higher quality standard to raise production costs in equilibrium will reduce the quantity demanded of the now regulated product and thus reduces both consumer and producer surpluses relative to the status quo ante. As a result, the volume of trade will be either reduced if the regulation means higher costs for foreign producers or increased if the domestic industry is more heavily burdened. Contingent on the specific circumstances, these costs may be outweighed by the gains from additional risk avoidance.

However, for instance, a food safety standard may lower the number of fatal incidents because it improves food hygiene. Thus, a global welfare enhancing sanitary and phytosanitary (SPS) measure would equalize marginal welfare gains and marginal welfare losses. Apart from protecting humans, animals, and plants from risks, many SPS measures fulfill the important function of addressing information asymmetric between consumers and producers.

Commodities that fall under the purview of SPS regulations are mainly agricultural products and foodstuffs, such as human and animal food, seeds, plants, and the like. All of these products display the feature that their health and safety implications are not always ascertainable prior to consumption. In economic terms, they are experience goods. Experience goods quality is revealed only once the transaction is completed and the goods consumed. Even though producers may have the necessary information to assess the product's quality, they do not necessarily share with consumers, who in many cases are unable to distinguish between safe and unsafe product. This information asymmetry may lead to market failures because low quality products may crowd their high quality counterparts out of the market place. Depending on associated risk and individual level of risk aversion, consumers would prefer safe products only if they were able to distinguish from less safe and cheaper ones. When safe and unsafe products are indistinguishable however, consumers buy the cheaper goods, which makes it unprofitable for producers to fabricate and sell safer goods, and will eventually force them to leave the market. In other words due to the information asymmetry that prevents consumers from ascertaining the products' quality, markets will in equilibrium tend to under supply high quality versions of the product, even when there is a demand for it.

One way of addressing the problem is to enact regulations tackling the information asymmetry. This can take the form of government regulation combined with consumer information. Hence by enacting SPS measures that ensure product characteristics and quality, experience goods may be transformed into search goods so as to restore market conditions to start to be in the absence of the information asymmetry. Such restoration of information symmetries can be conducive to trade as consumers are incentivized to buy. Whether SPS measures indeed have this effect is doubtful as some empirical research comes to the conclusion that the overall impact on trade in agricultural products is rather negative (Disdier, Fontagne, & Mimouni, 2008). However, other studies offer a rather mixed picture, identifying both positive and negative effects (Anders & Caswell, 2009).

The level of development of countries is likely to play an important role as it affects the level of available production technologies and consumer preferences. Producing higher quality may be relatively more expensive in developing countries than in developed countries. More importantly, the demand for quality, for instance in terms of product safety is likely to increase with income. Theoretically considerations will therefore suggest that optimal standards may differ significantly between developing and developed countries and that the potential for conflicts of interest is relatively high (WTO, 2005).

Analytical Review

Gravity model. A gravity model is used to explain bilateral trade flows using key economic variables that represent the size of country's economy, such as Gross Domestic Product (GDP) and the geographical distance between countries. A gravity model was developed by Tinbergen (1962) to explain bilateral trade flows between trading partners' by means of Gross Domestic Product and geographical distance between countries.

Gravity models rely on Newton's "Law of Universal Gravitation" formula. In a similar way, economists discovered in the 1960s that the equation of $F_{ij} = G (Ma_i * Mb_j)/D_{ij}$ performed well in explaining trade flows if F_{ij} is the "flow" from origin i to destination j; M_i and M_j are the relevant economic sizes of the two location; D_{ij} is the distance between the locations and G, a, and b are constants. Economic sizes of countries are represented by the GDP of countries. Distances between the locations are taken as to reflect the transportation cost that they face. The basic gravity model can be written as follows.

$$\text{Log (Trade Flow}_{ij}) = b_o + b_1 \log (\text{GDP}_i) + b_3 \log (\text{Distance}_{ij}) + e_{ij}. \quad (1)$$

From the empirical gravity model of Winters and Soloaga (2001), in the gravity model equation the trade between two countries depends on two sets of determinants, size of their Gross Domestic Products and trade costs. The explanation is that the size of the exporting country captures the exporter supply capacity whilst the size of the importing country captures the importers demand capacity. The trade costs can be imagined as "frictions" to trade and the literature suggests various proxies such as geographical distance, cultural similarity and adjacency. The rational of geographical distance can be found in the idea that a higher distance between trading partners would lead to higher transport costs and increased differences in preferences. The cultural similarity is normally captured by the use of common language which is expected to be reflected in lower transaction costs and closer preference, the adjacency dummy indicates that two countries share a common border, and this is expected to have a positive impact on trade. The basic model can be further sophisticated in order to increase its explanatory power, by including a number of other variables that influence bilateral trade flows such as land for capturing natural resources population for capturing economics of scale, remoteness of a

country measured by the average distance of the importer from its exporting partners weighted by exporters GDP share in world GDP (Winter & Soloaga, 2001).

Tobit model. The Tobit technique uses all observations, both those at the limit and those above it, to estimate a regression line generally, and in this study it is preferred over alternative techniques that estimate a line only with the observations above the limit. The coefficients obtained using the Tobit analysis called "beta" coefficients provide more information than are commonly realized. Tobit analysis is the probability of being above the limit and changes in the value of the dependent variable if it is already above the limit. The classical double-log specification shown in Equation (2) is normally used to estimate the gravity model that it has the immediate advantage that the estimate coefficient coincides with the response elasticity's. However some observation of endogenous variables might have zero values, which will cause a problem for the logarithmic transformation. In this study the Tobit analysis model was employed to deal with this issue.

The stochastic model underlying Tobit model may be expressed by the following relationship:

Where N is the number of observations, y_t is the dependent variable, x_t is a vector of independent variables and is a vector of unknown coefficients, and u_t is an independently distributed error term assumed to be normal with zero mean and constant variance 0^2. Thus the model assumes that there is an underlying, stochastic index equal to $(x_t + u_t)$ which is observed only when it is positive, and hence qualifies as an unobserved, latent variable.

As Tobit shows, the expected value of y in the model is

$$Ey = x\ F(z) + of(z), \tag{2}$$

where z is the unit normal density, and F(z) is the cumulative normal distribution function (individual subscripts are omitted for mutational convenience). Furthermore, the expected value of y for observations above the limit, here called y*, is simply x plus the expected value of the truncated normal error term.

$$\begin{aligned} Ey^* &= E(y/y > (0)) \\ &= E(y/u > -x) \\ &= x + of(z)/F(z). \end{aligned} \tag{3}$$

Consequently, the basic relationship between the expected value of all observations, Ey, the expected value conditional upon being above the limit, Ey*, and the probability of being above the limit, F(2), is

$$Ey = F(z)\ Ey^*. \tag{4}$$

A Priori Expectation

In the basic gravity model equation the trade between two countries depends on two sets of determinants: size of trade partners, normally expressed in terms of their GDP and trade costs. The intuitive explanation is that the size of the exporting country captures the exporter supply capacity, while the size of the importing country captures the importer demand capacity. The trade costs can be imagined as "frictions" to trade and the literature suggest various proxies such as geographical distance and cultural similarity, the rational of geographical distance can be found in the idea that an higher distance between trading partners would lead to higher transport costs and increased differences in preferences. The cultural similarity is normally captured by the use of common language which is expected to be reflected in lower "transaction costs" and cost preferences. The adjacency dummy indicates that two countries share a common border and this is expected to have a positive impact on trade. The basic model can be further sophisticated in order to increase its explanatory power including a number of other variables that influence bilateral trade flows, land for capturing natural

resources and population for capturing economies of scale. Thus the coefficient of the GDP of exporting country b2 and the coefficient of the GDP of importing country b1 are expected to positive. Since a high level of income in the exporting country indicates a level of production which increases the availability of goods for exports, also a high level of income in the importing countries suggests higher imports. A lower level of the sanitary and phytosanitary standard would indicate a more restrictive standard; therefore the coefficient would be positive and it similarities that more restrictive standards impact negatively in trade. The coefficients of colonial relationship and language similarities of dummy variables which evaluates the effects of preferential trading agreements would be positive while the coefficient of the dummy variable for landlockedness would be negative as landlockedness limits trading in landlocked countries (Winters & Soloaga, 2001).

Empirical Review

Different econometric models have been used in order to determine the effect of standards and technical regulations on trade. All share a common feature which is that they regress the trade flows on a proxy for standards along with other factors that promote or divert trade in order to isolate the impact of standards on trade. At the same time the definition of the "proxy" which clearly is the crucial trick of all these exercise has varied. Swann, Paul, and Mark (1996) regressed the British imports, exports, and net exports disaggregated at three-digit for the period 1985-1991 on international standards recognized by UK and Germany (shared standards) and on unilateral standards imposed either by UK or Germany using the number of standards as proxy of the severity of standards. He found that unilateral. British standards tend to have a positive effect on both exports and imports. The positive effect on exports leads us to think that domestic standards act as a "signaling device"; unfortunately the interpretation of the positive sign on imports is more puzzling effect on imports and is interpreted using the ad-hoc explanation that idiosyncratic British standards raise costs for domestic firms and allow the entry of lower cost imports. He also found that shared standards tend to have little impact on imports but appositive effect on exports, though smaller than the effect of national standards and finally that the impact of unilateral German standards tend to be positive for British imports and as expected, negative for British export.

Moenius (1999) in a very complete study that covered 471 industries disaggregated at four-digit level, 12 countries, and a period from 1980 to 1995, making use of gravity type model took as a proxy the number of standards in order to capture their severity and like Swann et al. divided the standards to into shared and unilateral standards. His main findings are that shared standards tend to have a positive impact on trade, even this is not robust when testing it for causality as he cannot reject the hypothesis that an expansion of trade generates an higher number of standards; very interesting in is study is that unilateral standards tend to promote trade in manufacturing sectors, but hinder trade in non manufacturing sectors such as agriculture. Both the works of Swann et al. (1996) and Moenius (1999) suffer a crucial limitation related to the use of the number of standards as a proxy for their severity; in fact the aggregation of heterogeneous standards may very well confuse the effects of standards that are trade restrictive with others that are trade enhancing; furthermore standards very in importance across sectors and products and different standards cannot be expressed to have the same effect.

The works of Otsuki, Wilson, and Sewadeh (2001) have been able to overcome these shortcomings as they fit a gravity model where the proxy that captured the severity of the standard is a direct measure of its severity expressed in maximum allowable contamination. They estimated the trade impact of aflatoxin standards on

both European imports from Africa and global trade flows and found out that the standards tend to be significant in most cases and have a disruptive impact on trade quantified in about 670 million USD of trade with respect to the baseline scenario where the standard used is the international CODEX Alimentarius standard, whilst on a global scale they calculate that the difference between a global harmonisation under the new restrictive European standard compared with a global harmonisation under the international CODEX Alimentarius standard would cost, in term of trade flows more than US$12 billion (Otsuki et al., 2001) with a distribution of net gains and losses that would negatively affect only non-OECD (Organization for Economic Co-operation and Development) countries.

Otsuki et al. (2001) did a study on the effect of European aflatoxin, sanitary and phytosanitary measures on the bilateral trade of Groundnuts from nine African countries to 14 EU member countries and Switzerland from 1989 to 1998. A gravity model was utilized as the analytical model for their study. Their results showed that new European Union sanitary and phytosanitary measures are likely to be a major constraint to African groundnut exports. In line with the study of Otsuki et al. (2001), in this study gravity models were utilized to analyze the bilateral trade values of sub-Saharan African countries cocoa exports to EU trading partners from 2001 to 2010. Independent data sets of the bilateral trade values for sub-Saharan African countries primary cocoa export and processed cocoa export to European Union trading partners from 2001 to 2010 were utilized in this study. In the specified gravity model for this study, dummies for common languages between trading partners and dummies for landlocked sub-Saharan African countries cocoa exporters were included, in addition to the dummies utilized in the empirical gravity model for the study of Otsuki et al. (2001). Otsuki et al. (2001) utilized a fixed effect model of ordinary least square as the regression model for the bilateral trade data in their study. In this study a mixed effect model which is the Tobit model was utilized for the regression of bilateral trade data.

Methodology

The scope of study includes cocoa exporting African countries located in sub-Sahara Africa. Sub-Sahara Africa is bounded by Sahara desert in the North, Atlantic Ocean in the west, Indian Ocean in the east, and jointly by Atlantic and Indian Ocean in the south. As a group these countries are usually referred to as sub-Saharan African countries.

Sub-Saharan African countries cocoa exporters and their trading partners were determined by purposive sampling. In this study 11 sub-Saharan African countries cocoa exporters were determined and these include, Cote d’ivoire, Nigeria, Ghana, Cameroon, Gabon, Togo, Uganda, Tanzania, Liberia, Madagascar, Democratic Republic of Congo. These were obtained as secondary data from United Nations commodity statistical trade database 2012 (COMTRADE, 2012). Purposive sampling was also utilized to determine the major trading partners of these sub-Saharan African countries which include nine European Union countries. These countries were also obtained from COMTRADE 2012 and these include Netherlands, Germany, France, United Kingdom, Belgium, Spain, Ireland, Italy, and Poland. Purposive sampling was also utilized to determine sub-Saharan African countries major processed cocoa exports (cocoa powder and cocoa butter).

The type of sources of data that were utilized in this study is secondary data and the sources include, World Bank database for economic outlook for countries of the world 2012, United Nations trade statistics database 2012 (COMTRADE, 2012), annual reports of International Economie (CEPII, 2011), and FAO worldwide regulations on mycotoxins 2003. Data obtained include, variables of sub-Saharan African

countries annual export trade values for cocoa beans, cocoa powder, and cocoa butter, variables of maximum residue limits for Aflatoxin B1 for sub-Saharan African countries cocoa exports EU trading partners, variables of annual trade values of sub-Saharan African countries export of cocoa beans, cocoa powder, and cocoa butter to EU trading partners, variables of annual sub-Saharan African countries cocoa exporter' geographical distances to trading partners capital cities, variables of common languages between sub-Saharan African countries cocoa exporter and EU trading partners, variables of colonial relationship between sub-Saharan African countries and EU trading partners, variables of land lockedness for sub-Saharan African countries cocoa exporter.

Analytical Methods

The analytical methods utilized in this study include, gravity model analysis, Tobit regression analysis, and descriptive statistics which include, averages, trend analysis, graphs, modes and tables. In this study a gravity model was utilized to capture the bilateral trade data for 11 sub-Saharan African countries primary cocoa exporter and processed cocoa exporter to their nine trading partners in the European Union from 2001 to 2010. The 11 sub-Saharan African countries major exporter of cocoa products and their nine trading partners in the European Union were determined from time series secondary data of sub-Saharan African countries annual cocoa export bilateral trade values for EU trading partners obtained from COMTRADE 2012. The sub-Saharan African countries cocoa exporter countries include Cote d'Ivoire, Nigeria, Ghana, Cameroon, Togo, Tanzania, Gabon, Uganda, Liberia, Democratic Republic of Congo, and Madagascar. The nine trading partners of these sub-Saharan African countries cocoa exporters in the European Union were also determined from COMTRADE 2012 and these include Netherlands, Germany, France, United Kingdom, Spain, Belgium, Ireland, Italy, and Poland.

In this study 99 combinations of sub-Saharan African countries major exporter of cocoa products and their trading partners in the European Union were determined for data capture for the empirical gravity model utilized in this study. In the study from COMTRADE 2012, 985 observations were made for sub-Saharan African countries cocoa beans exporter annual bilateral export trade values for EU trading partners in the period 2001 to 2010. Also from COMTRADE 2012, 585 observations were made for sub-Saharan African countries cocoa powder exporter annual bilateral export trade values for EU trading partners in the period 2001 to 2010 and from COMTRADE 2012; 485 observations were made for sub-Saharan African countries cocoa butter exporter annual bilateral export trade values for EU trading partners in the period 2001 to 2010.

In the gravity model, the maximum residue limits for Aflatoxin B1 for cocoa exports for each of the nine European Union countries trading partners were obtained from FAO 2003 worldwide regulations on mycotoxins. The maximum residue limits were utilized by these countries before compliance with 2002, Aflatoxin B1 standard harmonization law of the European Union. As Aflatoxin B1 standards are homogenous for cocoa products, the maximum residue limits for each of the nine European countries were utilized in this study as direct measure of Aflatoxin B1 maximum residue limit for primary cocoa exports which include cocoa beans export and also as Aflatoxin B1 direct measure for the processed cocoa exports, which include cocoa powder export and cocoa butter export. This is because some sub-Saharan African countries cocoa exports European Union trading partners became members of the European Union in 2007 and full compliance with the harmonized standard of 2 ug/Kg for Aflatoxin B1 for cocoa export to the European Union trading partners, was achieved in the preceding years.

In this study for the econometric estimation of the gravity model, the Tobit regression model was utilized, by regressing the dependent variable against the independent variables in the gravity model for the bilateral trade data of sub-Saharan African countries primary cocoa export to EU trading partners and also by regressing the dependent variable against the independent variables in the gravity model for the bilateral trade data of sub-Saharan African countries processed cocoa exports to EU trading partners in the given period, to determine the coefficients of the independent variables and their significance. SPSS computer software was utilized for the Tobit analysis.

In this study, descriptive statistics was utilized for comparative analysis of the effect of stringent aflatoxin standards of EU trading partners export market on sub-Saharan African countries primary cocoa and processed cocoa exports in the given period. In this respect the aflatoxin coefficients obtained from Tobit model estimation of the gravity models for the bilateral trade data of sub-Saharan African countries primary and processed cocoa export to EU trading partners in the given period, were inputted into tables and these were utilized for comparative analysis of the effect of stringent aflatoxin standard of EU trading partners on sub-Saharan African countries primary cocoa and processed cocoa exports in the given period.

In this study we utilized the empirical gravity model developed by Otsuki et al. (2001) where a proxy is used to capture the aflatoxin standard and a direct measure is utilized for its severity expressed in maximum allowable contaminations. This empirical model was adopted for this study because it can be used to estimate the trade impact of “aflatoxin standards” on bilateral trade flows as was done by Otsuki et al. (2001) to estimate the trade impact on the trade flow of groundnuts exports by European Union from African countries. In this study 99 combinations of sub-Saharan African countries major cocoa exporter and trading partners in the European Union were determined for data capture for the empirical gravity model utilized in this study. In the gravity model the maximum residue limits for Aflatoxin B1 in cocoa exports for each of the nine European countries trading partners were obtained from FAO 2003 worldwide regulations on mycotoxins. Different maximum residue limits were utilized by these countries before compliance to Aflatoxin B1 standard harmonization law of the European Union. Aflatoxin B1 standards are homogenous for cocoa exports.

Empirical specification of gravity model:

$$\text{In}\ (M_{ij}^{k,t}) = bo^{k} + b_i^k\ \ In\,(GDPPC_j^t) + b_b^k\ In\,(GDPPC_j^t) + b_3^k In(DIST_{ij})$$

$$+ b_4^k in(ST_j^{k,t}) + b_5^k COL_{ij} + b_6^k LANG_{ij} + b_7^k LANDLOCK_J + b_7^k YEAR + e_{ij}$$

where

“b” terms are co-efficient of product k,

i is the importer country,

j is the exporter country,

$M_{ij}^{k,t} =$ value of agricultural export product k from country j to country i in the year t,

$GDPPC_i^t = GDP$ per capita for the ith importer,

$GDPPC_j^t = GDP$ per capita for the jth exporter,

$DIST_{ij}$ = Geographical distance between capital cities in i and j.

Cultural variables:

ST^{kt}_{j} = maximum Aflatoxin B1 residue limit for agricultural export product k from country, j in the year t,

$LANG_{ij}$ = 1 if both countries share same language,

COL_{ij} = 1 if ith importer has colony ties with jth exporter,

$LANDLOCK_j$ = 1 if jth exporter is a landlocked country,

E_{ij} = error term.

Result of Tobit regression analysis of the gravity model for sub-Saharan African countries primary cocoa export to European Union trading partners 2001-2010. Table 4 shows that the coefficient for the Aflatoxin B1 standard for cocoa beans export is 0.922. This coefficient is positive, complied with a priori expectation and is significant at 1%. This implied that a unit tightening of the importer country Aflatoxin B1 standard significantly influenced a 0.922 unit decrease in the trade value of cocoa beans export trade from the exporter country to the importer country. The coefficient of the GDP per capita for the exporter country is positive and is 1.689. The coefficient is positive, complied with a priori expectation and is significant at 1%.

This implied that a unit increase in the GDP of exporter country influenced a 1.689 unit increase in the trade value for cocoa beans export trade from the exporter country to the importer country .The coefficient for the GDP per capita for the importer country is 0.240. The coefficient is positive complied with a priori expectation and it is significant at 1% level and this implied that a unit increase in the GDP per capita of the importer country influenced a 0.240 unit increase in the trade value of cocoa beans export trade from the exporter country to the importer country. The coefficient of the geographical distance from the cocoa beans exporter country to the importer country is -1.29. The coefficient is negative and complied with a priori expectation and it is significant at 1% level. This implied that a unit increase in the geographical distance influenced 1.29 decrease in the trade value of cocoa beans export trade from the exporter country to the importer country. The coefficient for annual average rainfall for exporter country is -1.57. The coefficient is negative, complied with a priori expectation and it is significant at 1% level. This implied that a unit increase in rainfall influenced a 1.54 unit decrease in the trade value of cocoa beans export trade from the exporter country to the importer country. The coefficient of the dummy for common language is 8.00. The coefficient is positive and complied with a priori expectation but it is insignificant. This implied that common official language for both exporter country and importer country of cocoa beans did not significantly influence increase in the trade value of cocoa beans export trade from exporter country to importer country. The coefficient of the dummy for colony relationship between importer country and exporter country is 12.207. The coefficient is positive and complied with a priori expectations but it is insignificant. This implied that colony relationship between importer country and exporter country of cocoa beans did not significantly influence increase in the trade value of cocoa beans export trade from the exporter country to the importer country. The coefficient of the dummy for land lockedness is -0.205. The coefficient is negative and complied with a priori expectations and is significant at 1%. This implied that land lockedness of exporter countries significantly influenced decrease in the trade value of cocoa beans export trade from exporter country to importer country. All the coefficient of the independent variables complied with a priori expectations and this implied that the variation in the dependent variables was well explained by the independent variables.

Table 4

Tobit Regression Analysis for Gravity Model of Sub-Saharan African Countries Primary Cocoa Export Annual Bilateral Trade Values for European Union Trading Partners From 2001-2010

	Cocoa beans		
Explanatory variables and dummies	Coefficient	Standard error	P > ItI
GDP per capita exporter	1.689*	0.298	0.020
GDP per capita importer	0.240*	0.156	0.126
Geographical distance	-1.298*	1.06	0.221
Rainfall	-1.57*	1.390	0.258
Aflatoxin B1 standard	0.922*	0.293	0.002
Dummy for common language	8.00	2.178	0.00
Dummy for colony	12.2077	2.614	0.00
Dummy for land lockedness	-0.205	15.440	0.003

Notes. Pseudo R2 = 0.0539; Prob > chi2 = 0.0000; Number of observations = 985; Significance: 1%*, 5%**, 10%***. Source: Computer result.

Result of Tobit regression analysis of the gravity model for processed cocoa export to European Union trading partners. Table 5 shows that the coefficient of Aflatoxin B1 standard for cocoa powder export is 0.666. The coefficient is positive and complies with a priori expectations and it is significant at 1%. This implied that the tightening of a unit of Aflatoxin B1 standard for cocoa powder export trade significantly influenced a 0.666 unit decrease in the trade value of cocoa powder export from exporter country to importer country. The coefficient for the GDP per capita exporter country for cocoa powder is 1.565 and it is significant at 1% level. The coefficient is positive and complied with a priori expectation. This implied that a unit increase in the GDP per capita of cocoa powder exporter country influenced 1.565 unit increase in the trade value of cocoa powder export trade from exporter country to importer country. The coefficient for the GDP per capita for cocoa powder importer country is 0.0014. The coefficient is positive and complied with a priori expectation and it is significant at 1% level. This implied that a unit increase in the GDP per capita of importer country influenced a 0.0014 unit decrease in the trade value for cocoa powder export trade from exporter country to importer country. The coefficient for geographical distance is -2.485. The coefficient is negative and complied with a priori expectation and it is significant at 1% level. This implied that a unit increase in geographical distance between exporter and importer countries significantly influenced 2.485 unit decrease in the trade value for cocoa powder export from exporter country to importer country. The coefficient of annual rainfall for cocoa powder exporter country is -1.737. The coefficient is negative and complied with a priori expectation and it is significant at 1% level. This implied that a unit increase in annual rainfall for exporter country significantly influenced 1.737 unit decrease in the trade value for cocoa powder export trade from exporter country to importer country. The coefficient of the dummy for common language is 0.962. This is positive and complies with a priori expectations and is significant at 1% level. This implied that common official language between exporter and importer country significantly influenced 0.962 unit increase in the trade value for cocoa powder export trade from exporter country to importer country. The coefficient of colony relationship between exporter country and importer country is 0.06. The coefficient is positive and complied with a priori expectation and it is significant at 1% level. This implies that colony relationships between exporter country and importer country for cocoa powder significantly influenced 0.06 unit increase in the trade value of cocoa powder export trade from exporter country to importer country. The coefficient of landlockedness for cocoa powder exporter

country is -1.12. This is negative and complied with a priori expectation and it is significant at 1% level. This implied that landlockedness of exporter country significantly influenced 1.12 unit decrease in the trade value of cocoa powder export trade from exporter country to importer country. All the coefficients of the independent variables complied with a priori expectation and this implied that the variations of the dependent variables are well explained by the independent variables.

Table 5

Tobit Regression Analysis for Gravity Model for Sub-Saharan African Countries Processed Cocoa Export Bilateral Trade Values for European Union Trading Partners From 2001-2010

	Cocoa powder			Cocoa butter		
Explanatory variables	Coefficient	Standard error	P > ItI	Coefficient	Standard error	P > ItI
GDP per capita exporter country	1.565*	0.331	0.01	3.811*	0.558	0.50
GDP per capita importer country	0.0014*	0.377	0.705	0.00612*	0.045	0.103
Geographical distance	-2.485*	1.133	0.029	-3.30966*	0.496	0.011
Rainfall	-1.737*	6.44	0.788	-2.398	0.496	0.000
Aflatoxin B1 standard	0.666*	0.624	0.257	0.2057*	0.125	0.100
Dummy for common language	0.962*	0.5093	0.100	0.420*	1.5073	0.050
Dummy for colony	0.006*	0.44	0.28	6.678	9.572	0.003
Dummy for landlockedness	-1.126*	2.552	0.65	-3.457	6.078	0.020

Notes. Cocoa powder: R2 = 2.36; Prob > chi2 = 0.000; Constant = 8,152.741; Number of observations: 585; Significance: 1%*, 5%**, 10%***. Cocoa butter: R2 = 4.54; Prob > chi2 = 0.000; Constant = 7,230.84; Number of observations: 485; Significance: 1%*, 5%**, 10%***. Source: Computer result.

Table 5 shows that the coefficient of Aflatoxin B 1 standard for cocoa butter export trade is 0.2057. The coefficient is positive and complied with a priori expectation and it is significant at 1% level. This implied that a unit tightening of the Aflatoxin B1 standard significantly influenced a 0.2057 unit decrease in trade value of cocoa butter export trade from the exporter country to the importer country. The coefficient of GDP per capita of cocoa butter exporter country is 3.811. This is positive and complied with a priori expectation and it is significant at 1%. This implied that a unit increase in the GDP per capita of exporter country significantly influenced 3.811 unit increase in the trade value of cocoa butter export from exporter country to importer country. The coefficient of the GDP per capita for the importer country is 0.00612. The coefficient is positive, complied with a priori expectation and it is significant at 1%. This implied that a unit increase in the GDP per capita of importer country significantly influenced 0.00612 unit increase in the trade value of cocoa butter export trade from exporter country to importer country. The coefficient for the geographical distance is -3.309. The coefficient is negative, complied with a priori expectation and significant at 1% level. This implied that a unit increase in geographical distance between exporter country and importer country significantly influenced 3.309 unit decrease in the trade value of cocoa butter export trade from cocoa exporter country to importer country. The coefficient for the rainfall is -2.398. The coefficient is negative and is insignificant. This implies that increase in annual rainfall insignificantly influenced decrease in trade value for cocoa butter export trade from exporter country to importer country. The coefficient of the dummy for common language is 0.420. The coefficient is positive, complied with a priori expectation and is significant at 1% level. This implied that common official language for exporter and importer countries significantly influenced a 0.420 unit increase in the trade value of cocoa butter export trade from exporter country to importer country. The coefficient for the colony relationship between importer country and exporter country is 6.678. This is positive, complied with a

priori expectation and is significant at 1%. This implied that the colony relationship between exporter and importer country significantly influenced a 6.678 unit increase in the trade value of cocoa butter export trade from exporter country to importer country. The coefficient of landlockedness is -3.457. The coefficient is negative, complied with a priori expectation and is significant at 1%. This implied that landlockedness of cocoa butter exporter country, significantly influenced a 3.457 unit decrease in the trade value of cocoa butter export trade from cocoa exporter country to cocoa importer country. All the coefficients of the independent variables complied with a priori expectation and this implied that the variations of the dependent variables are well explained by the independent variables.

Result of comparative analysis of the effect of stringent aflatoxin measures of sub-Saharan African countries cocoa trading partners' on primary and processed cocoa trade. Table 6 shows that 1 unit tightening of Aflatoxin B1 standard of importer country will lead to a 0.922 unit decrease in the trade value of exporter country primary cocoa beans export trade, 0.666 unit decrease in the trade value of exporter country processed cocoa powder export trade, and 0.2057 unit decrease in processed cocoa butter export trade. This indicates that tightening of Aflatoxin B1 standard of importer country will lead to a lesser market access restriction for exporter processed cocoa exports than for exporter primary cocoa exporters. The table indicates that tightening of the Aflatoxin B1 standard of importer country will lead to a lesser market access restriction for processed cocoa powder exports and processed cocoa butter exports of exporter country respectively.

Table 6

Comparative Analysis of the Effect of Stringent Aflatoxin Standards of EU Trading Partners' on Sub-Saharan African Countries Primary and Processed Cocoa Export Trade

	Primary cocoa export trade: Cocoa beans export trade	Processed cocoa export trade: Cocoa powder export trade	Processed cocoa export trade: Cocoa butter export trade
Aflatoxin B1 coefficient for cocoa export trade obtained from Tobit regression result	0.9	0.666	0.2057
Effect of tightening of aflatoxin standard of EU trading partner	1 unit tightening of Aflatoxin B1 standard of importer country will lead to a 0.9 unit decrease in the trade value of exporter country cocoa beans export trade	1 unit tightening of Aflatoxin B1 standard of importer country will lead to a 0.666 unit decrease in the trade value of exporter country cocoa powder export trade	1 unit tightening of Aflatoxin B1 standard of importer country will lead to a 0.2057 unit decrease in the trade value of exporter country cocoa butter export trade

Source: Author's computation from computer result.

In this study comparative analysis of the effect of stringent aflatoxin standard of the EU major trading partner on primary cocoa export and major processed cocoa export, indicated that tightening of Aflatoxin B1 standard of importer country will lead to a lesser market access restriction for exporter processed cocoa powder and cocoa butter exports than for exporter primary cocoa beans export. One of the major causes of this might be attributable to less detection of Aflatoxin B1 contamination in consignments of processed cocoa exports than consignments of primary cocoa export of exporter country. In this respect to create expansion of sub-Saharan African countries cocoa export to sub-Saharan African countries cocoa export trading partners, sub-Saharan African countries exporter of cocoa exports should proffer policies that would enable sub-Saharan African countries cocoa exporters to shift from export of primary cocoa beans majorly to sub-Saharan African countries cocoa trading partners, to the export of processed cocoa exports majorly to sub-Saharan African countries trading partners. This would cause an increase in export market access for sub-Saharan African countries cocoa

export and lead to significant increase in the annual foreign exchange trade values of sub-Saharan African countries cocoa export trade. This would enable major sub-Saharan African countries to diversify their mono income source from extractive oil and mineral.

Discussion

In this study comparative analysis of the effect of stringent aflatoxin standard of the EU major trading partner on primary cocoa export and major processed cocoa export, indicated that tightening of Aflatoxin B1 standard of importer country will lead to a lesser market access restriction for exporter processed cocoa powder and cocoa butter exports than for exporter primary cocoa beans export. One of the major causes of this might be attributable to less detection of Aflatoxin B1 contamination in consignments of processed cocoa exports than consignments of primary cocoa export of exporter country. In this respect to create expansion of sub-Saharan African countries cocoa export to sub-Saharan African countries cocoa export trading partners, sub-Saharan African countries exporter of cocoa exports should proffer policies that would enable sub-Saharan African countries cocoa exporters to shift from export of primary cocoa beans majorly to sub-Saharan African countries cocoa trading partners, to the export of processed cocoa exports majorly to sub-Saharan African countries trading partners. This would cause an increase in export market access for sub-Saharan African countries cocoa export and lead to significant increase in the annual foreign exchange trade values of sub-Saharan African countries cocoa export trade. This would enable major sub-Saharan African countries to diversify their mono income source from extractive oil and mineral.

Conclusion

The analysis of the effect of stringent aflatoxin standard on sub-Saharan African countries primary cocoa beans export trade in the period 2001 to 2010 showed 1 unit tightening of Aflatoxin B1 standard would lead to 0.922 unit decrease of the trade value of sub-Saharan African countries cocoa beans export trade. Also, analysis of the effect of stringent aflatoxin standard on sub-Saharan African countries processed cocoa powder export trade in the given period showed that 1 unit tightening of Aflatoxin B1 standard would lead to 0.666 unit decrease of the trade value of sub-Saharan African countries cocoa powder export trade and the analysis of the effect of stringent aflatoxin standards on sub-Saharan African countries primary cocoa butter export trade in the given period, showed that 1 unit tightening of Aflatoxin B1 standard would lead to 0.2057 unit decrease of the trade value of sub-Saharan African countries cocoa butter export trade.

In this study comparative analysis of the effect of stringent aflatoxin standard of the EU major trading partner on primary cocoa export and major processed cocoa export, indicated that tightening of Aflatoxin B1 standard of importer country will lead to a lesser market access restriction for exporter processed cocoa powder and cocoa butter exports than for exporter primary cocoa beans export. The table indicates that tightening of the Aflatoxin B1 standard of importer country will lead to a lesser market access restriction for processed cocoa butter export than for processed cocoa powder export of exporter country. One of the major causes of this might be attributable to less detection of Aflatoxin B1 contamination in consignments of processed cocoa exports than consignments of primary cocoa export of exporter country. In this respect sub-Saharan African countries exporter of cocoa exports should proffer policies that would enable sub-Saharan African countries cocoa exporters to shift from export of primary cocoa beans majorly to export of processed cocoa exports

majorly to trading partners, in order to significantly increase the annual trade value of sub-Saharan African countries cocoa export trade in foreign exchange.

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