The Impact of EU Pesticide Regulations on West Africa's Cocoa Exports

A.A. Tijani
and
M.B. Masuku

Research Paper 368

AFRICAN ECONOMIC RESEARCH CONSORTIUM
CONSORTIUM POUR LA RECHERCHE ÉCONOMIQUE EN AFRIQUE

Bringing Rigour and Evidence to Economic Policy Making in Africa

The Impact of EU Pesticide Regulations on West Africa's Cocoa Exports

By

A.A. Tijani
Department of Agricultural Economics
Obafemi Awolowo University
Ile-Ife, Nigeria
and
M.B. Masuku
Department of Agricultural Economics
and Management
University of Swaziland
Swaziland

AERC Research Paper 368
African Economic Research Consortium, Nairobi
December 2019

THIS RESEARCH STUDY was supported by a grant from the African Economic Research Consortium. The findings, opinions and recommendations are those of the author, however, and do not necessarily reflect the views of the Consortium, its individual members or the AERC Secretariat.

Published by: The African Economic Research Consortium
P.O. Box 62882 - City Square
Nairobi 00200, Kenya

ISBN 978-9966-61-061-4

Contents

List of tables

List of figures

List of abbreviations and acronyms

CCC	Coffee and Cocoa Council
COCOBOD	Ghana Cocoa Board
EU	European Union
EC	European Community
GDP	Gross Domestic Product
ICCO	International Cocoa Organization
ITC	International Trade Centre
LDC	Least Developed Countries
MINADER	Ministère de l'Agriculture et du Développement Rural
MRL	Maximum Residue Level
NPIA	National Project Implementing Agency
PAH	Polycyclic Aromatic Hydrocarbons
QCD	Quality Control Division
R&D	Research and Development
SPS	Sanitary and Phytosanitary Standards

Abstract

Cocoa is of vital importance to the economies of Cameroon, Cote d'Ivoire, Ghana and Nigeria, and it constitutes the largest part of the agricultural sector for these countries. The EU is a major importer of cocoa from West Africa, and therefore regulations on chemical residues in cocoa beans will have significant economic impact on the producing countries in West Africa.

The study quantified the impact of the EU pesticide regulations on exports of cocoa beans from West Africa using data spanning 2001 to 2016. Specifically, it determined the impact of EU pesticide regulations on West Africa's exports of cocoa beans, and also examined the differential impact of the EU regulations among the four major cocoa-exporting countries in West Africa. Data were collected on the values and quantities of cocoa exports, real exchange rate and importers' gross domestic product from various secondary sources. Difference-in-difference methodology was employed in analysing the data.

The results revealed that the regulations impacted negatively and significantly on West Africa's cocoa exports to the EU. The exports of West Africa's cocoa beans to the EU (and Switzerland) declined by 41% as a result of the policy reform. The effect, however, varied among the exporting countries in the sub-region. The effect of the regulations is negative and statistically significant for Cote d'Ivoire and Ghana, but insignificant for Nigeria and Cameroon. The regulations have caused exports of Cote d'Ivoire and Ghana to fall, relative to non-EU importing countries, by 34% and 47%, respectively. The results also revealed that the decline in exports of Cote d'Ivoire could be attributed to a 56% decline in unit prices of cocoa beans and a decrease in patronage by the EU, while that of Ghana could be attributed to a 36% decrease in quantity of exports to the EU and a decrease in patronage by the EU member states. These results imply inadequate conformity with the pesticide legislations.

In order to solve the problem of inadequate conformity and thereby inaccessibility of West Africa's cocoa exports to the EU markets, the national governments of the exporting countries should strengthen efforts aimed at assisting farmers and exporters to comply with international standards required by the EU. The national governments should actively participate in international standard-setting so that such standards do not become barriers to future exports of cocoa beans. This will also provide early warning to exporters in those countries and enable them to prepare and adjust to new standards. The study also suggests that adequate inspection facilities be provided at exit points in order to facilitate cocoa exports.

The results further imply that Ghana Cocoa Board should sustain and possibly scale up the quality of cocoa beans in order to continue to enjoy premium prices on cocoa exports; Cote d'Ivoire should strengthen measures aimed at raising cocoa quality standards and reinforced quality control particularly at the level of the farmers, if premium prices similar to those achieved in Ghana are to be obtained. Cameroon should intensify efforts to improve the quality of its cocoa bean exports. Nigeria should establish a cocoa board, like Ghana did, to specifically handle the marketing of cocoa beans and enhancing quality control.

1. Introduction

Background to the study

Cocoa is an important export for growing countries and a key import for processing and consuming countries. Cocoa trees generally grow in regions located within 200 latitude of the Equator. Ideal climate conditions for cocoa production are hot, rainy tropical areas with lush vegetation to provide adequate shading for the trees (World Cocoa Foundation, 2012). Nine countries of the world generate about 91% of global cocoa production. These are Cote d'Ivoire (37.4%), Ghana (20.7%), Indonesia (12.7%), Cameroon (5.0%), Nigeria (4.6%), Brazil (4.5%), Ecuador (3.4%), Dominican Republic (1.4%), and Malaysia (0.9%). However, West African countries account for about 74.4% of total cocoa production (World Cocoa Foundation, 2010). Smallholder farmers, who account for more than 90% of the global cocoa production, depend on export earnings for their livelihoods. In Africa, a typical cocoa farm measures 2–5 hectares, and there are 5–6 million cocoa farmers in the world, with 40–50 million people depending on cocoa for their livelihood (World Cocoa Foundation, 2012). After harvest, cocoa beans are generally exported to countries where processing facilities are available. The majority (39%) of these facilities are located in Europe, followed by Asia and Oceania (22%), the Americas (22%), and then Africa (17%) (World Cocoa Foundation, 2012).

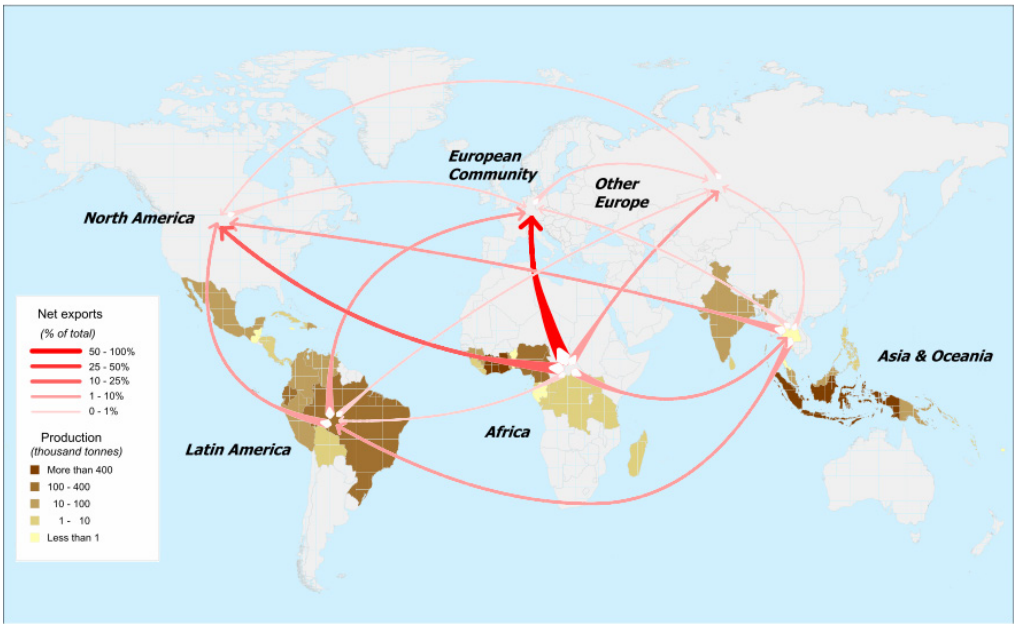
Cocoa can suffer considerable damage due to pests and diseases if not effectively controlled. In West Africa, pests and diseases are the main challenges to a sustainable cocoa economy, accounting for more than 40% of global losses, and resulting in reduced income for cocoa farmers. The recent emergence of parasitic plants such as mistletoe and epiphytes is of particular concern (Agritrade, 2013). Pesticides are commonly used against the major pests (Capsids (Miridae) especially Sahlbergella singularis and Distantiella theobroma) and diseases (black pod rot Phytophthora spp, especially: P. megakarya) of cocoa in West Africa (Bateman, 2009). However, these pesticides leave residues in cocoa beans, posing dangers to consumers.

Sanitary and phytosanitary (SPS) measures are designed to ensure human, animal and environmental safety. They are also used for trade protectionism and/or the enhancement of the flow of trade through quality products that meet the changing tastes and preferences of consumers. One of the SPSs commonly used in agricultural products is the restriction of the maximum levels of residues from pesticides.

Pesticide residue is a very small trace of pesticide that sometimes remains on the treated crop. A maximum residue level (MRL) is the maximum amount of residue legally permitted on food. Once residues are demonstrated to be safe for consumers, MRLs are set by independent scientists, based on rigorous evaluation of each legally authorized pesticide. MRLs act as an indicator of the correct use of pesticides and ensure compliance with legal requirements for low amounts of residue on unprocessed food. They ensure that imported and exported food is safe to eat. Countries choose the products they regulate, the pesticides they regulate for each product, and the MRL for a given product-pesticide pair (Ferro et al., 2013).

Figure 1 illustrates the complexity of trade in cocoa beans and the importance of the EU as the major market for cocoa beans from West African countries.

Figure 1: Distribution and main trade routes of cocoa: 2005-2006



Source: http://www.icco.org/statistics/cocoamap.pdf

In the EU, consumers are becoming increasingly aware of food safety concerns, with a perception that the use of chemicals and other substances in the production and processing of cocoa might be detrimental to their health. As a result, Regulation 396/2005, which defines the maximum levels of residues (MRLs) permitted in cocoa beans in the EU was introduced on 1st September, 2008. The regulation implies, for the first time, MRLs for cocoa beans in all EU member states. Cocoa consignments entering EU have to be routinely checked at the port of entry for chemical residues. If prohibited substances are detected or found at levels exceeding MRL, the consignments can be rejected. Also, EU Regulation (EU) 853/2011, which came into force in September 2012, defines maximum levels of polycyclic aromatic hydrocarbons (PAH) in food. The

regulation implies more extensive testing of cocoa beans and derived products for the presence of carcinogenic PAHs (Agritrade, 2013). In addition, in April 2013, the EU also introduced another regulation which defines the maximum level of cadmium in cocoa beans as 0.2mg/kg.

Inability to comply with these regulations could lead to the rejection of cocoa consignments entering the EU member states. For example, EU Regulation (EU) 853/2011 resulted in the rejection in December 2012 of a 2,000-tonne consignment of cocoa beans from Cameroon (Agritrade, 2013). The regulation on MRL for cadmium in cocoa beans is also reported to have affected Cameroon and to a lesser extent Ghana. In other words, these regulations have the potential, if not properly adhered to, to disrupt cocoa trade and consequently deprive smallholder farmers and governments in producing countries, of much needed revenues. Such disruption clearly has the potential to harm the welfare of the farmers and affect the countries' poverty alleviation programmes. Therefore, in West African countries, where cocoa exports are very significant for their economies, national authorities are expected to support producers in order to meet the requirements imposed by the EU.

Following regulation EC No. 396/2005, the International Cocoa Organization (ICCO) Executive Committee adopted an Action Programme on Pesticides in a drive to ensure that the legislation would not unduly affect the cocoa sector. The resulting technical advice from the Action Programme was directly passed on to the countries concerned by ICCO in 2007. It was further suggested to all producing countries that they carry out a pesticide audit, prioritizing the issues. In 2008, ICCO produced a Manual on the Safe Use of Pesticides in Cocoa Growing to provide the necessary guidance to the relevant stakeholders. The Manual is now available on the ICCO website.

ICCO also initiated the Cocoa SPS Africa project. The objective of the project was to enhance the capacity of five African cocoa producing countries to comply with SPS requirements and maintain and improve market access. The project was implemented in Cameroon, Cote d'Ivoire, Ghana, Nigeria and Togo and involved the following main activities: i) Creating awareness among cocoa farmers and other stakeholders along the cocoa supply chain about SPS standards in cocoa; ii) Enhancing the capacity of relevant stakeholders to apply the rational pesticide use component of GAP and GWP; iii) Enhancing the in-country capacity to monitor and enforce adherence to SPS standards in cocoa; iv) Strengthening regional collaboration to enhance capacity in individual countries on SPS standards in cocoa; and iv) Result evaluation and dissemination workshop. The project was managed at national and regional levels. At the national level, the project was implemented by a National Project Implementing Agency (NPIA) in each participating country. In addition, Ghana set up a Project Steering Committee constituting a smaller group of experts that met more regularly to discuss project implementation. This perhaps explained partly why the project recorded more achievements in Ghana.

In response to the efforts of ICCO, the major exporting countries in West Africa have also taken some measures to mitigate the impact of the regulation on the livelihoods of the smallholder farmers and their exports.

In Nigeria, a list of pesticides for use on cocoa farms was approved and a workshop to address the challenge was organized to fashion out a formidable strategy to tackle the challenges facing the cocoa industry in the country. One of the outcomes of the workshop was the evolution of a new national cocoa extension programme to educate farmers on the legislation and to encourage compliance with the EU regulation on MRLs. In order to build capacity to effectively implement SPS issues in Nigeria, workshops, seminars and conferences were organized continually to enhance competencies of enforcement officers.

In Ghana, Ghana Cocoa Board (COCOBOD) oversees the cocoa sector. Two of its five main subsidiaries, the Quality Control Company and the Cocoa Marketing Company, play leading roles in addressing the overall organizational goal of exporting premium and high-quality cocoa. The former inspects samples and grades cocoa beans before sealing the bags. A certificate is then issued. The latter check samples and either accepts a particular consignment or rejects it if the quality does not meet standards. A purity certificate is also issued. Ghana focuses on Japanese standards for pesticide residues, despite the relatively small proportion (4%) of its export market because Japan is believed to have the most stringent specifications for MRLs and conforming to their requirements reduces the burden of meeting the requirements of other cocoa importing countries. The processing of cocoa into cocoa butter, cocoa paste and confectioneries is an important component of the value chain, especially with the national goal of processing 50% of cocoa before export.

Cote d'Ivoire implemented new cocoa reforms on 2 November, 2011. The aim of the reforms was to raise and guarantee minimum farm gate prices on a sustainable basis in order to ensure sustainable livelihoods to cocoa growers and encourage them to boost output and reinvest in their ageing and sometimes neglected plantations. The reform was aimed at processing 50% of the country's production domestically by 2013. The reforms were based on (i) the establishment of a regulatory body, Caisse Café Cacao (CCC); (ii) the establishment of a new marketing mechanism involving the forward sale of 70% to 80% of the next year's crop; and (iii) the setting up of a reserve fund at the Central Bank of West African States in order to protect against the possibility of a future major drop in world cocoa prices. As part of the reform process, the CCC raised the quality standards applied to cocoa to try to strengthen Cote d'Ivoire's market position.

Cameroon has a strong cocoa policy. The Government of Cameroon, through the Ministère de l'Agriculture et du Développement Rural (MINADER), developed a new agricultural policy, including a provision to ensure that future production complies with international quality standards as well as EU sanitary and phytosanitary (SPS) standards for pesticide residue. The Government of Cameroon provides direct and indirect support to farmers to meet the necessary SPS standards for export. It has also taken measures to conduct more rigorous analysis of beans prior to export, and taking action against sub-standard drying practices, which can increase cadmium levels.

Statement of research problem

West Africa produces approximately 74.4% of the world's cocoa, and accounts for more than 85% of the cocoa used by the European cocoa industry. As such, Europe is a major importer of cocoa from West Africa, and an important contributor to national revenue for producing countries in the region. Cocoa is of vital importance to the economies of Cameroon, Cote d'Ivoire, Ghana, Nigeria and Togo, contributing a major proportion of their foreign exchange earnings and providing employment to millions of people. Cocoa constitutes the largest part of the agricultural sector for these countries except Togo. For Cameroon, Cote d'Ivoire and Ghana, it is the largest sector of the whole economy. It is, therefore, evident that threats to cocoa marketing would have a significant economic impact and this has led the authorities of these countries to prioritize access to consumer markets as being of national importance.

The EU regulations can affect cocoa exports in three main ways, depending on the capacities of exporting countries: trade-impeding effects, neutral effects, and catalyst effects. However, to many least developed countries (LDC) and developing countries, SPS are trade-impeding because they are expected to add to the series of costs faced by their farmers and exporters (Moise and Le Bris, 2013). Therefore in West African countries, where agricultural exports are very significant for their economies, evaluating the actual effects that a specific SPS has on agricultural international trade confers a constructive background for public strategy.

Despite the importance of these regulations to West Africa, only scanty studies were conducted to actually determine the extent to which this type of SPS has influenced the market access of cocoa beans originating from West Africa. The paucity of empirical studies may inhibit research and evidence-based policy formulation by West Africa governments in order to solve the problem of inadequate conformity and thereby inaccessibility of its exports to the markets of its trading partners (Shepherd and Wilson, 2013).

However, most of the few studies in this area on Africa usually focus on the highly valued products, particularly horticulture, with limited studies on traditional cash crops such as cocoa to the best of our knowledge. Although Kareem (2014) investigated the impact of the EU legislations on cocoa, the study neither specifically assessed the impact of the regulations on cocoa exports nor assessed the impact of the policy reform and its differential impact on individual exporting countries in West Africa. Kareem (2014) also gives support to the fact that the impact of standards on trade is product-specific.

To ensure evidence-based policy formulation by governments of cocoa-producing countries in West Africa, the study therefore investigated the impact of pesticide regulations of the EU on West Africa's cocoa exports. Broadly, the question the study sought to answer is: What is the impact of these EU regulations on West Africa's cocoa exports to the EU? More specifically, the study addressed the following questions:

Are the West African cocoa-exporting countries affected negatively by the EU pesticide regulations?

Are the leading cocoa-exporting countries in West Africa affected differently by the regulations?

Objectives of the study

The main objective of the study was to determine the impact of EU harmonized MRL regulations on exports of West Africa's cocoa beans. The specific objectives were to:

i) Determine the impact of EU pesticide regulations on cocoa exports of West African origin; and

ii) Examine the differential impact of the EU regulations among cocoa-exporting countries in West Africa.

Research hypotheses

H1: EU pesticide regulations have no effect on West Africa's cocoa exports.

H2: There are significant differences in the impact of the EU regulations among major cocoa-exporting countries in West Africa.

2. Literature review

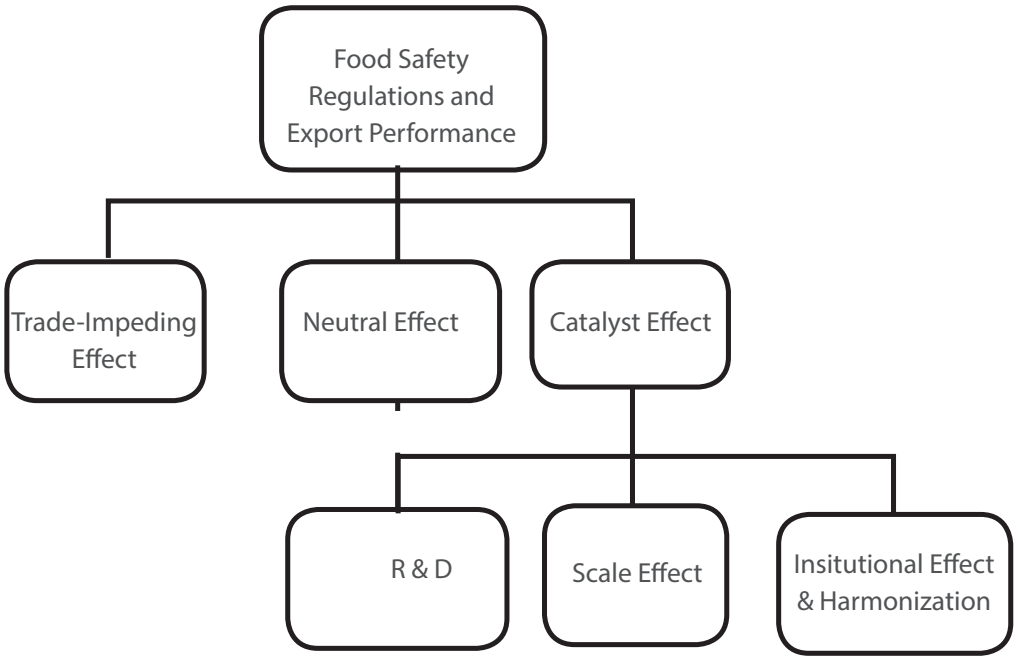
Theoretical literature

Sanitary and phytosanitary (SPS) measures are risk-reducing measures aimed at the protection of food safety, plant and animal health, and the natural environment. In the case of agricultural and food exports in particular, compliance with technical requirements is a prerequisite of successful export trade (Horton, 1998).

According to Henson and Loader (2001), the trade impacts of SPS measures have been grouped into three categories. First, they can inhibit trade by imposing an import ban or by prohibitively increasing production and marketing costs. Second, they can divert trade from one trading partner to another by laying down regulations that discriminate across potential supplies. Third, they can reduce overall trade–by increasing costs or raising barriers for all potential suppliers.

As shown in Figure 2, food safety regulations have three main effects: the trade-impeding effect, the neutral effect, and the catalyst effect. The trade-impeding effect occurs due to the negative impact of regulations, which leads to trade distortion against the exporters of food products. The neutral effect mostly occurs in developed exporting countries, where they can comply with restrictive regulations because of their research and development expenditures and high level of standards. The catalyst effect occurs when regulations force exporting countries to invest more in a specific market and increase their share in world trade. Such an effect also occurs when developed countries replace the exports of negatively affected developing countries in world markets. The catalyst effect is composed of research and development (R&D), scale effect, institutional effect, and efforts for harmonization. Most of the R&D is observed in the markets of developed countries. The scale effect can be observed in emerging markets, where firm size is increased in an effort to comply with restrictive regulations. The institutional effect is caused by institutional governance and guidance aimed at domestic exporting firms providing market information and technical assistance. The harmonization effects occur when a candidate country aims to join an economic union and harmonizes its regulations according to the principles of the union.

Figure 2: Food safety regulation and export performance interaction



Source: Atici (2013).

However, many African governments and some scholars (Bateman, 2009; Rutherford, 2011) opine that standards are trade-restrictive.

Methodological literature

Research related to the impact assessment of SPS on international trade has focused principally on the effects of these requirements on import/export flows in terms of quantity and/or value. Econometric methodologies (such as gravity models and single country models) have been frequently used to assess the impact of SPS (WTO, 2012; Lissovolik and Lissovolik, 2006; Atici, 2013). Gravity models were used in several studies to estimate the effects of policy changes on international trade (Kareem, 2014; Shepherd and Wilson, 2013; Otsuki et al., 2001; Xiong and Beghin, 2011; Ferro et al., 2013).

Other methods used in assessing the impact include inventory approach, price comparison, evaluation of quantity impact, computable general equilibrium models; cost-benefit analysis (Disdier and Van Tongeren, 2010; Kee et al., 2009; Van Tongeren et al., 2009). There is also an important number of studies conducted by case study methodology (Mimouni et al., 2009; World Bank, 2008; UNCTAD, 2010). Recently, a quasi-natural experimental method, difference-in-difference (DID) method has been employed to assess the impact of product standards (Ali, 2016).

Empirical literature

Empirical literature shows that many of the studies were conducted in order to determine the impact of product standards on developing economies, including African countries (see Kareem, 2014; Shepherd and Wilson, 2013; Crivelli and Groschi, 2012; Schlueter et al., 2009). The impact of food safety regulations on trade performance is mixed. Three strands of trade impact of standards are available in the literature: first, those that concluded that standards are trade-inhibiting; second, studies that found standards are trade-enhancing; and finally, some studies that found that standards are trade-inhibiting in the short run and enhancing in the long run.

Studies conducted by Czubala et al. (2009) and Otsuki et al. (2001) found that Africa's exports were restricted to the developed markets due to its inability to meet the standards set by these markets. Similarly, Ferro et al. (2013) found that the standard requirements in the importing countries inhibit export of agricultural food products to the developed markets. On the other hand, Xiong and Beghin (2011) found that standards do not significantly affect food and agricultural trade. However, some studies indicated that standards could have positive effects on those producers who are able to fulfil the requirements or, at least, an ambiguous impact (Crivelli & Groschl, 2012; Jayasinghe et al., 2010; Schlueter et al., 2009; Wilson and Bray, 2010). Ali (2016) found that SPS measures can facilitate exports in the long run but they may inhibit it in the short run.

Many of the empirical studies were conducted for countries and regions other than Africa (see, for example, Schlueter et al., 2009; Crivelli and Groschl, 2012), with the majority of African studies conducted on horticulture; while studies (such as Kareem, 2014) on traditional products (like cocoa) are scanty. Kareem (2014) found that EU standards for cocoa are trade-enhancing at the extensive margins, but inhibiting at the intensive margins.

Many of the studies concluded that standards are trade-impeding, particularly in respect of Africa economies. The reasons adduced for this include poor development of science and technology, institutions, management and absorptive capacities of producers. Empirical studies on the economies of Africa show that the measures would have adverse effects on the continent's exports at the initial stage but the subsequent impact would depend on the level of compliance with standard requirements (Boza, 2013).

3. Research methodology

The model

In order to assess the impact of EU regulations on cocoa exports, the study employed the difference-in-difference (DID) approach following Ali (2016). Difference-in-difference is a statistical technique used in econometrics and quantitative research in the social sciences that attempts to mimic an experimental research design using observational study data, by studying the differential effect of a treatment on a 'treatment group' versus a 'control group' in a natural experiment. It calculates the effect of a treatment (Regulation EC 396/2005)(i.e., an explanatory variable or an independent variable) on an outcome (cocoa exports)(i.e., a response variable or dependent variable) by comparing the average change over time in the outcome variable for the treatment group (the EU), to the average change over time for the control group (the non-EU trading partners). The approach takes into account general changes over times that are common to both the treatment (the EU) and control (the non-EU); it assumes that (i) the only differences between treatment and control are in the levels of observed and unobserved outcomes at the start and (ii) there is no difference in the potential for change, or starting growth rates between treatment and control. DID compares the EU which implemented EU regulations with non-EU importing countries, which did not before and after the policy reform. With longitudinal data, DID can provide a more robust estimate of the impact of a policy reform. The advantage of using the DID method is that it nets out the effects of additive factors that have fixed (time-invariant) impacts on cocoa exports, or that reflect common trends affecting the EU and non-EU equally, such as changes in prices.

The approach removes unobservable individual effects and common macro effects and assumes common time effects across groups and no compositional changes within each group. The difference-in-difference econometric approach accounts for most of the potential omitted variables. It washes out the effect of factors such as improvements in technology and infrastructure, institutional changes and economic growth that could influence cocoa exports to both the non-EU and the EU (Ali, 2016).

The basic model estimated is:

$$y_{ijt} = \beta_0 + \beta_1 X_t + \beta_2 T_t + \beta_3 X_i T_t + \varepsilon_{ijt}, \; i = 1,2,...,N; t = 0,1 \quad \text{..... (1)}$$

y_{ijt} denotes exports of cocoa beans of country i to country j at period t (intensive margins). It is measured in US dollars;

X_i denotes a dummy variable which equal to 1 for the EU and Switzerland and 0 otherwise;

T_t denotes post-EU regulation dummy variable ($T_t = 1$ for 2008-2016 and $T_t = 0$ for the 2001-2007 periods);

$X_i T_t$ denotes an interaction of the EU dummy variable and the EU regulation dummy variable.

The DID estimator is the OLS estimator of β_3, the coefficient of the interaction dummy variable. Furthermore, β_3 is a consistent estimator of the impact of the EU regulations.

$\beta 1$ is the EU specific effect (which accounts for the average permanent difference between the EU and the non-EU importing countries);

β_2 is the time trend assumed to be common to both the non-EU and the EU;

β_3 is the true effect of EU regulations. This represents the mean change in exports from pre-regulation to post-regulation among the EU.

Equation 1 can be augmented with other independent variables as indicated in Equation 2 below.

$$y_{it} = \beta_0 + \beta_1 X_{ijt} + \beta_2 T_{ijt} + \beta_3 X_{ijt} T_{ijt} + \beta_4 Z_{ijt} + \alpha_i + \gamma_j + \lambda_t + \varepsilon_{ijt} \quad \text{.....} \quad (2)$$

'Z' is a set of controls, which include importers' GDP per capita, real exchange rate, market share, exporter visibility, and time trend;

αi is exporter fixed effect;

γj is importer fixed effect;

λt is time fixed effect.

The above equation was estimated using a panel of annual time series data for the period 2001–2016. The estimation method is Ordinary Least Squares (OLS) and $\beta 3$ is the coefficient of interest. Its positively significant coefficient would suggest that, compared with the non-EU importing countries, cocoa exports to the EU have increased, while a negative and significant coefficient would suggest that cocoa exports to the EU have fallen.

Fixed effects for exporters and importers are included in order to account for time-invariant factors pertaining to these variables and the inclusion of fixed effects for time is to soak up any factors affecting the exporting countries at a particular time. To account for autocorrelation, standard errors are clustered at exporter-importer-year level in order to take care of the arbitrary correlation among individual clusters. To account for time-varying factors such as enhancement of exporters' experience over time, changes in demand for the product over time, changes in the costs of international business over time or improvement in importers' performance over time, exporter-year fixed effects are included. To account for reverse causality, the market share of exporting countries in the total import of the importing countries is included.

Heterogeneous impacts

Regulations could have different impacts on different exporting countries, in which case the average regulation impact for the entire West Africa hides the high (or low) impact on particular exporting countries and the average impact may not be informative for policy decisions. It is, therefore, necessary to model the heterogeneity of impact in estimation strategy. To analyse heterogeneous treatment effects, Equation 2 was estimated for each exporting country. In addition, Triple-difference (DDD) methodology was also adopted. This involves the addition of triple interaction terms into Equation 2. The coefficient on the triple interaction terms indicates how the regulation impact varies with the exporting countries.

Determination of sources of change in exports

The change in exports to the EU markets could be a result of change in quantity exported, change in unit price or adjustment along the extensive margins. The sources of change are decomposed by examining the impact of the EU regulations along these dimensions of exporters' performance.

A priori expectations

EU pesticide regulations may serve as a kind of technical barrier to trade and are expected to have a negative effect on export flow as found in some of the literature (Rutherford, 2011; Ferro et al., 2013). However, other researchers found non-negative impacts for some countries (Maertens and Swinnen, 2009; Wilson and Bray, 2010;

Xiong and Beghin, 2011). Thus, the EU regulations may have a negative or positive impact.

Data and their sources

The study employed a panel of annual data from 2001 to 2016 for the four major cocoa-producing countries in West Africa (Cote d'Ivoire, Ghana, Cameroon, and Nigeria), EU trading partners (such as the Netherlands, Germany, France, Belgium, the United Kingdom, Spain, Italy) and Switzerland and non-EU trading partners (such as USA, Canada, Japan, Malaysia, Russia and other non-EU trading partners). To ensure more reliable data and better coverage for years from 2001 to 2016, the data on cocoa imports (= WA exports) from the West African countries, as reported by the EU and other importing countries, were obtained from the International Trade Centre (ITC) Trade Map. The data series on GDP and real exchange rates were obtained from the International Monetary Fund's International Financial Statistics database (http://elibrary-data.imf.org).

4. Results and discussion

Estimated impact of EU regulations on West Africa's cocoa exports

To estimate the impact of the EU regulations on cocoa exports using difference-in-difference (DID) methodology, the cocoa importing countries were divided into two groups; the treatment group which comprises the EU and Switzerland where the EU regulations were introduced and implemented since 2008, and the control group, which comprises non-EU importing countries where the regulations were not introduced (Table 1). However, only a subset which comprises importing countries that imported cocoa beans for the entire period of study, was used for the estimation of Intensive Margins Models. The sample accounted for not less than 80% of exports of cocoa beans for the period under study. The trends in cocoa exports (in USD) to the world, the EU and non-EU countries are depicted in figures 3 and 4. As shown in the figures, West Africa's cocoa exports exhibit an increasing trend over the 2001–2016 period. Figure 2 specifically shows that the EU still remains the major importer of cocoa beans from West Africa before and after the introduction of the regulations. The surge observed in cocoa exports to the EU in 2003 was due to the shipment of larger quantities to the EU and the increase in the average price of cocoa, while that of 2011 was essentially due to the shipment of larger quantities of cocoa to the EU.

Table 1: List of countries importing cocoa from West Africa

#	TREATMENT GROUP	CONTROL GROUP
1	Belgium	New Zealand
2	Czech republic	South Africa
3	Germany	Ukraine
4	Spain	Singapore
5	Estonia	Saudi Arabia
6	France	Philippine
7	United kingdom	Mali
8	Greece	Mexico

continued next page

Table 1 Continued

#	TREATMENT GROUP	CONTROL GROUP
9	Italy	Lithuania
10	Netherlands	Sri Lanka
11	Poland	Korea
12	Portugal	Israel
13	Bulgaria	Iran
14	Ireland	India
15	Denmark	Hong Kong
16	Croatia	Brazil
17	Switzerland	Argentina
18		Indonesia
19		Australia
20		Turkey
21		China
22		Russia
23		Malaysia
24		Japan
25		Canada
26		USA

Figure 3: Cocoa exports to the world

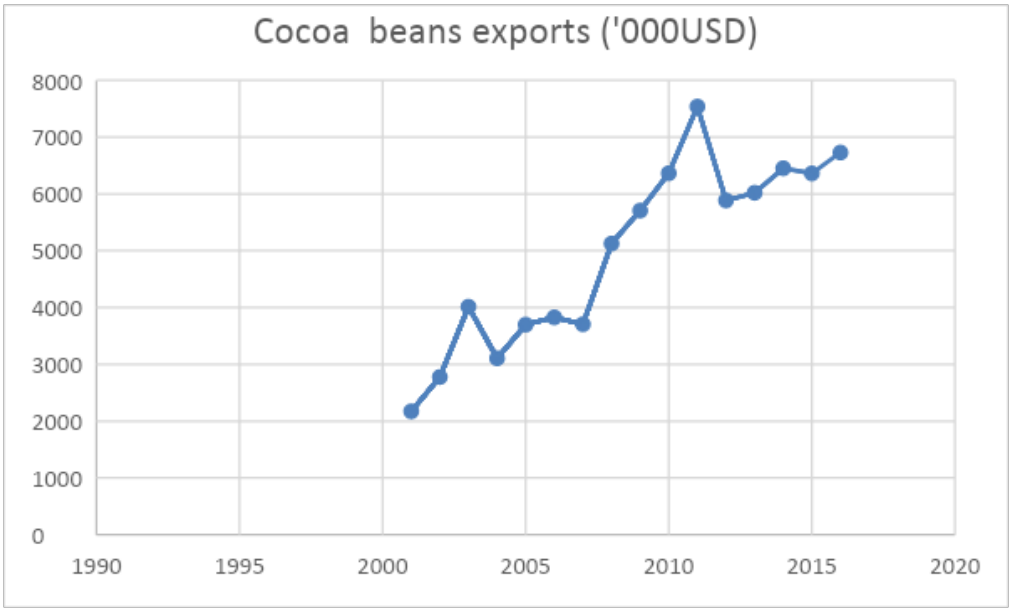
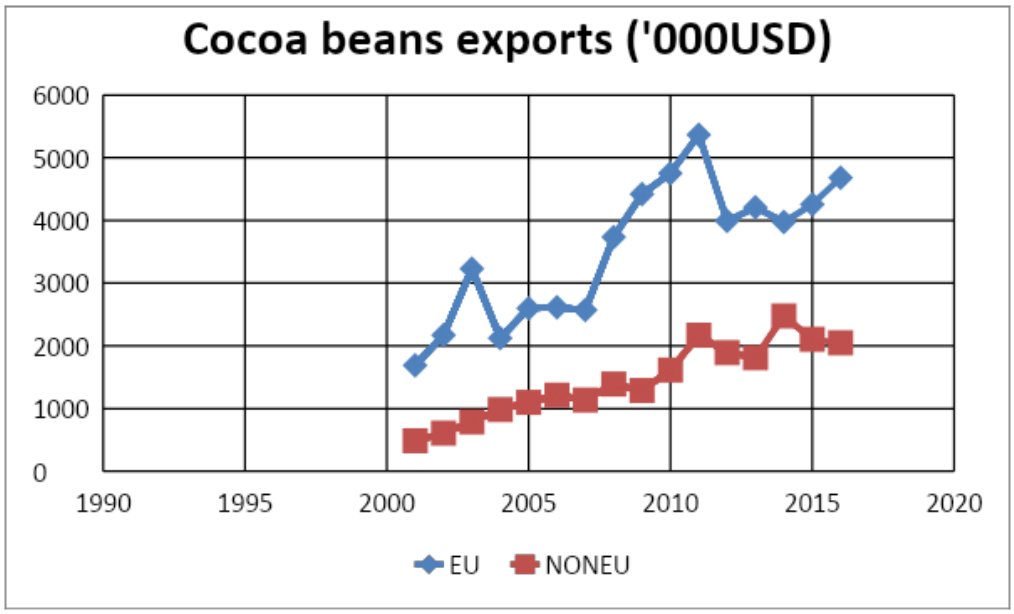


Figure 4: Exports to the EU and non-EU importing countries



Parallel trend test

A key assumption of the difference-in-difference estimation technique is that of a parallel trend or common trends affecting both control and treatment groups prior to the treatment. The following graphical and statistical analyses show that this key assumption of the difference-in-difference estimation approach essentially holds in respect of export value, export quantity and unit price for the period under study.

Figures 5, 6 and 7 plot West Africa's cocoa exports, export quantity and unit price to the control and treatment groups. The lines of best fit essentially suggest similarity in export trends to both markets before the policy reform (2001-2007).

Following Ali (2016), a statistical test of equality of growth rates (in export value, quantity and unit price) between the EU and non-EU was also conducted to confirm parallel trend assumption. Table 2 presents the results of two sample t-tests on an annual basis. As column (4) indicates, the difference between the mean growth rate of exports to the control and treatment groups is statistically insignificant. There is no statistically significant difference in the means in none of the years, indicating that the parallel trend assumption is satisfied, and the control group, which comprises countries where the regulation was not applied, could be said to represent a valid counterfactual group.

Figure 5: Parallel trends for exports (USD)

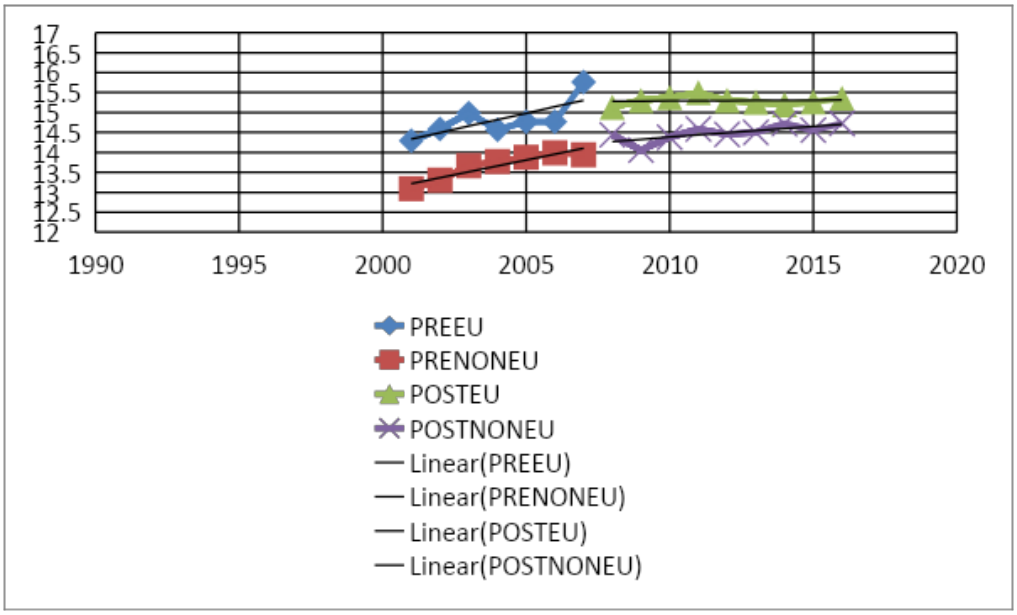


Figure 6: Parallel trends for exports (Tons)

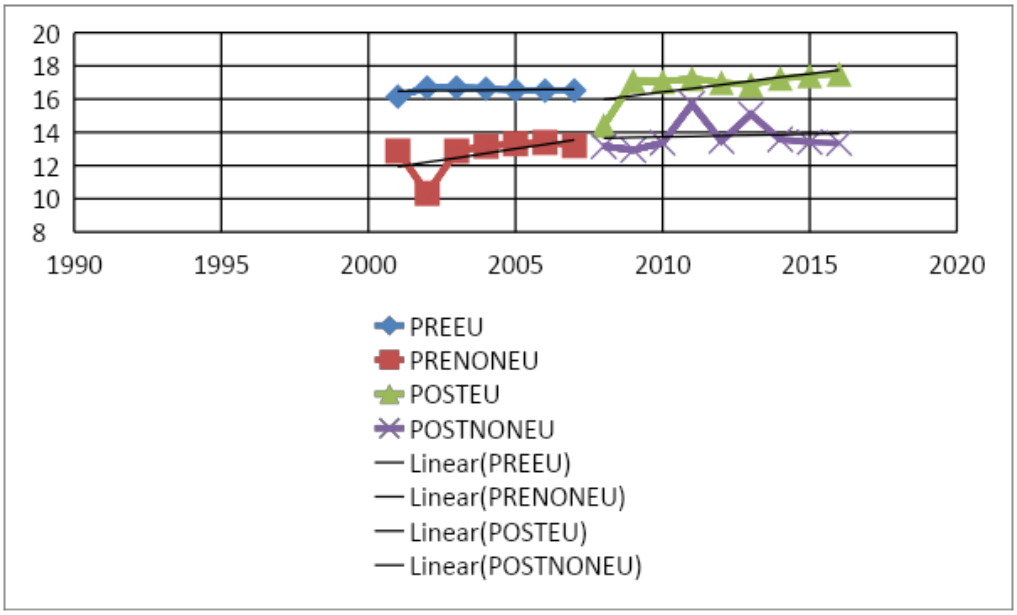


Figure 7: Parallel trends for unit prices (USD/Ton)

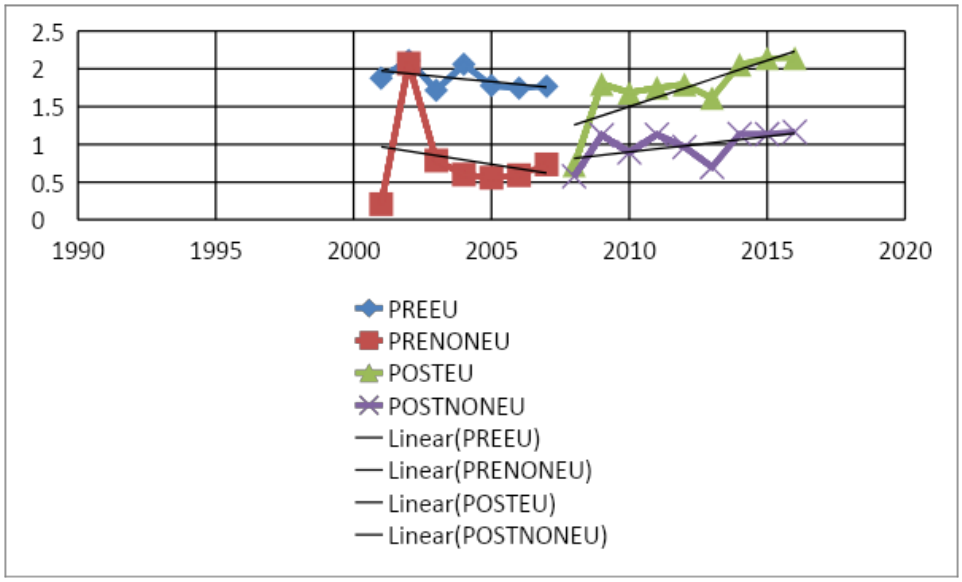


Table 2: Parallel trend tests

ΔGrowth rate	Treatment	Control	p-value of difference
	Exports (USD)		
2002	0.912 (0.370)	1.240 (0.486)	0.587
2003	0.060(0.086)	1.063 (0.719)	0.137
2004	0.358(0.291)	0.228(0.156)	0.726
2005	0.082(0.091)	1.022(0.346)	0.104
2006	0.265(0.115)	0.085(0.176)	0.374
2007	0.499(0.362)	0.949(0.603)	0.502
	Exports (Tons)		
2002	0.342(0.236)	1.106(0.587)	0.187
2003	0.152 (0.099)	1.694(1.076)	0.100
2004	0.154 (0.069)	0.326 (0.165)	0.293
2005	0.038(0.079)	0.913 (0.328)	0.161
2006	0.148 (0.089)	0.127 (0.104)	0.510
2007	0.012 (0.062)	0.413 (0.438)	0.294
	Unit price		
2002	16.288 (14.253)	14.0752(13.201)	0.313
2003	8.522(3.713)	5.360(5.798)	0.852
2004	7.681(2.968)	12.962 (12.544)	0.251
2005	17.925(15.655)	5.011(5.696)	0.795
2006	4.334(0.754)	4.905(1.509)	0.719
2007	2.642(0.401)	1.355(0.734)	0.134

Note: Δ growth indicates annual growth rate. Standard errors are in parentheses. The p-statistics pertain to the difference in the means of treatment and control groups.

Impact assessment estimation results

Table 3 presents the estimated impact of the regulations on cocoa exports. As shown in the table, the coefficient on the interaction term is negative, showing that, compared with the non-EU, exports of cocoa beans to the EU have fallen by 41% and the effect is statistically significant at a 5% significance level. Model II indicates that the inclusion of time-varying fixed effects, which account for time-varying factors, marginally affect the magnitude and significance of the interaction coefficient. The interaction coefficient still remains significant though at a 10% level. As the estimates show, these controls for time-varying variables corroborate baseline estimation results. Models 3 and 4 show that including exporter-related covariates capturing the effect of exporter size/exporter visibility (which measures how big an exporter is in a particular importing country) does not affect the magnitude and significance of the interaction term. The regressor of interest remains negative and statistically significant. The positive effect of exporter visibility on exports of cocoa beans suggests the largest exporting country having the least negative impact on its exports of cocoa beans. Model 5 shows that the magnitude, sign and significance of the interaction coefficient are not affected by the inclusion of controls for real exchange rate, gross domestic product (GDP), time trend and market share. As indicated in the model, the inclusion of these covariates leaves little effect on the coefficient of the interaction term.

Table 3: Impact estimation results
The dependent variable is intensive margins of exports (000'USD) in logs

	Linear Reg. I	Linear Reg. II	Linear Reg. III	Linear Reg. IV	Linear Reg. V
Interaction	-0.4102** (0.1807)	-0.3434* (0.1857)	-0.4012** (0.1802)	-.4873*** (0.1826)	-0.4070** (0.1831)
Reform	1.5678*** (0.2485)	1.2700*** (0.1987)	1.5273*** (0.2456)	1.4818*** (0.2558)	1.1708*** (0.3908)
Treat	1.9395*** (0.1627)	2.5366*** (0.1907)	1.9329*** (0.1625)	1.9440*** (0.1644)	1.8748*** (0.1708)
Exporter FE	Y		Y	Y	Y
Importer FE	Y	Y	Y	Y	Y
Time FE	Y		Y	Y	Y
Exporter-year FE		Y			
Exporter visibility			0.0009*** (0.0002)	0.0009*** (.0002)	
Interaction x visibility				0.2537*** (0.0732)	
R^2	0.55	0.50	0.55	0.56	0.56
Obs	800	800	800	800	800

Note: Robust standard errors are in parentheses * p < 0.10, ** p < 0.05, *** p < 0.01. The regressions include fixed effects for importers, exporters and time. Model V includes other covariates but their coefficients are not reported. These estimates were obtained using Stata 14 SE.

The model indicates a 40% dip in exports of cocoa beans to the EU compared with non-EU importing countries. The positive and significant coefficient on the 'reform' dummy suggests improvement over time in the exports of cocoa beans to the non-EU importing countries.

These results are consistent with the expectations of Bateman (2009) and Rutherford (2011) and the findings of Kareem (2014) and Ferro et al. (2013). However, they are contrary to the findings of other researchers who found non-negative impacts for some countries (Maertens and Swinnen, 2009; Wilson and Bray, 2010; Xiong and Beghin, 2011). These results imply that West Africa cocoa producing countries have not fully complied with the requirements of the EU pesticide regulations or that the efforts already put in place are effective in ensuring compliance with the EU pesticide regulations by farmers as well as exporters of cocoa beans in the sub-region.

Sources of decline in cocoa exports

The decline in exports of cocoa beans to European markets (EU and Switzerland) could be as a result of shipping higher quantities, charging higher prices, or adjustment along the EM. In order to pin down the precise source of a fall in exports along prices and quantities, the same baseline Equation 1 was estimated by using alternative dependent variables as follows.

Unit price = Unit value of cocoa beans per exporter by destination (in dollars)
Quantity = Weight of cocoa beans per exporter by destination (in tonnes)

These estimations, contained in Table 4, indicate that, relative to the control group, there are no statistically significant differences in quantity and unit value of cocoa bean exports to the EU. Model 2 indicates a negative but not significant effect on the quantity of cocoa bean exports while Model 3 also indicates a positive but not significant effect on the unit value of cocoa beans exports to the EU by the regulations. Model 1, which is a standard count data model, shows that the effect of the regulations on the number of EU countries buying cocoa beans from West Africa is negative but not significant.

Table 4: Effects on extensive margins, prices and quantities

Dependent variables	Extensive margins (1)		Exports (Tons) (2)		Unit Price (3)	
	Coeff	Robust Std. Err.	Coeff	Robust Std. Err.	Coeff	Robust Std. Err.
Interaction	-0.1067	0.0848	-0.2136	0.1967	0.0147	0.2991
R-squared	-		0.75		0.35	
Observations	128		800		800	

Note: The regressions include fixed effects for importers, exporters and time. Poisson Maximum Likelihood Estimator (PPML) was used to obtain the estimates in Model 1. These estimates were obtained using Stata 14 SE.

The insignificance of the interaction term in models 1 and 2 does not clearly suggest that the fall in the exports of cocoa beans may be attributed to shrinkage in the

number of importing countries per exporting country and shipping of lower quantities to the EU, relative to the non-EU, with the introduction of the regulations in the EU and Switzerland.

Table 5 also shows that the fall in the export of cocoa beans could not be attributed to a significant decrease in the share of the EU in cocoa beans exports after the introduction of the regulations. As indicated in the fourth row in the table, there is no significant difference in the share of exports of cocoa beans to the EU before and after the regulations. This thereby suggests that the fall may not be due to the decrease in export share to the EU after the regulations.

Table 5: Test of mean difference in export share of the EU

	WESTAFRICA		
Export share	Before reform	After reform	p-value of difference
Value	0.731 (0.017)	0.703 (0.015)	0.358
Quantity	0.971(0.05)	0.925(0.027)	0.174

Note: Standard errors are in parentheses.

The estimated negative effect on cocoa exports represents the average treatment effect over the period of estimation. Table 6 splits the interaction variable for individual periods for cocoa exports. The results in the table suggest that the regulations initially have negative effects on cocoa exports in 2008 and 2009 but positive effects later in the period of study, 2013–2015. The results suggest that the regulations have adverse effects in the short run and some enhancing effects in the long run because of some level of compliance with standard requirements by cocoa farmers and exporters in West Africa consequent upon the various measures put in place by the major producing countries in the sub-region. However, these effects are not statistically significant for the individual years in the post-implementation period.

Table 6: Speed of adjustment – decomposing trade effect along time

	Coefficient	Robust Std. Err
Int_2008	-.1444	0.2088
Int_2009	-.0443	0.1973
Int_2010	0.1220	0.2062
Int_2011	0.2837	0.2109
Int_2012	-0.0255	0.2593
Int_2013	0.0849	0.1944
Int_2014	0.2798	0.2046
Int_2015	0.1470	0.1965
R^2	0.53	
Obs	800	

Note: These coefficients were obtained using Stata 14 SE; the regressions include fixed effects for exporters and importers but these are not reported as they are not of direct interest.

The results contained in Table 3 show that the null hypothesis of no effect on exports of cocoa beans can be rejected at 5% level of significance and therefore conclude that the regulations have a negative impact on the exports of cocoa beans to the EU in conformity with a priori expectations. These results do provide some evidence in support of our research hypothesis of negative impact of the regulations on West Africa's cocoa exports.

The differential impact assessment of the EU regulations among exporting countries

To assess differential impact of the regulations among the exporting countries using the DID methodology, a sample of importing countries was selected for each exporting country. The lists of countries in the sample of each country are presented in Table 7.

Table 7: The list of importing countries in the sample

Cote d'Ivoire		Cameroon		Ghana		Nigeria	
Treatment Group	Control Group	Treatment Group	Control Group	Treatment Group	Control Group	Treatment Group	Control Group
Switzerland	New Zealand	Italy	Turkey	Portugal	Thailand	Switzerland	Turkey
Greece	South Africa	UK	Thailand	Ireland	South Africa	Portugal	South Africa
Czech rep	Ukraine	Germany	Indonesia	Greece	Israel	Poland	Singapore
Portugal	Singapore	Spain	China	Denmark	Iran	Estonia	Russia
Bulgaria	Saudi Arabia	France	Russia	Croatia	India	UK	Malaysia
Poland	Philippine	Belgium	Malaysia	UK	USA	Spain	Japan
Estonia	Mali	Netherland	Japan	Switzerland	Turkey	Netherland	Indonesia
Italy	Mexico		Canada	Spain	Singapore	Italy	India
UK	Lithuania		USA	Poland	Russia	Germany	Brazil
Spain	Sri Lanka			Netherland	Malaysia	France	China
France	Korea			Italy	Indonesia	Belgium	USA
Belgium	Israel			Germany	Japan		Canada
Germany	Iran			France	China		Australia
Netherlands	India			Bulgaria	Australia		
	Hong Kong			Estonia			

continued next page

Table 7 Continued

Cote d'Ivoire		Cameroon		Ghana		Nigeria	
Treatment Group	Control Group	Treatment Group	Control Group	Treatment Group	Control Group	Treatment Group	Control Group
	Brazil			Belgium			
	Argentina						
	Indonesia						
	Australia						
	Turkey						
	China						
	Russia						
	Malaysia						
	Japan						
	Canada						
	USA						

Table 8 presents the summary of the distribution of the importing countries into treatment and control groups. The treatment group comprises the EU countries and Switzerland while the control group consists of non-EU importing countries.

Table 8: Treatment group versus control group

Country	Treatment group	Control group
Cote d'Ivoire	14	26
Ghana	16	14
Nigeria	11	13
Cameroon	7	9

A statistical test of equality of export growth rates between the EU and non-EU was conducted to confirm parallel trend assumption in respect of each exporting country. The results of two sample t-tests on an annual basis are presented in tables 9, 10 and 11. As indicated in the tables, the difference between the mean growth rate of exports in the control and treatment groups is statistically insignificant for export value, quantity and unit price in all cases. There is no statistically significant difference in the means in any of the years, indicating that the parallel trend assumption is satisfied, and the control group which comprises countries where the regulation was not applied can be said to represent a valid counterfactual group.

Table 9: Parallel trend test for exports (USD)

ΔGrowth rate	Treatment	Control	p-value of difference
Nigeria			
2002	0.425 (0.110)	1.664(1.185)	0.143
2003	0.143(0.188)	1.678(0.672)	0.102
2004	0.739(0.844)	0.341(0.257)	0.147
2005	0.030 (0.119)	0.379 (0.444)	0.101
2006	0.052(0.120)	0.111(0.073)	0.428
2007	0.207(0.202)	0.235(0.000)	0.944
Cameroon			
2002	3.395(2.253)	3.810(0.012)	0.946
2003	0.071 (0.176)	0.204(0.023)	0.535
2004	0.287(0.172)	0.225(0. 234)	0.881
2005	0.247 (0.108)	0.318(0.034)	0.785
2006	0.978(0.625)	0.872(0.567)	0.277
2007	0.047 (0.330)	1.494 (0.083)	0.145
Cote d'Ivoire			
2002	0.425 (0.110)	1.664 (1.184)	0.259
2003	0.280(0.088)	0.239 (0.366)	0.146
2004	0.739 (0.844)	0.341 (0.257)	0.689
2005	0.030 (0.119)	0.379 (0.444)	0.414
2006	0.052(0.120)	0.111(0.073)	0.701
2007	1.1087 (1.034)	0.559 (1.034)	0.456
Ghana			
2002	0.576(0.198)	0.547(0.284)	0.937
2003	0.182(0.197)	1.726(1.483)	0.342
2004	0.158(0.097)	0.362 (0. 202)	0.391
2005	0.248(0.097)	1.071(0.424)	0.901
2006	0.249 (0.100)	0.234(0.345)	0.969
2007	0.217(0.164)	1.349(1.254)	0.408

Table 10: Parallel trend test for exports (tons)

ΔGrowth rate	Treatment	Control	p-value of difference
Nigeria			
2002	0.069 (0.024)	1.682(1.478)	0.101
2003	0.011(1.786)	0.012(0.000)	0.107
2004	0.089 (0.023)	0.472(0.254)	0.500
2005	0.035(0.018)	0.251(0.400)	0.100
2006	0.011(0.002)	0.216 (0.055)	0.189
2007	0.081(0.148)	0.110 (0.000)	0.916
Cameroon			
2002	1.957(1.159)	3.509 (2.154)	0.692
2003	0.479 (0.350)	0.060 (0.053)	0.542
2004	0.339(0.207)	0.256(0.197)	0.870
2005	0.233 (0.106)	0.250 (0.230)	0.947
2006	0.694 (0.544)	0.898(0.749)	0.282
2007	0.162 (0.250)	0.846 (0.789)	0.169
Cote d'Ivoire			
2002	0.069 (0.013)	1.682 (1.478)	0.200
2003	0.011 (0.023)	0.568(0.408)	0.131
2004	0.089 (0.034)	0.472(0.254)	0.604
2005	0.035(0.013)	0.251(0.400)	0.433
2006	0.011(0.004)	0.216 (0.055)	0.683
2007	0.220(0.132)	0.045 (0.242)	0.429
Ghana			
2002	0.186(0.153)	0.251(0.254)	0.834
2003	0.286(0.236)	2.781(0.240)	0.309
2004	0.314(0.090)	0.459 (0.226)	0.562
2005	0.174 (0.074)	0.966 (0.390)	0.750
2006	0.053(0.106)	0.110(0.178)	0.444
2007	0.080 (0.119)	0.768 (0.907)	0.378

Table 11: Unit price

ΔGrowth rate	Treatment	Control	p-value of difference
		Nigeria	
2002	2.674(0.546)	5.684(2.647)	0.183
2003	7.884(1.175)	4.659(0.020)	0.120
2004	7.347(9.305)	6.769 (1.210)	0.157
2005	0.834(6.501)	7.016 (21.521)	0.107
2006	1.745(1.207)	1.338(5.514)	0.186
2007	3.312(0.352)	2.580 (0.000)	0.298
		Cameroon	
2002	2.748(0.703)	4.959(2.345)	0.401
2003	5.348(1.472)	6.540(4.108)	0.741
2004	9.732(7.453)	4.197(2.134)	0.165
2005	7.921(3.848)	10.891(1.342)	0.435
2006	5.582(0.619)	3.846(0.540)	0.299
2007	4.657 (0. 912)	2.847 (1.192)	0.440
		Cote d'Ivoire	
2002	2.674 (0.546)	5.684 (2.647)	0.233
2003	3.477 (1.287)	5.840 (1.013)	0.185
2004	7.347(9.305)	6.770(1.210)	0.162
2005	0.834(6.501)	7.016 (2.521)	0.706
2006	4.745(11.207)	1.338(5.514)	0.220
2007	1.879 (3.182)	3.031 (0.723)	0.732
		Ghana	
2002	4.750(4.872)	1.127(5. 925)	0.342
2003	5.105 (4.591)	5.474(0.600)	0.349
2004	4.968 (3.718)	3.118(3.198)	0.417
2005	6.117(5.006)	4.149(13.510)	0.638
2006	6.967(1.407)	5.545(1.087)	0.429
2007	3.990(0.564)	2.009 (1.489)	0.250

Impact assessment results for exporting countries

Table 12 presents baseline estimation results, which include time and importer fixed effects. As shown in the table, the coefficient on the interaction term is negative in models I - III, but positive in model IV. The positive sign for model IV may be due to the growing interest in organic cocoa production as well as origin-related quality cocoa in Cameroon. These mean that, compared with the control group, cocoa exports to the treatment group decrease by 34%, 47% and 44% for Cote d'Ivoire, Ghana and Nigeria, respectively, while exports rise by 28% for Cameroon. However, the effects are only statistically significant for Cote d'Ivoire and Ghana.

It appears from these estimations that the effect of the regulations is mainly negative and statistically significant for the two leading exporting countries in West Africa and the world. This is in line with the results obtained for the pooled data for West Africa.

Table 12: Impact estimation results

	Cote d'Ivoire (I)	Ghana (II)	Nigeria (III)	Cameroon (IV)
Interaction	-0.3406** (0.1569)	-0.4655*** (0.1458)	-0.4394 (0.2691)	0.2766 (0.3102)
Importer FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Adjusted R-Sq	0.86	0.87	0.73	0.96
Observation	288	304	128	96

Note: Robust standard errors are in parentheses. These coefficients were obtained using Stata 14 SE; ** $p < 0.05$, *** $p < 0.01$. The regressions include fixed effects for time and importers but these are not reported as they are not of direct interest.

Table 13 presents estimation results of Equation 2 for each of the four major cocoa-exporting countries in West Africa. The inclusion of additional covariates in equations whose results are presented in Table 12 does not affect the sign and significance status of the interaction terms in Table 13 except for Nigeria. Table 13 shows that exports from Cote d'Ivoire and Ghana to the EU dip by 34% and 57%, respectively, compared with those to the non-EU importing countries that are not affected by the regulations. These results essentially support the research hypothesis of a negative impact of the EU regulations on West Africa's exports to the EU as a result of the introduction of the EU regulations.

Table 13: Estimation results of expanded models

	Cote d'Ivoire	Ghana	Nigeria	Cameroon
Interaction	-0.3366** (0.1669)	-0.5687*** (0.1393)	-.3128 (0.2855)	0.2323 (0.3238)
R-Sq	0.86	0.88	0.74	0.95
Observations	288	304	128	96

Note: Robust standard errors are in parentheses. These coefficients were obtained using Stata 14 SE; ** $p < 0.05$, *** $p < 0.01$. The regressions include time and importers fixed effects and other covariates but these are not reported as they are not of direct interest.

Table 14 presents baseline estimation results for quantities of exports. As shown in the table, the coefficient of the interaction term is positive but not significant for Cote d'Ivoire and Cameroon, but negative and statistically significant for Nigeria and Ghana. The table shows that quantities of exports from Ghana and Nigeria have fallen by 36% and 54%, respectively.

Table 14: Baseline estimation results of exports (tons)

	Cote d'Ivoire	Ghana	Nigeria	Cameroon
Interaction	0.2246 (0.1836)	-0.3606*** (0.1336)	-0.5370* (0.2797)	0.2424 (0.3109)
Importer FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Adjusted R-Sq	0.95	0.89	0.70	0.91
Observation	288	304	128	96

Note: Robust standard errors are in parentheses. These coefficients were obtained using Stata 14 SE; * $p < 0.10$, *** $p < 0.01$.

Table 15 shows that the regulations have negative and significant impact on unit prices of exports of cocoa beans from Cote d'Ivoire. In contrast, it has a negative but not significant effect on Cameroon and Ghana, and positive but not significant effect on Nigeria. The table indicates that, relative to the control group, unit prices of cocoa beans exported from Cote d'Ivoire decreased by 56%.

Table 15: Baseline estimation including fixed effects for unit prices

	Cote d'Ivoire	Ghana	Nigeria	Cameroon
Interaction	-0.5652*** (0.1466)	-0.1050 (0.0679)	2.5284 (1.5724)	-0.1131 (1.4860)
Importer FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Adjusted R-Sq	0.93	0.58	0.25	0.68
Observations	288	304	128	96

Note: Robust standard errors are in parentheses. These coefficients were obtained using Stata 14 SE; *** $p < 0.01$.

Table 16 shows that the regulations have negative effects on extensive margins (EM) for Cote d'Ivoire, Ghana and Nigeria while the effect is positive for Cameroon. These effects are statistically significant in all cases. These estimations show that the regulations have resulted in shrinkage of extensive margins for the EU, relative to non-EU, in respect of Cote d'Ivoire, Ghana and Nigeria. The coefficients of the interaction terms indicate that the regulations exert greatest impeding effect on EM for Nigeria and the least for Ghana. However, the regulations enhance extensive margins in the case of Cameroon. This enhancement may be attributed to growing interest in organic cocoa production as well as origin-related quality cocoa from Cameroon (Agritrade, 2013).

These results show that the fall in cocoa exports to the EU by Ghana and Nigeria could be attributed to the fall in quantities of cocoa exports and shrinkage in extensive margins. However, the fall in cocoa exports to the EU by Cote d'Ivoire could be attributed to a fall in unit prices and shrinkage in extensive margins.

Table 16: Adjustments along the extensive margins of markets

	Cote d'Ivoire	Ghana	Nigeria	Cameroon
Interaction	-.2444*** (.0268)	-.0853* (.0332)	-.2703*** (.08637)	0.3518*** (0.1069)
Time FE	Y	Y	Y	Y
Wald chi2	1214.45***	-	124.84***	1018.11***
Observations	32	32	32	32

Note: Robust standard errors are in parentheses. These coefficients were obtained using Stata 14 SE; * $p < 0.10$, *** $p < 0.01$.

In Cote d'Ivoire, the dip in exports of cocoa beans to the EU, relative to non-EU importing countries, could be attributed to a fall in unit prices of cocoa exports to the EU compared with non-EU importing countries. The decrease in unit prices cast some doubt on the quality of cocoa beans produced in the country. This means that the cocoa sector reforms in Cote d'Ivoire and the activities of the Coffee and Cocoa Council (CCC) have not yielded the expected results in terms of improvement in the quality of cocoa beans. Also, it might probably mean that high quality cocoa beans are processed locally following the reform process targeting processing 50% of cocoa beans produced locally, which caused an increase in investments in local cocoa processing since 2008.

The decrease in cocoa bean exports to the EU compared to the control group by Ghana might be attributed to the increasing trend in local processing of cocoa beans in the country while the negative (but insignificant) effect on the unit prices of cocoa exports to the EU is indicative of the high quality of Ghana's cocoa beans. This high quality of cocoa beans has been attributed to the Ghana Cocoa Board which is charged with the regulation of cocoa marketing in the country. The Ghana Cocoa Board has developed, through its specialized Quality Control Division (QCD), highly recognized expertise and an internationally trusted reputation in maintaining consistently high quality of exported cocoa beans; and thereby consistently fetches premium world market prices. The premium might also be linked to Sanitary and Phytosanitary Standards (SPS), in addition to the excellent product safety performance in the cocoa sub-sector that has enabled Ghana to meet the standards of international markets.

With these results, the null hypothesis of no significant differences in the effect of the regulation among major cocoa exporting countries in West Africa could be rejected by concluding that there are significant differences in the effect of the regulations among major cocoa-exporting countries in West Africa. This is further supported by the significance of the coefficient of DDD2 in Table 17. The results contained in the table show that the null hypothesis can be rejected at a 10% level of significance, thereby concluding that the regulations have differential impact among cocoa-producing countries in West Africa.

Table 17: Estimated triple D estimation results

Heterogeneous effects	Coefficient	Robust Std. Err,
Interaction	-.5303**	0.2701
DDD1	-.1588	0.2507
DDD 2	0.4463*	0.2475
DDD 3	0.4205	0.3073
R^2	0.56	
Obs	800	

Table 18 presents the placebo sensitivity results. The placebo test was carried out to establish that the effects of the regulations on exports of cocoa from West Africa are not driven by other factors. In order to assess this, we used 'fake' treatment group by dropping all the outcomes for treated observations and then inserting a phantom treatment group in the middle of the remaining data to form the fake treated group. Difference-in-difference estimation was then applied to the data to obtain the results presented in Table 18. As shown in the table, the coefficient on the interaction term is not statistically different from zero for all four cocoa-producing countries (Ghana, Nigeria, Cote d'Ivoire and Cameroon) and West Africa. These results suggest that the impact on cocoa exports from West Africa is certainly driven by Regulation EC 396/2005 of the EU.

Table 18: Sensitivity test results

Variables	Ghana	Nigeria	Cote d'Ivoire	Cameroon	West Africa
Interaction	-0.207 (-1.24)	-0.012 (-0.10)	-0.167 (-1.17)	0.096 (0.80)	-0.018 (-0.34)
Reform	0.994 (0.42)	1.157 (1.16)	-0.134 (-0.79)	1.623 (2.43)	-0.179 (-1.67)
Treat	0.121 (0.08)	-0.069 (-0.69)	-0.008 (-0.62)	-0.022 (-0.21)	-0.002 (-0.19)
Exporter FE					Y
Importer FE	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y
R^2	0.435	0.973	0.436	0.970	0.796
Obs	288	63	288	64	703

5. Conclusions and policy implications

West Africa's cocoa exports to the world, the EU and non-EU countries exhibit increasing trends over the 2001–2016 period. The descriptive analysis shows that the EU still remains the major importer of cocoa from West Africa after the introduction of Regulation EC 396/2005.

The results of the study show that the implementation of the regulation has led to a 41% fall in West Africa's exports to the EU, compared with non-EU importing countries, over the period under study. This suggests that the regulation has an impeding effect on cocoa exports to the EU. This fall might be due to a 36% fall in the quantities of cocoa exports to the EU, compared with 54% for the non-EU trading partners from Ghana and Nigeria, and a 56% fall in unit prices of cocoa beans imported from Cote d'Ivoire by the EU relative to non-EU countries. The fall could also be attributed to the shrinkage in extensive margins among Nigeria, Ghana and Cote d'Ivoire. This means that the various efforts directed at ensuring that smallholder farmers and exporters comply with the regulation have not yielded the expected results of sustaining access of West Africa's exports to the EU. In other words, the various efforts had not prevented national revenue and livelihoods of cocoa farmers from being adversely affected by the regulations. The study suggests that the various measures undertaken at all levels were not effective in meeting the requirements of the regulations, thereby resulting in adverse effects on imports of cocoa beans by the EU.

However, this effect varies among the four major cocoa-exporting countries in West Africa. The regulations have significant adverse effects on cocoa imports from Cote d'Ivoire and Ghana, while it has no significant adverse effect on cocoa imports from Nigeria and Cameroon by the EU. The study revealed a 34% and 47% fall in exports of cocoa beans to the EU, relative to non-EU importing countries, from Cote d'Ivoire and Ghana, respectively.

The decrease in exports from Cote d'Ivoire, Ghana and Nigeria could be attributed to the fall in the quantities of cocoa exports to the EU, relative to the non-EU, and shrinkage of extensive margins. The quantities of cocoa beans exports to the EU by Ghana and Nigeria fell by 36% and 54%, respectively, compared with other countries not affected by the regulations. However, that of Cote d'Ivoire could be attributed to a 56% fall in unit prices of cocoa beans and shrinkage of extensive margins.

The fall in unit prices of cocoa beans imported by the EU, compared with non-EU trading partners, from Cote d'Ivoire during the period under study means that cocoa

sector reforms and the activities of the Coffee and Cocoa Council (CCC) in Cote d'Ivoire have not brought about the desired improvement in the quality of cocoa beans.

The decline in cocoa exports to the EU, compared with non-EU trading partners, by West Africa is suggestive of ineffectiveness of the various measures put in place to ensure compliance of cocoa farmers and exporters with the EU regulations by national authorities. The fear of a possible decline in West Africa's cocoa exports to the EU as a result of the regulations is confirmed by the findings of the study. The effect, however, varies among the four main exporting countries in the sub-region, possibly because of the differences in measures put in place by the four governments.

These results imply that, to sustain access to the EU markets for cocoa exports, Ghana Cocoa Board and other agencies should scale up the quality of cocoa beans in order to continue to enjoy premium prices on cocoa exports; Cote d'Ivoire should strengthen measures aimed at raising cocoa quality standards. Issues of quality control also need to be addressed in Cote d'Ivoire, particularly at the level of the farmers, if premium prices are to be obtained similar to those achieved in Ghana. Nigeria should re-establish a cocoa board as done in Ghana to specifically handle marketing of cocoa. Policies and programmes aimed at ensuring compliance with SPS regulations should be sustained and strengthening at all levels in all the exporting countries in West Africa.

To ensure that EU pesticide regulations do not constrain the export potential of West Africa, the national governments of the exporting countries should strengthen efforts at assisting farmers and exporters to comply with international standards required by the EU. The national governments should actively participate in international standard-setting in order to influence future standards so that such standards do not become barriers to exports of cocoa beans. This will also provide early warning to exporters in those countries to enable them prepare and adjust to new standards. The study also suggests that adequate inspection facilities be provided at exit points in order to facilitate cocoa exports.

The EU importing countries should provide technical and financial support to all the national, regional and international initiatives put in place by cocoa-producing countries, regional organizations and ICCO to monitor and enforce adherence to SPS standards in cocoa. Technical and financial support should be provided to analysis laboratories and research stations in order to improve analytical capacity for residue on cocoa, especially in Cameroon and Nigeria. The chocolate and confectionery industries should continue to complement the educational, regulatory and infrastructural support provided in cocoa-producing countries in West Africa.

6. Areas of further research

It would be important to understand the impact of the regulations on actors along the cocoa supply chain – smallholder farmers, produce buyers, agrochemical companies and cocoa-exporting firms. Since the current research only analyses country-level impacts without the need for firm-level data, a more detailed analysis with firm data would provide additional and more detailed insight. Understanding which firms are able to meet standards or divert trade to other destinations is an important issue to understand for policy-smakers. Most importantly, understanding the impact of regulations on the livelihoods of smallholder farmers would be a relevant policy research area.

References

Agritrade. 2013. Executive Brief Update, October 2013.

Ali, S. 2016. "Export response to sanitary and phytosanitary measures and technical barriers to trade: Firm-level evidence from a developing Country". CREDIT Research Paper No. 16/02. At www.nottingham.ac.uk/economics/credit/

Atici, C. 2013. "Food safety regulations and export responses of developing countries: The case of Turkey's fig and hazelnut exports". FAO Commodity and Trade Policy Research Working Paper No. 39.

Bateman, R. 2009. Pesticide Use in Cocoa: A Guide for Training Administrative and Research Staff. UK: ICCO.

Boza, S. 2013. "Assessing the impact of sanitary, phytosanitary and technical requirements on food and agricultural trade: What does current research tell us?" Working Paper Series 2, SECO/WTI Academic Cooperation Project.

Crivelli, P. and J. Groschl. 2012. "The impact of sanitary and phytosanitary measures on market entry and trade flows". IFO Working Paper No. 136, August.

Czubala, W., B. Shepherd and J.S. Wilson. 2009. "Help or hindrance? The impact of harmonised standards on African exports". Journal of African Economies, 18: 711–44.

Disdier, A.C. and F. Van Tongeren. 2010. "Non-tariff measures in agri-food trade: What do the data tell us? Evidence from a cluster analysis on OECD imports". Applied Economic Perspectives and Policy, 32(3): 436–55.

Ferro, E., J.S. Wilson and T. Otsuki. 2013. "The effect of product standards on agricultural exports from developing countries". Policy Research Working Paper No. 6518. The World Bank, Washington, D.C.

Henson, S. and R. Loader. 2001. "Barriers to agricultural exports from developing countries: The role of sanitary and phytosanitary requirements". World Development, 29(1): 85–102.

Horton, L.R. 1998. "Food from developing countries: Steps to improve compliance". Food and Drug Law Journal, 53(1): 139–71.

Jayasinghe, S., J. Beghin and G. Moschini. 2010. "Determinants of the world demand for U.S. corn seeds: The role of trade costs". American Journal of Agricultural Economics, 92(4): 999–1010.

Kareem, O.I. 2014. "The European Union technical barriers to trade and Africa's exports: Evidence from sanitary and phytosanitary measures". The EU technical regulations and Africa export. EUI Jan 2014.

Kee, H.L., A. Nicita and M. Olerreaga. 2009. "Estimating trade restrictiveness indices". The Economic Journal, 119(534): 172–99.

Lissovolik, B. and Y. Lissovolik. 2006. "Russia and gravity: The gravity of outsider status". IMF Staff Papers, 53(1): 1–26.

Maertens, M. and J.F.M. Swinnen. 2009. "Trade, standards, and poverty: Evidence from Senegal". World Development, 37: 161–78.

Mimouni, D., C. Averbeck and O. Skorobogatova. 2009. "Obstacles to trade from the perspective of the business sector: A cross-country comparison". In World Economic Forum, ed., The Global Enabling Trade Report 2009, pp. 69–76.

Moise, E. and F. Le Bris. 2013. "Trade costs – what have we learnt: A synthesis report". OECD Trade Policy Paper No. 150. OECD Publishing.

Otsuki, T., J. Wilson and M. Sewadeh. 2001. "Saving two in a billion: Quantifying the trade effect of European food safety standards on African exports". Food Policy, 26(5): 495–514.

Rutherford, M. 2011. "Assessing and addressing pesticide practice in cocoa producing countries to meet regulatory standards". Paper presented at the International Workshop on Safe Use of Pesticides in Cocoa and Harmonized Legislation for Food Safety. Kuala Lumpur, 25–27 January.

Schlueter, S., C. Wieck and T. Heckelei. 2009. "Regulatory policies in meat trade: Is there evidence for least trade-distorting sanitary regulations?" American Journal of Agricultural Economics, 91(5): 1484–90.

Shepherd, B. and N.L.W. Wilson. 2013. "Product standards and developing countries agricultural exports: The case of the European Union". Food Policy, 42: 1–10.

Van Tongeren, F., J. Beghin and S. Marette. 2009. "A cost-benefit framework for the assessment of non-tariff measures in agro-food trade". OECD Food Agriculture and Fisheries Working Paper No. 21.

Wilson, N. and V. Bray. 2010. "It happened all at once: Switching regressions, gravity models and food safety". Paper presented at the AAEA, CAES, WAEA Joint Annual Meeting, Denver, Colorado. July.

World Bank. 2008. "A survey of non-tariff measures in the East Asia and Pacific region". The World Bank Policy Research Report No. 42853.

World Cocoa Foundation. 2010/2012. Cocoa Market Update.

WTO. 2012. World Trade Report 2012. Geneva: World Trade Organization.

Xiong, B. and J. Beghin. 2011. "Aflatoxin redux: Does European aflatoxin regulation hurt groundnut exporters from Africa?" Iowa State University Department of Economics Staff Research Paper.

UNCTAD. 2010. Non-Tariff Measures: Evidence from Selected Developing Countries and Future Research Agenda. Geneva: United Nations Publications.

Appendixes

YEAR	OBSERVATION (N= 144)	SAMPLE		Nigeria			
				'000USD		Tons	
		EU	NONEU	EU	NONEU	EU	NONEU
2001	9	7	2	144.657	6.650	139.299	3.850
2002	9	7	2	219.497	8.682	138.299	5.026
2003	9	7	2	395.006	23.662	178.040	14.424
2004	9	7	2	237.838	63.356	134.254	38.170
2005	9	7	2	305.447	6.692	188.970	4.424
2006	9	7	2	246.739	33.564	150.812	21.594
2007	9	7	2	304.249	53.664	162.421	33.070
2008	9	7	2	382.102	66.248	157.733	29.420
2009	9	7	2	648.793	37.688	233.405	14.302
2010	9	7	2	665.174	61.612	202.006	22.026
2011	9	7	2	664.679	82.002	203.137	27.726
2012	9	7	2	423.395	32.004	167.298	14.812
2013	9	7	2	416.720	46.492	166.045	23.724
2014	9	7	2	478.846	62.332	158.496	20.272
2015	9	7	2	483.617	7.456	159.326	4.422
2016	9	7	2	622.223	75.456	205.514	23.422

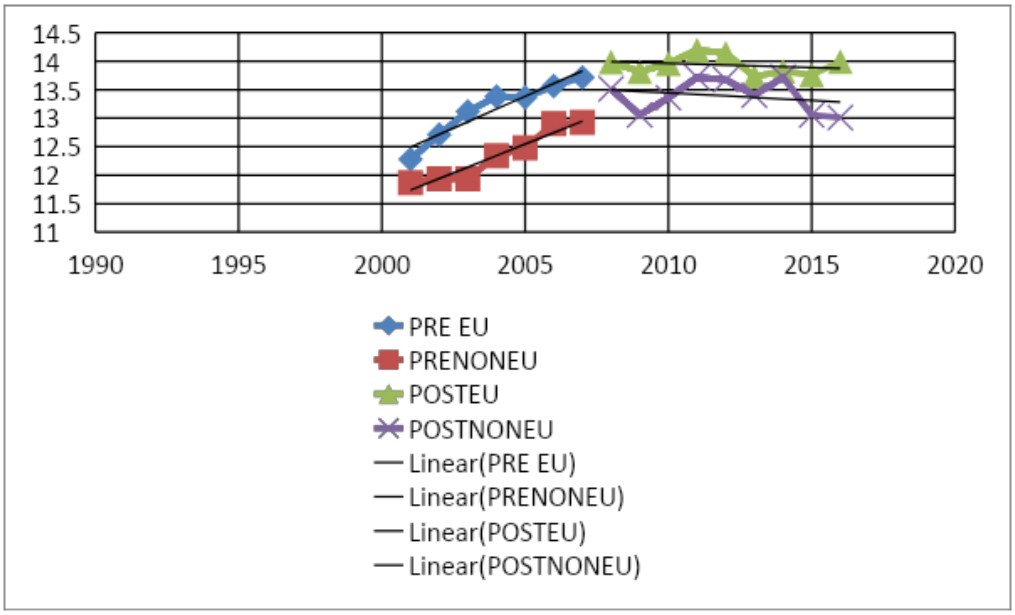
YEAR	OBSERVATION (N= 304)	SAMPLE		Ghana			
				'000USD		Tons	
		EU	NONEU	EU	NONEU	EU	NONEU
2001	19	9	10	215.318	142.648	158.336	120.876
2002	19	9	10	331.325	152.854	177.052	135.690
2003	19	9	10	496.878	152.854	188.614	135.690
2004	19	9	10	645.950	228.934	270.042	119.421
2005	19	9	10	638.594	262.913	329.857	154.248
2006	19	9	10	776.387	402.050	348.157	233.540
2007	19	9	10	902.940	410.884	365.635	196.766
2008	19	9	10	1186.180	449.506	392.399	175.168
2009	19	9	10	999.833	468.571	386.128	164.806
2010	19	9	10	1155.041	632.461	376.798	181.151
2011	19	9	10	1466.000	907.401	345.785	364.816
2012	19	9	10	1384.902	871.088	444.356	305.159
2013	19	9	10	916.590	663.172	343.295	256.787
2014	19	9	10	1010.205	906.712	364.213	396.084
2015	19	9	10	945.457	854.292	302.806	264.677
2016	19	9	10	1193.697	737.555	395.624	405.517

YEAR	OBSERVATION (N= 96)	SAMPLE		Cameroon			
				'000USD		Tons	
		EU	NONEU	EU	NONEU	EU	NONEU
2001	6	4	2	187.870	2.03	104.177	1.73
2002	6	4	2	86.589	8.06	56.008	3.99
2003	6	4	2	183.548	38.77	93.621	17.99
2004	6	4	2	131.122	30.87	82.882	16.91
2005	6	4	2	191.602	37.81	125.487	21.24
2006	6	4	2	181.869	25.77	107.204	15.94
2007	6	4	2	240.360	3.30	114.957	1.62
2008	6	4	2	299.258	8.23	125.697	2.99
2009	6	4	2	559.812	15.67	207.854	5.10
2010	6	4	2	518.523	31.18	189.164	8.33
2011	6	4	2	444.957	6.54	154.295	2.40
2012	6	4	2	331.334	9.94	130.350	3.95
2013	6	4	2	350.322	14.38	146.095	5.40
2014	6	4	2	451.136	8.22	154.885	2.61
2015	6	4	2	423.194	12.52	151.722	6.95
2016	6	4	2	409.801	15.21	133.090	7.95

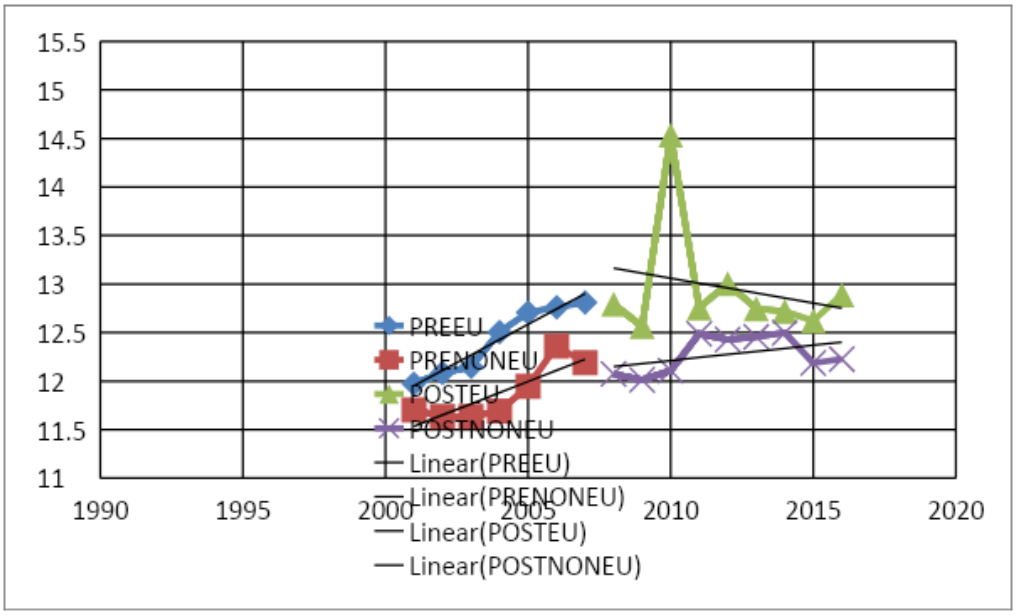
YEAR	OBSERVATION (N= 288)	SAMPLE		Cote d'Ivoire			
				'000USD		Tons	
		EU	NONEU	EU	NONEU	EU	NONEU
2001	18	10	8	1139.032	334.757	1008.735	268.714
2002	18	10	8	1532.213	437.326	1757.056	218.211
2003	18	10	8	2152.265	571.225	1835.181	261.693
2004	18	10	8	1108.230	660.664	1617.485	365.678
2005	18	10	8	1464.915	790.570	1473.895	448.467
2006	18	10	8	1409.178	751.202	1422.913	402.586
2007	18	10	8	1122.625	667.566	1138.372	313.902
2008	18	10	8	1867.227	866.883	1754.113	316.820
2009	18	10	8	2209.683	765.992	1196.121	265.263
2010	18	10	8	2411.611	888.063	1492.515	445.922
2011	18	10	8	2791.961	1173.194	1917.377	465.525
2012	18	10	8	1853.487	978.432	1324.954	397.435
2013	18	10	8	2525.393	1086.689	1544.456	333.627
2014	18	10	8	2034.817	1499.066	1045.103	475.927
2015	18	10	8	2404.481	1229.186	1453.796	455.337
2016	18	10	8	2453.356	1220.112	1409.086	455.583

YEAR	OBSERVATION (N= 800)	SAMPLE		Wet Africa			
				'000USD		Tons	
		EU	NONEU	EU	NONEU	EU	NONEU
2001	50	29	21	1686.877	486.085	1410.547	395.17
2002	50	29	21	2169.624	606.922	2128.415	362.917
2003	50	29	21	3227.697	786.511	2295.456	429.797
2004	50	29	21	2123.14	983.824	2104.663	540.179
2005	50	29	21	2600.558	1097.985	2118.209	628.379
2006	50	29	21	2614.173	1212.586	2029.086	673.66
2007	50	29	21	2570.174	1135.414	2181.385	545.358
2008	50	29	21	3734.767	1390.867	2429.942	524.398
2009	50	29	21	4418.121	1287.921	2023.508	449.471
2010	50	29	21	4750.349	1613.316	2260.483	657.429
2011	50	29	21	5367.597	2169.137	2620.594	860.467
2012	50	29	21	3993.118	1891.464	2066.958	721.356
2013	50	29	21	4209.025	1810.733	2199.891	619.538
2014	50	29	21	3975.004	2476.33	2122.697	894.893
2015	50	29	21	4256.749	2103.454	2067.65	731.386
2016	50	29	21	4679.077	2048.333	2143.314	892.472

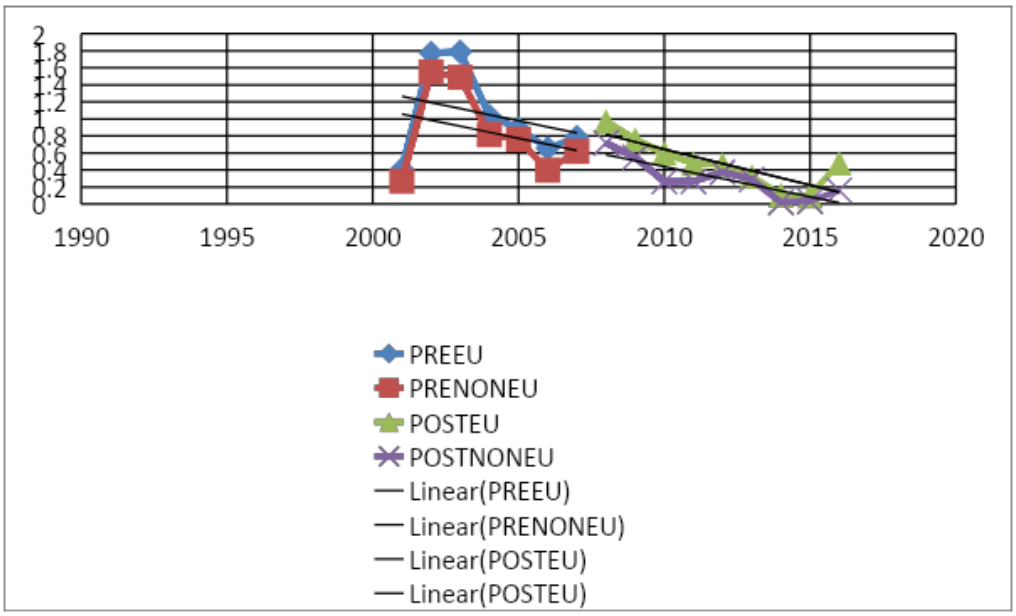
GHANA
Exports (USD) in Logs



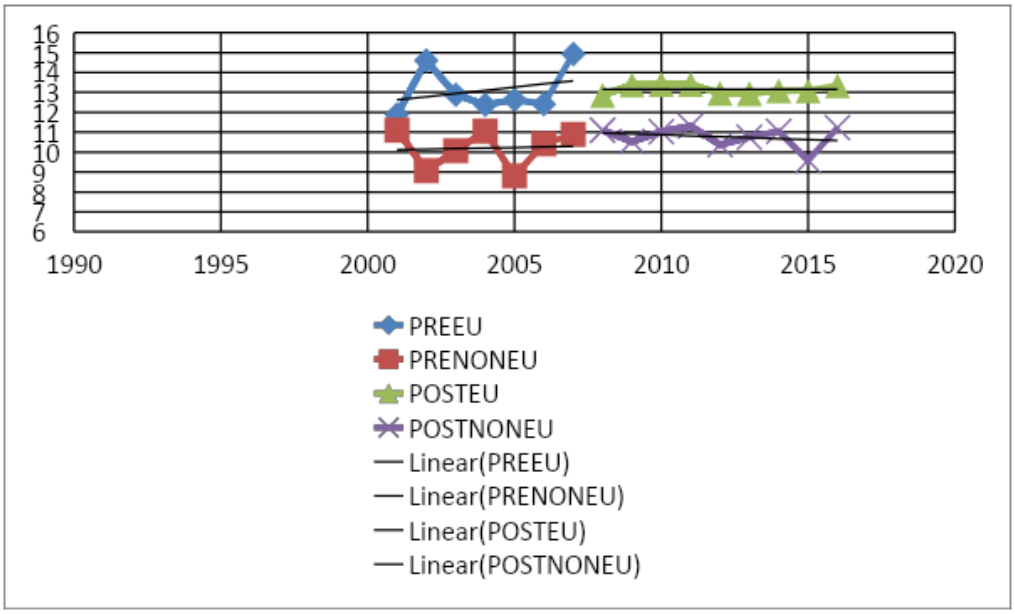
Exports in Tons



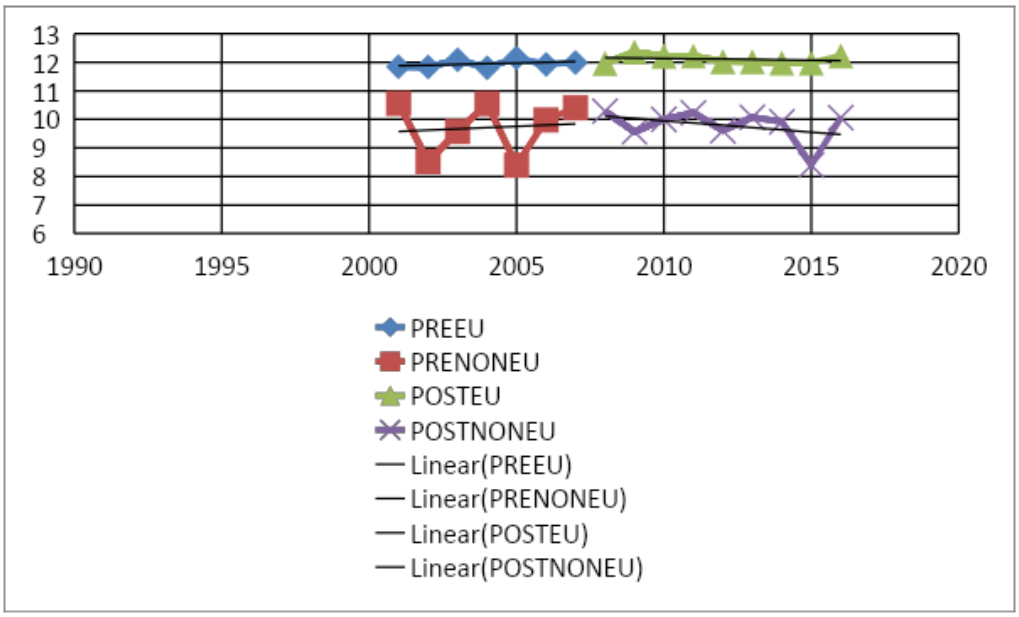
UNITPRICE



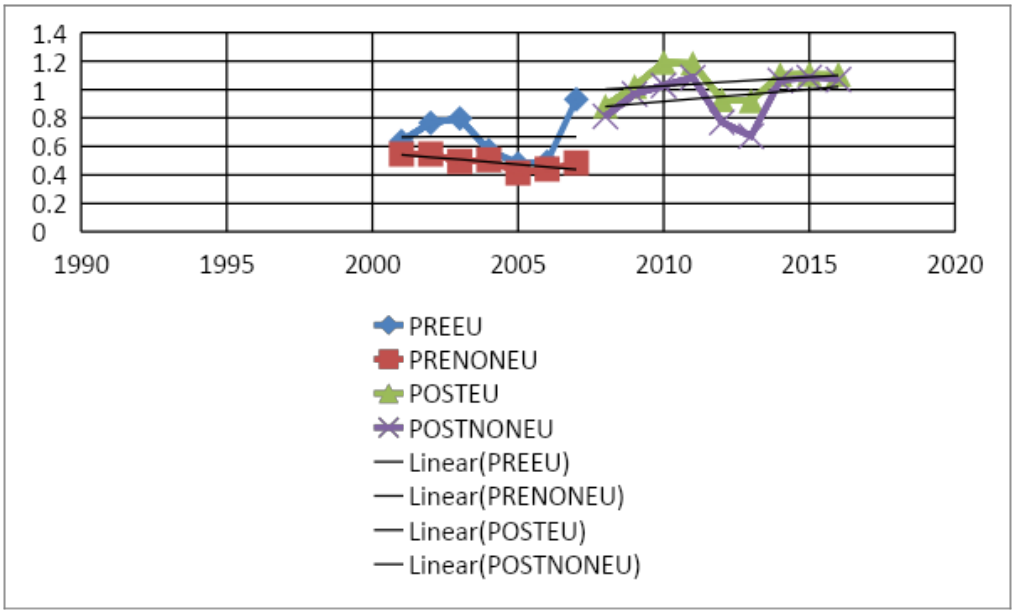
NIGERIA
Exports (USD)



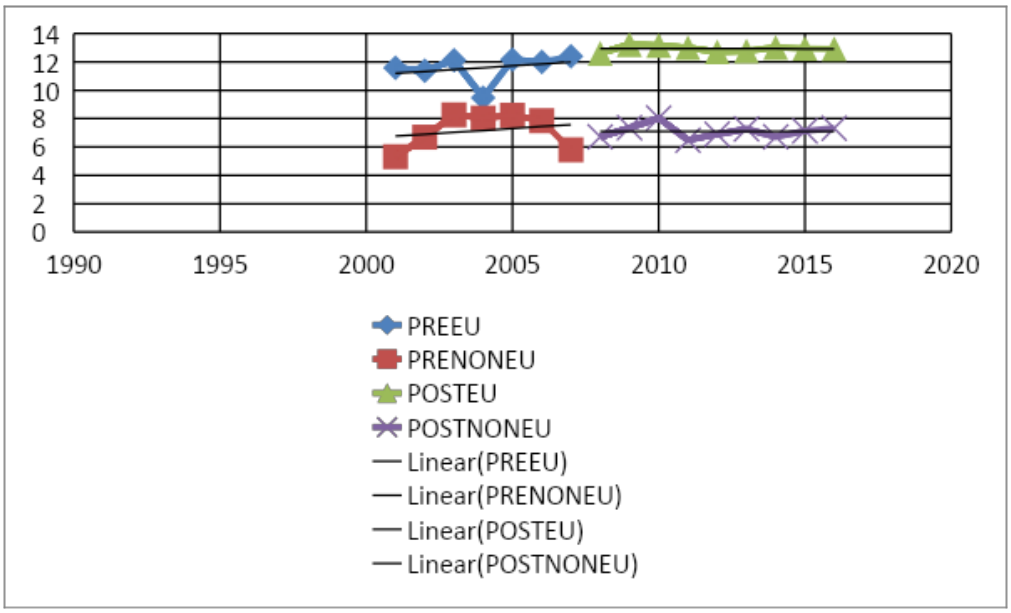
Exports (Tons)



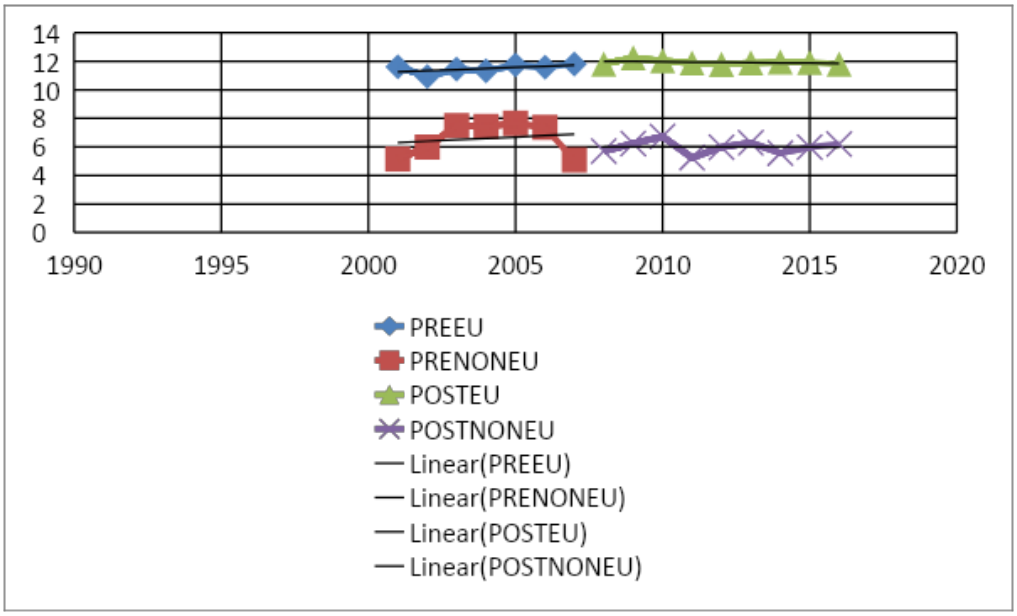
UNIT PRICE (USD/TON)



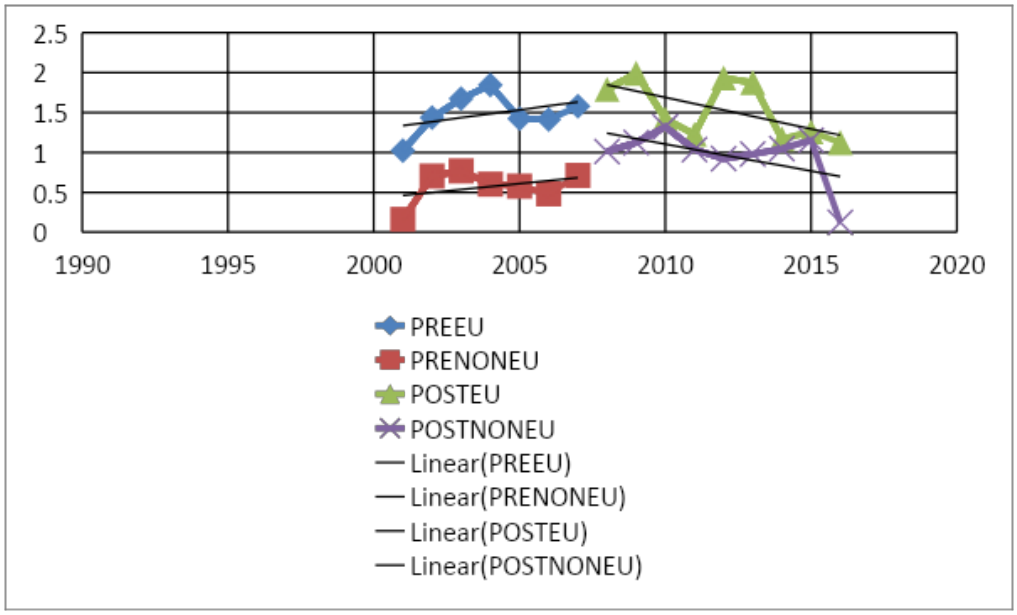
CAMEROON
Exports (USD)



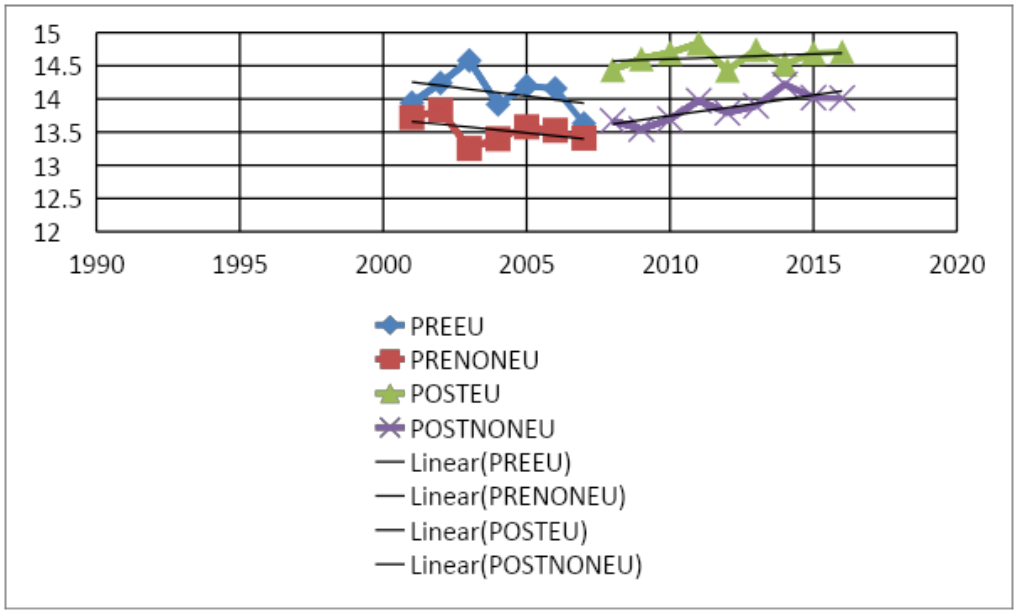
Exports (USD)



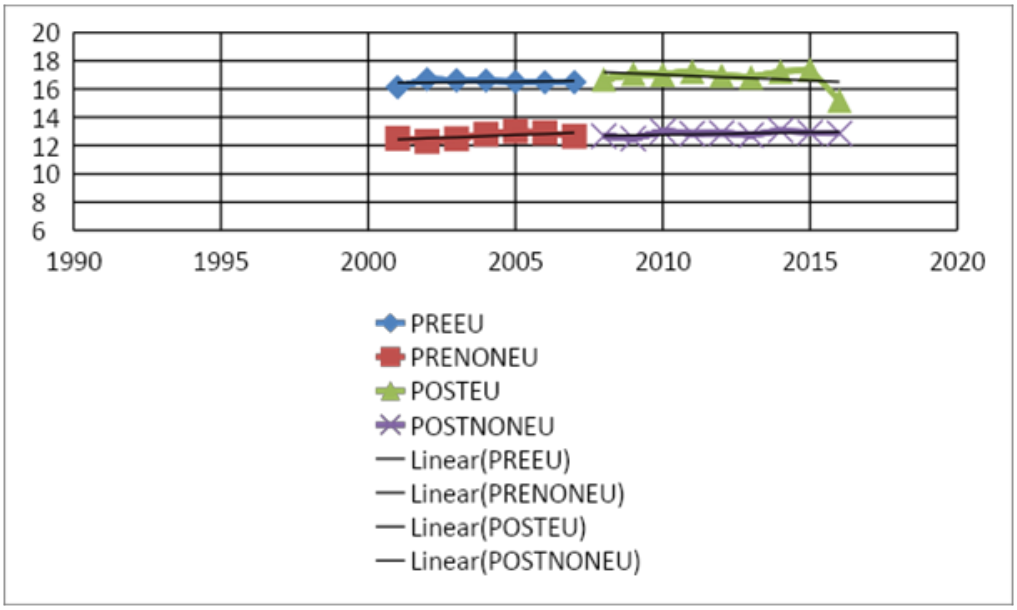
UNIT PRICE (USD/TON)



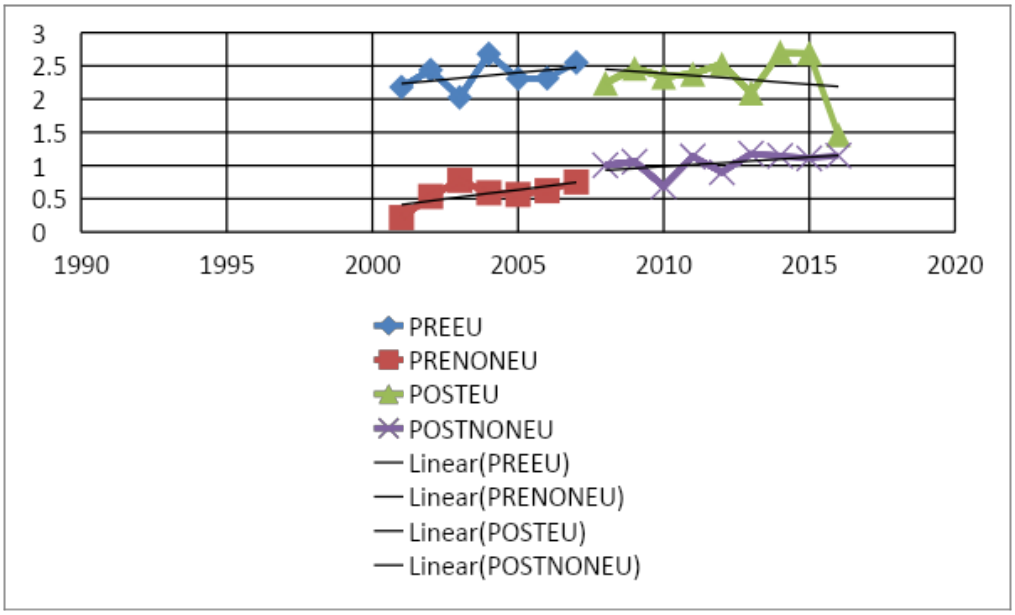
COTE D'IVOIRE
EXPORTS (USD)



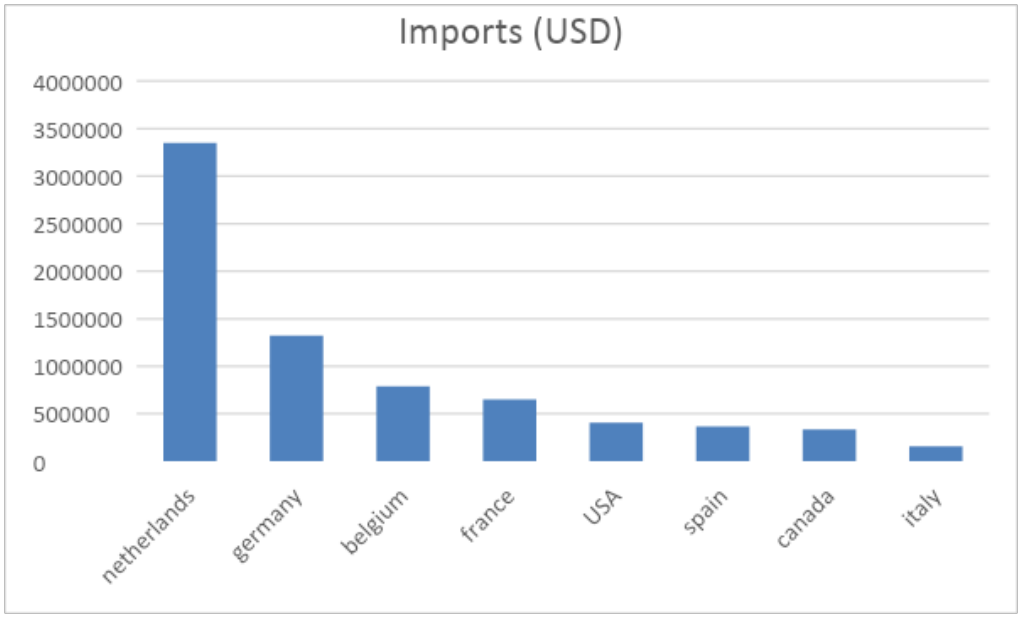
EXPORTS (TONS)



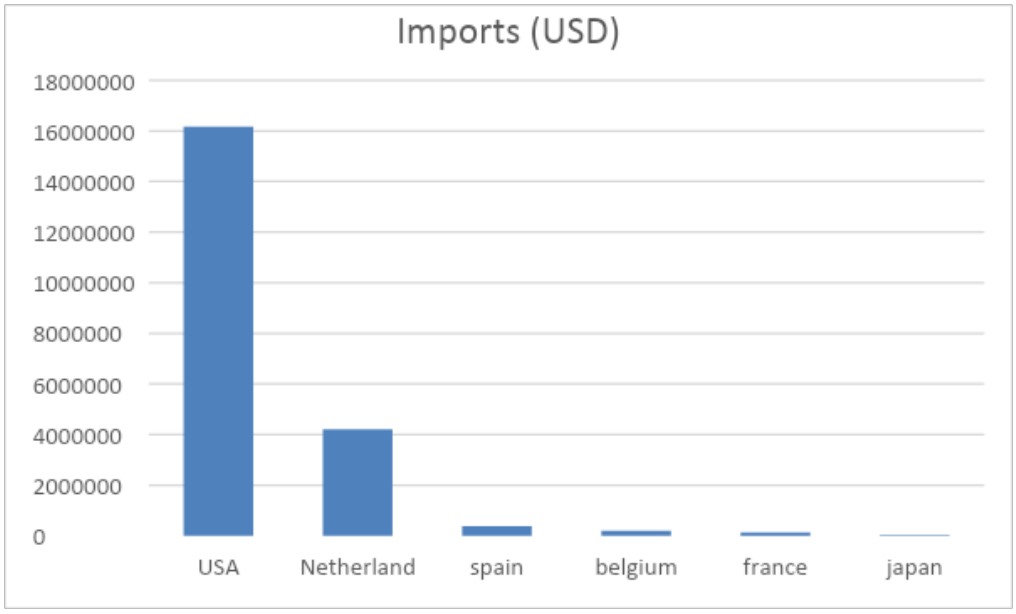
UNIT PRICE (USD/TON)



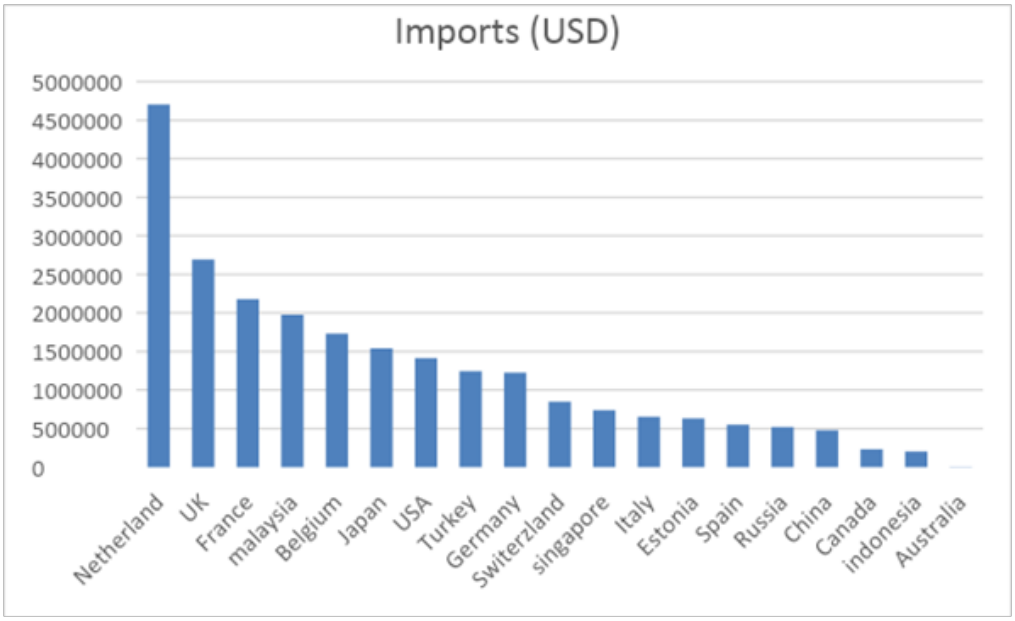
Nigeria



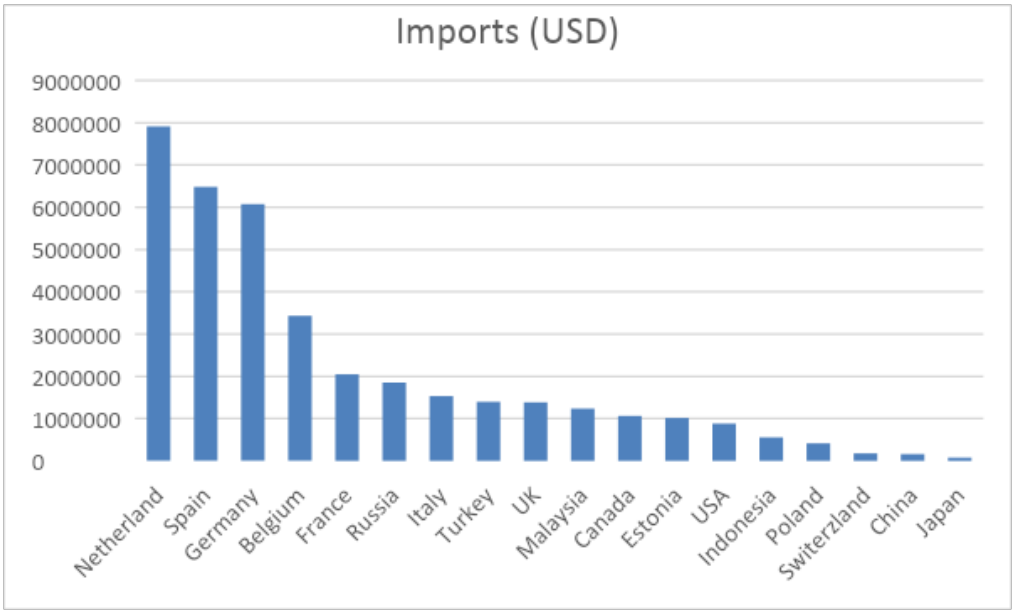
Cameroon



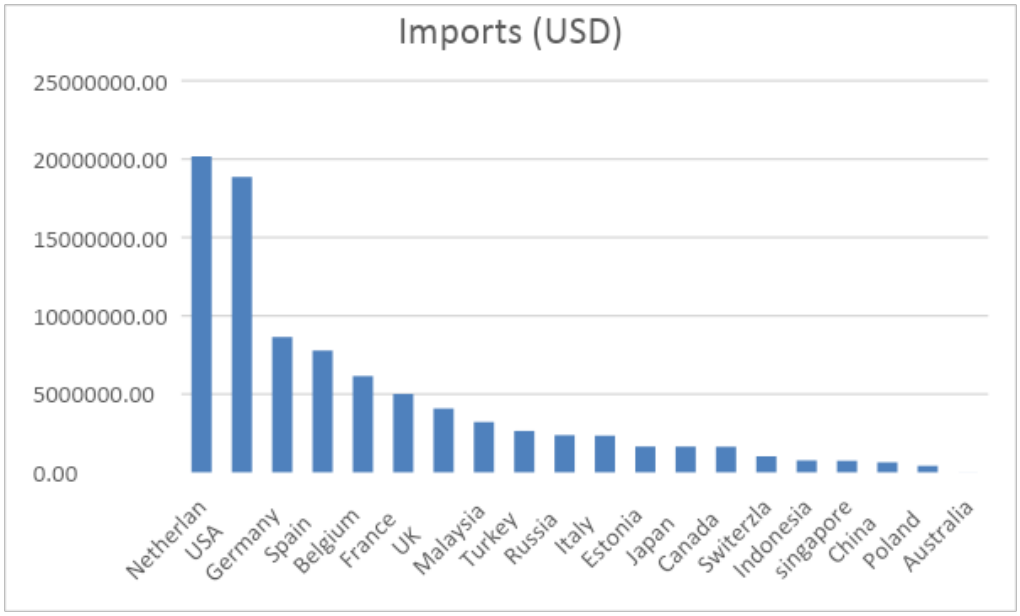
Ghana



Cote d'Ivoire



West Africa


Imports (USD)
25000000.00
20000000.00
15000000.00
10000000.00
5000000.00
0.00
Netherlan
USA
Germany
Spain
Belgium
France
UK
Malaysia
Turkey
Russia
Italy
Estonia
Japan
Canada
Switerzla
Indonesia
singapore
China
Poland
Australia

Mission

To strengthen local capacity for conducting independent, rigorous inquiry into the problems facing the management of economies in sub-Saharan Africa.

The mission rests on two basic premises: that development is more likely to occur where there is sustained sound management of the economy, and that such management is more likely to happen where there is an active, well-informed group of locally based professional economists to conduct policy-relevant research.

www.aercafrica.org

Learn More

www.facebook.com/aercafrica

www.instagram.com/aercafrica_official/

twitter.com/aercafrica

www.linkedin.com/school/aercafrica/

Contact Us
African Economic Research Consortium
Consortium pour la Recherche Economique en Afrique
Middle East Bank Towers,
3rd Floor, Jakaya Kikwete Road
Nairobi 00200, Kenya
Tel: +254 (0) 20 273 4150
communications@aercafrica.org