EXPORT COMPETITIVENESS OF WORLD MAJOR COCOA PRODUCERS IN THE CONTEXT OF SANITARY AND PHYTOSANITARY STANDARDS

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DEDICATION

Thiswork is dedicated tothe Almighty, Allah (SWT), for the gifts of life, faith and provision; to my parents, Mr Abiodun Ganiyu Akin-Olagunju and Mrs Morili Akin-Olagunju (néeAbdus-Salaam), for their constant support with prayers and to my wife and children, for their sacrifices.

ABSTRACT

Sanitary and Phytosanitary (SPS) standards in agricultural trade have witnessed increased usage as a result of health and environmental concerns. Increasing stringency and multiplicity of the standards by importing countries limit true competitiveness of cocoa export. Previous studies have assessed competitiveness from non-quality factors which masks the reality of global awareness on food quality and safety. Hence, export competitiveness of world major cocoa producers in the context of SPS standards were investigated.

Secondary data covering 2005-2016 were sourced from International Trade Centre, FAOSTAT, World Bank and Homologa Agrobase-Logigram for the five major cocoa producing countries (Cote d'Ivoire, Ghana, Indonesia, Nigeria, Cameroun) and 19 main importing countries (10 from the EU: Belgium, Estonia, France, Germany, Italy, Netherlands, Poland, Spain, Switzerland, UK and nine from other parts of the world: The US, Canada, Brazil, Russia, Malaysia, Japan, China, Thailand, Singapore). Data used were value of cocoa trade, importer Gross Domestic Product (GDP) per capita, distance between trade partners, cocoa productivity and exporter GDP per capita. Value of trade and GDPs per capita were in million (m) dollars. Stringency Indices (quality measures) in EU Trade-EUT (STI_{eu}) and World Trade-WT (STI_w) were generated from number and maximum residue levels of regulated pesticides in addition to commonly-used pesticides on cocoa beans in exporting countries. Competitiveness Scores (CS) were generated from individual standard trade values, Codex trade losses in the absence of harmonisation and percentage changes from Codex trade values. Data were analysed using descriptive statistics and panel Poisson Pseudo-Maximum Likelihood regression within gravity model context at $\alpha_{0.05}$.

Cocoa trades were \$63,287.23±136,769.60 and \$52,074.01±121,161.80, importer GDPs per capitawere \$39,763.35±17,901.54 and \$32,907.17±20,203.70 and distances were 6,184.62±2,571.30 km and 7,709.05±3,466.30 km for EUT and WT, respectively. Cocoa productivity in exporting countries was 0.45±0.13 tonnes/ha, while exporter GDP per capita was \$1,811.07±974.30. Stringency was stricter for EUT (STI_{eu}=0.6373±0.2990) than WT (STI_w=0.4297±0.3513). Stringency indices had significant effect on trades for EUT (β=0.0365) and WT (β=0.0658). The STI_{eu} trades were \$181.69m, \$95.55m, \$1.97m, \$47.15m and \$27.85m, while trade losses were \$440.07m, \$272.75m, \$3.69m, \$159.07m and \$151.16m for Cote d'Ivoire, Ghana, Indonesia, Nigeria and Cameroun, respectively when standards were not harmonised. This represented -70.8, -74.1, -65.2, -77.1 and -84.4% changes from Codex values. The STI_w trades were $1,800.00m, $554.56m, $288.20m, $231.30m and $103.08m, with losses of $100.00m, $361.89m, $141.44m, $242.21m and $256.75m, while percentage changes were 5.9, -39.5, -32.9, -51.2 and -71.4% for Cote d'Ivoire, Ghana, Indonesia, Nigeria and Cameroun, respectively. The CS were 0.33, 0.30, 0.17, 0.27 and 0.25 for EUT, while they were 1.49, 0.33, 0.21, 0.25 and 0.27 for WT in Cote d'Ivoire, Ghana, Indonesia, Nigeria and Cameroun, respectively. Average trades of the exporting countries were $630.44m, $321.19m, $169.93m, $134.71m and $108.83m, while average CS were 0.91, 0.32, 0.26, 0.26 and 0.19 for Cote d'Ivoire, Ghana, Nigeria, Cameroun and Indonesia, respectively.

The major cocoa producing countries with high trades, despite stringent sanitary and phytosanitary standards, were more competitive.

Keywords: Codex trade, Pesticides regulation, Standard harmonisation, Stringency indices
Word count: 480

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CERTIFICATION

I certify that this work was carried out by **Olaide Asimiyu AKIN-OLAGUNJU** under my supervision in the Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria.

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CAISTAB	*Caisse de Stabilisation et du Soutien des Prix des Produits Agricoles*
CBN	Central Bank of Nigeria
CCC	*le Conseil du Café-Cacao*
CDP	Cocoa Development Programme
CEPII	Center for International Prospective Studies
COCOBOD	Ghana Cocoa Board
CODEX	Codex Alimentarius
COPADEC	National Cocoa Diseases and Pests Control Programme
CRIG	Cocoa Research Institute of Ghana
CRIN	Cocoa Research Institute of Nigeria
CS	Competitiveness Score
CTA	Cocoa Transformation Agenda
EU	European Union
EUREPGAP	Euro-Retailer Produce Working Group Good Agricultural Practices
FAO	Food and Agriculture Organisation
FAOSTAT	FAO Statistics
GAP	Good Agricultural Practices
GATT	General Agreements on Trade and Tariff
GDP	Gross Domestic Product
GSS	Ghana Statistical Services
HCHO	Helpman-Chamberlain-Heckscher-Ohlin
ICCO	International Cocoa Organisation
MRL	Maximum Residue Level
NBS	National Bureau of Statistics
NTB	Non-tariff Trade Barrier
NTM	Non-Tariff Measures
ONCC	*Office National du Café et du Cacao*
ONCPB	*Office National de Commercialisation des Produits de Base*
PAN	Pesticides Action Network
PERSUAP	Pesticides Evaluation Report and Safer Use Action Plan
PPML	Poisson Pseudo-Maximum Likelihood
ROW	Rest-of-World

RS	Rank Score
SPS	Sanitary and Phytosanitary Standards
STI	Stringency Index
TBT	Technical Barriers to Trade
UK	United Kingdom
UNCTAD	United Nations Conference on Trade and Development
USA	United States of America
USAID	United States Agency for International Development
WCF	World Cocoa Foundation
WDI	World Development Indicators
WTO	World Trade Organisation

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

1.1.1 Global cocoa production and trade

Cocoa is an important export crop which was native to South America but is now produced in diverse humid regions of the world. Its significance stems from its usage in beverage, confectionery and pharmaceutical industries (UNCTAD, 2016). At present, Africa is the leading cocoa-producing continent in the world (Figure 1)with the West African sub-region producing 70% of world's cocoa and supplying 90% of cocoa requirement of the European Union (Crozier, 2013; Wessel and Quist-Wessel, 2015). Major world suppliers include Nigeria, Cote d'Ivoire and Ghana (West Africa) and Cameroun (Central Africa). Indonesia, located in Southeast Asia, is also a major player ranking third in world production after Cote d'Ivoire and Ghana and followed by Nigeria and Cameroun (Figures2 & 3).

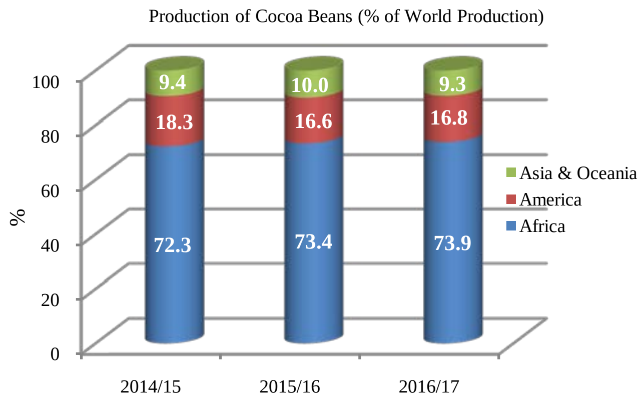
Cocoa is the most important agricultural export crop in Nigeria and contributes significantly to the total non-oil export (Figure 4). Cocoa beans export in Nigeria was valued at ₦642.8 million (2005), ₦48.1 billion (2006), ₦59.7 billion (2007), ₦172.2 billion (2008), ₦108.9 billion (2009) and ₦86.8 billion (2010) (NBS, 2010 & 2012). Nigeria holds fourth position in the world cocoa export after Cote d'Ivoire, Ghana and Indonesia (CBI, 2016).Cote d'Ivoire is the largest producer of cocoa in the world, supplying approximately 40% of world cocoa need with the local processing industry absorbing close to 20% of total cocoa beans produced. Cocoa sector in Cote d'Ivoire employs over 18.2% of the population, constitutes primary income sources for more than three-quarter of the rural population, contributes more than 10% to the country's GDP and constitutes 40% of its exports earnings (Global Witness, 2007; CTB-BTC, 2011; Hatloy *et al*., 2012).

Cocoa is the mainstay of Ghanaian economy and second largest foreign exchange earner at 30% share of export earnings. It represents about 20% of the agricultural GDP and 7% of national GDP (CTB-BTC, 2011; Kolavalli *et al*., 2012; USDA/FAS, 2012). It is singularly an important crop when its share in total crop, shown in Figure 5, is considered. Although, Ghana is second to Cote d'Ivoire in production level, the quality of its cocoa is better and thus earns a higher premium price of between 3 and 5%. It also has a significant transformation industry (Kolavalli *et al*., 2012).

Indonesiansreside mostly in the rural areas and their smallholding activitiesare responsible for placing the country on the world map as the third largest cocoa producer in the world (Akiyama and Nishio, 1996; USAID/Indonesia PERSUAP, 2013). Sulawesi is the most important cocoa-producing region in Indonesia supporting close to seven-tenth of the cocoa emanating from the country and representing nearly one-tenth of global supply (Perdew and Shively, 2009). Similarly, cocoa sectoris the largest sector of the economy in Cameroun (STDF/ICCO, 2013) and its growth had belied the bleak future usually painted for Sub-Saharan Africa (SSA) agriculture (Dewbre and Borot de Battisti, 2008).

Essentially, Cameroun, Cote d'Ivoire, Ghana and Nigeria altogether produced 96.4%, 95.2% and 96.0% of output from Africa for the periods 2014/15, 2015/16 and 2016/17, respectively while Indonesia produced 81.3%, 80.6% and 78.4% of the total output from Asia and Oceania for the same respective periods. In all, the five (5) producers altogether took 77.3%, 72.7% and 83.7% share of world production for 2014/15, 2015/16 and 2016/17 respectively. Similarly, Cameroun, Cote d'Ivoire, Ghana and Nigeria altogether produced average of 93.7% and 95.9% of output from Africa for the periods 2007-2010 and 2014-2017 respectively. Indonesia produced average of 82.9% and 80.1% of total output from Asia and Oceania for the same periods, respectively. Aggregating further, all the five (5) countries had average of 79.5% and 77.9% shares of total world output for 2007-2010 and 2014-2017 periods respectively (CTB-BTC, 2011; ICCO, 2017).

One important characteristic of less developed countries (LDCs), which are mostly African nations, is the export of natural resources in unprocessed or semi-processed forms, of which agricultural products are key components (NEPAD, 2013). In such instance, trade standard becomes subject of focus due to its possible effects on commodity exchange. In addition, the World Trade Organisation (WTO) was established to foster good trade relationship among member-countries with agriculture featuring prominently in its trade agreement and dispute settlement documents (UNCTAD, 2003).



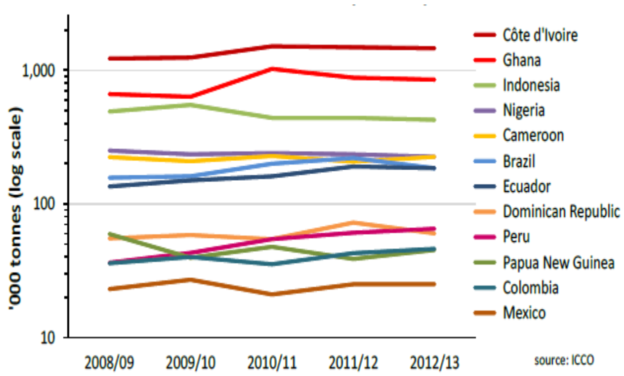


Figure 1: Production shares of cocoa exporters from producing continents
Source: ICCO (2017)

Figure 2: Global cocoa production ranking
Source: Bateman (2015)

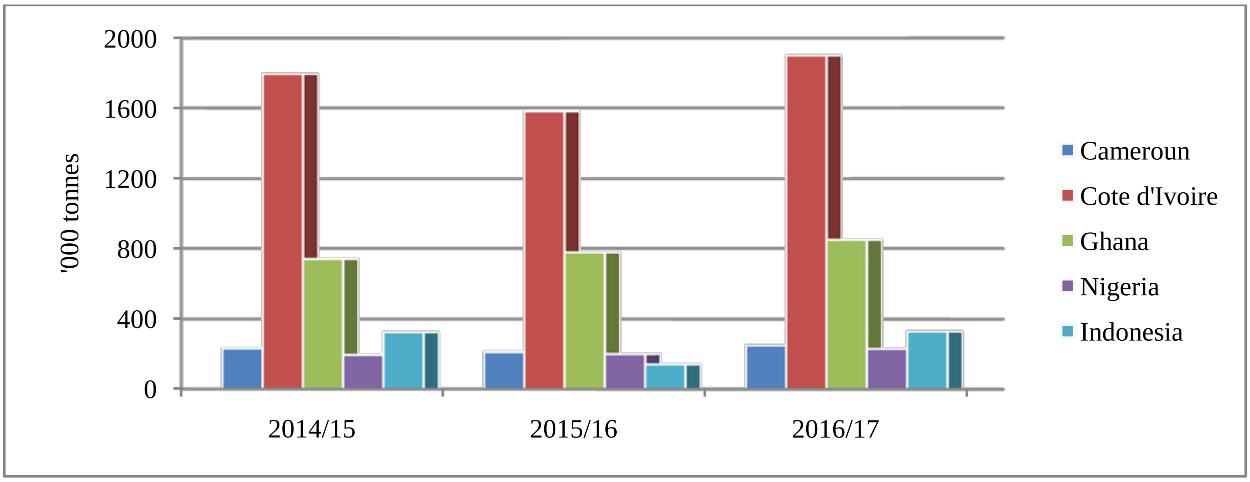
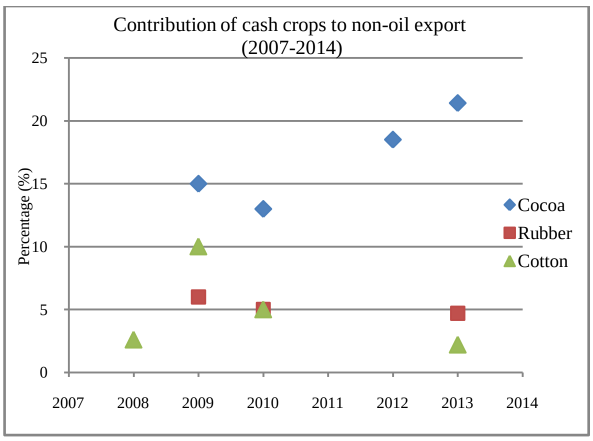


Figure 3: Cocoa production quantities from main exporting countries
Source: ICCO (2017)



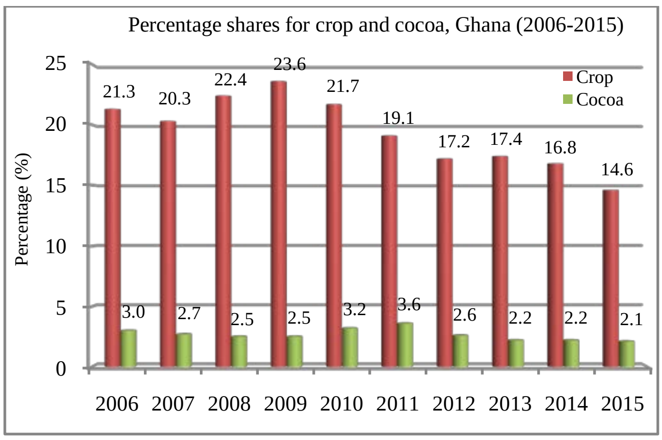


Figure 4: Percentage contribution of main cash crops to non-oil export in Nigeria. ***Source: Central Bank of Nigeria (2009-2013)***

Figure 5: Percentage shares of all crops and cocoa for Ghana
Source**:** ***Ghana Statistical Services (2015)***

1.1.2 SPS measures and international trade

The bilateral and multilateral negotiations fostered through the General Agreement on Tariffs and Trade (GATT) and the World Trade Organisation (WTO) which culminated in reduction of tariffs have succeeded in promoting Non-Tariff Measures (NTMs) (Ferro*etal*., 2013; UNCTAD, 2013). Prior to the Uruguay Round, protectionist tariff and non-tariff barriers (NTBs) like import quotas, export subsidies and quantitative restrictions among others, were the most significant impediments to trade in both developed and developing countries (Love and Lattimore, 2009). The final act of the Uruguay Round Agreement signed in 1994 and which established the WTO in 1995 to replace the 47-year old GATT saw the reduction of tariff and non-tariff trade barriers (NTBs) in many sectors (Todaro and Smith, 2012; WTO, 2012b). Although, some countries have reduced the originally high tariffs and others have tariffied their NTBs, some other NTMs like Sanitary and Phytosanitary (SPS) measures have emerged and have become another key challenge to contend with in agricultural trade and international cooperation (Henson *et al*., 2000; Bankole, 2003a&b; Iacovone, 2004; Crivelli and Groschl, 2012; Wei*etal*., 2012; WTO, 2012a).

Sanitary and Phytosanitary (SPS) measures refer to *"human, animal and plant health standards and activities, which protect against risks from contamination, toxins or disease-causing matter in food"* (CRFM, 2014). Sanitary refers to human and animal health while phytosanitary indicates plant protection (WTO, 2012c).As noted by Engler *etal*. (2012), there are different forms of SPS measures. These include: number of pests, diseases and weeds regulated; quarantine treatment requirement; maximum residue limit/foreign bodies; microbiological requirement; packaging materials for quarantine treatment; labelling requirements; GAP/EUREPGAP (microbiological, safety and labour welfare requirements); quality standard (grading); registration of production site; registration of export firm and product and import permission. The primary focus of this work is the SPS measurerelated to number and maximum residue level (*MRL*) ofregulated pesticides used in cocoa production.The *mrl* data was chosen because of comprehensiveness and availability at global level.

Sanitary and Phytosanitary (SPS) measures are very important and their usage is on the increase because they enhance trade through change in consumer tastes and preferences in importing countries in addition to their significance in protecting man, animal and the environment (Kareem, 2013 & 2014a).

1.1.3 **Harmonisation of standards**

The Codex Alimentarius Commission (Codex) was jointly established by the Food and Agriculture Organisation (FAO) and the World Health Organisation (WHO) to take care of standards, quality and safety in the international agricultural/food trade. Nigeria, like other members of the commission, has local equivalence of the Codex, the National Codex Committee (NCC), which was set up in 1973.Codex Standards are very important in international trade as they are recognised by the WTO as tool in arbitration in casesof trade dispute(SON, undated).

Although Codex issues general codes, individual countries are at liberty to legislate national standards (Drogue and DeMaria, 2012) and this has given the opportunity of variance in number and stringency of standards that exporters need to deal with.In the submissions of Wilson and Otsuki (2001) and Chen *et al*. (2008), the differences in the production, technological and demographic characteristics of individual countries dictate the type and nature of quality standards across countries with the implication of unrestricted variation in the number and stringency of standards that the developing countries exporting commodities to developed nations will have to abide with. Harmonisation of standards is desirable because of its effect in fostering regional and economic integration in contrast to complexity that heterogeneity brings for policy treatment especially in the export sector (Engler *et al*., 2012). Heterogeneity of standards is costly, considering its multi-faceted impact in terms of additional production and transaction costs, reduced production efficiency due to inability to benefit from economy of scale as a result of producing for segregated markets. Heterogeneity of standards is also costly to the government from the perspective of dividedsupports for exporters producing for different markets (Foletti and Shingal, 2014a).At macro level, loss of efficiency associated with complying with varying importing countries' standards is a possible impediment to trade and could stand in the way of true assessment of export competitiveness.

1.1.4 **Export competitiveness**

Economics is about allocation of scarce resources among unlimited wants, a realisation that guides researchers tofocus onsector of the economythat will bring maximum welfare benefits to the masses (Latruffe, 2010). Theconcept of competitiveness is practically similar.Although, there is no agreed definition of competitiveness due to its expansiveness and multidimensional nature, it could be defined as the capability of a country to supply goods and services that meet local and international quality, quantity and price requirements which ultimately leads to improved citizens welfare (Latruffe, 2010; Zmuda and Czarny, 2017). Several indices have been developed to measure competitiveness. These include Global Competitiveness Index (GCI) and Business Competitiveness Index (BCI) by the World Economic Forum (WEF) which suggest thatinstitutional policies, infrastructure andtrade barriers have strong bearing on competitiveness; Trade Competitiveness Index (TCI) developed by Economic Commission for Africa (ECA), which stresses enabling environment, productive resource and infrastructure; and Logistics Performance Index (LPI) developed by the World Bank (UNESCAP, 2009).

Many developing countries have benefitted and some are still benefitting from global integration in form of export growth and diversification.Examples include developing countries of Asia ranging from the Asian Tigers (e.g Taiwan, Singapore, Hong-Kong); to the South-East Asian countries of Malaysia, Thailand and Indonesia and more recently, Vietnam, Cambodia and China (UNCTAD, 2008b). Notable examples in Africa are: Tunisia, Mauritius and Botswana.Many of these countries were able to transit from primary-product led economy to advanced economy. Their ability to create competitively advantaged situations for their primary exportsthrough investmentin extensive use of agricultural input and engagement in strong policy-making, quickened their paces towards development (OECD, 2013).

1.1.5 **SPS measures, standardharmonisation and export competitiveness**

Competitiveness in international trade borders on the comparative advantage theory in whichfactor endowments, locationand scale effects determine how countries are able to tap into dividend of integration and this is reflected in product pricing (UNCTAD, 2008b; Latruffe, 2010).Since competitiveness has been defined as ability to meet up with market requirements, competitiveness in terms of SPS will signify the extent to which a country gets its products better-priced based on its level of compliance to quality standards.Competitiveness in this context will indicate the extent to which an exporting country conforms to the set of rules governing international trade. The higher the competitiveness, the better the capacity of compliance. Applying this to cocoa trade, this is built upon the ability of the exporting countries to monitor quality requirements (e.g chemical usage)incocoa production and storage.

Harmonisation is much desired in the assessment of competitiveness in this regard. Variance in the number and stringency of standards that exporters need to deal with is associated with negative consequences such as poor assessment of competitiveness.With consideration given to harmonisation, countries are put on the same pedestal because differing market conditions will preclude true reflection of individual strengths.

1.2 Statement of Research Problems

Producing countries export most of the cocoa producedasunprocessed driedfermented beans(Global Witness, 2007)**.** With this understanding, closeness is expected between the production and export line graphs for these countries. However, going by graphs presented in Appendix IV, this is largely not the case particularly in recent times (from early 2000s). Large disparity between production and export values bring two likely possibilities: producing country absorbing part of its production for home consumption/processing (as is the case with Indonesia, Cote d'Ivoire and Ghana) or of export being hindered as a result of non-compliance to quality standards in the export market. Since the capacity of developing countries is low with respect to processing (CBI, 2016), large gap likely implies trade hindrance due to poor quality standard, the extent of which vary from country to country. A specific case in point is Nigeria where large gap persisted from around 1988 (see Appendix IV), a period of post liberalisation when quality standards were reported to have been jettisoned (Shepherd and Farolfi, 1999). The undesirable consequences of liberalisation were mostly observed in Nigeria where the drastic nose-diving of cocoa quality brought about complaints from European importers and Japan together with the attendant upward review of stringency of import standards (Jonfia-Essien, 2012) in response to 'popular demand' in their respective countries.

At present, there are lots of emphasis on the reduction or elimination of pesticides' use due to the effect of its residue on man, animal and the environment (MacLaren, 2002; Bambrick, 2004; Drogué and DeMaria, 2012; Wei *et al*., 2012). At the international market, buyers are becoming more insistent on products that conform to certain standards as dictated by consumers who largely influence the implementation of the moderate public standards together with the more stringent private standards, due to their market power (UNCTAD, 2007). Increasing income levels and the associated high degree of societal awareness is fueling this insistence (Iacovone, 2004; Boza, 2013; Ferro *et al.*, 2013).

Globalisation has brought several opportunities as well as numerous challenges (UNCTAD, 2008a). The single market situation that globalisation createscould be leveraged to meetmany buyers but this has also brought stiff competitive conditions which market players must brace up to, with the implication that weaker market players are edged out (AfDB, 2013). Success in agricultural trade is tied toconformitywithconsumers' standards, and inability to achieve thismeans rejection, with attendant losses to the smallholders who constitute bulk of producers (UNCTAD, 2007&2016).In developing countries,especially of African origin, agricultural performance has not met up with economic growth recorded. These countries have not benefitted from the tariff reductions being promoted by the WTO(AfDB, 2013) partly due to inability to meet up with export standard.Working on the grey areas of compliance to the standards could reposition developing countries for better competitiveness and enhanced export performance (World Bank, 2005).

The United Nations Conference on Trade and Development, UNCTAD (2015) reported that by 2013, almost all the world agricultural commodity exchanges were being affected by one form of SPS measure or the other while technical measures and requirements applied to about two-thirds of world trade. Although SPS measures are issued primarily for protection, there are concerns that the measures are used as protectionist devices to frustrate trade (Bankole, 2003a; Iacovone, 2004; Crivelli and Groschl, 2012; Wei *etal*., 2012; WTO, 2012a; Kareem, 2013 & 2014b; UNCTAD, 2013). Agricultural sector was not left out of the trade protection cases which skyrocketed in 2013 with around 300 new complaints brought to the WTO (UNCTAD, 2015). These complaints were put up to guard against loss of revenue by the affected nations.

Past studies have shown that large amounts of revenue loss were associated with non-harmonisation of standards**.** Wilson and Otsuki (2001) showed an increase of value of trade by US$38.8 billion as against US$6.1 billion if Aflatoxin B1 standard is harmonised. Otsuki *etal*. (2001) estimated loss of export to be US$400 million under EU standards compared to US$670 million gain if Codex guidelines had been adopted. Wilson *etal*. (2003) reported 57% rise in beef trade amounting to about US$3.2 billion increment if the Codex standards were to be employed. Foletti and Shingal (2014) found out that non-harmonisation of *mrl* standards across EU decreased the probability of entering market and the volume traded consequent upon market entry. Furthermore, assessment of export competitiveness in primary (agricultural) products without recourse to quality parameters, either in current or harmonised forms, is akin to neglecting the realities of the international food market.

To address these problems of quality challenges and non-harmonisation of standards in cocoa trade, this study seeks answers to the following research questions:

- What are the trends of SPS measures in cocoa-importing countries?
- What is the nature of the relationship between SPS standards and values of trade for the major cocoa trading partners?
- How do SPS standards affect values of cocoa trade between the major trade partners?
- What is the cost implication of the current standards for the cocoa-exporting countries in relation to the baseline international standard?
- How competitive are the exporters based on the standard types?

1.3 **Objectives of the Study**

The main objective of the study is to assess the competitiveness of cocoa beans export among major cocoa producing-cum-exporting nations of the world in the EU and World markets from the perspectives of individual countries' and harmonised standards. The specific objectives are to:

1. Analyse the trends of SPS measures in individual cocoa-importing countries.
2. Examine the relationships between individual SPS standards and values of cocoa trade in EU and World markets.
3. Determine the effect of individual SPS standards on values of trade in EU and world markets.
4. Estimate the cost implication of adopting individual SPS standards in lieu of Codexstandard by importing countries.
5. Evaluate the level of competitiveness of the major exporters based on individual and Codex standards.

1.4 **Justification of the Study**

In Nigeria, some programmes are being instituted by federal and state governmentsto revamp cocoa production through the Cocoa Transformation Agenda (CTA), Cocoa Development Programme (CDP) and lately, Agricultural Promotion Policy (APP) due to its importance as an export crop(Idowu *et al*., 2007; Cadoni, 2013; FMARD, 2018). Similarly, other exporting countries are not left out of this drive. For example, government of Indonesia commenced revitalisation and rejuvenation policy in its cocoa sector named *GernasKakao* (National Movement to Accelerate the Revitalisation of Cocoa) which was aimed at hitting a targeted 1 million tonnes production mark by 2013-2014 (Hafid *et al*., 2012; IDS/IFAD, 2015). Governments of Cote d'Ivoire and Ghana were also involved in serious rehabilitation and replanting drives to stem the declining productivity occasioned by ageing trees and problems of pests and diseases (Wessel and Quist-Wessel, 2015).

The impacts of these programmes on the various cocoa-producing nations have been mixed. For instance, cocoa output in Cameroun increased from 229,203 tonnes in 2008 to 268,941 tonnes in 2012 and 291,512 tonnes in 2016. In contrast, cocoa output in Indonesia reduced from 803,593 tonnes (2008) to 740,500 tonnes (2012) and 656,817 tonnes (2016). With respect to Cote d'Ivoire, Ghana and Nigeria, there were initial increments in outputs between 2008 and 2012 (Cote d'Ivoire – 1,382,441tonnes to 1,485,882 tonnes; Ghana – 680,781 tonnes to 879,348 tonnes; Nigeria – 367,020 tonnes to 383,000 tonnes) but later decreased to 1,472,313 tonnes, 858,720 tonnes and 236,521 tonnes, respectively (FAOSTAT, 2018). In addition to other challenges brought about by fluctuating outputs, the cocoa-exporting countries might not benefit fully from the little gains achieved if non-compliance to standard requirements restricts market access or compromise in quality standards brings about loss of earnings through discounting of their cocoa products at the international market.

There are lots of emphasis now on food safety in international community through reduction or possibly elimination of pesticides'useas a result ofeffect of chemical residue on man, animal and the environment (MacLaren, 2002; Bambrick, 2004; Drogué and DeMaria, 2012; Wei *et al*., 2012). Similarly, there are global debates on the essence of standards in retarding the progress of the smallholder-led effort and acting as clog in the wheel for poverty reduction efforts in developing countries (Lee *et al*., 2012).Quality issues for cocoa need be studied for the government to be properly informed in taking decisions about the challenges of compliance with international standards in importing countries and thus, acceptance of cocoa. This becomes necessary because processors and retailers in the developed countries are largely swayed by the opinion of the consumers/retailersin the implementation of public as well as the more stringent private standards (UNCTAD, 2007).

Several works (Wilson *etal*, 2003; Xiong and Beghin, 2011; Drogue and DeMaria, 2012; Engler *etal*, 2012; Foletti and Shingal, 2014a) have addressed the effect of harmonisation on many agricultural products and for diverse countries but this work focuseson cocoa beans for major exporting countries that are exclusivein terms of the enabling environmental conditions for cocoa production. Also, Bankole (2003a&b) worked on the cost of compliance to sanitary and phytosanitary (SPS) standardsby processed agricultural and food products' exporting firms in Nigeria but did not assess competitiveness.In addition, this research deviates from past studies by assessing competitiveness among major cocoa exporters through quality factor (SPS measure). Previous studies only employed ordinary trade values without consideration for quality parameters.

Furthermore, the study adopted a new way of generating the standard (SPS) variable for the cocoa tradeby adding pesticides being commonly used by cocoa farmers in the producing countries to the list of regulated pesticidesand also penalised any country in which a prohibited pesticide is still in use with highest stringency value. Past works considered only regulated pesticides and did not impose any penalty with respect to prohibited pesticides' usage in exporting countries. These shortcomings did not fully portray the situationon ground in the exporting countries.Adopting the new approaches will the give opportunity of incorporating the state of the cocoa sector inexporting countries, thus paving way for a realistic competitiveness assessment.Rank-based methodology was also used in assessing level of competitiveness of exporters based on information from current and harmonised standards, one of the key contributions of this work to export competitiveness assessment.

1.5 **Definition of Terms**

This sub-section explains some terms used in this work. Some of the terms are used in their general meaning while others are modified in a way that is specific to this study. These include:

a. **Tariff**: This is a tax levied on imported goods. It might be a fixed charge per unit of import (specific) or a fraction of total value of import (*advalorem*). Tariff is used primarily by governments as income source but has also been (mis)applied to protect domestic producers (Krugman and Obstfeld, 2003).

b. **Non-tariff trade barrier (NTB)**: is "any government policy, other than a tariff, which reduces imports but does not similarly restrict domestic production of import substitutes" (Dunn and Mutti, 2004).

c.**Non-Tariff Measures (NTMs):**Policies that change the situation of international trade but which do not include tariff (UNCTAD, 2015). The terms NTBs and NTMs are used interchangeably but NTM is preferred because it leaves out judgment of protectionist intent which can only be arrived at after a comprehensive analysis involving great deal of data (WTO, 2012c).

d.**Sanitary and Phytosanitary (SPS) standards:** Theseare a body of particular rules and regulations set by countries which domestically produced and imported goods must conform to in terms of quality level, health and safety standard and are usually monitored by institutions.

e.**Maximum residue level (*MRL*)** is the tolerable amount of detectable active ingredient of pesticides in cocoa beans when tested at port of entry into importing countries. It reflects the quantity of pesticides absorbed by the produce during production and storage treatments in exporting countries.

f.**Stringency Index:**This refers to the measure of standard used in this study. It was generated from information on number of regulated and commonly-used pesticides and their *mrl* values.

g.**Regulated pesticides:** Regulated pesticides are pests and disease-controlling chemicals that importing countries allow to be used on cocoa in the producing/exporting countries.The exporting countries must abide by the conditions set on these chemicals before the cocoa beans are allowed entry.

h.**Compliance:** This describes the ability of a firm or country to meet up with the required standard in domestic or international market. Also, compliance cost implies either the direct or opportunity cost of meeting up with the requisite standards.

i.**Codex** is the international code of voluntary standards for food additives, pesticides residue, veterinary drugs and other issues that affect consumer food safety. It is managed by the Codex Alimentarius Commission.

j.**Harmonisation** refers to a situation where all the varying importing country-level standards related to cocoa beans or its products are brought to the level of Codex which is the internationally-agreed standard.

k.**Competitiveness** is defined as the ability of an economic unit to meet up with quality, quantity or price requirements in domestic or international market. In this study, competitiveness was assessed based on the ability of the cocoa-exporting countries to comply with the import standards of their major trade partners.

1.6 **Plan of the Report**

The rest of the report is structured as follows: Chapter Two discusses the theories upon which the work is based,reviews methodologies in use for the workandthe empirical reviewson the effects of SPS standards and its harmonisation on trade. The chapter addresses the conceptual frameworks for the study andends with other salient issues in the cocoa sector such as market liberalisation, trends of cocoa production and export, and pesticides usage and regulation. Chapter Three presents the research methods comprising scope of the study, data types and sources, analytical techniques and research limitations. Discussions of the results are given in Chapter Four while the report ends with summary of findings, conclusion and policy recommendations in Chapter Five.

CHAPTER TWO

LITERATURE REVIEWAND CONCEPTUAL FRAMEWORK

2.1 Literature Review

2.1.1 Theoretical review

The development of the international trade theory consists essentially of four (4) stages:Pre-classical stage, Classical stage, Neo-classical stage and the New Trade Theory (NTT) stage. During the pre-classical period, “mercantilism” was the dominant trading system. This systemwas prevalent in the 16th to the 18th century, encouraging exports but discouraging imports through the activities of trading companies and was characterised by strict state (monarchical) control. Mercantilism was opposed to free trade stressing instead, the protectionist role of the state (Husted and Melvin, 2010).This was one of the reasons that prompted Adam Smith to write his book, *The Wealth of Nations* (1776)(Love and Lattimore, 2009).

The classical theory of free international trade was first developed by Adam Smith and was built upon by other economists. The theory is widely known as Ricardian Theory due to the outstanding contributions of David Ricardo (Husted and Melvin, 2010). The traditional trade theory emphasises that differences in factor endowments is responsiblefor the specialisation of countriesand export of goods or services where they have edge (WTO, 2010). In the idea of Adam Smith, absolute advantage plays important role in the exchange of goodswith the assumptions of labour as the only factor of production, immovability of production factor, balanced trade, absence of trade barriers and constant returns to trade. On the other hand, Ricardo and later economists in the classical school of thought,favouredcomparative advantage in resource endowments stressingthat it is possible for a country to benefit from international trade even if it does not have absolute advantage in the production of any good provided it specialises in goods for which it has the least absolute disadvantage or the greatest absolute advantage (Husted and Melvin, 2010).According to Todaro and Smith (2012), the principle of comparative advantage maintains that *“a country should, and under competitive conditions, will specialise in the export of the products that it can produce at the lowest relative cost”*.

The Ricardian theory of comparative advantage is the first formal model of international trade and perhaps the most important concept in international trade theory.Ricardo posits that there is only one factor of production, a significant role for technological difference among countries and general benefit to trade. A country with comparative advantage incurs the least opportunity cost for the production of goods and services.

Eli Heckscher and Bertil Ohlin (H-O) were credited with the neo-classical development of international trade theory (Todaro and Smith, 2012). H-O model is one of the most important economic models in international trade. It extends the Ricardian model by introducing the second factor of production, capital, with the assumptions of perfect competition and constant returns to scale. Under this model, there will be gainers and losers but the welfare effect is still expected to be positive. According to WTO (2008), there are four main propositions in the H-O model:H-O theorem, Stolper-Samuelson theorem, Rybczynski theorem, andFactor-Price Equalisation theorem. The H-O theorem sees differences in resource endowments as being the cause of international trade,Stolper-Samuelson theoremdescribes the relationship between changes in output and factor prices, Rybczynski theorem shows changes in factor endowments and output of final goods while Factor-Price equalisation theorem submits that equal prices of goods across countries (which signifiesa free trade situation) will equalise prices of labour and capital(wages and rents) globallytaking into consideration the assumptions of equal technology and perfectly competitive market.

Although Ricardian model stresses differences in technology as the basis for trade while H-O model highlights resource endowments, the real-world situation combines the two conditions and incorporates others like demands and preferences, welfare gains, risks and uncertainties, economies of scale, transportation costs and government policies (Todaro and Smith, 2012; WTO, 2012). On the other hand, Baldwin (undated) noted some setbacks to the H-O model. These are that factor endowment cannot explain most of the real-world trade situation because of 2-way movement of similar goods and the fact that exchanges occur between countries of similar factor endowments. These and many more were dealt with by contemporary economists from the early 70's.

In contrast with the position of neo-classicals that trade should occur primarily between countries of different resource endowments, economists observed that countries that are similar in resource endowments and production technologies, the two factors that are central to comparative advantage exposition, still engage in trade (Dunn and Mutti, 2004). In solving this puzzle, they came up with submissions which have since been grouped under the term, “New Trade Theory”. Several treatises were written to explain this “intra-industry” trade (which is more important among countries with similar resource endowments than for those with differing endowments, as noted by Baldwin [undated]),the accompanying increasing returns to scale (IRS) and the assumptions of imperfectly-competitive market (monopolistic competition). Notable among these are the works of Krugman (1979, 1982 & 1985), Brander and Krugman (1983) and Helpman (1981).

Basu (2003) noted that economies of scale and imperfect competition, which are considered as integral part of the new trade theory, providean alternative to the theory of comparative advantage as explanation for the large volume of trade in similar (but not necessarily identical) products between countries that have the same factor endowments and technology. The economy of scale can come in two ways: external and internal. With external economy of scale, there is free entry and exit for firms, ushering in perfect competition and the accompanying price-taking situation. Increase in output is brought about by aggregate contribution from the different firms. On the other hand, internal economy of scale connotes restriction. The fact that each firm increases it scale of production to raise industry output confers imperfect competitive advantage giving rise to monopoly or oligopoly and thus, price-setting behaviour. Furthermore, modelling monopoly and oligopoly under imperfect competition and internal economy of scale in trade analysis presents serious challenges. Therefore, trade economists focus on monopolistic competition which consists of very few large firms, each with products that can be differentiated by consumers.

Krugman and Obstfeld (2003) also submitted that countries engage in trade because of differences in resources or scale economies which make them specialise in the production of goods and services. With increasing returns to scale, market become imperfectly competitive and is either dominated by a monopoly or oligopoly. Specialisation in a handful of good and service brings about greater output in a country which is exchanged with consumers in another country thus benefitting from higher returns to production and product differentiation. Under perfect competition, firms are price takers whereas they set prices under imperfect competition which is the case of few firms dominating the market or where the products are seen by consumers to be of different varieties or qualities.Thus,economy of scale, imperfect competition and product differentiation are seen as the new causes of international trade with welfare gains coming from availability of larger number of varieties at the disposal of consumers in the trading countries and cost reduction consequential to increasing returns from production on a large scale.

Several works have been written to explain the new trade theory and to enunciate extensions to the basic propositions. These include: Krugman (1979), the pioneering work that developed simple model to explain the role of firms' internal economy of scale as the cause of trade instead of factor endowment and technology being promulgated previously; Krugman (1980), which introduced additional (restrictive) assumptions on cost and utility to the earlier work;Krugman (1982), which modelled the role of trade liberalisation; Brander and Krugman (1983), that detailed how price discrimination of rival oligopolisticfirms serves to bring about two-way trade in identical products, an extension termed 'reciprocal dumping' model and Krugman (1985), that analysed the different approaches to modelling market structure within the context of the new trade theory. In contrast, Helpman (1981) extended Heckscher-Ohlin theory to incorporate monopolistic competition, product differentiation and economy of scale.

To cap this section, some points are worth noting. The new trade theory has been able to explain, to a large extent, the large volume of trade (mostly in manufactured products)which occursamong the developed countries. However, it may not be suitablefor the trade in primary (agricultural) products taking place between the developing and the developed worlds. Secondly, it is possible that welfare gains from international trade are unequally distributed which can be perpetuated due to unequal powers of national governments and absence of an effective global coordination (Todaro and Smith, 2012). Thus, sovereign states may possibly result to protection of domestic firms or consumers through several policies in order to correct the welfare losses. As Krugman (1982) noted, there is likelihood of pressure to institute trade barrier when the political economy of differentiated product is considered.

After reviewing the various theories of international trade in succession, the two (2) theories upon which this work is based are presented in the next two sections: the Theory of Consumer Behaviour and the Helpman-Chamberlin-Heckscher-Ohlin Theory.

a. **Theory of Consumer Behaviour**

This work relies on the Theory of Consumer Behaviour (Lancaster 1966) with application to food safety in international trade. A product is seen as having attributes in which safety constitutes one of such attributes with consumer preference for safety modelled using composite utility function that acknowledges convexity assumption among the attributes (Hoffmann, 2010). Mas-Collel, Whinston and Green (1995) presented the preference-based approach to decision theory using a utility function in which the preference relation is assumed to be continuous (the consumer cannot reverse preference at the limiting points of the sequences). Mathematically, the preference relation $\gtrsim$ on set X is continuous if it is preserved under limits i.e for any sequence of pairs,

$\{(x^n, y^n)\}_{n=1}^{\infty}$ with $x^n \gtrsim y^n$ for all *n*,
$x = lim_{n\to\infty} x^n,$ and $y = lim_{n\to\infty} y^n,$ …(1)

where *x* and *y* = the sequences/consumption bundles, $\gtrsim$= "at-least-as-good-as" relation
Introducing utility maximization, the consumer will choose the most preferred bundle (*x*), in this case food safety, as follows:

$$Max u(x) x \geq 0$$
$$\text{Subject to } p * x \leq w \text{ (Walrasian budget set)} \qquad \ldots (2)$$

where the given commodity price $p \gg 0$ and wealth level $w > 0$ with the Walrasian budget set referring to the market condition.

Mitchell (2003) gives an elucidation of demand and supply sides of food safety economics. The study noted that food safety market is characterised by imperfect information with implications for social costs in addition to the individual private costs. Thus, there is need for regulation with considerable balance between social cost and benefit. This becomes imperative because, as pointed out by Wilson and Otsuki (2001), the economic basis for food safety regulations is rooted in the concept of a 'socially optimum' level of risk at which marginal cost of food safety regulation equals their marginal benefits to the society. Since food is a necessity, consumers value the safety of their food supply. The demand for safe and quality food is reinforced as income of consumers increases because of increased awareness and the accompanying willingness to pay. Additionally, the level of resources at the disposal of the regulatory authority will dictate the extent to which consumers hold them to ransom in ensuring that food found within its jurisdiction is safe. This extends to the other participants in the food supply chain. Availability of improved technology (processing, transportation, research) will raise expectations of consumers because they are aware that such technologies exist. On the other hand, firms are less willing to provide food safety because the consequence of unsafe food are not readily observed by consumers which might have influenced their decision to purchase, if otherwise. This is the credence attribute.

The implication of the introduction of stringent SPS measures by the importing countries, from theoretical perspective, is shown in Figure 6. Quantity Q_{c1} of cocoa beans is being supplied by exporting firms at price P_{c1} to meet the demand D_{c1} of consumers at the current level of SPS measure. Imposition of tighter regulation means additional/compliance cost for cocoa exporters which cause them to cut back on quantity of export. This is shown by the new supply curve S_{c2}. The assurance of premium quality increases consumer demand, shifting the demand curve to D_{c2} with the consumers willing to purchase at higher price P_{c2} being charged by the exporters.

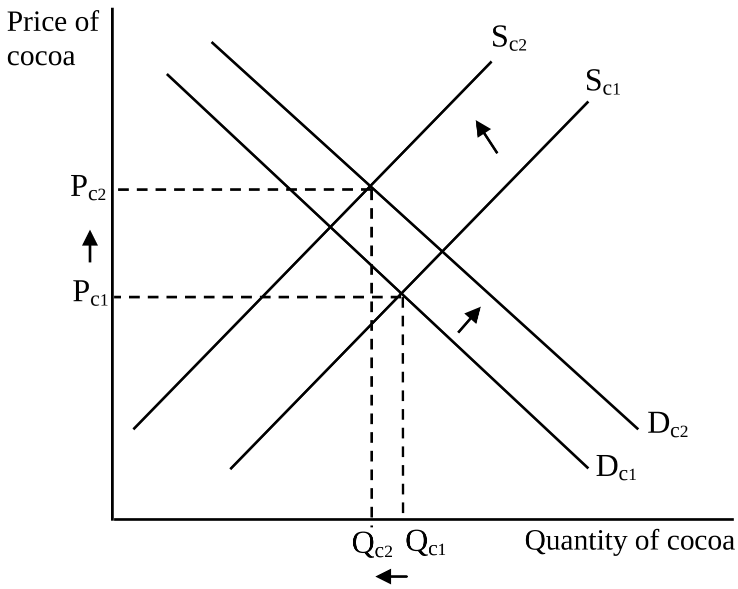


Figure 6: Effect of regulation on demand and supply of cocoa beans
Source: Modified from Mitchell (2003)

b. **The Helpman-Chamberlin-Heckscher-Ohlin Theory**

The factor proportions theory of trade, otherwise referred to as Heckscher-Ohlin theory of trade, is attributed to two Swedish economists, Eli Heckscher and Bertil Ohlin. The Heckscher-Ohlin (H-O) Theorem states that a country will export the good that requires intensive use of the factor for which it has comparative advantage. Under free-trade equilibrium, the two trading countries move to a higher indifference curve, signifying gains but how the gains will be distributed is explained by Stolper-Samuelson theorem which is still within the framework of H-O theorem. According to Dunn and Mutti (2004), H-O theory explains perfectly situation where the factor endowment of a country differs from worldwide factor endowment pattern and also provides a coherent framework upon which other approaches can be built.

The factor proportions theory explains the trade in primary product like cocoa betweenthe cocoa-exporting countries where the weather conditions is suitable for its production and the importing countries where it isnot grown. Though the focus of this study is not factor proportions *perse*, the H-O free trade theory can be extended to the effect of Sanitary and Phytosanitary (SPS) measures, which is form of NTB, through tariffication (Figure7). An extension also becomes necessary due to the fact that there is need to give explanation to the great deal of trade that happens among countries of similar endowments. The new trade theory extension to the idea of comparative advantage given by Helpman (1981) is very much relevant to this work than those of Krugman (1979, 1980) and Brander and Krugman (1983) because Helpman (1981) presents product differentiation, economies of scale and monopolistic competition using Chamberlin-Heckscher-Ohlin approach.It also integrates the Theory of Consumer Behaviour into the aspect of monopolistic competition and combines some elements of gravity model by relating intra-industry trade to income per capita, volume of trade and country size.

The effect of tariff imposed by an importing country that is large enough to influence world price is shown in Figure7. The graph shows that the importing country enjoys improved terms of trade because trading line changes from TT to P_3C_3. Thus, there is welfare improvement over free trade as the country produces at P_3 and consumes at C_3. This analysis is extended to the effect of SPS measure on cocoa trade thus: SPS will drive a wedge betweenprice of cocoa in the supplier's market (world price) and the higher domestic price faced by consumers in the EU and world markets occasioned by the introduction of the SPS.

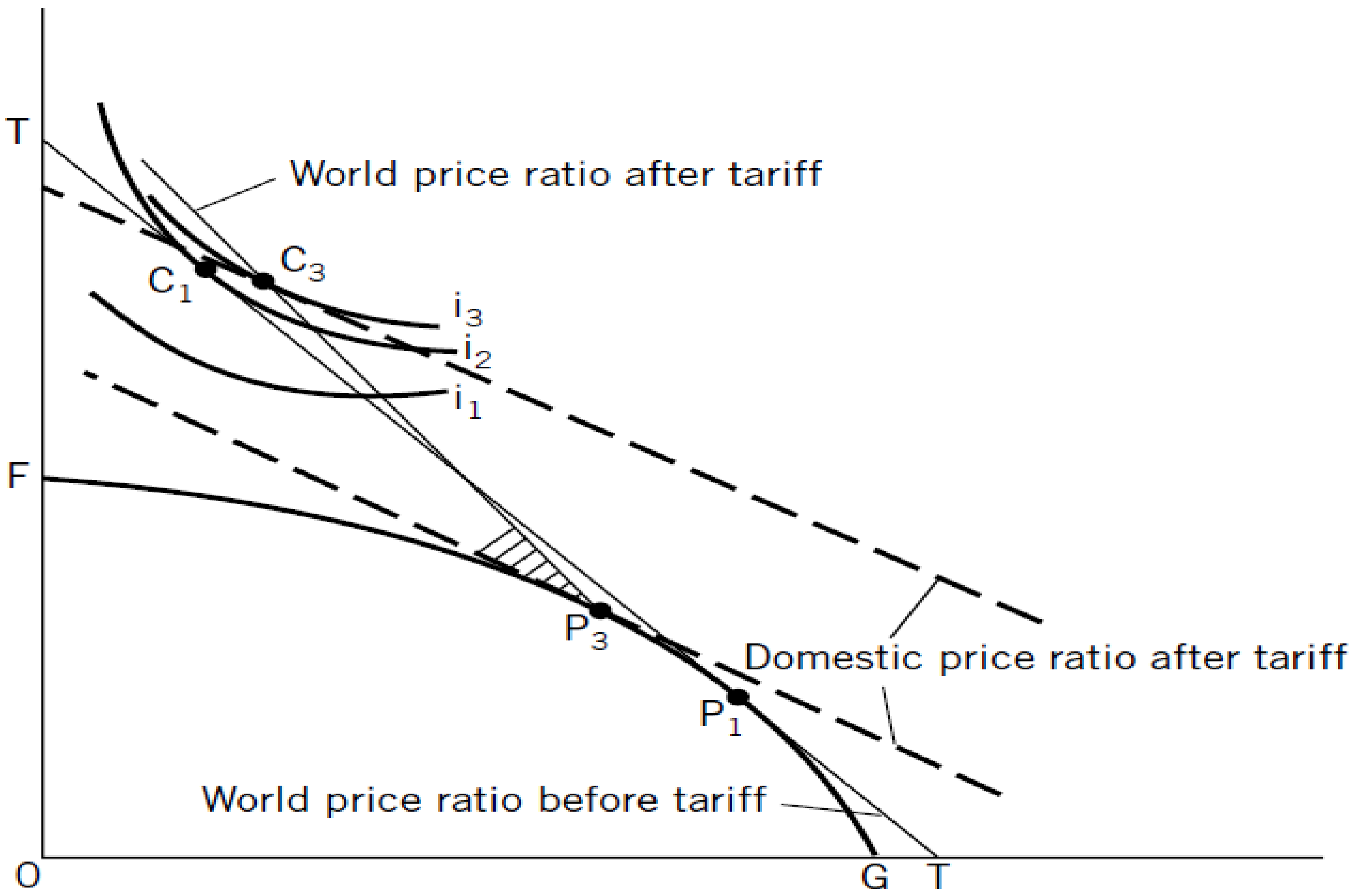


Figure 7: Effects of tariff in a general equilibrium for a large (importing) country
Source: Dunn and Mutti (2004)

Also, the importing countries, especially the EU countries,absorbs great amount of cocoa beans, consuming 37% and 36% of cocoa beans in 2010/11 and 2011/12 respectively (Pipitone, 2012; Anga, 2014). Therefore,any imposition of measure will likely affect supply and world price which makes large country case applicable for the analysis.

As regards the role of government who is the custodian of public regulatory standards, Olper (2016) highlighted its main role in addition to roles of other stakeholders in the regulatory standard institution with respect to non-tariff measures (NTMs) and the welfare effects.The study noted that due to the differing ways in which researchers model key variables in regulation studies as a resultof non-generalised underlying assumptions, the uncertainty accompanying benefits of new regulation due to differing scientific testing procedures and abstracting of the real characterisation of NTMs, there is no consensus on the welfare effects of NTMs. With this, governments have the opportunity of selecting from plethora of policy alternatives and might resolve to the less efficient regulation in order to protect domestic industries (due to political motives). This might not augur well for the anticipated welfare effect.

2.1.2 **Methodological Review**

This section looks at the review of methodologies pertaining to this study and it focuses on two items: (a) methodologies on effect of regulation on trade, and (b) methodologies on competitiveness. Methodologies on impact of regulation on trade are first attended to, followed by competitiveness.

I. **Review of methodologies on effect of regulation on trade**

Beghin and Bureau (2001) and Beghin (2006) identified several methodologies in assessing impact of regulations on trade and tendered that no unifying methodology exists because of the heterogeneous nature of regulations and absence of systematic data. According to the studies, while some methodologies focus mainly on trade impacts, others focus on welfare impacts. Price-wedge estimation, surveys and gravity models belong to the former category (trade) while Benefit-Cost analysis and Computable General Equilibrium (CGE) models belong to the latter (welfare). Given below are the different methodologies with their benefits and shortcomings:

a. **Methodologies on welfare impact of regulation**

i. **Benefit-Cost analysis**

The benefit-cost analysis deal with efficiencies or otherwise associated with NTMs. This method allows for quantification of benefits and costs accruing to economic actors. It has the advantages of specific treatment of NTMs, more detailed analysis of welfare effects and the possibility of seeking alternative regulatory pathways. However, it has the setbacks of necessitating detailed information on NTMs, and complexity/accuracy of its willingness-to-pay method of evaluation (Fugazza, 2013).

ii. **Computable General Equilibrium (CGE)models**

The CGE models are very useful in analysing effect of change in standards and regulations in the various market settings. It is useful in assessing sectoral impact of NTMs through price differences. The equation for examining the sectoral impacts of NTMs in its log-linear form as specified in Andriamananjara *etal*. (2004) is given by:

$$lnP_r = ln\ P_w + \ln(1+\mu) + \ln(1+\tau) + \ln(1+\delta) + \ln(1+\rho) \qquad \ldots(3)$$

where,

P_r = retail prices

P_w =world prices

μ = percentage markup due to distribution cost

τ = percentage markup due to tariff

δ = percentage markup due to transportation cost

ρ = percentage markup due to NTM (tariff equivalent)

Despite the usefulness of CGE model, its measures of standardsare usually heavily aggregated and it presents some complexities in specification thereby not giving a definitive policy direction (Bankole, 2003b). Fugazza and Maur (2008) also observed that modelling of NTBs using CGE is in its early stages and admitted serious challenges in applying CGE modelling to NTBs analysis. Assessing price or quantity impact of Non-Tariff Measures (NTMs) with CGE is difficult and does not present an agreeable way to incorporate demand-shift and supply-shift effects which are key to quantifying effects of NTMs(UNCTAD, 2013).

b. **Methodologies on trade impact of regulation**

i. **Inventory-based approaches**

Inventory measures assess effects of standards in different sectors and on different products using variables such as number of regulations affecting a particular product, number of pages of regulations, number of border rejections or number of complaint or notifications against suspected discriminatory or protectionist practices (Beghin and Bureau, 2001). Inventory approach could be achieved with frequency index (FI) which indicates presence or absence of an NTM (Fugazza, 2013).

$$FI_k = \left[\frac{\sum D_k M_k}{\sum M_k}\right] * 100 \ldots(4)$$

where D_k=Dummy representing presence of NTM on product *k;*

M_k= presence or absence of import of product *k*.

However, FI does not show relative importance of NTMs with respect to their effects on import. The importance is shown with coverage ratio (CR), which is given by a similar formula but with slightly different indicators.

$$CR_k = \left[\frac{\sum D_k V_k}{\sum V_k}\right] * 100 \ldots(5)$$

where D_k =Dummy representing presence of NTM on product *k;*

V_k = Value of import of product *k*.

Notwithstanding the easy collection of data, simplicity of calculation and high level of standard disaggregation/specificity in inventory approaches,there is absence of information on price or quantity impact. It is only useful in calculating trade restrictiveness indices which will serve as input in other estimations (Fugazza, 2013). It could also not differentiate the scale of importance of a particular NTM and data on border rejections is not available for most countries (Beghin and Bureau, 2001).

ii. **Surveys and case study approaches**

In survey method, information is collected on most important and specific items of interest with in-depth details (Beghin and Bureau, 2001). Survey method has the advantage of identifying and studying impact of NTM that otherwise would've been difficult to assess and gives room for specificity. However, it could be expensive to carry out and does not give room for cross-country comparison (Gay *etal*., 2010; Fugazza, 2013). It could also be affected by the nature of the design instrument and the perceptions of both the collector and supplier of information (Beghin and Bureau, 2001). Surveys give a general overview of matters but since it is done only once, it does not take trend and dynamics into account. Case studies focus more on the cost incurred by the exporting countries or firms in meeting up with the standard requirement of the importing countries rather than impact on trade(Iacovone, 2004).

iii. **Price-wedge estimation**

The 'price gap' (price impact) is estimated as the difference between the domestic price in the NTM-constrained market and the international price after correcting for other factors that might influence prices like wholesale/retail margins, rents/profits and other taxes apart from tariffs and subsidies (Snorrason, 2012; WTO, 2012c). Mathematically,

$$TE_{NTM} = (P_{d_k}/P_{w_k}) - (1 + \tau_k + C_t) \qquad \ldots (6)$$

TE_{NTM} = Tariff equivalent of NTM on product k

P_{d_k} = Domestic price of product *k*in importing country

P_{w_k} = World price of product

τ_k = Tariff on product*k*imported into countries (in *advalorem* terms)

C_t = International transport margins (in *advalorem* terms)

Alternatively, *advalorem* equivalents could be estimated through import demand elasticities which are associated with quantity impact calculations that incorporate interaction between NTM and a vector of factor endowments of the importing countries (UNCTAD, 2013). Although price-wedge method allows easy estimation of *advalorem* equivalents but presents difficulties in the calculation of internal and external prices, the erratic nature of unit-value data, problems of disaggregation and inability to capture quality differences in products (WTO, 2012c;UNCTAD, 2013).It also poses problem in terms of interpretation of *ad-valorem* equivalents and suffers from assumption of perfect substitution between domestic and foreign goods which is key in the price estimation(Beghin and Bureau, 2001; Fugazza, 2013). Price-wedge estimation is also done on individual basis rather than lump sum and any error made in its calculation is carried over the welfare effect estimation in which it is usually applied (Andriamananjara *etal*., 2004).

iv. **Gravity model**

Gravity model has been used broadly to model agricultural trade and to analyse effects of food safety standards on agricultural trade. It was first used by Tinbergen (1962) to study levels of bilateral trade flows and is compatible with neoclassical and imperfect competition models (Wei *et al*., 2012). Anderson (1979, 2010) noted that gravity model is one of the '*most successful empirical models in economics*' and '*probably the most successful trade device*' due to its high explanatory powers. The gravity model provides linkage between trade flows and trade costs which is defined as all the expenses incurred in taking goods to the consumers excluding the cost of production (Anderson and Wincoop, 2004).

In the basic gravity model equation, trade between two countries depends on their sizes (GDP, population, land area) and trade costs (distance, cultural affinity and adjacency). The gravity function can be written thus,

$$Y_{ij}^{k} = f\left(X_i, X_j, D_{ij}, T_{ij}\right) \qquad \ldots(7)$$

where Y_{ij}^{k} = value of commodity k exported from country i to j.

X_i = size of the exporting country i.

D_{ij} = Distance between country i and j.

T_{ij} = Other factors influencing trade flows between i and j.

The size, which is in terms of market magnitude, economies of scale, purchasing power and natural resource endowments, captures supply capacity for the exporter and demand capacity for the importer. The trade costs are in terms of increased transaction cost, high transportation cost and differing preferences (Soloaga and Winters, 2001; Iacovone, 2004).In a gravity model, the interaction between two areas is dictated by the degree of presence of appropriate variables in the two areas and of distance between them (Chen *et al.*, 2008).

In its application to the estimation of effect of NTM, gravity model can be specified as follows, adapting from Fugazza (2013):

$$lnx_{sij,t} = \emptyset_{sij,t} \ln\left(1 + tar_{sij,t}\right) + \gamma' NTM_{sj,t} + \beta' Z_{ij} + fe_{si} + fe_j + fe_t + \varepsilon_{sij,t} \qquad \ldots(8)$$

where,

$lnx_{sij,t}$ = log of value of trade in product *s* between exporter *i* and importer *j*intime*t*;
$ln(1+tar_{sij,t})$=log of tariff applied by country *j* on import of product *s* from country *i*intime*t;*
$NTM_{sj,t}$ = set of NTM-related indicators applied by country *j* on product *s*intime*t;*
Z_{ij} = set of bilateral gravity variables for importers *j* and exporters *i;*
Ø = coefficient of tariff;
γ' = vector of coefficients from NTM-related variables;
β' = vector of coefficients of bilateral gravity variables;
fe_{si} = exporting country fixed effect; fe_j = importer fixed effect;
fe_t = time-specific fixed effects;
$\varepsilon_{sij,t}$ = error term of the equation given product *s* traded between importer *j* and exporter *i* at time *t*.

Gravity models are used for both cross-section and panel data. Cross-section models are advantageous because of lower data usage but panel models are preferable because they give better identification of the measures (UNCTAD, 2013).Also, gravity model has high explanatory value and effectiveness in examining policy implications (Wilson and Otsuki, 2007; WTO, 2007) but focus only on trade impact neglecting welfare effects of NTMs and does not disentangle demand and supply-side effects (Otsuki *etal*., 2001; Beghin, 2006). Finding suitable proxy for measuring standard also constitutes key challenge (Iacovone, 2004) and is restrictive in terms of number of products and countries to be covered (Fugazza, 2013).

Though welfare-based approaches seem better because of direct effect on life, the choice for this study is the approaches that focus on trade impact due to its (trade impact) importance in international negotiations and dispute settlements. Among these, gravity model is the prime choice because of its extensive use in literature to assess effect of standard on trade and ability of incorporating other approaches into it as measures of trade restrictiveness.

Several estimation methods have been adopted with gravity model. Specifically, dealing with zero trade values, which are prominent in trade data, usually present serious methodological challenges.The standard way of estimation gravity models by taking logarithms of variables results to drop of zero trade values when OLS is used because it is impossible to take logarithm of zero in addition to the fact that OLS does not fit into the gravity model, theoretically(UNCTAD/WTO, 2012; Shepherd, 2013). This reduces the number of observations. Also, the practice of adding a small value gives inconsistent estimates and application of Tobitis partially justified with respect to the treatment of zero trade values as observed or not and loss of important information occurs with censoring (Salvatici, 2013). Although Heckman treats zero trade as borne out of decision not to export and uses 2-step method to assess effect of standard on trade, not unobservability, the model has been criticized for assuming homoskedasticity and neglecting issue of Jensen's inequality (Boza, 2013).Helpman Melitz Rubinstein (HMR) model is a variant of Heckman selection model. Poisson regression properly takes care of zero trade but is inappropriate when there is excessive zeros and over-dispersion.In such instances, zero-inflated models such as Zero Inflated Negative Binomial Pseudo-Maximum Likelihood (ZINBPML) and Zero-Inflated Poisson Pseudo-Maximum Likelihood (ZIPPML) become appropriate (Salvatici, 2013) though they also have the drawback of varying results when changes are made to the scale of the dependent variable (Drogue and DeMaria, 2012).

Poisson estimation method was used for the gravity model in this study. Poisson regression model with Maximum Likelihood Estimation (MLE) was preferred to the Ordinary Least Square (OLS) method due to some problems identified in the OLS estimation method which include possible endogeneity problem among the macro variables as a resultof their linkages and the inappropriateness of using t-statistics as means of inference (Geda *et al*., 2012). The poisson regression is widely adopted because it produces consistent estimates and this desirable property is carried over to its panel application (Honore and Kesina, 2015). Although some studies have raised the issue of appropriateness of poisson estimation model in instances of over-whelming zero values as indicated above, the export values used in this study did not havesuch setback.

II. **Review of methodologies on competitiveness**

Several methods have been employed in the assessment of competitiveness. These include Revealed Comparative Advantage (RCA) – Balassa Index;Revealed Symmetric Comparative

Advantage (RSCA) (Nwachukwu *et al.*, 2010);Vollrath'sRelative Trade Advantage (RTA) – a modification ofBalassa Index – composed of Relative Export Advantage (RXA) andRelative Import Advantage (RIA);Export Market Shares (EMS) which could be measured in terms of export or import (Latruffe, 2010) andshift-share analysis method. Some of these methods are examined in the following sub-sections.

a. **Revealed Comparative Advantage (RCA)**

The Revealed Comparative Advantage (RCA), otherwise known as the Balassa Index, is given by Boansi (2013) as follows:

$$RCA_{ij} = \frac{X_{ij}/X_{it}}{X_{jw}/X_{tw}} \dots (9)$$

where,

X_{ij}= Value of export of a commodity *j* from country *i*.

X_{it}= Total export*t* from country *i*.

X_{jw} = Value of world export of commodity *j*.

X_{tw} = Total of world export of agricultural production.

An RCA>1 indicates that there is comparative advantage for the country in the commodity of interest. The symmetric form of RCA(i.e RSCA) could then be computed thus (Nwachukwu *etal.*, 2010),

$$RSCA = \frac{(RCA-1)}{(RCA+1)} \dots (10)$$

The values of RSCA varies from -1 to +1. The higher the value, the higher the level of a country's competitiveness with respect to the commodity under consideration.

b. **Relative Trade Advantage (RTA)**

The RTA is generated from RXA and RIA. The RXA measures "the ratio of a country's export share of a commodity in the world to its export share of other commodities" (Latruffe, 2010). Thus,

$$RXA_{ij} = \frac{X_{ij}/X_{ik}}{X_{nj}/X_{nk}} \dots (11)$$

where,

RXA_{ij} = Relative Export Advantage

X = Value of export

i = country

j = commodity

k = other commodities for the World

n = other World countries apart from ithcountry.

Relative Import Advantage (RIA) is got by replacing the export values in the formula with import values.Relative Trade Advantage (RTA) is calculated by finding the difference between RXA and RIA.

c. **Shift-Share method**

In the shift-share framework, a country's aggregate export growth ratesare decomposed into several factorswhich includegrowth pertaining to the overall array of products in case of product mix, overall growth rate of world export and performance of a country's export relative to others (Lakkakula *etal.*, 2015).

Another notable measure of competitiveness is Policy Analysis Matrix (PAM). However, it is not included here because it belongs to the class of strategy management measure of competitiveness and not trade measure of competitiveness (Latruffe, 2010).

2.1.3 Empirical Review

In this section, literature was reviewed on the effect of SPS measure on trade, presenting different methodologies that have been adopted and the results.

a. **Effects of SPS measures on trade**

Wilson and Otsuki (2001) studied the impacts that adoption of international standards and its harmonisation will have on trade flow in agricultural products. The results showed that the value of cereals and nuts exports is negatively affected by Aflatoxin B1 standard but this negative relationship was not significant in the case of dried and preserved fruits. This points to the fact that the effect of aflatoxin standard cannot be generalised globally. Otsuki*etal*. (2001) analysed the quantitative effect of aflatoxin standards on trade flow from African countries to the EU and found out that trade in cereals, dried fruits and edible nut are negatively affected by EU aflatoxin standards. Specifically, 10 percent decrease in the level of aflatoxin (tighter standard) will reduce trade flow by 11 percent for cereals and 4.3 percent for fruits, nuts and vegetables.Wilson*etal*. (2003) analysed the effect of *mrl* standard of antibiotics on beef trade in relation to the widely reported dispute between the EU and the US on the safety of hormone treated beef. It was found out that stricter standard had negative effect on bovine trade. The afore-mentioned studies used gravity model.

Bankole (2003b) utilised ordinary least square (OLS) approachto assess the effect of SPS measures on export of processed agricultural and food products from Nigeria. The study found out that imposition of these measures by importing countries generated a substantial cost of compliance for the exporting Nigerian firms though it also made producers and exporters improve upon production/processing standards and geared them towards considering alternative markets. The study noted that attempts to meet the standard by exporters did not lead to increase in exports due to the restrictive nature of the SPS which was an indication of protectionist intents of standards in importing countries. Iacovone (2004) studied the effect of Aflatoxin B1 standard on trade flow between Europe and Latin America, introducing GDP per capita into the gravity equation. Tobit estimation was employed to deal with the problem of zero values in the endogenous variable and it performed better than the OLS. The study found out that the standards of importing countries affected trade flows negatively. Specifically, 1% reduction in the standard reduced trade volume by 0.67%. Also, the coefficients of GDP and GDP per capita of importing countries were positive while that of the geographical distance was negative. However, the cultural similarity did not seem to be important.

Gebrehiwet *et al.* (2007) estimated the trade effects of total aflatoxin level imposed by OECD (Organisation for Economic Cooperation and Development) countries on South African food exports. The study made use of panel data, used F-test to choose the appropriate model tested the model for heteroskedasticity and deflated the data using the countries' CPI (Consumer Price Indices). Importing countries' GDP, distance and total aflatoxin level were the significant factors affecting export. Also, 1 percent increase in total aflatoxin level decreased trade flow by 0.41 percent. Okello*etal*. (2007) studied the impact of stringent food safety standard on green beans exported from Ethiopia, Kenya and Zambia. The nature of the standards did favour smallholder producers but target market options and collective action through farmer associations assisted in retaining the smallholders in the supply chain due to improved access to finances and technical advice.

Chen *et al.* (2008) tested the effects of Chlorpyrifos *mrl* standards on China's export of vegetables and the Oxytetracycline *mrl* standards on China's export of fish and aquatic products using two-stage Generalised Least Square (GLS) model for the econometric regression analysis. Commodity output was used as a mass factor in the gravity model in lieu of GDP because of the fact that output of a commodity represents potential for export in addition to capturing the supply-side effects on the export of the commodity. The output was lagged one year to avoid potential endogeneity. The study reported that higher food safety standards imposed by importing countries had negative and statistically significant effect on China's export. From the regressions, 10 percent decrease in the value of Chlorpyrifos *mrl* (tighter standard) will decrease value of China export by 2.8 percent for the whole groups of vegetables while the same percentage decrease in the value of Oxytetracycline *mrl* will decrease value of export of fish and aquatic products by 2.7 percent. Also, trade effect of equal relative change in standards was much larger than that of a change in the import tariff. Specifically, coefficients of output of the agricultural products (vegetables, fish and aquatic products) were positive and statistically significant which implied that export of the commodities increased with increase in China's domestic production. The coefficients of importing countries' GDP were positive and significant for the two groups which signified that increase in importing countries' purchasing power and market size will boost demand for the products. Similarly, the *mrl* standards were positive and significant meaning that tighter standard will reduce export in all categories. On the other hand, the variables for the distance and tariff imposed by importing countries were negative and statistically significant.

Disdier*etal*. (2008) examined the impact of SPS and TBT measures on trade flow between developing countries and OECD members and found out that the measures generally impede trade between the two country groups significantly but the same could not be said of OECD member countries' intra-trade. Furthermore, though EU countries' regulations were among the lowest of all OECD countries in terms of coverage, they were somewhat stringent. This explained why EU imports were more negatively affected. Disdier*etal*. (2008b) combined survey, case study and econometric approaches (gravity model) to analyse the effect of SPS and TBT measures on tropical and diversified products being exported from Costa Rica, Ecuador, Ethiopia and Kenya to European Union (EU), United States (US), Canada, Japan, Australia and Switzerland.The study came up with the following findings: there was inconsistency in the level of standard among importing countries, large firms were able to cope with the requirements due to economy of scale, higher cost incurred by producers/exporters did not translate to market loss and tariff was significant as an export barrier. The study also found out that the aim of these measures varied by countries and this could pose serious challenge in meeting up with the requirements. Jongwanich (2009) utilised panel data econometric analysis without gravity model. The study observed that SPS standards imposed on developing countries' processed food export could hinder trade due to less transparency of SPS in comparison with tariff or quotas and SPS should be viewed in the light of an opportunity by developing countries to improve process and quality standards in the competitive market situation.

Munasib and Roy (2011) studied the impact of aflatoxin standard on maize export using a 2-stage Heckman process for the gravity model and introducing a new concept, BTC (Bridge to Cross), as a measure of standard. BTC is the regulatory gap in SPS standards between exporting and importing countries. Thus, the poorer an exporting country is, the higher will be the BTC judging from the less stringent standards prevalent in poorer countries. The study noted that one salient element of gravity models that incorporate zero trade flow between countries (developed following the work of Helpman, Melitz and Rubinstein [HMR], 2008) is the exclusion variable. Finding an exclusion variable in the context of trade flow is extremely difficult because most variables that affect propensity to export also affect volume of exports. Some exclusion variables that have been used in literature include common religion and common language but Munasib and Roy (2011) argued that common religion (similarly common language and colonial affiliation) affect both propensity to trade and trade volume. The study therefore made use of historical frequency of non-zero trade between two trading countries.The results of the analysis showed that the effect of BTC varied significantly and negatively with the size of exporter and there was a stronger effect for poorer countries especially those in Sub-Saharan Africa.

Xiong and Beghin (2011) adopted the HMR and ZINBPML (Zero-Inflated Negative Binomial Pseudo-Maximum Likelihood) estimation procedures for the gravity model equation while testing the effect of aflatoxins on trade in groundnut products between Africa and the EU. Xiong and Beghin (2012) used the PPML (Poisson Pseudo-Maximum Likelihood) estimator to cater for zero trades and *mrl* stringency score as the measure of standard. The score is a measure of stringency of *mrl* on a particular product in reference to Codex value.

Unlike most studies, Drogué and DeMaria (2012) utilised information on *mrl* levels of all pesticides involved in the production of apples and pears for both exporting and importing countries. In the study, dissimilarity index was used to compare ‘closeness’ of standard in both countries and was introduced into the gravity equation as an exogenous variable while quantity produced of apple and pears replaced exporter GDP to model supply. The study adopted Zero-Inflated Negative Binomial (ZINB) model to deal with the problem of zeros that are usually associated with disaggregated trade data after using Ramsey test to confirm its superiority over Ordinary Least Square (OLS) and Poisson Pseudo-Maximum Likelihood (PPML) models. The study found difference in regulation to be an important determinant of trade in apples and pears that could sometimes retard trade.

Wei *et al.* (2012) analysed impacts of food safety standards on tea exports from China. The values of export and the GDP were deflated using the CPI while tea output was lagged by one year to avoid potential endogeneity. Ordinary Least Square (OLS) and country fixed-effect models were used to estimate the gravity model though the OLS was only used as a baseline model for comparison with the more consistent estimations. Fixed-effect and time dummies were introduced into the gravity model to address endogeneity caused by omitted variable. The study found out that the *mrl*s of pesticides used in tea production imposed by importing countries had considerable effect on China’s tea export. This made them come up with the conclusion that the large variation in safety standards among the importing countries, and tighter restrictions which comes in form of increase in coverage of regulated pesticides among other measures suggested that developing countries will face difficulty in exporting food products. Tran *etal*. (2012) tested whether food safety standard retards seafood trade among the EU, Japan and North America markets using alternative models. The study adopted Heckman and ZINB models based on tests and behaviour of parameters, but concluded that no one particular model was superior. Strict standard on seafood exporthad negative impact on exporting countries revenue.

Engler *etal*. (2012) assessed the effect of harmonisation on Chilean fresh fruit trade from exporters’ perspective. Although previous studies have depicted negative effect of stricter standard on trade, the study contended such simplicity and concluded that there are different effects at different levels with different policy implications and treatment. It was noted that though Chilean fruit exporters had to deal with complex, conflicting and uncertain SPS environments, the government and the private sector took compliance to the international requirements by exporters as a challenge and thus instituted programmes to assist them. The study concluded that harmonisation was not really in view. In a related study, Melo *etal*.

(2014) determined the effect of aggregated and disaggregated Sanitary, Phytosanitary and Quality (SPSQ) requirements on Chilean fruit exports. The results supported the earlier study (Engler *etal*., 2012) that stringency of standards has negative impact on trade but elicited additional information of higher effect if imposed by developed nation. Moreover, at disaggregated level of standards, it was discovered that though the effect was negative for phytosanitary measure and *mrl*, it was positive for Good Agricultural Practice (GAP), supporting findings in literature that standard could improve trade.

In the assessment of impact of SPS on agricultural and food trade, Crivelli and Groschl (2012) applied the Heckman selection procedure within the context of gravity model, using Maximum Likelihood (ML) approach to account for potential sample selection bias and zero trade flow in order to avoid generating biased coefficients. The study submitted that SPS measures related to conformity assessment impeded market entry and trade flow while SPS measure related to product characteristics posed an entry barrier but increase trade flow once standard was met. Distance had negative impact on trade while common language, adjacency and common colonial heritage increased trade. Common religion positively affected probability of market entry and there was minimal negative effect of tariff on trade flow. Also, countries similar in income trade more with one another while countries with similar population size showed higher probability to trade but no significant effect on amount of trade conditional upon market entry.

Kareem (2013 & 2014b) and Ferro *et al.* (2013), like Munasib and Roy (2011), used the two-stage HMR model (which is an extension of Heckman model) within the context of gravity model and developed estimation procedure to obtain effect of standards on extensive and intensive margins of trade.Kareem (2013, 2014a&b) introduced a new variable, Hurdle-to-Pass (HTP), which was defined as the number of standards faced by a commodity in a particular year, as a measure of standard. The studies argued that it is non-compliance with all the standards as a whole that will lead to border rejection or negative effect on trade flow and treating all the standards together will also grant the opportunity of making conclusions/generalisations on market access.Ferro *et al.* (2013) also created standard restrictiveness index (SRI) which combined information on number of pesticides regulated per product and the *mrl*value on each product.

The results of effect of SPS on Africa's exports to the EU by Kareem (2013 & 2014a) indicated that the impact of SPS was product-specific.Ferro *et al.* (2013)'s study of the impact of standards on agricultural exports from developing countries revealed that each additional pesticide regulated by the importer was associated with a lower probability of trade. More restrictive standards in a destination market meant that less firm will be exporting to such market and thus limited trade. Higher tariffs and greater distance restricted both probability and intensity of trade. However, common language, colonial relationship and sharing common border increased the likelihood of trade while colonial relationship and sharing common border increased intensity of trade. Also, low-income countries were affected more by standards than high-income countries and average number of standards per product increased with increase in importer's GDP per capita.

Murina and Nicita (2014) also adopted the gravity model but with Poisson regression method to cater for zero trades. The study examined the effect of SPS measures on agricultural exports from Lower Income Countries (LICs) to the EU and discovered a lowering of exports by 14% which amounted to about 3 billion US dollars. Though LICs felt the burden of regulatory standards more, compliance was found to be positively and significantly affected by membership of deep trade agreements for the LICs compared to other countries. This signified internal capability for adjustment costs for the middle and higher income countries.

Foletti and Shingal (2014 a&b) adopted a two-step Heckman model to test the effect of heterogeneity/homogeneity of *mrl* standard on bilateral agricultural trade. Common language was used as exclusion variable in the HMR model. Probit regression was utilised in estimating the extensive model (first stage) while non-linear Least Square regression was employed in the intensive model (second stage). In the study, heterogeneity indices of *mrl*s were constructed and included in the 2-stage Heckman model of the gravity equation. The standard heterogeneity index tested whether importing and exporting countries had equal *mrl* for the same pesticide and crop. The value ranged between 0 (no heterogeneity) and 1 (presence of heterogeneity). Shingal *etal*. (2017) stood out in its assessment of stricter standard on trade as a result of treatment of endogeneity but also adopted heterogeneity index similar to Foletti and Shingal (2014 a&b). It was concluded in the study that with full consideration for endogeneity, stricter standards generally improved trade and this was not dependent on the country-type imposing it.

b. **Effects of harmonisation of standards on trade**

This part of the section discusses the effect of harmonisation of standards on trade.Wilson and Otsuki (2001) showed that if the current (stringent) international standard on Aflatoxin B1 is adopted, trade will increase by US$6.1 billion as against world export increase by US$38.8 billion if there is harmonisation at the level of Codex. Otsuki*etal*. (2001) observed that in comparison to the international (Codex) standard, EU standard will constitute a far greater impediment to the agricultural trade flow between the partners. In real terms, loss of export is estimated to be US$400 million under EU standards compared to US$670 million gain if Codex guidelines had been adopted. Wilson *etal*. (2003) submitted that if the Codex (harmonised) standards were to be employed, trade in beef will rise by 57 percent over the pre-harmonised situation translating to about US$3.2 billion increment.In the submission of Moenius (2006), harmonisation might reduce trade or increase trade depending on whether it is adaptation cost (compliance cost) that is involved thereby reducing trade, or it had to do variety (with price implication) thereby increasing trade.Drogue and DeMaria (2012) suggested that ambiguous result of harmonisation on trade in apple and pears (positive, negative or no-effect) implied that it might not be the best because consumers in developed countries might suspect collusion and breach of international agreements on *mrl*s.

Mangelsdorf *etal*. (2012) assessed the effect of voluntary and mandatory standards on Chinese agricultural export. Results showed that Chinese domestic standards had positive effects on trade and this positive effect increases in magnitude if the standards are in harmony with international standards. In addition,Foletti and Shingal (2014a) found out that harmonisation of *mrl* standards across EU increased the probability of entering market and the volume traded once entry was secured for the inter- and intra-EU agricultural trade. Similarly, Foletti and Shingal (2014b) observed a diminishing effect of heterogeneity of *mrl* standards on trade at market entry level, due to compliance cost, if the regulation in destination market is stricter. However, standards heterogeneity is advantageous to countries putting up stricter standards, in terms of volume traded, after securing entry into the importing country as a result of being viewed as supplying goods of high quality.

2.1.4 **Synthesis of results from literature review**

The review established that gravity model, as an econometric approach, had been used extensively in analysing the effects of SPS on trade as noted by Boza (2013) and Ferro *et al.* (2013). It is effective in examining policy implications once the relationship is estimated thus making it an appropriate tool to use for trade policy analysis involving SPS. Coupled with this are improvements in model and variable specifications which have been achieved by researchers over the years. Thus, this study adopts econometric approach, specifically, gravity model with PPML method because of its advantages and the nature of the data. As regards standards variable, studies reviewed have adopted differing measures ranging from number of standards, *mrl* of pesticides to new concepts such as Bridge-to-Cross (BTC), Similarity Index (SIM), Heterogeneity Index, Stringency Index (SI), Hurdle-to-Pass (HTP) and Standard Restrictive Index (SRI). This study adopts Stringency Index (STI) which combines information on number of regulated pesticides and the *mrl* due to availability of historical *mrl* data.

Furthermore, empirical review established that larger percentage of literature agreed to the fact that SPS measures have negative effect on agricultural trade especially for developing or least developed countries though the effect could not be generalised for all countries and products. Despite this convergence, however, Xiong and Beghin (2011) found out that stricter and harmonised EU aflatoxin standard (lowering of *mrl*s of aflatoxin in groundnut and its products), which was adopted in 2002, had no significant effect on export of African groundnut both at the extensive and intensive margins. Thus, it might just be right to say that there is mainly 'dual effect'. Moenius (2006) concluded that country-specific agricultural standards might increase trade as a result of taking advantage of market information or reduce trade due to cost associated with adapting product to suit specific market.Boza (2013) also put it succinctly that SPS may act as impetus to trade due to consumer trust but also as impediment due to costs incurred by exporters with the overall effect depending on producer's profile/reputation (which usually depends on the economic status of the country), stringency of standards and extent of harmonisation.With respects to the effects of harmonisation of standard on trade,literature showed varying effects ranging from positive to negative to none-effect, depending on the standard variable involved or whether it is the supply or demand side. .

Review of the different methods used in assessing competitiveness revealed that they are based on market exchange without any recourse to issues of quality. The methodology used in this study deviates from previous approaches by building quality parameters into export competitiveness measurement. The rank scores for standard-scaled export values under current and harmonised situations were averaged to generate competitiveness score for each exporting country. The higher the competitiveness score, the higher level of competitiveness of the exporting country.

2.2 Conceptual Framework

The conceptual framework for this study, shown in Figure 12, is a composition of ideas drawn from several sources.The framework consists of two sides: the demand side and the supply side. These two sides affect cocoa trade through interplay of sizes of partners, measured in GDP or population, and their distances apart.On the supply side, cocoa production is affected by farming/storage practices and environmental conditionswhich dictate the nature of pesticides usage. In addition, the incentive created by government through policies such as pesticides subsidy and tax exempt on some chemical inputs has important role and these policies are ultimately dependent on government stand on liberalisation.

With respect to the individual producing units, attractive prices in the world cocoa market make farmers abandonthe required post-harvest activities like proper fermentation and drying. All these factors affect quality of cocoa being exported. At the point of supply, exporting firms continually face challenges in complying with the SPS requirements of the importing countries mainly as a result of problems created by production practices. Although SPS measures constitute challenge to the cocoa exporters, it is an opportunity to upgrade product and process standards. Any firm that is able to overcome the challenges of compliance, gains access to the world cocoa market and enjoys premium price. Reputation also plays an important role here because companies from resource-rich, quality-assuring and economically-stable countries are likely to adjust better to standards change. Inability to meet up with requirementsleads to product rejection,translating to losses and the attendant negative consequences.

On the demand side, governments and retailersin importing countries,mostly developed nations,usually cite health and environmental concernsof safeguarding consumers as the reasons for imposing stringent measures on import though there are usually hidden protectionist intents from the side of governments. Also, consumers in importing countriesare better placed economically and have better access to information through improved technology. Thus, they are wary of their safety and are ready to pay higher prices charged forprocessed foods made from high quality cocoa beans. These characteristics of the consumers affect the level of stringency of SPS and TBT measures which is backed up by legislation to ensure provision of high quality and safe food products.

The individual standards in importing countries have been observed to be more stringent than the general standards and harmonisation is meant to bridge the gap. To the exporters who are mostly developing nations, harmonisation is a better alternative because of the opportunity of focusing on the same set of standards and thus a means of improving trade. However, stakeholders in importing countries might see it as robbing them of their sovereignty and limiting opportunity of selecting the best out of the alternatives. Thus, harmonisation is usually not readily welcome and this has implications for trade at both intensive and extensive margins.

Considering competitiveness (Figure 9), compliance to SPS standards brings about market access and this in turn, increases competitive nature of exporters. Any cocoa-exporting country that is able to abide by the requisite international regulations gets its product sold in the market and even at premium price depending on the quality of the product. Thus, higher revenue earning is a function of level of competitiveness as dictated by the extent to which a country is able to meet up the quality requirements. Furthermore, the higher earning affords the citizens improved welfare outcome through higher national income and better reputation which is one of the ‘selling points’ in the international goods market. .

CONCEPTUAL FRAMEWORK

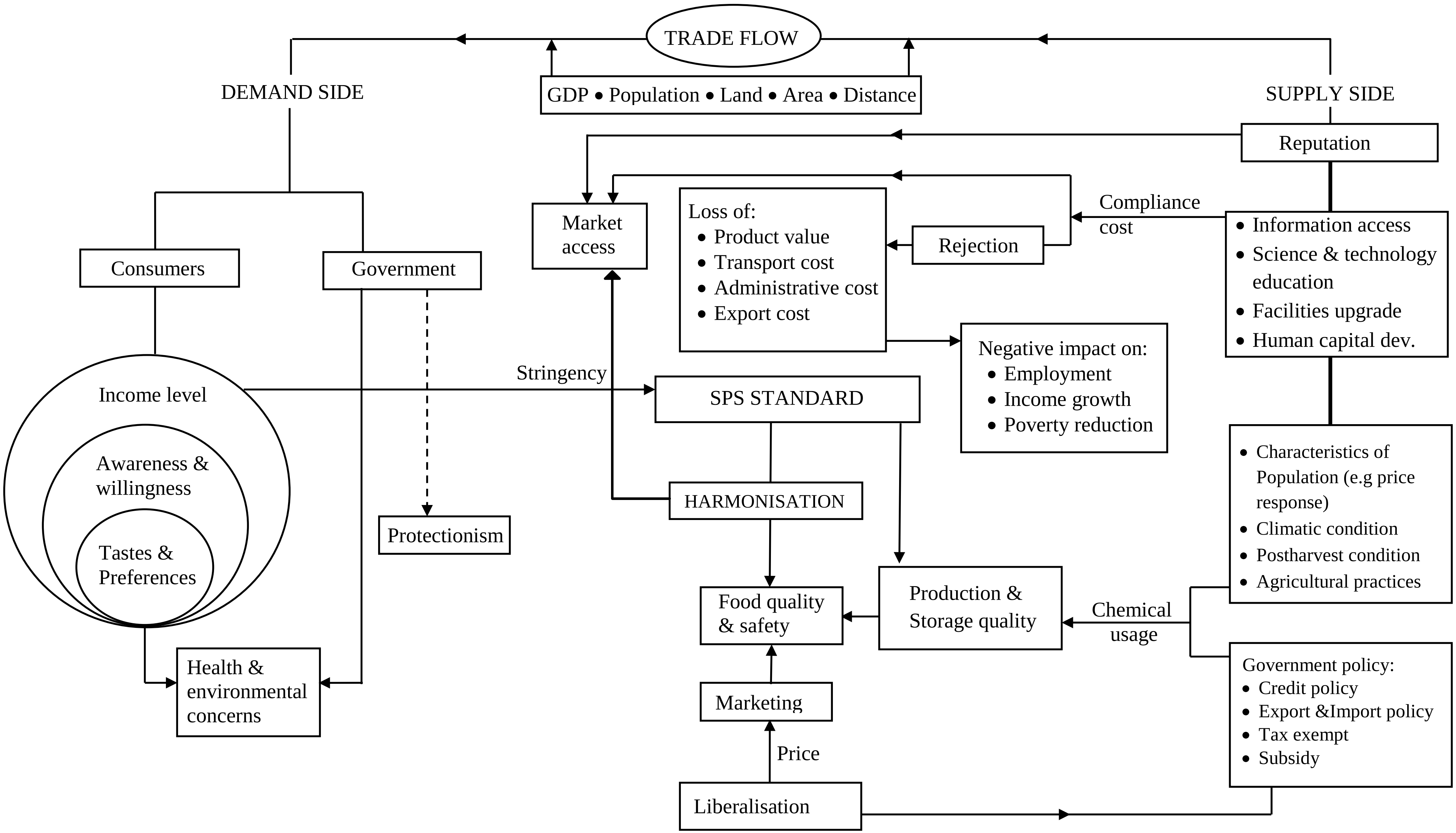


Figure 8: Conceptual Framework for SPS Standards, Harmonisation and CocoaTrade

Adapted from: James & Anderson, 1998; Henson *et al.*, 2000; Wilson & Otsuki, 2001; Iacovone, 2004; FAO, 2006; Ferro *et al.*, 2013; Kareem, 2013; UNCTAD, 2013.

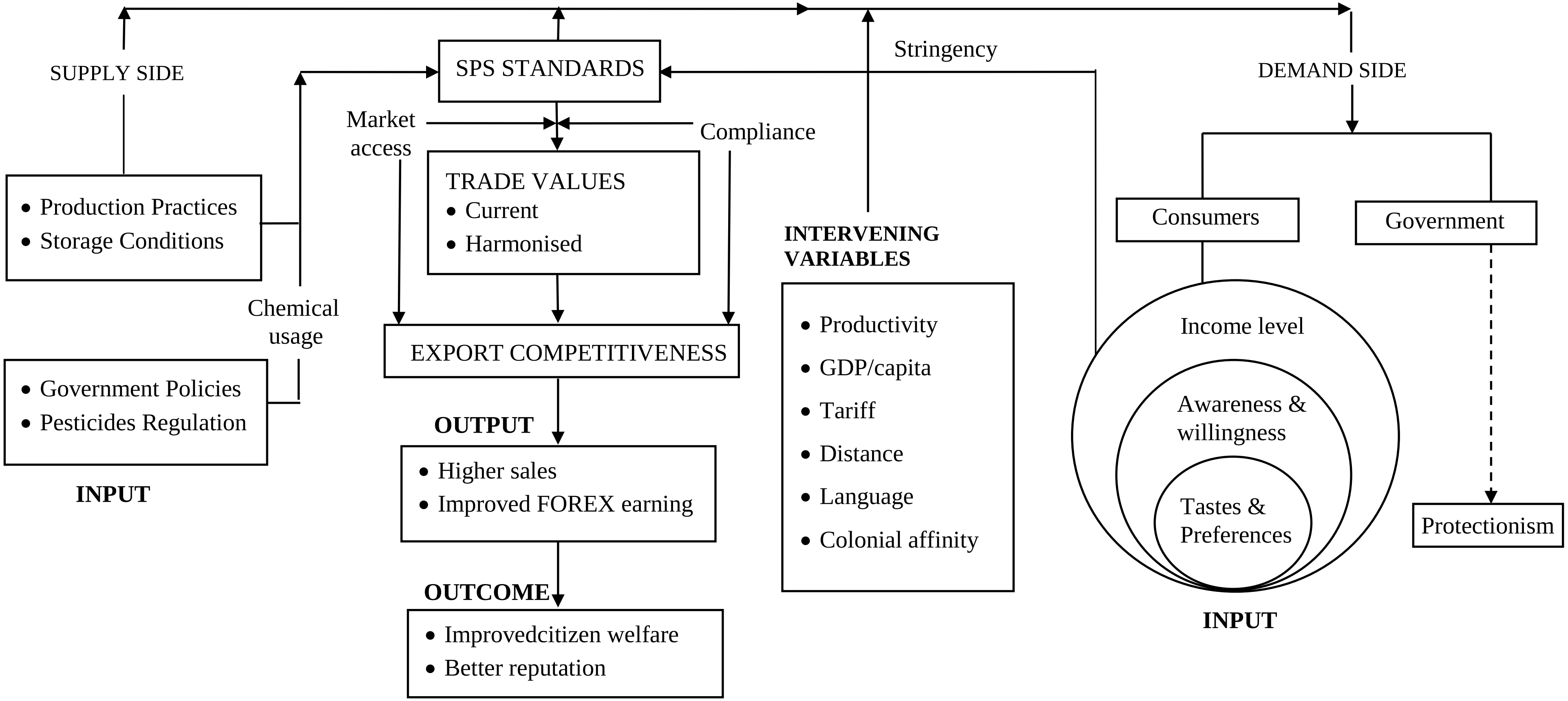


Figure 9: Conceptual Framework for SPS Standards and Export Competitiveness

2.3 Additional Issues in Cocoa SectorsofExporting Countries

a. Cocoa market liberalisation in exporting countries

The story of cocoa quantity and quality in exporting countries is incomplete without mentioning market liberalisation. Prior to independence, the colonial masters established control over cash crop marketing in their various jurisdictions. With their exit, the various African governments still maintained the status quo because the marketing board system afforded them the opportunity of controlling strategic export commodities and to collect taxes (Gilbert, 2009; Kolavalli *et al*., 2012). Marketing boards are public institutions established by government and with regulatory powers backed with legislation to see to the effective management of export crops (Adegeye and Dittoh, 1985).

Before the advent of produce boards, marketing of agricultural commodities was mostly unorganised with no guarantee of sustainable government revenue, adequate producer prices or required product quality. Since agricultural production in developing countries is largely dependent on climatic conditions, fluctuations in supply and prices becomes inevitable. Smallholder nature of production with fractional individual contributions also requires coordination in order to benefit from economy of scale. Moreover, requirements of value addition, quick evacuation and negotiation of favourable price with foreign buyers are functions that could not be carried out on individual basis due to financial and institutional requirements (Akinyosoye, 2005). These made the marketing board arrangement inevitable.

In Nigeria, the initial regional board arrangement was reformed through the Commodity Board Act No. 29 of 1977 (as amended by the Commodity Board [Amendment] Act No. 30 of 1979) and six new commodity boards, which include Nigerian Cocoa Board, were established (Idachaba, 2006). The Ghana Cocoa Board (COCOBOD) was established in 1947 to monitor cocoa chain right from input supply to export with serious emphasis on quality. Related functions were given to C*aisse de Stabilisation et du Soutien des Prix des Produits Agricoles* (The Stabilisation Fund) which was in operation in Cote d'Ivoire and a similar system under the ONCPB *(Office National de Commercialisation des Produits de Base*) operative in Cameroun. The CAISTAB was charged with the responsibilities of setting and guaranteeing purchase prices for farmers, making up for any shortfall in exporting prices in addition to collecting taxes for government (ECOWAS-SWAC/OECD, 2007; Gilbert, 2009).

The wave of cocoa market liberalisation swept through the producing countries in the eighties due to pressure from donor institutions brought about declining prices, poor farm gate prices, deviation from primary roles, politicisation of marketing boards and alleged corrupt practices. The liberalisation policies were effectively carried out during the following times: Nigeria, 1986; Cote d'Ivoire, 1998-2002 and Cameroun, 1991-1994. Ghana implemented partial liberalisation in 1992-93 though mini-reformation had been carried out in the 1960s (Walker, 2000; ECOWAS-SWAC/OECD, 2007; Gilbert, 2009).

The scrapping of cocoa board brought significant change to cocoa marketing in Nigeria ushering in era of liberalisation where there is free entry into the cocoa marketing business (Walker, 2000; Cadoni, 2013; Ajetomobi, 2014). The organised and controlled mechanisms instituted during the cocoa board era which brought significant improvement in production and pricing (Ayinde *et al*., 2013) were abandoned and laissez-faire arrangement adopted which made traders and marketers who could not even differentiate between good cocoa beans and bad ones rush to cocoa trading. As a result, the quality of cocoa reduced drastically especially in Nigeria, and cocoa beans were either rejected or priced lowly (Akinyosoye, 2005; Cadoni, 2013).

In Ghana, partial liberalisation held sway. Unlike Nigeria, which happened to be the first African country to liberalise cocoa trade (Cadoni, 2013), the cocoa sector in Ghana is partially liberalised making it one of the few examples of export commodity sector in Africa that has resisted the pressure of full liberalisation. The Ghanaian government introduced a private sector-led system for producer price determination and procurement of cocoa from farmers but left external marketing to the cocoa board (COCOBOD). While the current arrangement still leaves substantial control in the hands of the government, the institutional arrangement is able to achieve the basic objective of letting farmers get good prices for their products though quality is also compromised (Kolavalli *et al*., 2012). In Cameroun, ONCPB was initially replaced by ONCC (*Office National du Café et du Cacao*) in 1991 but poor performance brought further liberalisation which led to relegating its function to compilation of statistics. The Ivorian CAISTAB was abolished in 1999 and replaced with new complex system comprising of five (5) new structures in 2000-2002 period while a body of stakeholders constituted by the government - *le Conseil du Café-Cacao* (CCC) - was managing cocoa affairs from 2012 (Gilbert, 2009; UNCTAD, 2016).

In Indonesia the government adopted hands-off approach and this has assisted in boosting its smallholder-based cocoa revolution. Between 1980s, the time that Indonesia took the world cocoa market by surprise, and the early 90s, Indonesia's cocoa production increased at the rate of 26% per annum and the smallholders benefitted immensely by getting highest farm-gate price possible for any producer country in the world. All these were as a result of the freehand given to the smallholders, farming 0.5-1.5ha in land area and who constitute a little below 90% of the producing force, to operate under a competitive market condition. Similarly, production increased by eight-tenths in the last decade (2000-2005) though the problems of pests, diseases and ageing trees has been causing decline since 2007 (Akiyama and Nishio, 1996; IDS/IFAD, 2015).

The effect of liberalisation on cocoa marketing has been generally mixed. While the most-aired opinion seems that liberalisation has led to decline in cocoa quality, some authors have dissenting opinion on the effect of liberalisation on quality. With respect to increased production, clue could be taken from the boom in Indonesia mentioned above and significant positive effect on production of export crops in Nigeria at inception of liberalisation, as noted by Yusuf and Falusi (1999) and supported by cocoa production graph for Nigeria given in Appendix IV which shows initial upward trend from 1987 to 1994.

b. **Trends of cocoa production and export**

The comparison of major producers' aggregate production and export with the world totals ('000 tonnes) for the period 1961-2013, presented in Appendix II, shows that both have been rising with increasing world volumes. Also, the percentage share of the major exporters in world export has been consistently higher than their share of world output right from 1961 but the trend changed from around 2001. In disaggregated terms, production and export shares of Cote d'Ivoire have been rising from its initial third position in 1961. However, it started experiencing decline from around year 2000. These general and disaggregated trends show that events in Cote d'Ivoire, highest producer in the world, affected production and export. The time of decline corresponds to the time of political turmoil in Cote d'Ivoire (Global Witness, 2007). The graphs also show that Ghana was the highest producer and highest exporter from 1961. However, this role has been consistently dipping afterwards and Ghana was overtaken by Cote d'Ivoire as country with highest production and export shares from around 1977-78. The decline continued until Ghana got its balance and started maintaining a somewhat uniform level from the early 80s. On the other hand, Indonesia started rising to prominence from the early 80s especially in production shares. Its export share has been less uniform in growth.

The share of Nigeria in both production and export has also been declining from its second position in the 1960s and early 1970s. On the other hand, Cameroun has been maintaining low profile from inception. While Cameroun’s share of world production and export was around 6% in the early 1960s, its share of world production rose to around 8% in 1968 and maintain the little rise until its decline from 1973. Its world production share fell below 5% in 1990 and has remained so till 2007. Cameroun’s share of world export has similar trend and also been revolving around 5%.

The trends ofoutput, area harvested and yield are shown in Appendix III. The graphs show increasing production trend in recent years. Efforts of various governments of the cocoa producing nations in terms of setting up programmes aimed at boosting production have yielded fruits (see Appendix IV also). Such programmes include GERNAS programme in Indonesia, Cocoa Transformation Agenda (CTA) in Nigeria and mass spraying activities of CODAPEC (National Cocoa Diseases and Pests Control Programme), an arm of Ghana Cocoa Board (COCOBOD). Such programmes were instituted in the producing countries as panacea for declining yield (see Appendix III) occasioned by ageing trees, problems of pests and diseases, among others (Wessel and Quist-Wessel, 2015).

Related to this is the area harvested for cocoa which has been on the increase in Cote d’Ivoire, stagnating for Nigeria until year 2000 and 2007 when it increased by an approximate 500,000 hectares and reducing for Ghana until 1995, when it started rising. These trends point to the fact that increases in output in exporting countries have been fuelled mostly by increase in size of land put under cocoa production. Even with this expansion, yield is still fluctuating and moving in downward trends.

Cocoa exporting countries has not limited their trade to only cocoa beans, but rather diversified to other cocoa products. It is undisputable that cocoa beans is the most traded cocoa derived product for most cocoa producing nations (Barry Callebaut, 2007; Global Witness, 2007; Afrane and Ntiamoah, 2011), origin grinding (i.e processing in the country of origin) is getting very important. Some other cocoa-derived products like cocoa butter, cocoa powder and cocoa mass are being produced in significant amounts and exported from some of the major cocoa beans producers. Notably, about 17% of cocoa produced in Cote d'Ivoire is exported as processed products (Global Witness, 2007), grindings in Cote d'Ivoire and Ghana account for 14% of world volume (ECOWAS-SWAC/OECD, 2007) while 19% of global production was ground in Africa in 2013/14 production season (UNCTAD, 2016). Also, cocoa beans producing nations like Brazil and Malaysia absorb most of their cocoa beans for processing (ECOWAS-SWAC/OECD, 2007; Hutz-Adams *et al.,* 2016).

c. **Pesticides usage and regulation in exporting countries**

Although bio-safety is the choice of consumers worldwide due to the hazardous effects of pesticides on health, the usage of pesticides in the management of cocoa beans is virtually unavoidable because losses could be considerably high in the event of serious pest and diseases attack or quality affected in mild infestations (McMahon *etal*., 2009; Soro *etal*., 2014). In addition, pesticides application happens to be the most adopted method of controlling pests and diseases on cocoa farms due to its efficacy (Asogwa and Dongo, 2009). Thus, there is need to maintain balance between productivity/profitability and health concerns in pesticides usage (Afrane and Ntiamoah, 2011). In view of this, national governments in cocoa exporting countries have instituted regulatory framework in dealing with issue of agrochemicals in their respective domains.

In Cote d'Ivoire, representatives from different ministries form the Inter-departmental Committee on Pesticides (established through Decree 89-02). This committee is statutorily mandated to supervise approval of manufacturing, sales and usage of pesticides. Issue of cross-border movement of unapproved pesticides is being seriously addressed through human capital development. The Pesticides Control and Management Act (Act 528) of 1996 is in operation in Ghana to regulate agrochemical procurement and usage through the Cocoa Research Institute in Ghana (CRIG), an arm of Ghana Cocoa Board (COCOBOD) saddled with the responsibility of screening pesticides, and National Pesticides Technical Committee (USAID/WCF, 2012b; Akrofi *et al*., 2013). The government of Ghana assists cocoa farmers through the mass spraying programme being conducted by the National Cocoa Diseases and Pest Control (COPADEC). The mass-spraying programme has helped in raising cocoa production in Ghana (Afrane and Ntiamoah, 2011).

In Nigeria, National Agency for Food and Drug Administration and Control (NAFDAC) is in charge of issues related to regulation of pesticides and other chemicals, backed by the Drug and Related Products Act No. 19 of 1993. However, Cocoa Research Institute of Nigeria (CRIN) approves pesticides for use on cocoa farms. Conflicting roles of agencies is a particularly important problem in pesticide regulation in Nigeria, as is the case in some other exporting countries (FAO, 2006; Naibbi, 2011; USAID/WCF, 2012b). As regards Cameroun, the National Commission on Certification of Plant Protection Products and Equipment Certification meets to approve agrochemicals for sale in registered outlets in the country. Lack of adequate information on agrochemical market and poor institutional framework for control and monitoring are the key areas of challenge in the central African country (USAID/WCF, 2012b).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Scope of the Study

This study assesses cocoa exporting countries' competitiveness based on current and harmonised standards. The study covered five (5) exporting countries: Cote d'Ivoire, Ghana, Indonesia, Nigeria and Cameroun, in order of world production ranking (Cadoni, 2013; Bateman, 2015; Hutz-Adams *et al*., 2016). Nineteen (19) importing countries absorbing significant amount of cocoa from the exporters were also considered. The list includes Netherlands, Germany, Belgium, Estonia, France, Spain, Italy, Switzerland, Poland, United Kingdom, United States of America (USA), Canada and Brazil. Others are Japan, China, Malaysia, Singapore, Thailand and Russia. The study covered 2005-2016 due to the availability of comprehensive *mrl* data for this period.

3.2 Data Type and Source

Data for this study were drawn from a number of national and international agencies. Data on value of trade were sourced from International Trade Centre (ITC); productivity, output, quantity exported and producer prices were from Food and Agriculture Organization Statistics (FAOSTAT); exporter GDP and GDP per capita, importer GDP and GDP per capita and tariff were got from World Development Indicators (WDI) of The World Bank; distance, language and colonial affinity were from Centre for International Prospective Studies (CEPII; Mayer and Zignago, 2011); number of regulated pesticides in exporting countries were from Cocoa Research Institute of Ghana (CRIG), Cocoa Research Institute of Nigeria (CRIN) and some documents such as Pesticides Evaluation Report and Safer Use Action Plans (PERSUAP) of the United States Agency for International Development (USAID) while *mrl* values of pesticides and number of regulated pesticides in importing countries were from the Homologa Database. These are presented in the table of analysis of objectives in the appendix. Other secondary data were from National Bureau of Statistics (NBS), Ghana Statistical Survey (GSS), Ghana Cocoa Board (COCOBOD) and International Cocoa Organisation (ICCO). Data from the different sources were harmonised by ensuring same units irrespective of source and by normalising.

3.3 AnalyticalTechniques

3.3.1 Objective 1: Analyse the trends of SPS measures in individual cocoa-importing countries.

The trends of number of regulated pesticides and *mrl* of pesticides were shown with line and bar graphs while the trends of Stringency Indices (STIs) for EU and World cocoa trades were shown with kernel plots.

3.3.2 Objective 2: Examine the relationships between individual SPS standards and values of cocoa trade in EU and World markets.

The Stringency Index (STI) is the main measure of standard. It was generated from the number of pesticides considered for each exporting country (which included the number of regulated pesticides and pesticides that are commonly used by farmers on cocoa farms and by exporters during storage) and their *mrl* values. The relationships of the STIs with values of trade were depicted with scatterplots and the accompanying parametric regression line fittings. In calculating the STIs, this study adapted the formula used in Ferro *et al*. (2013), specified as:

$$STI_{ijct} = \frac{1}{N_{j\,(c)}} \sum_{n(c)=1}^{N(c)} \frac{MRL_{max\,.t} - MRL_{jct}}{MRL_{max\,.t} - MRL_{min\,.t}} \ldots (12)$$

where,

STI_{ijct} = Stringency index for cocoa beans in importing country *i* with respect to exporting country *j* in year *t*.

$N_{j\,(c)}$ = Number of pesticides considered in exporting country *j*.

MRL_{jct} = Exporting country *j*'s *mrl* value for cocoa pesticides in year *t*.

$MRL_{max\,.t}$ = Highest *mrl* value for cocoa in year *t* considering all importing countries in trading group (EU or World); it is the least restrictive.

$MRL_{min\,.t}$ = Least *mrl* value for cocoa in year *t* considering all importing countries in trading group (EU or World); the most restrictive.

The STI values were calculated for *mrl* value of each active ingredient (pesticide), for each year. To calculate the STI, the regulated pesticides and their *mrl* values were followed through the Homologa *mrl* data for the cocoa importing countries for each year. The lists of active ingredients in pesticides (fungicides, insecticides and storage chemicals) comprise those that are approved for use in the respective exporting countries (regulated pesticides) and those that are commonly used by the cocoa farmers, though not approved by each country's respective overseeing agency(ies). Twenty-six (26) pesticides were considered for Nigeria; twenty-five (25) for Cote d'Ivoire; thirty (30) for Ghana; twenty-three (23) for Indonesia and thirty-three (33) for Cameroon.

The calculated STI values were then used to replace each *mrl* value and were thereafter aggregated for individual country's pesticides list to generate the annual STI for each importing country with respect to its trading partner. This procedure was repeated for Codex yearly *mrl* values to get Codex Stringency Indices for EU (STIeucdx) and the World (STIwcdx). The STI varied between 0 and 1; with 0 being least restrictive and 1 being most restrictive. The Codex STI values were common for all importing countries; therefore, they were used as basis for harmonisation.

3.3.3 Objective 3: Determine the effect of individual SPS standards on values of trade in EU and world markets.

This objective was addressed with the gravity model. Adapting from IHS (2016), the explicit log-linear form of the gravity model is given as follows, incorporating heterogeneous destination in cocoa trade:

$$lnY_{mn_kit} = \alpha + lnX_{mit_{/n_kit}}{}'\beta + \delta_{mn_ki} + \gamma_{mn_kt} + \epsilon_{mn_kit} \dots (13)$$

where

lnY_{mn_kit} = log of the trade value of product *k* (cocoa) between m^{th} exporter and n^{th} importer pair with *i* importer cross-sections and time *t*.

$lnX_{mit\,/n_kit}$ = log of (vector of) explanatory variables each for cocoa exporter *m* and importer *n* across *i* cross-sections and *t* time.

β = coefficients, which might be constant or vary across cross-sections or time

i = cross-sectional units (number of cocoa-importing countries which is 10 for EU trade and 19 for world trade),

t = time (2005-2016); m_k = cocoa-exporting country; n_k = cocoa-importing country

α = overall model constant which is the intercept

$\delta_{m_k n_k i}$ = cross-section effects for cocoa exporter *m* and importer *n* pairs (random or fixed)

$\gamma_{m_k n_k t}$ = time-specific effects for cocoa exporter *m* and importer *n* pairs (random or fixed)

$\epsilon_{m_k n_k it}$ = error terms of the cocoa exporter *m* and importer *n* pairs equation across cross-sectional units *i* and time *t*.

The variables included in the analysis were as follows,

$lnY_{m_k n_k}$ = log of value of cocoa beans trade (current $US)

lnX_{1m_k} = log of productivity for cocoa beans exporters (tonnes/ha)

lnX_{2m_k} = log of GDP at market prices for cocoa exporting countries (current $US)

lnX_{3n_k} = log of GDP at market prices for cocoa importing countries (current $US)

lnX_{4m_k} = log of GDP per capita for cocoa exporters (current $US)

lnX_{5n_k} = log of GDP per capita for cocoa importers (current $US)

$lnX_{6m_k n_k}$ = log of STI (Stringency Index) with respect to exporting-importing country pairs

$lnX_{7m_k n_k}$ = log of distance between capitals or economic centres of gravity of exporting-importing country pairs (in km)

lnX_{8n_k} = log of tariff rate imposed on primary products by importing countries (simple mean, in %)

$D_{lang\ k}$ = Language dummy (D=1 if common official language exists between exporting-importing country pairs; D=0 otherwise).

D_{col_k} = Colonial tie (D=1 if trading country pairs have colonial ties; D=0 otherwise)

i. **Poisson regression method**

Santos Silva and Tenreyro (2010) defined the poisson regression by:

$$\Pr(y_i = j|x_i) = \frac{\exp(-\lambda)\lambda^j}{j!}, j = 0,1,2, ... \qquad \dots (14)$$

where λ is specified as,

$$\lambda = \exp(x_i'\beta) = \exp(\beta_0 + \beta_1 x_{1i} + \cdots) \qquad \dots (15)$$

$\beta$is the vector of parameters to be estimated and this can be done by maximising log-likelihood function given by,

$$lnL(\beta) = \sum_{i=1}^{n}[-\exp(x_i'\beta) + (x_i'\beta)y_i - \ln(y_i!)] \dots (16)$$

The poisson regression model is applied to count data as well as multiplicative models of other data types. The score vector of the model is given by,

$$s(\beta) = \sum_{i=1}^{n} [y_i - \exp(x_i'\beta)] x_i, \qquad \ldots (17)$$

while the Hessian matrix is given by,

$$H(\beta) = -\sum_{i=1}^{n} \exp(x_i'\beta) x_i \, x_i'. \qquad \ldots (18)$$

Thus, β will be consistently estimated as long as,

$$\mathrm{E}(\mathrm{y_i}|\mathrm{x_i}) = \exp(x_i'\beta) \qquad \ldots (19)$$

i.e whenever the conditional mean is correctly specified.

Poisson estimation method was used for the panel regression because it takes proper care of the zerotrade flow especially in the case of non-proliferation of zero values as is the case with this work wherein the zero trade values made up 26% in the EU trade while it was 30% in the case of World trade. The poisson regression model for cross-sectional data is run with *poisson* command in Stata and the panel option with *xtpoisson*. On the other hand, pseudo-maximum likelihood version developed by Santos Silva and Tenreyro (2006) is executed using the *ppml* user-written programme installed as add-on in Stata, which applies only to cross-sectional data. For this study, *xtpoisson* command was adopted because of the panel nature of the data used. Hausman test was carried out to select the appropriate model (random or fixed) while Ramsey test was conducted to ascertain the suitability of the poisson model. Two variants of the models were also tested: Model 1 containing both GDP and GDP per capita in addition to other variables and Model 2 having only GDP per capita in addition to the remaining gravity equation variables.

ii. Panel Unit Root and Co-integration Tests

Panel unit root test

The panel unit root was used to investigate the stationarity of the variables used in the study. The panel unit root test is similar to but not identical with that of a single time series (QMS, 2010). The unit root in this case is defined in terms of whether there are restrictions on the

Autoregressive (AR) process across cross-section or series. Given the following AR (1) process for panel data,

$$Y_{it} = \rho_i Y_{it-1} + X_{it}\delta_i + \epsilon_{it} \qquad \ldots (20)$$

where i = cross-section units or series (i = 1, 2, … , N)

t = periods (t = 1, 2, … , T_i)

Y_{it} = dependent variable

X_{it} = explanatory variables

ρ_i= autoregressive coefficients

ϵ_{it}= errors

If $|\rho_i| < 1$, Y_i is trend stationary. But if $|\rho_i| = 1$, Y_i contains unit root.

The panel unit root tests carried out in this study were: Levin, Lin and Chu (LLC); Im, Pesaran and Shin (IPS); Augmented Dickey Fuller – Fisher (ADF-Fisher) and Philip Perron – Fisher (PP-Fisher)**.** The LLC and IPS tests adopt the null of unit root (i.e non-stationarity). Two assumptions are usually made with respect to the autoregressive coefficients:

(a) ρ_i could be common across cross-sections, so that $\rho_i = \rho$. This is the assumption for LLC. Alternatively,

(b) ρ_i could vary across cross sections: assumption for IPS, ADF-Fisher and PP-Fisher.

The assumption of homogeneity across cross-sections is viewed as a key flaw for LLC while the assumption of cross-sectional independence, relevance to balanced panel only, and sensitivity to lag lengths, are also the main points against IPS. The Fisher-type tests are seen as viable alternatives to LLC and IPS because they take care of the shortcomings (Geda *etal*., 2012).

Panel cointegration test

Panel co-integration test was used to check whether long-term relationship exists among variables in the panel data. The co-integration test in panel analysis uses an extension of Engle and Granger (1987) framework which was developed by Pedroni (1999, 2004) and Kao (1999). The decision criteria with respect to the Engle-Granger framework, is that if variables are co-integrated, the residual will be I(0) i.e integrated at the level of the data. On the other hand, if the variables are not co-integrated, the residual will be I(1) i.e integrated at first difference. For the Pedroni framework, assuming the following equation is given,

$$Y_{it} = \alpha_i + \delta_i t + \beta_{1i} X_{1i,t} + \beta_{2i} X_{2i,t} + \cdots + \beta_{mi} X_{mi,t} + \epsilon_{i,t} \qquad \ldots (21)$$

where

t = 1, … , T; i = 1, … , N; m = 1, … , M

α_i = individual effects; δ_i = trend effects; $\epsilon_{i,t}$ = residuals

Y and X are integrated of order one i.e I(1).

Under the null hypothesis of no co-integration, the residual $\epsilon_{i,t}$ will be integrated of order one. The rejection of the null hypothesis means that there is co-integration.

Pairwise correlation test

Pairwise correlation test was also carried out to find out if there is a possible bicausality between productivity and value of trade, which is the dependent variable.

iii. **Description of variables**

The dependent variable used in this study is the value of the cocoa trade between major cocoa producing/exporting nations and importing nations. It was measured in current US dollars. The explanatory variables, whose relationships were tested against value of trade, are given below:

a. **Productivity (**X_1=ln1prdctvy**)**: In the traditional gravity equation, land masses of trade partners stand for their sizes. Direct land size was not included in this study because a primary product like cocoa is grown on a limited area of the exporting countries' land masses. In lieu of this, output per unit area, was adopted as proxy to compare yield across countries and how this affects cocoa supply to the international market. It is expected that high land productivity will drive trade. Productivity is being tested newly for gravity model in this study. It was measured in tonne/ha.

b. **Exporter GDP** (X_2=lngdpx): A country's GDP, otherwise referred to as its national income, measures the supply capacity of the nation. A high-income cocoa-exporting country will be able to supply products at cheap prices thus capturing diverse markets in line with price equalisation theory (Salvatici, 2013). With this, positive relationship should exist between GDP and value of trade.

c. **ImporterGDP** (X_3=lngdpi): Positive relationship is expected between GDP and value of trade because nations with high GDP tend to trade more (Head, 2000). The importing countries in this study, who were mainly industrialised nations, are expected to absorb large amount of cocoa beans from the exporters thereby improving trade.

d. **Exporter GDP per capita** (X_4=lngdpcx): The exporter GDP per capita shows the level of income of individuals within the developing countries supplying cocoa to the international market. Since cocoa production is mostly carried out by smallholders in developing countries (Asante-Poku, 2013; UNCTAD, 2016), GDP per capita might stand for the supply capacities of the exporting countries. Thus, positive relationship is expected between this variable and value of trade. On the other hand, high income level in exporting country might discourage cocoa export due to higher prices attached to value-added products which domestic industries might want to tap into.

e. **Importer GDP per capita** (X_5=lngdpci): This indicates the purchasing power of consumers in the importing countries. Positive relationship is expected between importer GDP per capita and value of trade (Crivelli and Groschl, 2012; Wei *etal*. 2012; Kareem, 2013) as a result of consumptive ability. Higher income per capita means that consumers will have ability to purchase more cocoa products and thus leads to increased trade in raw cocoa beans which is necessary for their production. All GDP variables were measured in current US dollars.

f. **Stringency Index** (X_6= lnsti): Stringency index (STI) is a continuous variable. It is one of the measures that have been used to capture restrictiveness of standards in agricultural trade. The direction of effect of measure of standard could be positive (Shingal *etal*., 2017), negative (Ferro *etal*., 2013; Melo *etal*., 2014), a mix of both (Xiong and Beghin, 2012; Kareem, 2014a) or none-existent (Xiong and Beghin, 2012) depending on the type of regulation, compliance capacity or type of margin (extensive or intensive).

g. **Distance** (X_7= lndist): In the gravity equation, bilateral distance is a proxy for bilateral trade costs that reflects negatively on consumer prices (Salvatici, 2013). Also, when high cost is incurred in taking product to a particular market, profit margin is narrowed. With these, negative relationship is expected between distance and trade value. This was summarised in the submission of Anderson (2014) that countries separated by large distance trade less. Distance between capital cities of each trading partner pair was measured in kilometers (km).

h. **Tariff** (X_8= ln1tariff): Tariff is one of the trade instruments that had been in usage prior to the popularisation of SPS measures. It is a rate that importing countries usually charge on goods entering their countries. Since it introduces additional cost to trade, it is a form of barrier which is likely to reduce trade. Tariffs are of different forms but the one used in this study was simple mean rate (%) which performs better than the weighted mean (UNCTAD/WTO, 2012).

i. **Language** (D_1=D_{lang}): Language was introduced as a dummy variable into the gravity equation. It takes value of 1 if the trading partners have the same official language and 0, otherwise. Countries that speak the same language are expected to trade more as a result of common cultural basis. Notwithstanding this positive relationship, Disdier *etal*. (2008b) reported a negative relationship between language and value of trade while Iacovone (2004) reported mixed effect.

j. **Colonialties** (D_2=D_{col}): Countries that have had one form of colonial relationship have shared history and are likely to trade more (Head, 2000). There would've been cross-influences on consumption pattern which is very important for food product such as cocoa. Positive relationships between colonial affinity and value of trade have been reported by virtually all studies in the gravity model analysis of effect of standard on agricultural trade.

3.3.4 **Objective 4:Estimate the cost implication of adopting individual SPS standards in lieu of Codex standard by importing countries.**

The elasticities of standard variables (STIs) derived from the gravity equations (EU and World) were used together with values of trade to assess the cost effect of standards on export for different scenarios (non-harmonised and harmonised). Methods of Wilson *et al*. (2003) and Chen *et al*. (2008) were adopted in this work. Thus,

$$dEX_{ij}^{k} = \beta\left(\frac{EX_{ij}^{k}}{STI_{i}^{k}}\right)\left(STI_{codex}^{k} - STI_{i}^{k}\right) \ldots (22)$$

dEX_{ij}^{k} = change in value of trade for cocoa beans from 5 exporting countries *j* to 19 importing countries *i*,

β= estimated elasticity of standard for EU trade and world trade i.e coefficient of Stringency Index variable,

EX_{ij}^{k} = Value of trade between exporter *j* and importer *i*,

STI_{i}^{k}= Importers' measure of standard on cocoa (pre-harmonised level of standard),

STI_{codex}^{k} =baseline (international) measure of standard in cocoa harmonised level of standard), The essence here is to see the changes associated with difference in standard (individual and Codex) and the percentage relationship with the baseline.

3.3.5 Objective 5: Evaluate the level of competitiveness of the major exporters based on individual and Codex standards.

In order to determine the level of competitiveness of each exporting country, the exporters were ranked based on three (3) criteria: export value at the current level of importers' standards, change of current export value from estimated Codex value and percentage change from Codex. The averages were taken to get average Rank scores (RS) which were then transformed to Competitiveness scores (CS). The relationship between RS and CS is given by,

$$CS = \frac{1}{(i + RS)} \ldots (23)$$

Where *i* is a discrete factor that could take values 1 and above. The factor is 1 for positive values of RS. However, if rank score is negative (RS<0), the factor must satisfy the condition: i>|RS|. That is, it must be greater than the absolute value of rank score whenever the average rank score is negative. This is necessary to be able to take the inverse of rank score. The higher the CS, the higher the level of competitiveness of the exporting countries.

3.4 Limitations of the Study

Some of the challenges encountered in data availability, completeness, structure and specifications, and the way they were addressed are presented in this section. Firstly, some data were found missing and the missing values were replaced using the last export values because linear and exponential trend values were overtly large. Moreover, the last export values were considered more appropriate due to dwindling cocoa production in the main exporting countries as a result of ageing trees and farmers (Idowu *et al.*, 2007; IDS/IFAD, 2015) and observed low productivity in addition to the dwindling cocoa producer prices in the world market (FAOSTAT, 2016).

With respect to the number of regulated pesticides and the *mrl* values, missing values were replaced with Codex values since most countries, especially the ones used in this study, resolve to Codex in the absence of national legislation, as shown by Homologa Agrobase-

Logigram documentation. In the absence of Codex*mrl* values, the default 0.01mg/kg was used. The harmonised standard was also used generally for the EU countries from 2011 except for countries that still maintained national regulation. For Asian countries, Codex and ASEAN (Association of Southeast Asian Nations) values in the *mrl* data were used in the cases of missing data depending on the year. Furthermore, for most of the exporting countries, the lists of regulated pesticides were available. However, this was not the case for pesticides that are commonly used by cocoa farmers in different producing countries. They were scouted from literature and other sources. Also, comprehensive *mrl* historical data collected by Homologa Agrobase-Logigram was only available from 2005-2016 and this has limited the period covered by the work.

The panel Poisson regression executed with non-transformed dependent variable for this study gave spurious results. To overcome this defect, log transformation of the dependent variable was carried out. This problem might have occurred as a result of the structure of the data (panel of panel) which is a very important consideration in using PPML, as noted by Santos Silva and Tenreyro (2010), who actually worked with cross-sectional data. More so, log transformation has been adopted by Abdoulaye (2016) within a Poisson regression context, perhaps in a multiplicative sense.

In the assessment of the effect of standards on export for different standard scenarios (individual and harmonised), especially while calculating change in trade value from Codex, a challenge of infinite numbers was encountered. There were four (4) such values for EU trade analysis out of six hundred (600) observations (5 exporters x10 importers x 12 years) and eight (8) cases for world trade out of one thousand, one hundred and forty (1,140) observations (5 exporters x 19 importers x 12 years). In contrast to what was done in Wilson *etal*. (2003) in a similar circumstance wherein values were truncated at a particular level, this study adopted a rescaling approach. Firstly, individual countries' STI values of zeros (4 for EU and 8 for world) were replaced with 0.00001 to lower the outcome estimates from infinity to infinitely large numbers. Maximum normal positive value was then equated to the largest (infinite) value and other infinitely large values were scaled down proportionately. This rescaling gave the opportunity of meaningful comparison among countries and prevented loss of important information that would have occurred through truncation.

Table 1: Explanatory variables and their possible signs

Dependent variable: Value of Export Explanatory variables:	Expected signs	Sources
1. Exporter GDP/GNP	+	Gebrehiwet *et al.* (2007), Crivelli and Groschl (2012)
	– , +	Kareem (2013), Wilson *et al.* (2003)
2. Importer GDP/GNP	+	Wilson *et al.* (2003), Iacovone (2004), Chen *et al.* (2008), Gebrehiwet *et al.* (2007), Wei *et al.* (2012) Kareem (2013), Crivelli and Groschl (2012)
3. Exporter GDP/GNP per capita	+	Wilson and Otsuki (2001)
	– , +	Otsuki *et al.* (2001)
4. Importer GDP/GNP per capita	+	Otsuki *et al.* (2001), Iacovone (2004) Wilson and Otsuki (2001), Drogue and DeMaria (2012)
5. Exporter Output	+	Chen *et al.*(2008),Wei *et al.* (2012), Drogue and DeMaria (2012)
6. Land area (Exporter)	–	Soloaga and Winters (2001)
7. Land area (Importer)	–	Soloaga and Winters (2001)
8. Population (Exporter)	–	Gebrehiwet *et al.* (2007), Wilson *et al.* (2003)
9. Population (Importer)	–	Gebrehiwet *et al.* (2007), Wilson *et al.* (2003)
10.Measure(s) of standard		
a. Aflatoxin B1	–	Otsuki *et al.* (2001), Wilson and Otsuki (2001), Iacovone (2004) Gebrehiwet *et al.* (2007),
	none	Xiong and Beghin (2011)
b. Maximum Residue Level (*MRL*)	–	Wilson *et al.* (2003),Chen *et al.*(2008), Wei *et al.* (2012)
c. *MRL* Heterogeneity Index	–	Foletti and Shingal (2014a&b)
	+	Shingal *etal*. (2017)
d. *MRL* Stringency Score	– , +	Xiong and Beghin (2012)
e. Hurdle to Pass (HTP)	– , +	Kareem (2013, 2014a&b)
f. Standard Restrictive Index (SRI)	–	Ferro *et al.* (2013)
g. Similarity Index (SIM)	–	Drogue and DeMaria (2012)
h. Bridge to Cross (BTC)	–	Munasib and Roy (2011)
i. SPS (conformity assessment)	–	Crivelli and Groschl (2012)
j. SPS (product characteristics)	– , +	Crivelli and Groschl (2012)
k. SPS measures	–	Disdier *et al*. (2008; 2008b), Jongwanich (2009), Fontagné *et al.* (2013), Murina and Nicita (2014)
l. SPQ regulations	–	Melo *et al*. (2014)
11. Distance	–	Otsuki *et al.* (2001), Iacovone (2004), Disdier *et al*. (2008b) Soloaga and Winters (2001), Gebrehiwet *et al.* (2007), Chen *et al.* (2008), Wei *et al.* (2012), Wilson and Otsuki (2001), Crivelli and Groschl (2012), Ferro *et al.* (2013), Wilson *et al.* (2003), Drogue and DeMaria (2012), Foletti and Shingal (2014b)
	+, –	Kareem (2013)
12. Tariff by importer	–	Chen *et al.* (2008), Ferro *et al.* (2013); Disdier *et al.* (2008b) Crivelli and Groschl (2012); Drogue and DeMaria (2012)
	+ , –	Wei *et al.* (2012)
13. Language	–	Disdier *et al*. (2008b)
	+	Crivelli and Groschl (2012); Drogue and DeMaria (2012); Foletti and Shingal (2014b); Shingal *etal*. (2017)
	+ , –	Soloaga and Winters (2001), Iacovone (2004)
14. Colonial ties	+	Otsuki *et al.* (2001), Ferro *et al.* (2013), Disdier *et al.* (2008b) Wilson and Otsuki (2001), Wilson *et al.* (2003)
	+ , –	Shingal *etal*. (2017)

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter describes the assessment of cocoa export competitiveness from theperspective of the effects of SPS standards on values of cocoa trade. The chapter comprisesfive sections. The first section looks at the trends of SPS measures in the importing countries in terms of number of regulated pesticides, the *mrl*s of the pesticides and the stringency indices.The second section examines therelationship between cocoa trade values and the measure of standard; the third section focuses on the role of SPS standard in determining trade flow while the fourth sectionanalyses the cost implication of current levels of importers' standards and presents possible effect of harmonised standard on individual exporters and all the exporters in the aggregate.Chapter five evaluates the competitiveness of the exporters based on information from current and harmonised trade values.

4.1 Trends of Sanitary and Phytosanitary (SPS) Measures

The first part of this section examined the trends of number and *mrl* values of regulated pesticides for individual importing countries and for country groups. The second part assessed the trendsof Stringency Indices (STIs) in comparison with the values of export for thetrade partners.

4.1.1 Trends of number of regulated pesticides and *mrl* of pesticides

This sub-section has two (2) divisions. The first division looked at the trend of number of regulated pesticides for individual cocoa-importing countries and averages for country groupings while the second division focused on the average *mrl* values of pesticides for each importing country and meansof average *mrl* values for country groups.

a. Number of regulated pesticides in individual importing countries and their group-level averages

i. Number of regulated pesticides for individual importers

This division presentsthe number of regulated pesticides that each importing country legislated upon on yearly basis, starting with the countries in the European Union. This is followed by other countries and all the importing countries pulled together. By pesticides, the study referred to active ingredients found in different brands of pesticides for which historical *mrl* values were kept by the Homologa Agrobase-Logigram. The higher the number of the pesticides regulated by a particular importer, the more restrictive such country is because the exporting country will have to abide by many pesticides *mrl* regulation.

The number of regulated pesticides on country basis is presented in Figure10 (a few countries are represented here, others could be found in Annex A of Appendix V). France had the highest number of regulated pesticides (181) for year 2005 followed by Switzerland (55) and Netherlands (54) in the same year. Other countries had a few number. In 2006, however, Netherlands increased the list approximately 10-foldsandremained at this level in subsequent years also. France had initial large number of pesticides (181) equally in 2005 and 2006 and subsequent small number until 2011 when national French standard was harmonised with EU standard. Belgium had large list prior to EU 2011 full harmonisation but values were not available for 2005 and 2006 and were replaced with Codex values. Estonia, Germany, Poland and United Kingdomhadlarge values from 2008 in response to harmonisation and new EU *mrl* regulation. Similarly, no regulated pesticides were given for these countries prior to 2008. Therefore, Codex values were also used. It is worthy of note that harmonisation of *mrl* standard was already in place in the EU in 2008 but many countries still had national regulations. Full harmonisation was however in place from 2011 wherein all EU countries adopted uniform *mrl* regulation with the exception of Switzerland that still kept national regulation.

Switzerland maintained uniform list of 55 active ingredients till 2009 and started increasing the list from 2010. Switzerland still had national pesticide list which though increasing in number, was incomparable to the larger number in the EU harmonised list. Italy regulated an average of 5 pesticides between 2005 and 2010. In summary, with respect to the number of regulated pesticides, Netherlands had the most stringent regulation, followed by Spain and Belgium in decreasing order. Italy had consistently maintained low stringency while France had lowered its level of stringency drastically before the commencement of harmonisation of EU *mrl*standard.

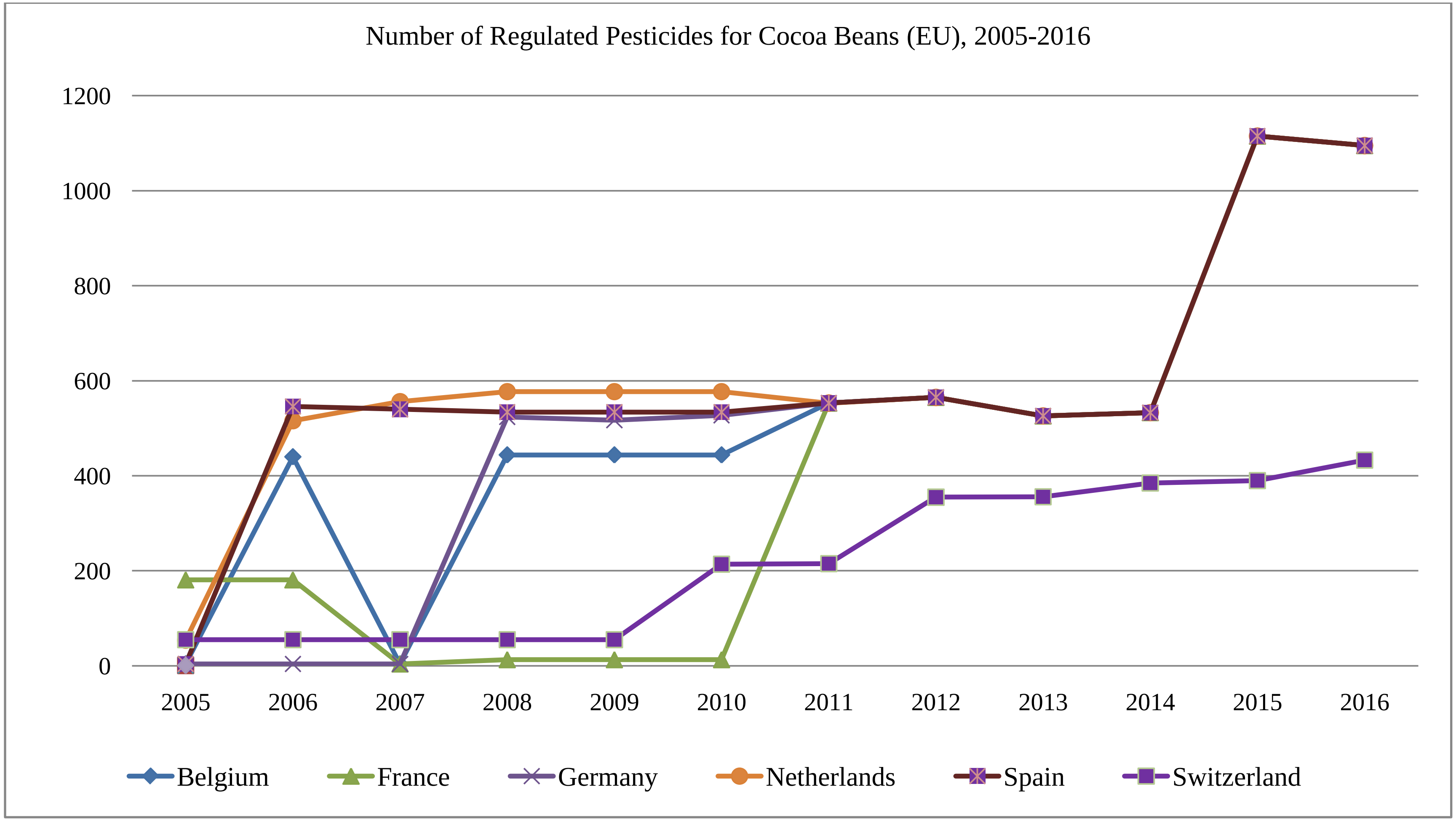


Figure 10: Number of regulated pesticides for cocoa beans in the importing EU countries
Data Source: Homologa Agrobase-Logigram (2017)

Japan was the only country with prominent number of regulated pesticides for other countries outside the EU (Annex A of Appendix V). In 2005, Japan had twelve (12) active ingredients listed for inspection on cocoa beans imported to the country. This was reduced to seven (7) active ingredients in 2006. However, the list was increased to one hundred and seventy-nine (179), six hundred and thirty-three (633) in 2013 and seven hundred and three (703) in 2016. The closest country to Japan but in actual fact with far lower number of regulated pesticides was Malaysia which had an average of forty (40) pesticides from 2007. Other countries that had appreciable number of regulated pesticides were USA (average of 14), Brazil (av. 14) and Singapore (av. 9) while China had the lowest (av. 4). These are presented in Figure 11.

The number of regulated pesticides in Japan was far more than that of other countries and was even increasing with time periods. This indicates stringency of Japanese regulation. It was more for period 2011-2016 and less for 2007-2010. It was least for the time period 2005-2006 which was prior to the time Japan reviewed its law on import of agricultural commodities to a more stringent level, withparticular reference to cocoa beans.

As regards Malaysia, the reduced stringency of *mrl* regulation might not be unconnected with the fact that Malaysia, though a producing country, is a net importer of cocoa beans for its processing industry. The reduction might serve as an incentive for attracting prospective exporters. This situation is also similar for USA (though with more lenient standard than Malaysia) because it processes much cocoa for its large chocolate industry (Panlibuton and Meyer, 2004) and thus need large consignments and might consider cocoa beans of lower quality for blends. Brazil is also a net importer of cocoa beans for processing, Singapore isan industrialised entity, while China and Thailand are emerging markets in cocoa purchase and thustheir regulationsmight be at emergence stage. Comparison of both EU and non-EU countries showed that it was only Japan whose regulation was at par with EU countries in terms of stringency of standards among countries outside the EU.

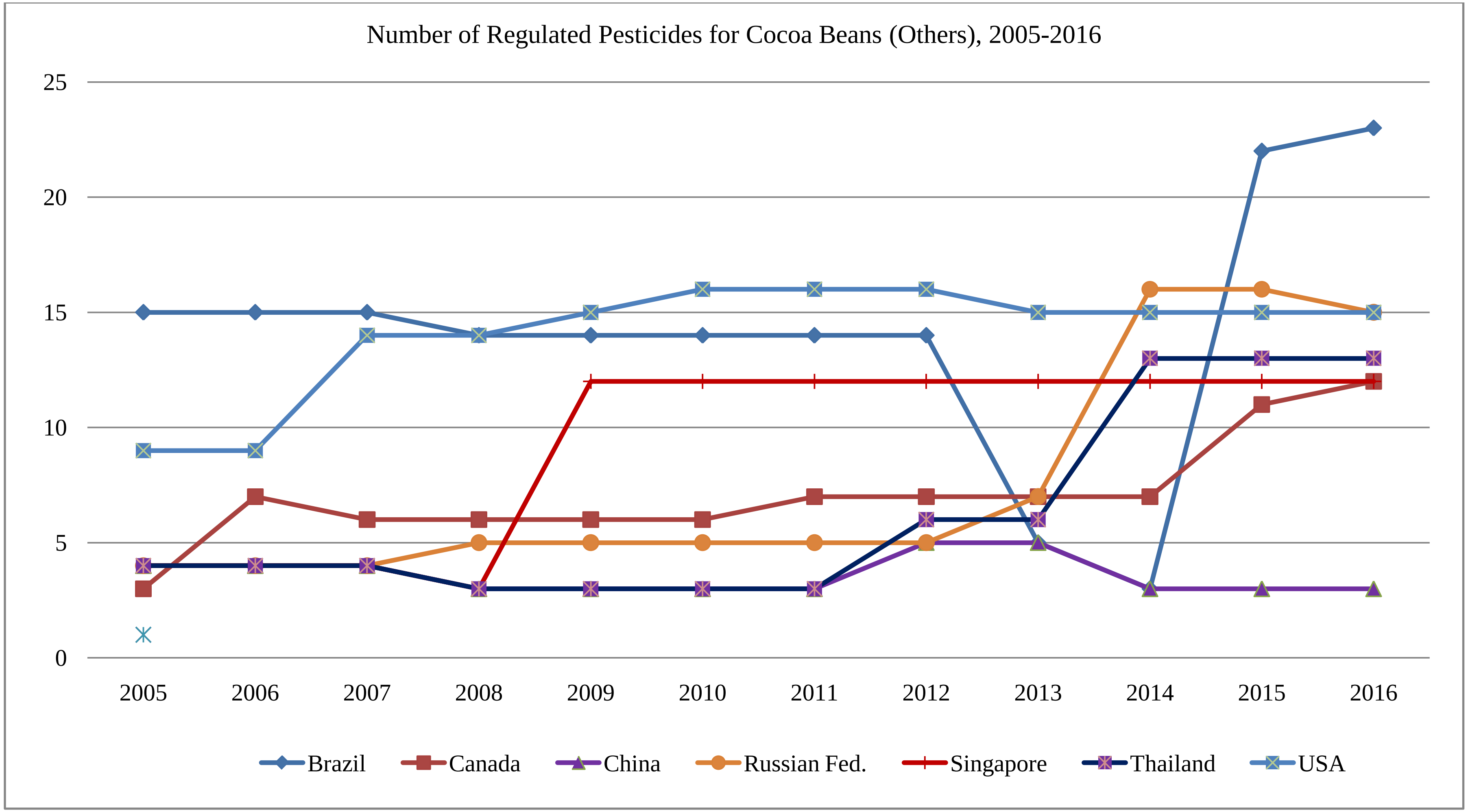


Figure 11: Number of regulated pesticides for cocoa beans in importing countries other than the EU
Data Source: Homologa Agrobase-Logigram (2017)

ii Number of regulated pesticides for country groupings

Analysis of number of regulated pesticides based on country groupings in addition to the total value for all importing countriesis presented in Figure 12in a combined line and bar graphs. The total number of pesticides for all importing countries showed upward trends mostly. Significant increases were observed in 2006, 2008, 2011 and 2015. The year 2006 corresponded to the time of initial large pesticide list by Belgium, Netherlands and Spain. Also, the EU rolled out new *mrl* regulation in 2008 (2nd September) while full harmonisation of *mrl* regulation was implemented in 2011. The graphs showed that global regulation for cocoa beans with respect to the number of pesticides had been increasingly stringent with time and this had been driven largely by the EU regulation changes as shown by high values for the percentage of total exhibited by the EU.

The mean values presented in Figure 13 also showed that mean number of pesticides in EU had been consistently higher than for other countries taken together and the pattern of increases for EU was similar to that of mean of total. This confirmed the stringency of EU regulation and the fact that increases in the global average number of regulated pesticides, and by extensionthe overall stringency, had been driven by EU values. The mean values for other countries outside the EU had remained almost uniform with little increases at some pointssuch as in 2011 probably in response to the raising of standard by the EU.

b. Average *mrl*of pesticides in individual importing countries and for country groupings

i. Average *mrl*of pesticides in individual importing countries

Average *mrl* values of pesticides that each importing country legislated upon on yearly basis are presented in Figure 14 (a few countries are presented here and values for other countries could be found in Annex B of Appendix V). The judgment on stringency with *mrl* value is in contrast to that of number of regulated pesticides: the lower the *mrl* value, the higher the stringency of standards. These averages are irrespective of the type and number of pesticides regulated in each country (Ferro *etal*., 2013). The USA had the highest value of average *mrl* throughout the period of the study (2005-2016). It was followed by Canada and lastly, Russian Federation. The high average *mrl* values meant that the countries were least-stringent in regulation since there is leeway for the cocoa exporting countries if high amount of residue is found in their cocoa beans at the importing countries’ borders.

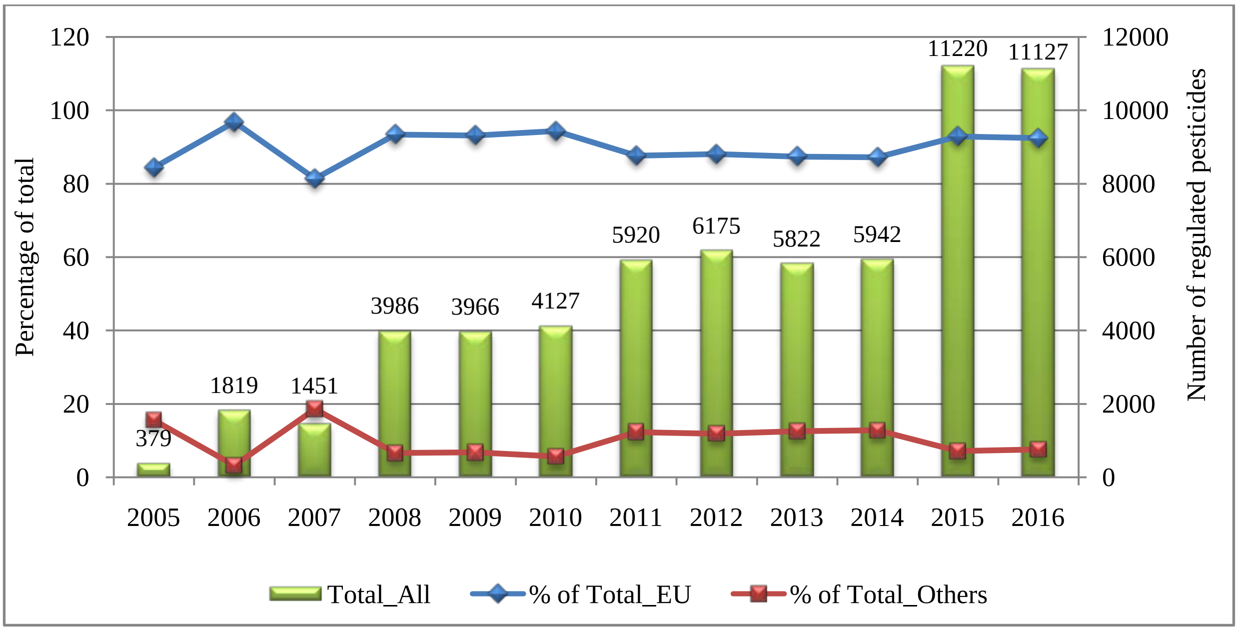


Figure 12: Trends of percentage shares of country groupings and no. of regulated pesticides

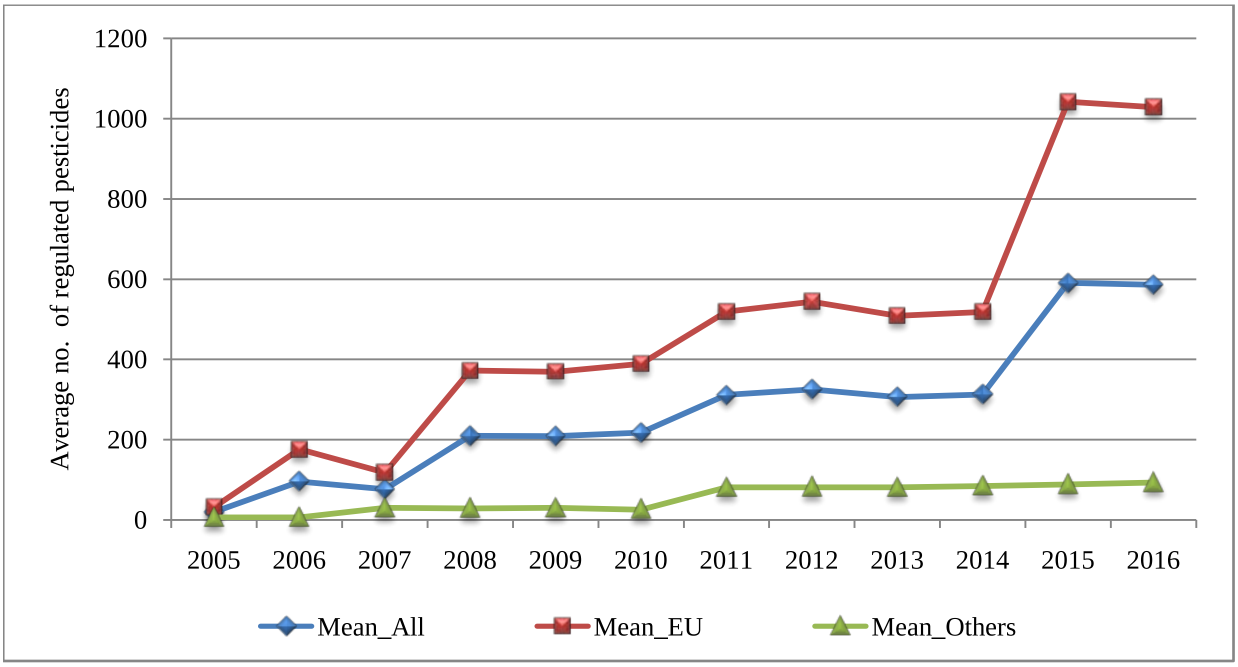


Figure 13: Average number of regulated pesticides for country groupings

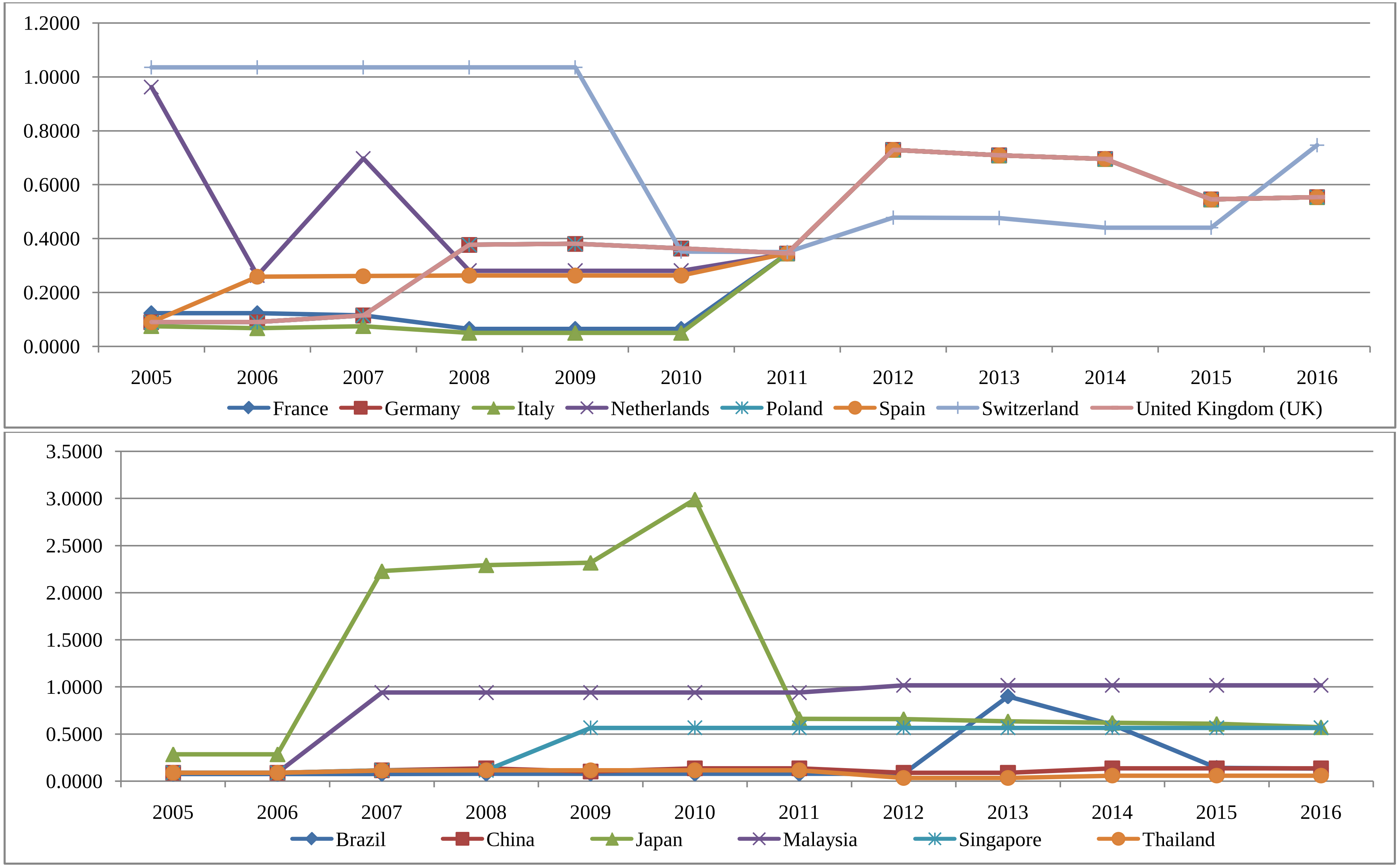


Figure 14: Average *mrl* of pesticides for each importing countries (EU and others)

Data Source: Homologa Agrobase-Logigram (2017)

ii. Mean of average *mrl* of pesticides for country groupings

Trends of average *mrl* values for all pesticides regulated by all importing countries, the EU-harmonised values and the Codex values are presented in Figure 15 with bar chart (for all countries) and line graphs (for EU-harmonised and Codex). The bar graph showed fluctuating but downward trend. The first line graph (EU) had almost uniform slope in 2008-2009 and 2012-2014, increased in value from 2011-2012 but a reduction in 2014-2015. The second line graph (Codex) showed averagely similar plot values between 2005 and 2014 after which the value shot up and remainedon the same level in 2016.

The downward though fluctuating movement of the mean *mrl* values for importing countries implied that *mrl* standards were becoming more stringent with time. In addition, the line graphs showed that average *mrl*values for Codexwere lower than for EU harmonised with the exception of years 2015 and 2016. At first glance,thisindicated that Codex standard was more stringent than EU-harmonised. However, this is not necessarily so. The number of pesticides being regulated under Codex was very small compared to the number of pesticides for the EU harmonisedand the *mrl* values for the latter varied between small and largevalues whereas there were just few small *mrl* values for the limited number of pesticides regulated under Codex. This made the average *mrl* value for the EU-harmonised group to be larger. In addition, increases in average *mrl* value for EU-harmonised followed the time pattern of pesticide list expansion (2008 and 2011/12), which supported the assertion that the number of pesticides actually influenced general average *mrl* value and by extension, stringency of standards.

Judging from previous explanation, the expectation between 2014 and 2015was that higher number of pesticides will translate to larger average *mrl* value and therefore, low stringency. However, the opposite occurred. The number of pesticides regulated by the EU increased from 5182 to 10425 but the average *mrl* value was lower, indicating higher stringency. This signified that increase in number of pesticides was accompanied by lowering of *mrl* value of each pesticide, a tightening of standard. In contrast, the small list for Codex (6 pesticides) still translated to higher average *mrl* value which meant that the Codex standard was relaxed.

A simpler and clearer picture was painted by the 3-line graph in Figure 16. The double average *mrl* values for the EU group of countries was lower than the general average anddouble average *mrl* values for others were higher than the general averages in all the years. This indicated that the *mrl* standard was more stringent in the EU than in the non-EU bloc of countries. Furthermore, the pattern of slope for the general average was similar to that of non-EUbloc showing that changes in the general average *mrl* values were likely driven by other countries, not EU. This was particularly true based on the fact that there was large disparity between minimum and maximum *mrl* values for non-EU countries (min=0.0001, max=300) than for the EU (min=0.010, max=70).

The implications of these distributions are as follows: when all the major cocoa-importing countriesare considered, there is low disparity in stringency between the two distinct groups of low and high stringency. On the other hand, if only the EU importers are taken into consideration, there is notably high disparity between the two groups in the distribution.The general conclusion that could be drawn for this section (Section 4.1.1) is that the EU bloc generally had more stringent standards facing cocoa export from the developing countries who were the major exporters of cocoa beans.

4.1.2 **Trends of Stringency indices (STIs) for cocoa trade**

This section centred on trends of stringency indices for cocoa trade. The first division presented the distribution of the Stringency indices for EU (STIeu) and World cocoa trades (STIw) while the second division showed trade partners' trends of stringency indices in comparison with trade values for global cocoa trade.

a. **Distribution of the Stringency indices (STIs)**

The distribution of the individual countries' stringency indices with respect to the World (STIw) and the EU (STIeu) cocoa standards were shown in Figures 17 and 18 respectivelyusing the kernel line diagrams. The two line-graphs, which were both bi-modal, were combined in Figure 19. The first line distribution (Figure 17) showed that, with respect to the world cocoa standard, importing countries were more concentrated at the lower (left) end of the distribution and the distributions at the two ends were close. In contrast, more countries were found at the upper (right) end of the distribution for the EU cocoa importers' standard and with more disparity in the modal distributions. Moreover, the combined plots showed that at the lower end of the stringency indices, the density of the STIw is greater than STIeu while STIeu is denser at the upper end of the standard continuum. This also shows that EU countries had more stringent standards.

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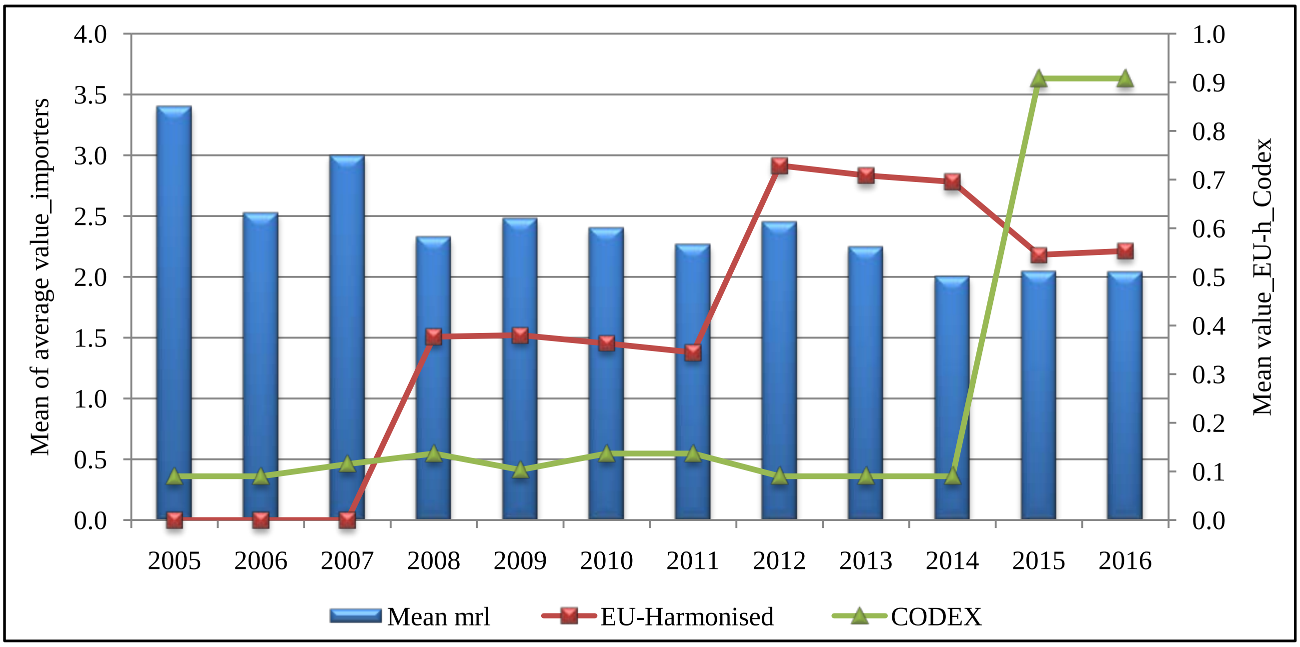


Figure15: Average *mrl* values for all importers, EU-harmonised and the Codex

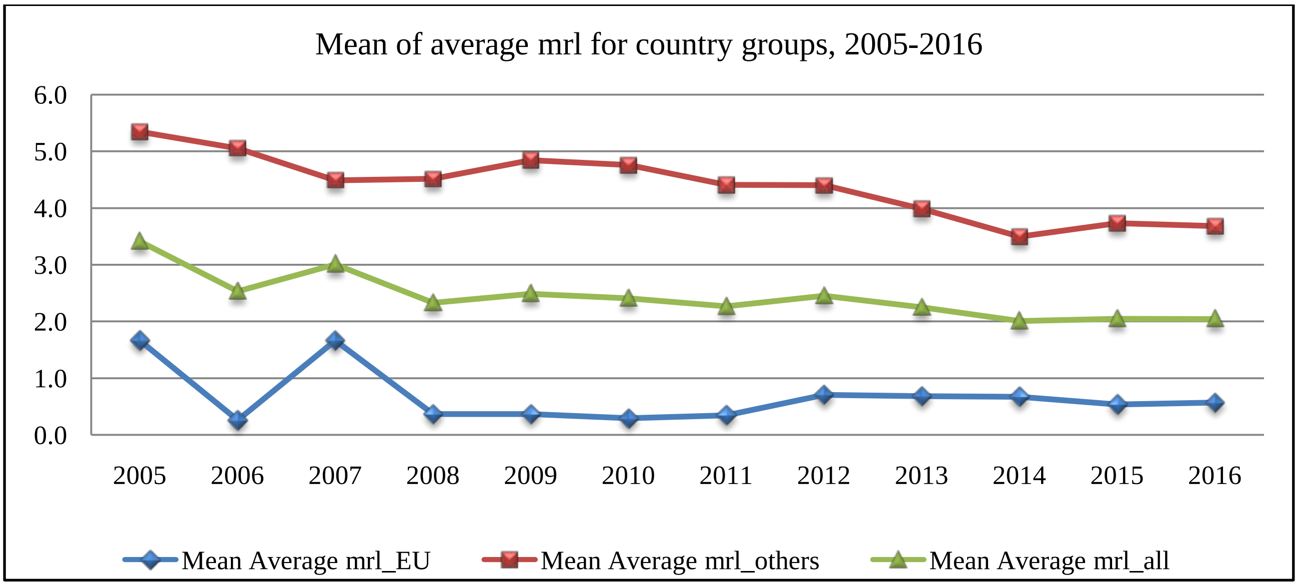


Figure16: Mean of the average *mrl* values of active ingredients in pesticides for country groupings

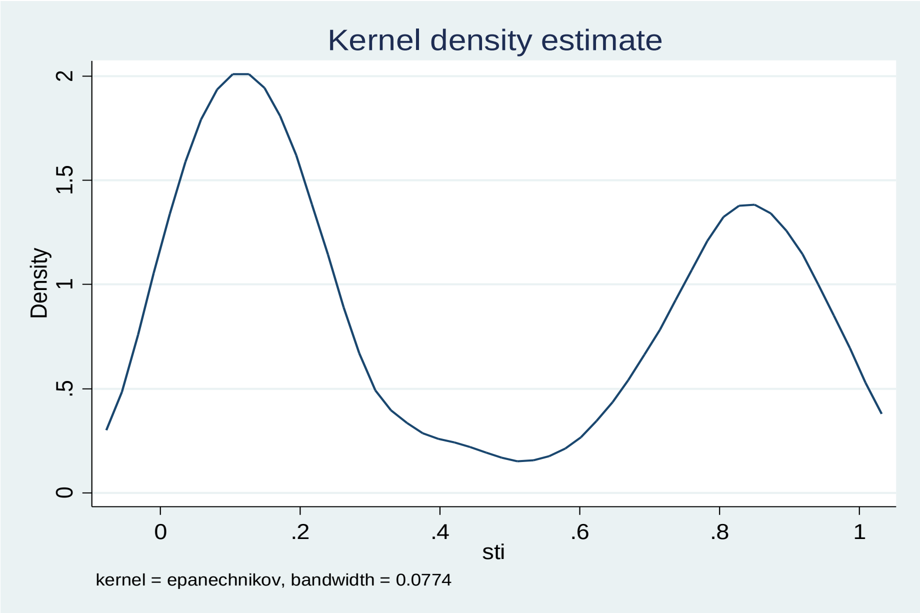


Figure 17: Kernel density plot for Stringency Indexwith respect to world cocoa trade (STIw)

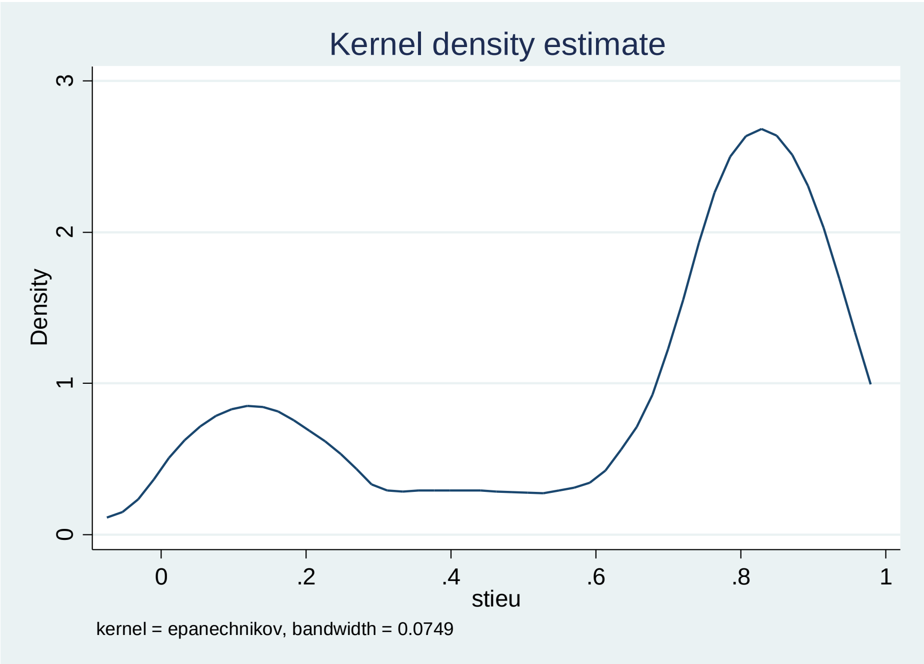


Figure 18: Kernel density plot for Stringency Index with respect to EUcocoa trade (STIeu)

b. **Trends of global stringency indices and values of cocoa trade on individual exporting countries basis**

i**.** **Nigeria**

Positive relationships were observed between stringency indices and value of Nigerian export to Belgium, Estonia, France, Germany, Netherlands and Spain. For Italy, there was an initial increase in value of export with increasing STI value but there was a decline later on. Value of export and the stringency index for Spain followed almost a perfectly similar trend. The same was applicable to Netherland. Low stringency index in China was accompanied by increase but fluctuating increase in cocoa beans import from Nigeria. Trade with Japan was irregular with respect to increasing cocoa standard. Export to the United Kingdom was also at high level but also fluctuated downwards in 2007 and 2013. The low and uniform import standard in USA was associated with increasing import while low level of standard in Singapore was associated with an initial increasing but a subsequent declining trend after 2010. All these are presented in Figures19a&b. On a general note, increase in EU standard was not really discouraging export from Nigeria but had slight negative impact. For some of the other importing countries, it is intuitive that low standard will encourage export.

ii. **Cote d'Ivoire**

The relationships between Ivorian exports and importers' standards are presented in this section (Figure 20a&b). Brazilian low STI initially increased cocoa trade with Ivory Coast but export value dropped drastically from 2012 as a result of marginal increase in STI. Canada maintained low STI which increased marginally in 2012 and around 2015. The Canadian cocoa import was large and decrease in trade was only with minor dip. China's low STI was accompanied with large cocoa import that just decreased slightly around 2008 to return to initial levels. Low STI in Canada, Malaysia and China encouraged import from Cote d'Ivoire. For Italy, there wasn't much difference between the time STI was low (pre-2009) and when it was high (post-2009). Although import standard in Brazil was low, its import from Cote d'Ivoire dropped in 2012 and had remained close to zero since then. Cote d'Ivoire might have diverted its export to more profitable markets or Brazil looked more inward since it is also a major producer but net importer of cocoa beans for its processing industry (Hutz-Adam *etal*., 2016).

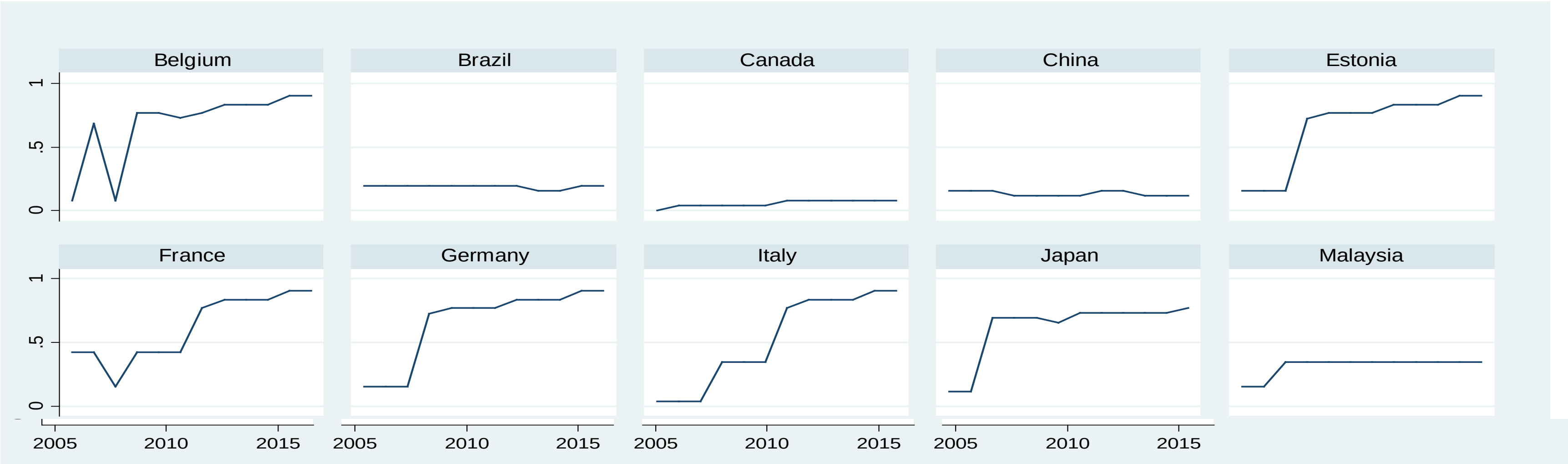
Netherlands was importing large quantity of cocoa from Cote d’Ivoire and increase in standards in 2008 and 2011 did not really influence trade. The reason for this could be that Cote d’Ivoire is the largest cocoa beans exporter in the world and Netherlands largest importer (CBI, 2016). With this, Cote d’Ivoire could easily adjust to any changing regulation. The situation is similar but at a lesser degree for other EU countries like Spain, United Kingdom, France, Germany, Italy and Estonia. The USA is a large importer that constantly maintained low STI. Thus, cocoa beans from Cote d’Ivoire could easily pass ‘acid test’ of the American market since it produces for more stringent markets.

iii. **Ghana**

Cocoa export to the EU countries remained high despite increases in standard, a situation similar to what obtained for Cote d’Ivoire. The affected EU countries were Netherlands, United Kingdom, Spain, Germany, Italy and Estonia. Similarly, despite stringent Japanese regulation, import of Ghanaian cocoa had been large. This observation from the data portrayed real situation on ground in Ghana wherein the Ghana Cocoa Board (COCOBOD) had been constantly monitoring and properly testing cocoa being exported to the Japanese market especially since 2008 when Japan added more active ingredients to its already stringent regulation (Jonfia-Essien, 2012).

Less stringent regulations in China, Malaysia, Thailand and Singapore was making them easy markets for Ghanaian cocoa though more volume went to China and Malaysia than to Thailand and Singapore. The very significant trade being conducted with lowly regulated USA cocoa market suffered minor setback between 2006 and 2011 but had normalised since then. These and the graphs for the remaining countries could be seen in Figure 21a&b.

Nigeria: Stringency Indices



Nigeria: Log of values of export

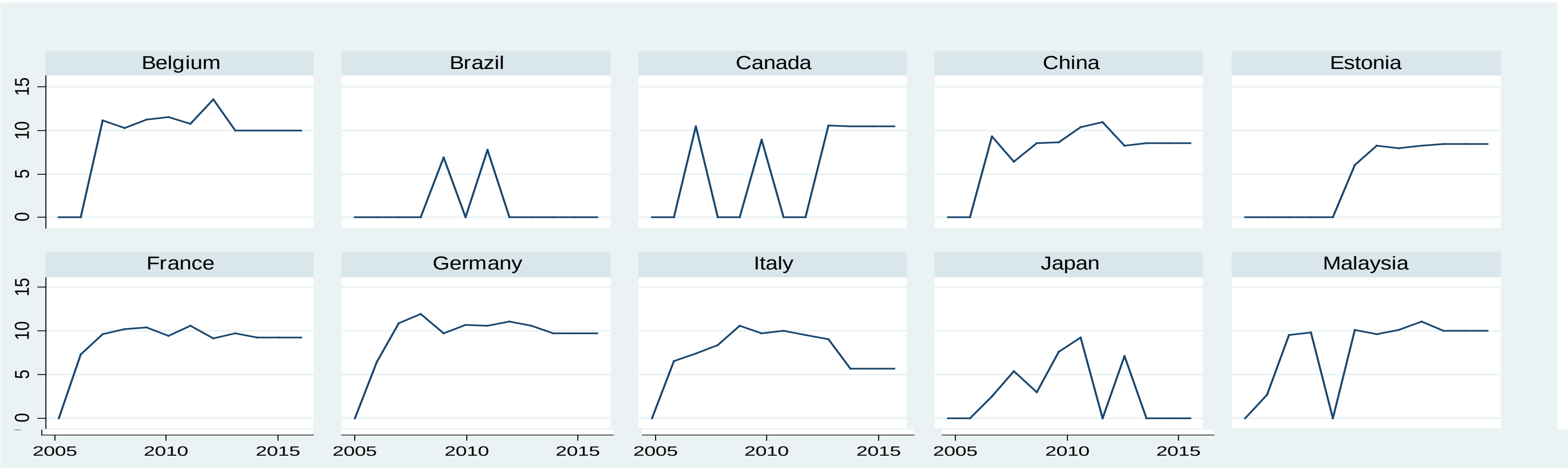


Figure 19a: Trends of log of values of export from Nigeria with respect to Stringency Indices (STIs) in importing countries

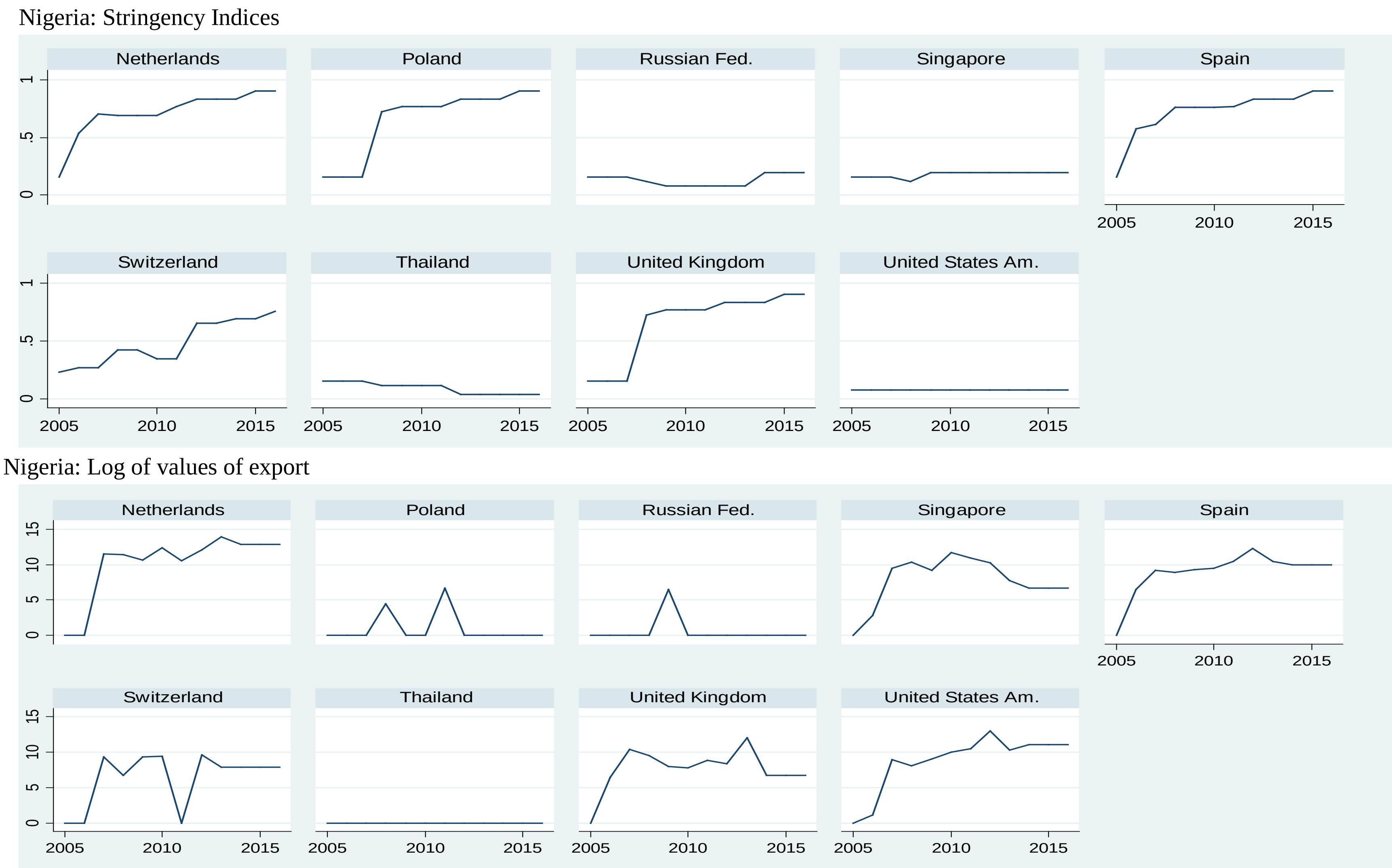
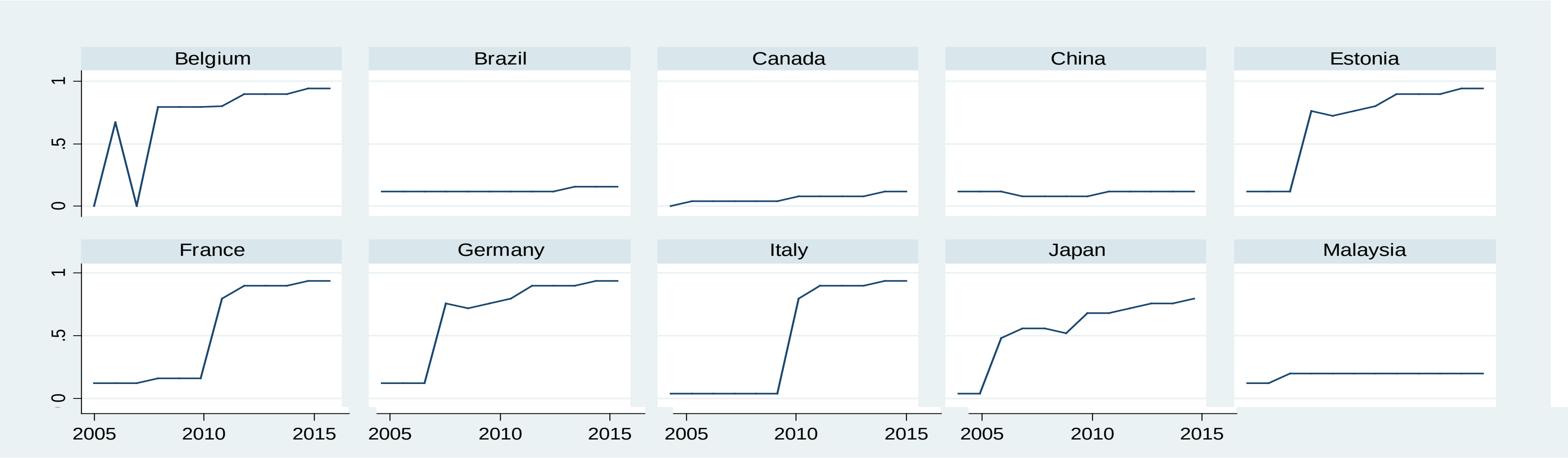


Figure 19b: Trends of log of values of export from Nigeria with respect to Stringency Indices (STIs) in importing countries

Cote d'Ivoire: Stringency Indices



Cote d'Ivoire: Log of values of export

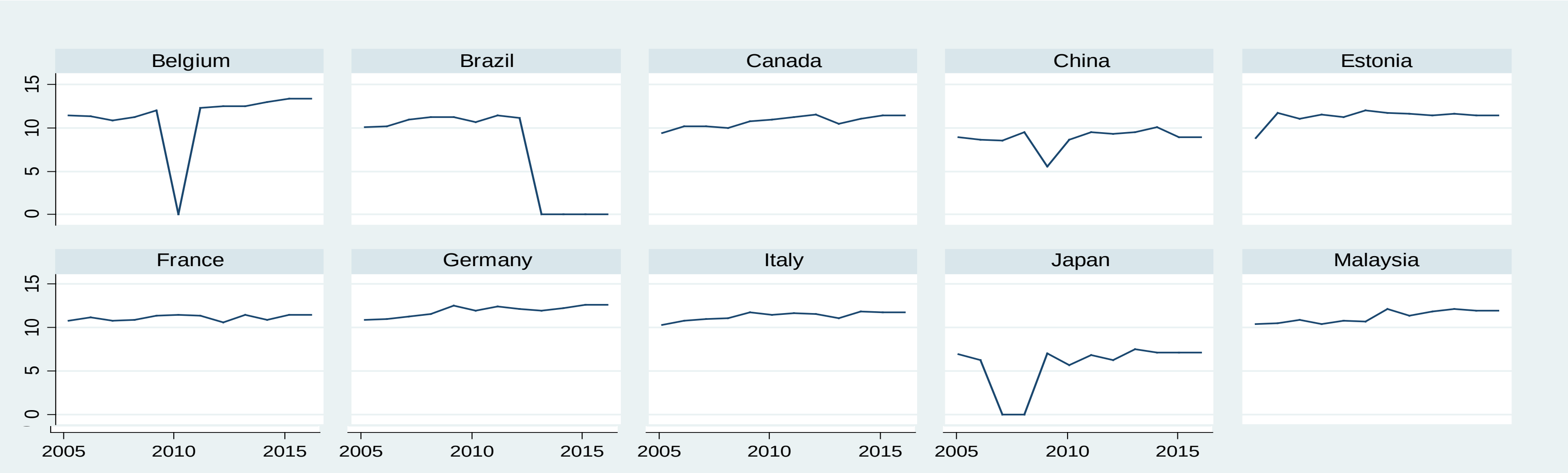
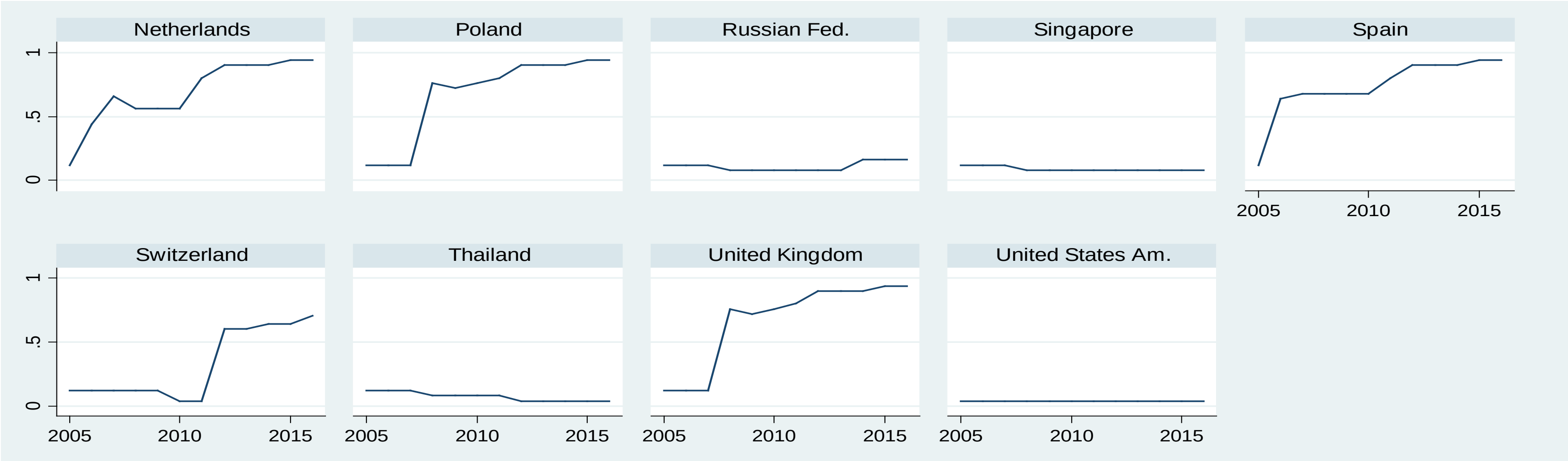


Figure 20a: Trends of log of values of export from Cote d'Ivoire with respect to Stringency Indices (STIs) in importing countries

Cote d'Ivoire: Stringency Indices



Cote d'Ivoire: Log of values of export

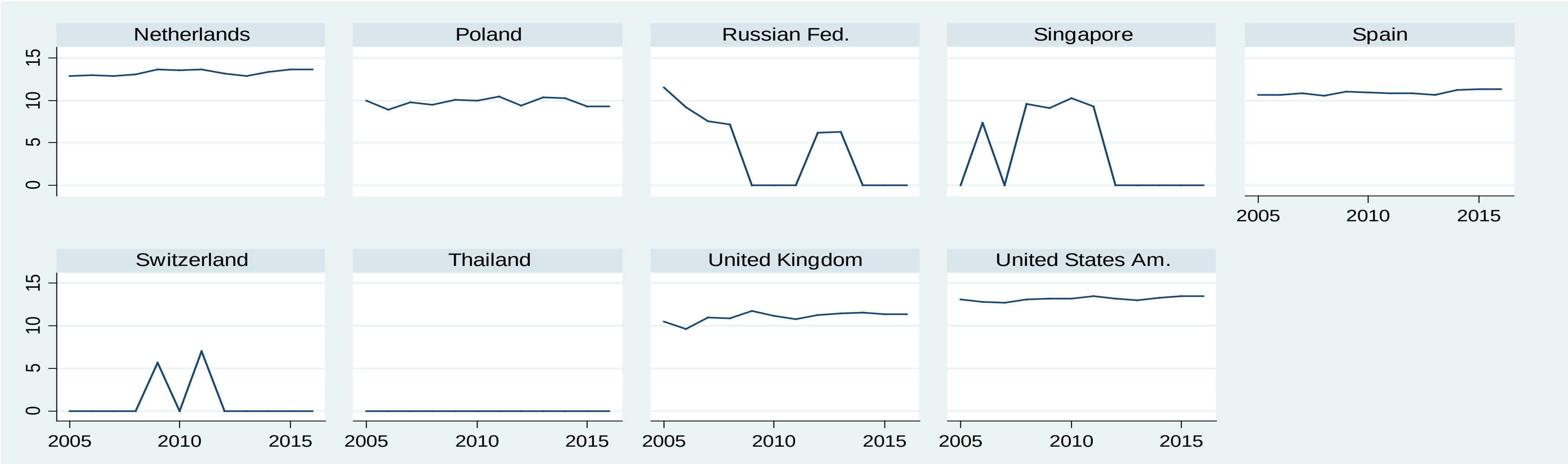
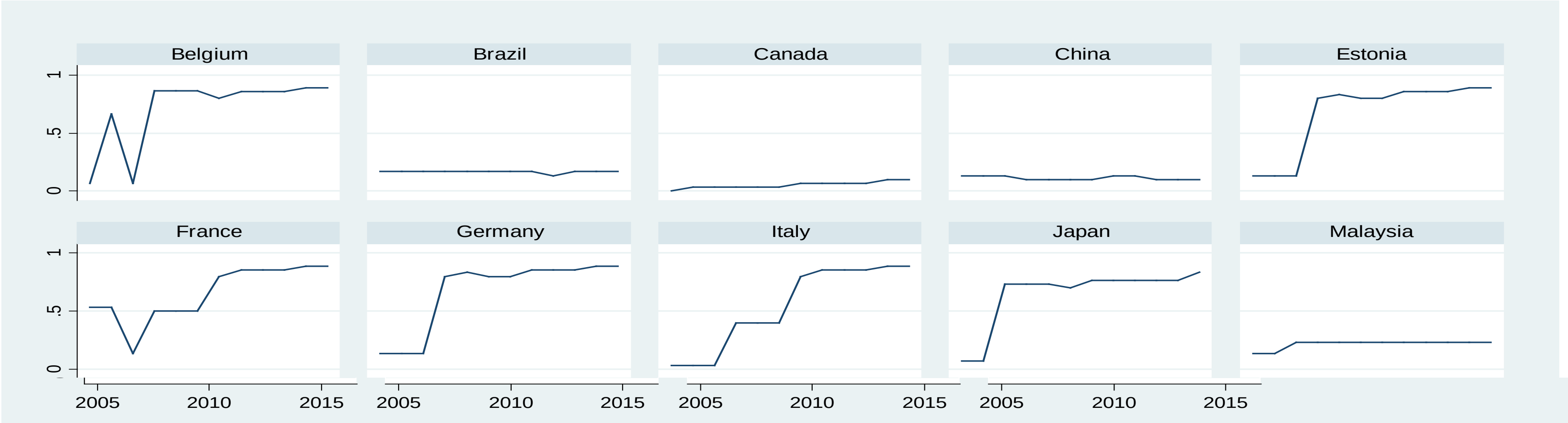


Figure 20b: Trends of log of values of export from Cote d'Ivoire with respect to Stringency Indices (STIs) in importing countries

Ghana: Stringency Indices



Ghana: Log of values of export

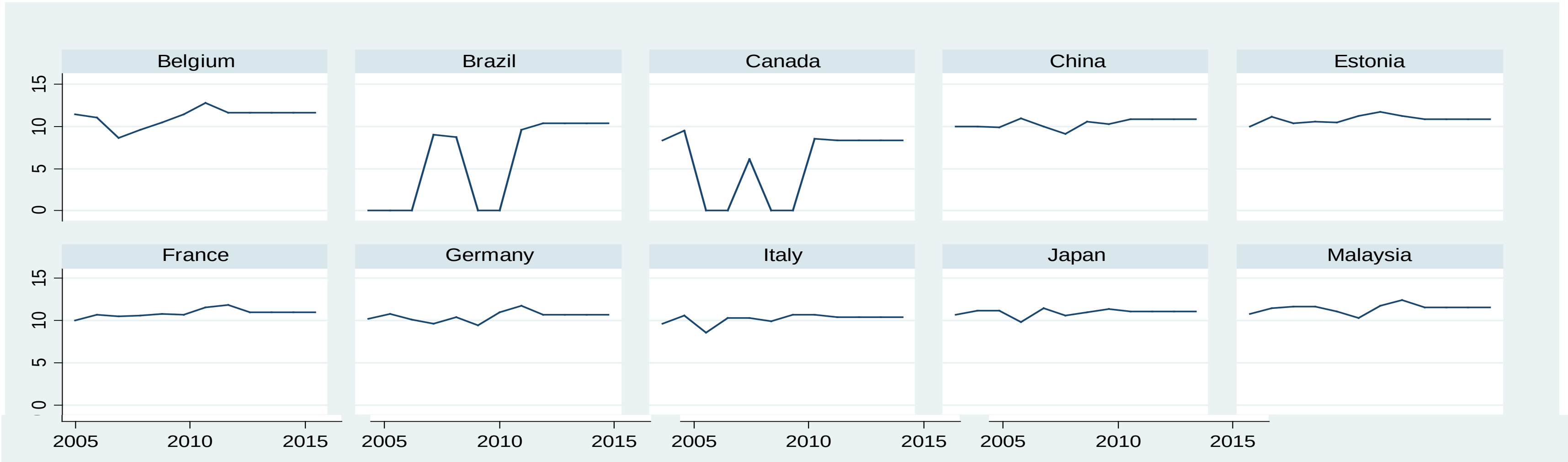
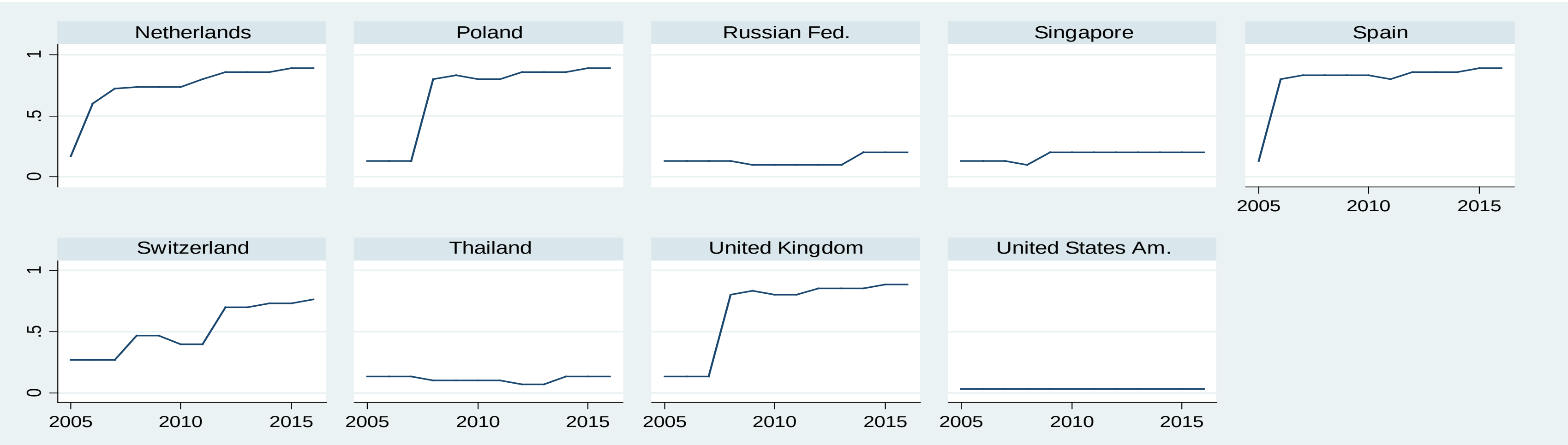


Figure21a: Trends of log of values of export from Ghana with respect to Stringency Indices (STIs) in importing countries

Ghana: Stringency Indices



Ghana: Log of values of export

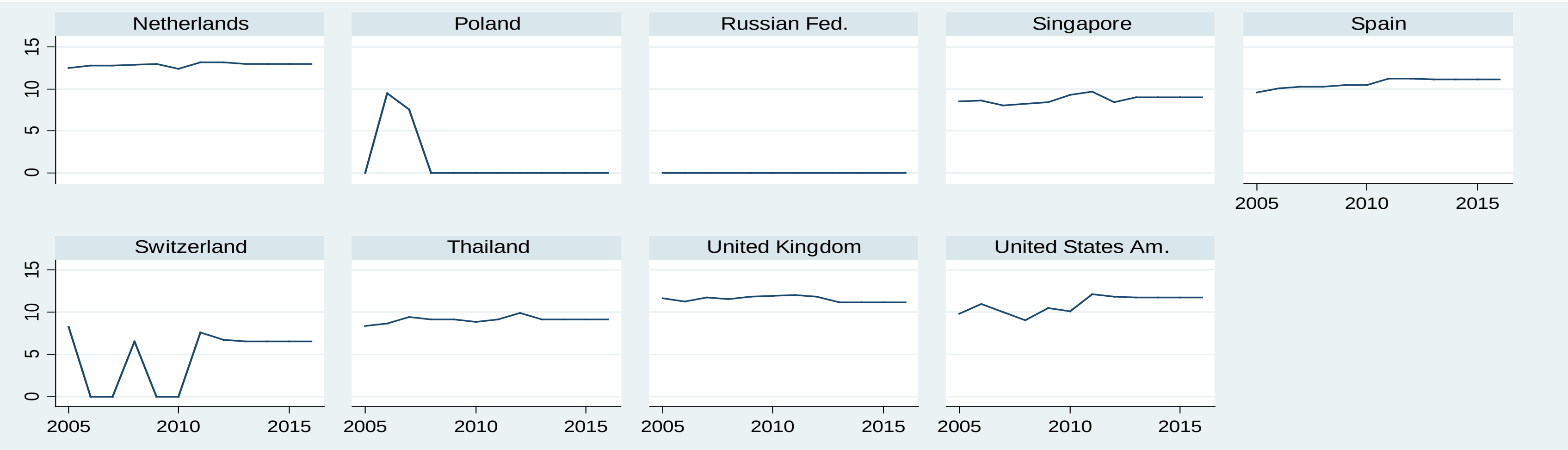


Figure21b: Trends of log of values of export from Ghana with respect to Stringency Indices (STIs) in importing countries

iv. **Indonesia**

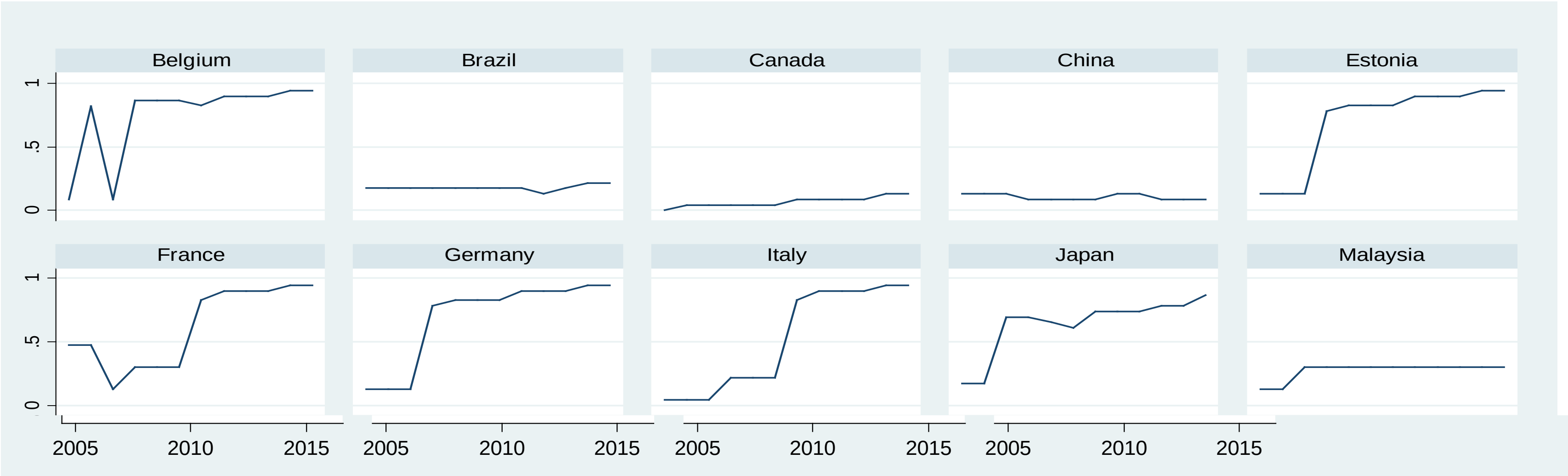
Indonesia's cocoa export to Netherlands was the lowest among other exporters and was downward-moving. Thus, Indonesian trade was the most negatively (or rather only slightly negatively) affected with Netherland's increasing standard among the cocoa exporters considered for this study. Similarly, its export to USA showed fluctuations along with a downward trending pattern from 2010 despite the low stringency of USA standard. The value of export to Japan was reducing with upward movement of Japanese STI. Export to China and Thailand followed similar pattern of initial high values from 2005 but sudden decline some times before 2015 despite their friendly cocoa standard environments. This could result from the fact that China and Thailand were not the major importers and Indonesia had focused on more profit-yielding markets like Malaysia.

Indonesia had most favourable trade with Singapore and Malaysia though Singaporean and Malaysian cocoa standards increased around 2009 and 2007 respectively. From the perspective of trade theory, closeness of Malaysia and Singapore to Indonesia would encourage trade but there is additional information here: Indonesia selling its cocoa to its neighbours was also driven by their low regulations. To support this statement, slight reductions in trade values could still be observed in Figure 22a&b for the two countries with increased standard despite the favourable trade regimes. German cocoa imports showed declining movement with increasing STI, while imports into Estonia, Belgium and Italy followed very irregular trends.

v. **Cameroun**

In the EU market, Cameroonian cocoa exports to Netherlands and Spain were high and marginally upward-sloping despite high and increasing STI. Germany also received significant exports that reached the peak in 2010 but declining afterwards, as revealed in Figure 23a. Exports to UK, Italy and Estonia were fluctuating as STIs increase. Export to USA was also not stable despite low importer standard in the American market. Cocoa import into Belgium from Cameroun was initially sloping downwards but later increasing as Belgian cocoa regulation tightens. French and Japanese cocoa imports largely declined for most part of the period considered in the study. Thailand's import from Cameroun remained at its encouraging high level as it lowers standards. In general, regular pattern of high and increasing export with increasing STI could only be seen for Netherlands, Spain and Malaysia and to a lesser degree, for Germany.

Indonesia: Stringency Indices



Indonesia: Log of values of export

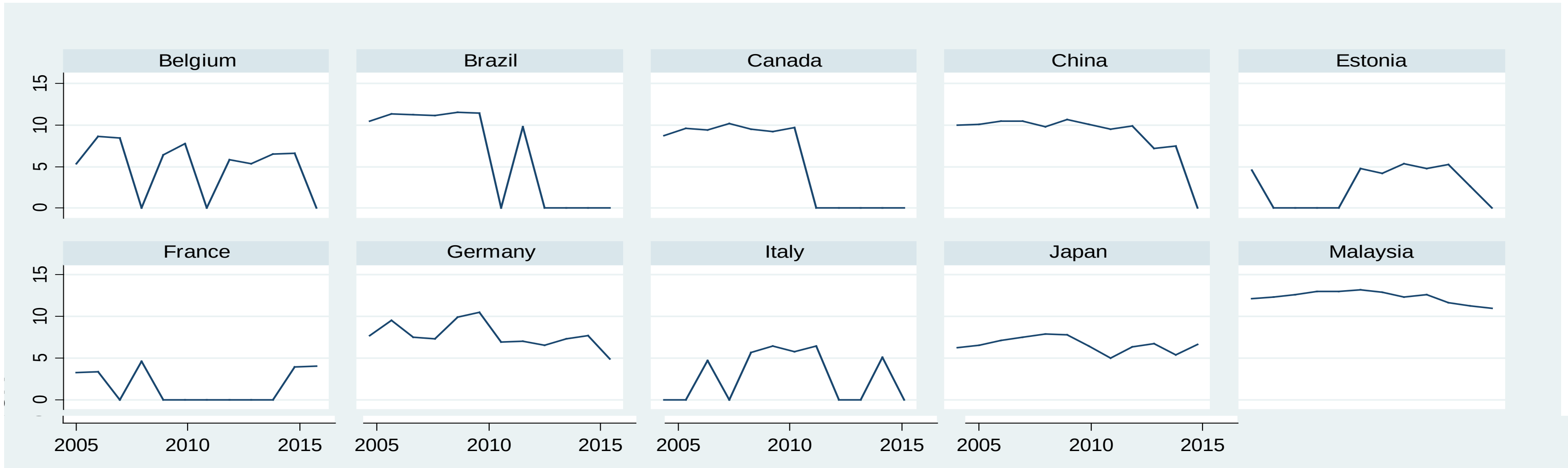
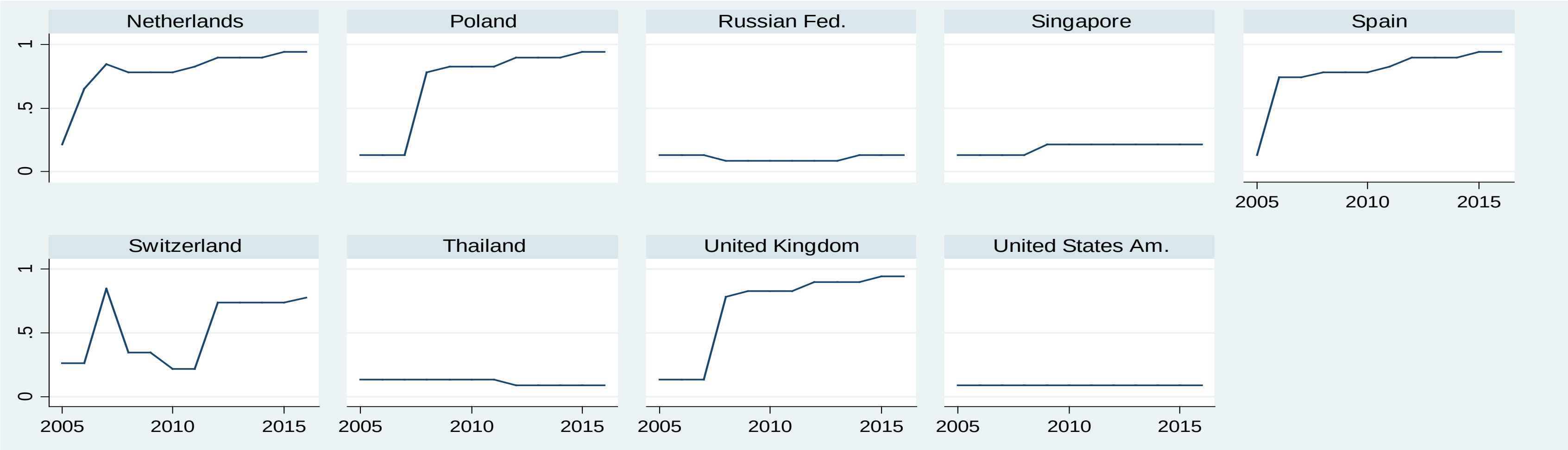


Figure22a: Trends of log of values of export from Indonesia with respect to Stringency Indices (STIs) in importing countries

Indonesia: Stringency Indices



Indonesia: Log of values of export

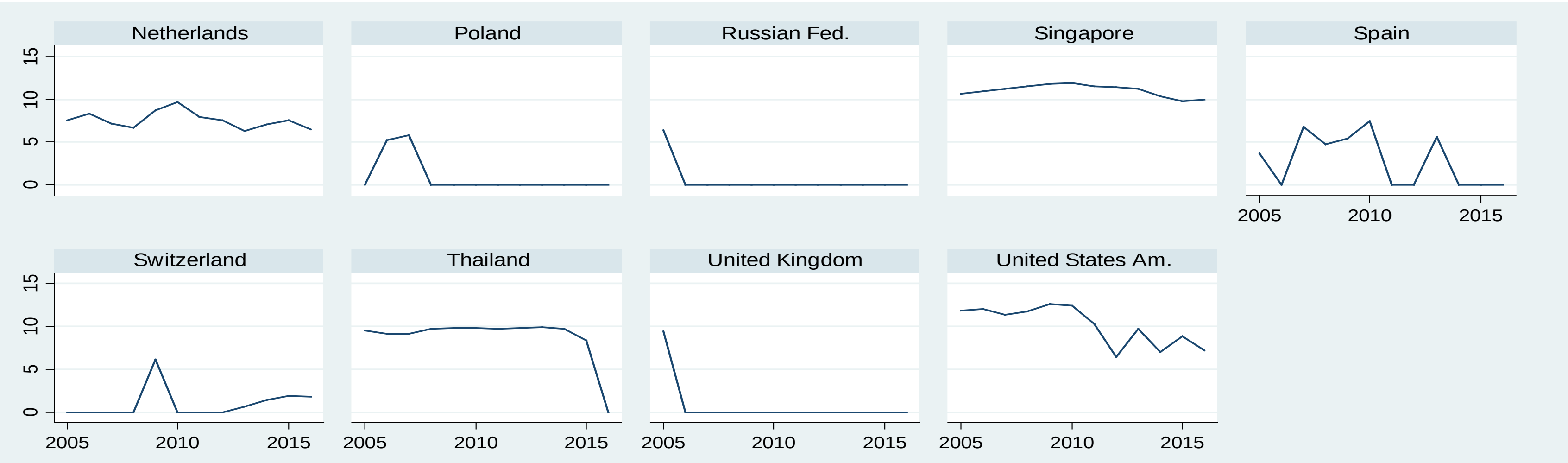
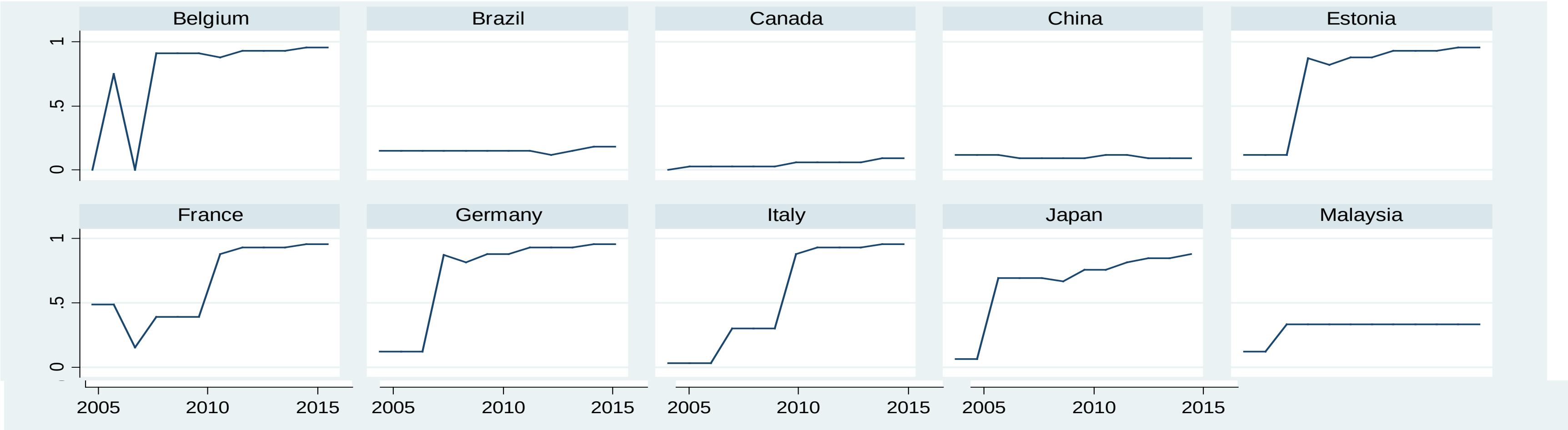


Figure22b: Trends of log of values of export from Indonesia with respect to Stringency Indices (STIs) in importing countries

Cameroun: Stringency Indices



Cameroun: Log of values of export

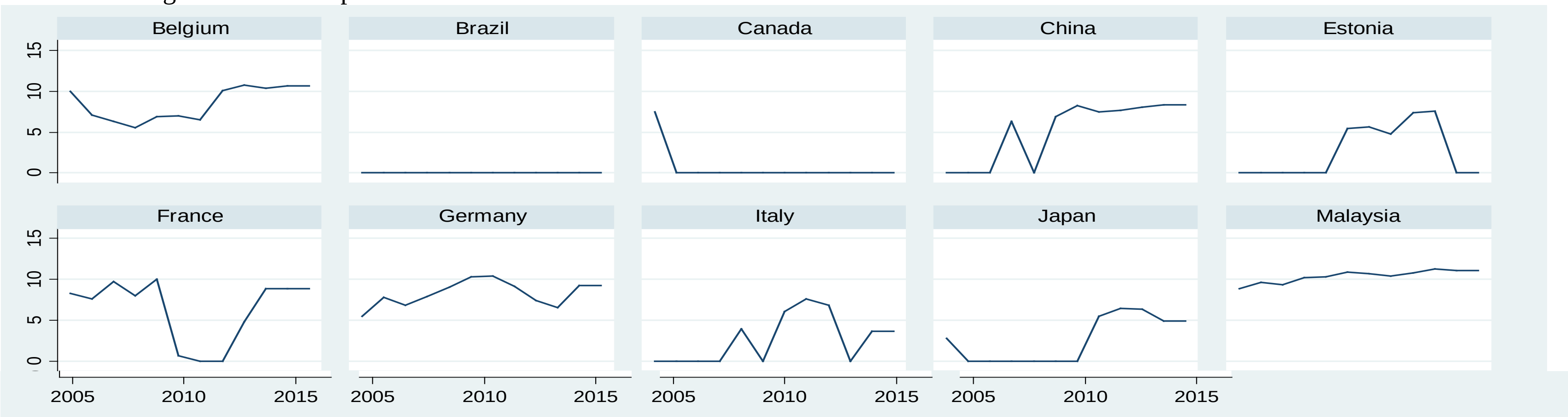
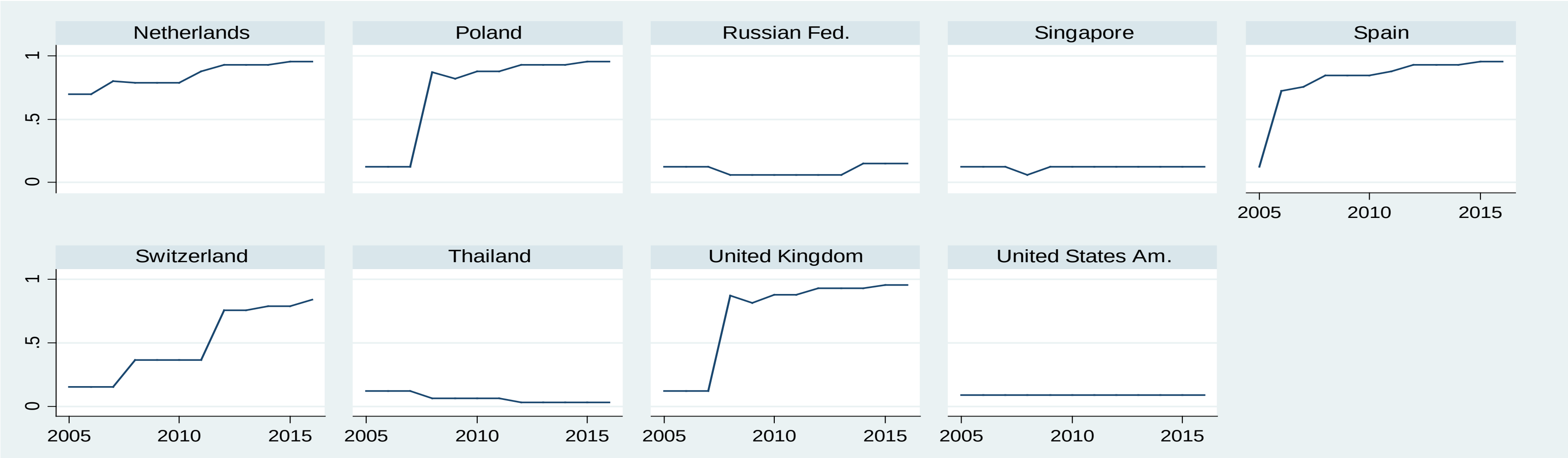


Figure23a: Trends of values of export from Cameroun with respect to Stringency Indices (STI) in importing countries

Cameroun: Stringency Indices



Cameroun: Log of values of export

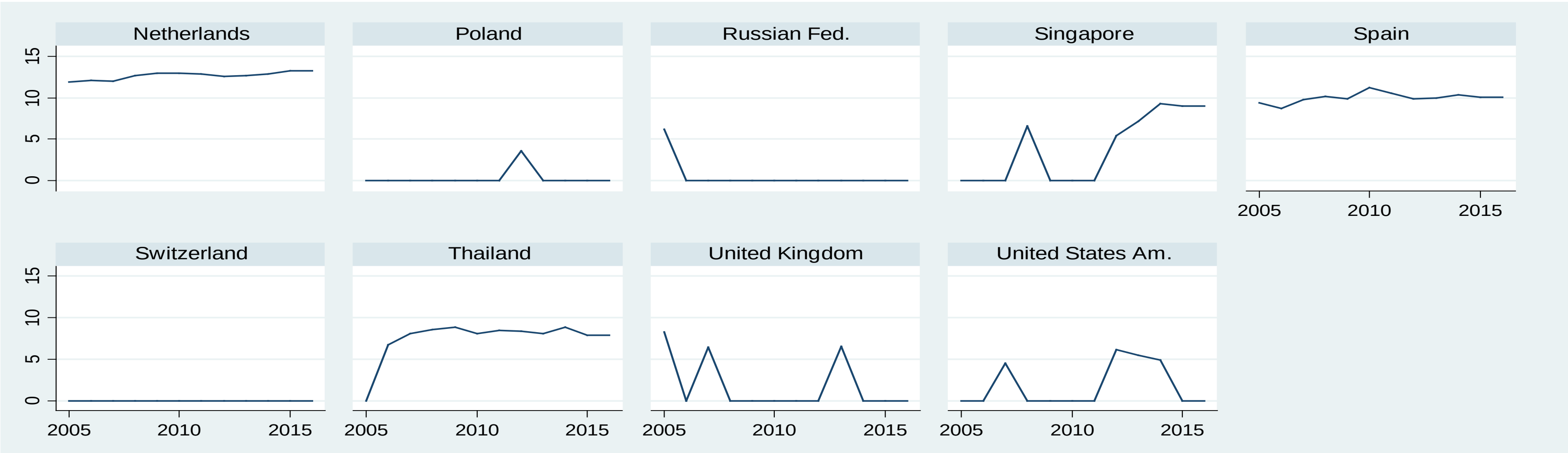


Figure23b: Trends of values of export from Cameroun with respect to Stringency Indices (STI) in importing countries

4.2 Relationship between SPS Standards andValues of Cocoa Trade

In this section, the relationship between stringency indicesfor the World (STIw) and EU (STIeu) cocoa trades and trade values were presented (Figures 24a and 25a). Regression line fittings were done in the two cases with lowess (locally-weighted scatterplot smoother), anon-parametric method in the two cases (Figures 24b and 25b). For the world trade case, though more points were concentrated at the lower end of the standard continuum, the points were almost equally distributed at the two nodes. The points were more dispersed at the lower end of the continuum for the EU case.

The regression lines fitted showed that there is a positive relationship between the value of cocoa exported and the stringency indices in both world and EU cocoa trades. This meant that stringent standard did not deter cocoa trade but rather improved it. It should be noted, however, that this is a non-parametric regression whose result needs be treated with care. Parametric regression is a simple linear model that gives underlying structure of data through scatterplot. Therefore, there is need to further test the result proposition through more robust statistical procedures especially in a study like this where linearity assumption might not hold. Further statistical analyses were carried out in subsequent sectionsin order to either confirm or refute the nature of the relationship between value of trade and stringency indices shown by the non-parametric procedure.

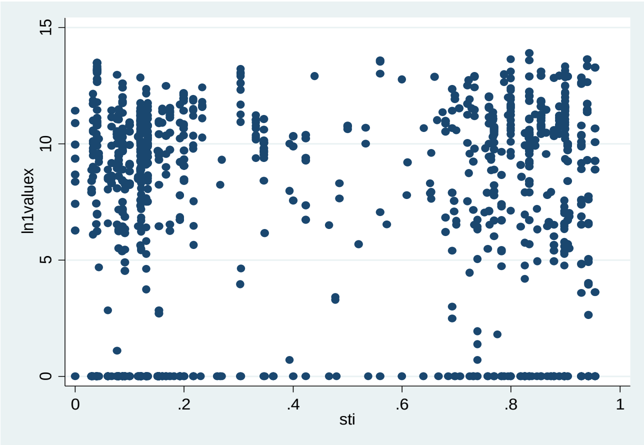


Figure 24a: Scatterplot for the relationship between value of export and stringency index for World cocoa trade (STIw).

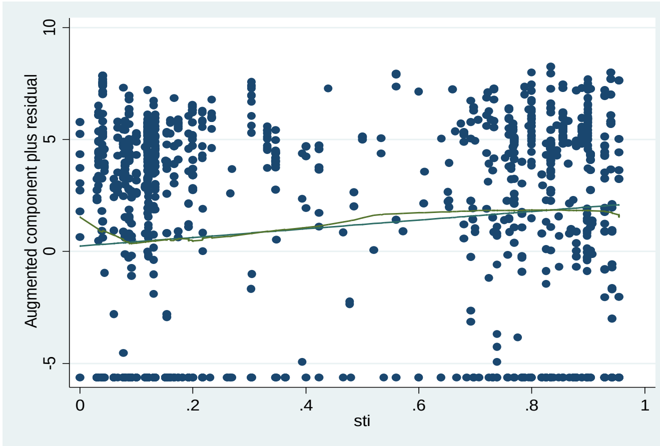


Figure 24b: Regression line fitting for the relationship between value of export and stringency index for World cocoa trade (STIw).

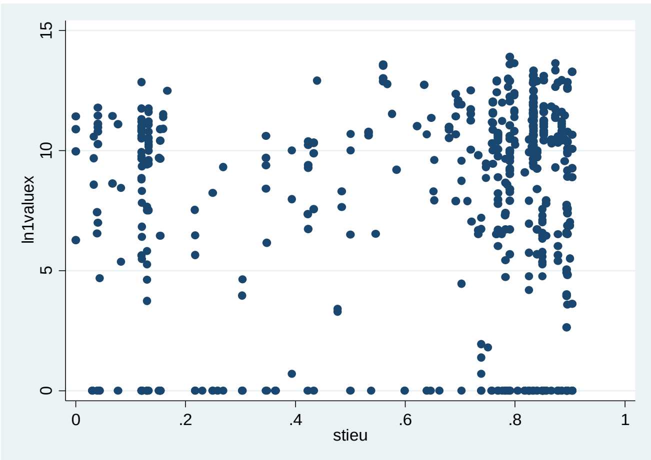


Figure 25a: Scatterplot for the relationship between value of export and stringency index for EU cocoa trade (STIeu)

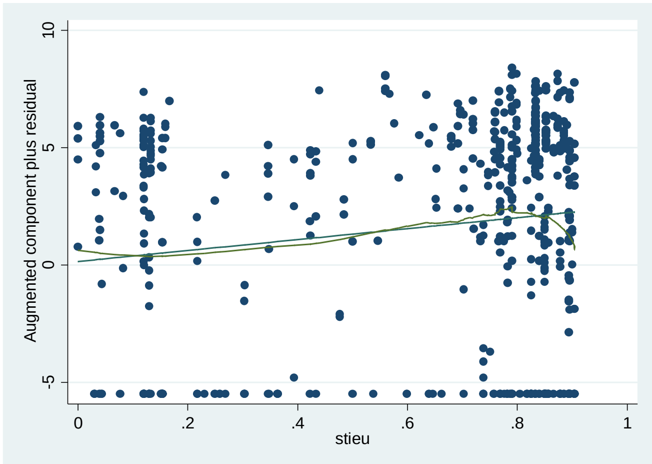


Figure 25b: Regression line fittingfor the relationship between value of export and stringency index forEU cocoa trade (STIeu)

4.3 Effect of SPS Standards on Values of Trade

This section commenced with summary statistics, stationarity test and cointegration test for the variables used in regression analyses. Effects of SPS measure and other variables on value of World trade were thereafter tested with regression analyses for each exporting country. The section was capped with regression results involving all trading partners for World, EU and Rest-of-the-World (ROW) trades through Poisson panel estimations.

4.3.1 Summary statistics of variables used in the study

Summary statistics of the STIs and other variables used in the study are shown in Table 2. The table showed that the mean values of importer GDP and distance for World trade were higher than for EU trade. This is intuitive because in as much as many countries were involved in the World cocoa trade, their total GDP will be higher and more distances will be covered. In contrast, the mean estimates of value of trade, importer GDP per capita and Stringency Index for EU trade were more than for World trade implying that more trade was conducted in the EU on the average, consumers in the region had higher purchasing power and the import standard was more stringent. With respect to data distribution, the table showed large disparities between minimum and maximum (World and EU) trade values which is reflected in standard deviations being higher than the means. However, productivity, exporter GDP per capita and EU importer GDP per capita showed better distribution.

4.3.2 Assessment of stationarity of variables and their long-run relationships

i. Panel unit root test

Stationarity test was carried out on the variables. Results presented in Table 3 showed that out of all, log of value of cocoa export, log of (cocoa land) productivity in exporting countries, log of importer GDP, log of importer GDP per capita and log of individual importers' stringency indices were stationary at levels. Logs of exporter GDP and GDP per capita showed stationarity with LLC test. The test was not performed on the remaining variables: colonial affinity and common language were dummies while distance variable was time-invariant. Time-invariant variables are deemed stationary and tariff rate was the same for all the EU countries.

Table 2: Summary Statistics of Variables Used for Panel Regression

	Variables	Trade type	Mean	Standard deviation	Min.	Max.
1.	Value of Trade	World	52 074.01	121 161.80	0	1 093 814
		EU	63 287.23	136 769.60	0	1 093 814
2.	Productivity	World / EU	0.4487	0.1332	0.2201	0.8495
3.	Exporter GDP	World / EU	2.36e+11	3.18e+11	1.07e+10	1.16e+12
4.	Exporter GDP/capita	World / EU	1 811.07	974.30	501.72	4 595.43
5.	Importer GDP	World	2.57e+12	3.63e+12	1.40e+10	1.79e+13
		EU	1.50e+12	1.15e+12	1.40e+10	4.06e+12
6.	Importer GDP/capita	World	32 907.17	20 203.70	1 740.10	97 749.10
		EU	39 763.35	17 901.54	7 976.07	97 749.10
7.	Stringency Index	World	0.4297	0.3513	0	0.9544
		EU	0.6373	0.2990	0	0.9042
8.	Distance	World	7 709.05	3 466.30	886.14	16 371.12
		EU	6 184.62	2 571.34	3 639.54	12 188.31

ii. **Panel cointegration test**

After ascertaining the stationarity of the variables, cointegration analyses were carried out between key variables to ascertain the nature of their long-run relationships. The variables considered were values of exports and stringency indices. Results of the cointegration analyses shown in Table 4 revealed that long-run relationships exist between logs of export values and stringency indices.The pairwise correlation coefficient values of 0.1944 (World trade) and 0.1222 (EU trade)in Table 5which were significant at 1% removed the possibility of causality between the two variables.

4.3.3 **Effects of SPS standards on value of trade between each exporter and all importers**

Regression was carried out for each exporter with respect to World trade. Hausman test results, shown in Annex 1 of Appendix VI, favoured the usage of random effect model for all the exporting countries. The regression results are shown in Table 6. The model with both GDP and GDP per capita performed better for all the exporter equations and was therefore the only one reported. The number of significant variables for each country was as follows: Nigeria (four), Ghana (one), Indonesia (three) and Cameroun (six) while no variable was significant for Cote d'Ivoire. For Nigeria, productivity and standard stringency variables were significant at 1% and 5% significant level respectively, while exporter GDP and per capita exporter GDP were both significant at 10%. The log of productivity had strong negative relationship with the dependent variable. A 1% increase in productivity of was associated with reduction in trade by 7.0%. The productivity was output per unit land area under cocoa cultivation. Understandably, increased trade will arise from increased cocoa production. However, if increased output continually arises from land expansion and the two are out of consonance, particularly if marginal increase in land under cultivation is more than marginal output, there will be negative relationship between trade and productivity. This was the situation in Nigeria. Wessel and Quist-Wessel (2015) had identified land expansion as one of the features of cocoa production in West Africa and a serious environmental challenge that a sustainable cocoa production system must tackle. Coupled with this, are the problems of ageing trees and pests/diseases.

Table 3: Summary of Results of Panel Unit Root Tests

Variable (Notation)	Levin, Lin and Chu (LLC)		lm, Pesaran and Shin (IPS)		ADF-Fisher		PP-Fisher		Comment
	Statistic	Probability	Statistic	Probability	Statistic	Probability	Statistic	Probability	
Log of value of export	-13.976	0.000	-9.066	0.000	135.138	0.000	174.301	0.000	I(0)
Log of productivity	-20.171	0.000	-14.026	0.000	216.692	0.000	54.727	0.039	I(0)
Log of exporter GDP	-3.657	0.000	1.934	0.974	12.922	1.000	19.919	0.993	I(0)
Log of importer GDP	-6.572	0.000	-3.272	0.000	70.780	0.001	129.170	0.000	I(0)
Log of exporter GDP per capita	-3.144	0.001	2.313	0.990	11.183	1.000	16.835	0.999	I(0)
Log of importer GDP per capita	-6.564	0.000	-3.274	0.001	71.314	0.001	118.613	0.000	I(0)
Log of Stringency Index -STI	-34.745	0.000	-11.868	0.000	72.358	0.000	114.392	0.000	I(0)
Log of EU Stringency Index –STIeu	-1.979	0.024	-2.382	0.009	37.287	0.011	77.820	0.000	I(0)

ADF: Augmented Dickey Fuller; PP: Phillips-Peron. I(0): Stationary at level.

Table 4: Summary of Pedroni Residual Panel Co-integration Test Result for the Relationship between Value of Export and Stringency Indices (World and EU)

a. (ln1valuex lnsti)*

Statistic	Values	Probability
	Within dimension (H_a: Common AR coefficient)	
Panel v-Statistic	1.071	0.142
Panel rho-Statistic	-3.801***	0.000
Panel PP-Statistic	-7.802***	0.000
Panel ADF-Statistic	-4.948***	0.000
	Between dimension (H_a: Individual AR coefficient)	
Group rho-Statistic	-1.412*	0.079
Group PP-Statistic	-7.697***	0.000
Group ADF-Statistic	-5.417***	0.000

b. (ln1valuex lnstieu)*

Statistic	Values	Probability
	Within dimension (H_a: Common AR coefficient)	
Panel v-Statistic	1.198	0.116
Panel rho-Statistic	-2.922***	0.002
Panel PP-Statistic	-6.364***	0.000
Panel ADF-Statistic	-6.007***	0.000
	Between dimension (H_a: Individual AR coefficient)	
Group rho-Statistic	-1.224	0.111
Group PP-Statistic	-6.624***	0.000
Group ADF-Statistic	-6.367***	0.000

Null Hypothesis: No co-integration; Significance: ***1%, **5%, *10%

Table 5: Pairwise Correlation Results for Gravity Model Variables (World and EU trades)

	Value of trade	Productivity	Exporter GDP	Exporter GDP/capita	Importer GDP	Importer GDP per capita	Stringency Index
Value of trade	1.0000						
Productivity	0.1944*** 0.1222***	1.0000					
Exporter GDP	-0.1317*** -0.3012***	-0.3002*** -0.3002***	1.0000				
Exporter GDP/capita	-0.0419 -0.1617***	-0.2823*** -0.2823***	0.8411*** 0.8411***	1.0000			
Importer GDP	0.0632** 0.1572***	-0.0261 -0.0165	0.0331 0.0188	0.0835*** 0.0478	1.0000		
Importer GDP per capita	0.1292*** 0.1829***	-0.0393 -0.0395	0.0496* 0.0444	0.1253*** 0.1127***	0.2162*** 0.5092***	1.0000	
Stringency Index	0.1354*** 0.1433***	-0.1120*** -0.1895***	0.1413*** 0.1954***	0.2474*** 0.4604***	-0.1558*** 0.0069	0.3020*** 0.0778*	1.0000

Level of significance: ***1%, **5% and *10%.
Upper and lower values are for world and EU trades, respectively.

On the other hand, increase in trade in Ghana was associated with higher yield. A 1.7% increase in trade value came out of 1% increase in productivity, which happened to be the only significant variable for Ghana. By the initial result (i.e result for Nigeria), yield borne out of factors other than land expansion should give positive relationship with trade. This was particularly the case in Ghana. The positive relationship between trade and productivity implied that other factors such as proper control of pests and diseases, better agronomic practices and input support for farmers were the drivers of increased yield. This result and explanation matched the situation in Ghana where government had been supplying (subsidised) inputs to farmers and engaging in mass-spraying programme through the National Cocoa Diseases and Pests Control Programme (CODAPEC) which was implemented by the Ghana Cocoa Board (COCOBOD). The cocoa-tree spraying programme commenced in 2001 and had since led to tremendous increase in output (Afrane and Ntiamoah, 2011).

The cocoa standard variable was only significant for Nigeria. A one-point increase in the stringency index increased trade by 19.8 percent, which indicated that trade value is relatively inelastic with respect to standard variable. Trade increased 3-folds with a unit increase in Nigeria’s per capita GDP. Importer GDP and colonial affiliation increased Indonesia’s trade while longer distance reduced trade with importing partners. The changes in trade with one-point increase in the respective variables were: 19.3 percent (importer GDP), 88.7% (colonial relationship) and -43.6% (distance). These results show that standard is a very important factor for Nigerian cocoa sector with the implication of slow response of value of cocoa export to change in standard, probably as a result of low compliance capability. In addition, the higher the GDP, the higher the capacity for trade.

Cameroun had three (3) variables a-piece being significant at 5% (importer GDP per capita, colonial affinity, tariff) and 10% (exporter GDP, exporter GDP per capita, same official language). Exporter GDP, importer GDP per capita, colonial relationship and tariff were positively related to trade value while exporter GDP per capita and language variable had negative relationship with value of cocoa trade. Since exporter supply capacity is denoted by its GDP, the results implied that a unit increase in Cameroun’s supply capacity will lead to approximately 5 units increase in trade. Also, if importers’ GDP per capita increases by 100%, trade will increase by 72.5%. This meant that high income level of citizens of importing countries influenced trade positively because with high purchasing power, consumers were able to pay for cocoa products and thus users of the raw cocoa beans imported more.

Moreover, a factor increase in exporter GDP per capita was associated with reduction in value of trade by a factor of 6.6 as shown by results presented in Table 6. The possible reason for this is that cocoa beans were mostly produced by smallholder farmers who were exposed to the vagaries of fluctuating cocoa price in the international market and did not get deserved share of the world cocoa price (UNCTAD, 2016). This had negative reflections on their productive capacities. Results for the remaining variables revealed that Cameroun was trading more with countries with which it had differing official language and importer tariff was not trade-impeding. The result on tariff is in line with Wei *etal*. (2012) that showed the possibility of positive or negative relationship with trade. Trade with countries of similar language reduced by 238% ($e^{1.218}$ – 1= 2.38) though existence of colonial relationship increased trade by 243% ($e^{1.233}$ – 1= 2.43). The negative relationship of the language variable with trade value is supported by Disdier *etal*. (2008b).

Table 6: Parameter Estimates for Effects of SPS Standards on Values of Cocoa Export for Individual Exporters and All Importers (World Trade)

Exporter	Nigeria		Cote d'Ivoire		Ghana		Indonesia		Cameroun	
	Random Effects Poisson Regressions									
Dependent variable: ln1valuex	Coefficient (Robust s.e)	z-value	Coefficient (Robust s.e)	z-value	Coefficient (Robust s.e)	z-value	Coefficient (Robust s.e)	z-value	Coefficient (Robust s.e)	z-value
ln1prdctvy	-7.006*** (1.487)	-4.71	0.321 (1.334)	0.24	1.674* (0.865)	1.93	0.879 (0.619)	1.42	0.786 (3.340)	0.24
lngdpx	-2.307* (1.34)	-1.72	-1.307 (2.569)	-0.51	-0.020 (1.628)	-0.01	-4.324 (3.777)	-1.14	4.993* (2.646)	1.89
lngdpcx	3.006* (1.751)	1.72	1.377 (2.529)	0.54	0.022 (1.442)	0.02	4.515 (4.034)	1.12	-6.587* (3.686)	-1.79
lngdpi	-0.013 (0.222)	-0.06	0.053 (0.112)	0.47	-0.020 (0.047)	-0.42	0.193** (0.080)	2.41	-0.130 (0.205)	-0.63
lngdpci	0.329 (0.354)	0.93	-0.138 (0.472)	-0.29	0.137 (0.604)	0.23	-0.257 (0.262)	-0.98	0.725** (0.323)	2.24
lndist	-0.004 (0.871)	-0.00	-0.554 (0.572)	-0.97	0.266 (0.958)	0.28	-0.436*** (0.136)	-3.20	0.918 (0.915)	1.00
langd	0.521 (0.926)	0.56	-0.080 (0.452)	-0.18	-0.202 (0.906)	-0.22			-1.218* (0.633)	-1.92
colond	-0.395 (0.651)	-0.61	0.134 (0.402)	0.33	0.504 (0.609)	0.83	0.887*** (0.237)	3.75	1.233** (0.508)	2.43
lnsti	0.198** (0.098)	2.03	0.008 (0.077)	0.10	-0.011 (0.089)	-0.12	-0.002 (0.101)	-0.02	0.086 (0.151)	0.57
ln1tariff	0.353 (0.372)	0.95	-0.199 (0.267)	-0.74	0.077 (0.233)	0.33	-0.114 (0.196)	-0.58	0.325** (0.159)	2.04
constant	38.543 (29.118)	1.32	28.616 (34.821)	0.82	-1.450 (16.497)	-0.09	84.440 (70.943)	1.19	-83.487** (39.236)	-2.13
Log pseudo-likelihood	-597.85		-589.49		-563.54		-585.14		-500.52	
Wald chi2	175.25		28.70		129.33		111.49		50.66	
Prob>chi2	0.000		0.001		0.000		0.000		0.000	

Number of observations: 227 Standard error in parenthesis
Number of groups: 19 Significance: ***1%, **5% and *10%.

4.3.4 **Effects of SPS standards on World cocoa trade (all exporters vs. all importers)**

Table 7 shows the result of the effect of importers' SPS standards on the value of export from all the exporting countries using fixed effects. Fixed effects model was settled for since it produces more consistent estimates (Baldwin and Taglioni, 2006) and using random effect option might give biased results in the presence of heteroskedasticity, which is usually present in trade data (Santos Silva and Tenreyro, 2006). Two models were presented and model 2 was preferred because there were more significant variables and better compliance with a priori expectation. The log pseudo-likelihood value was also higher (-3558.63) in addition to the significance of the Wald statistics (chi^2=74.07; Prob>chi^2=0.000). Robust option of the Poisson regression was adopted to obtain heteroskedasticity-robust-standard error in order to get Huber/White or Sandwich estimators (Torres-Reyna, 2007). The non-significance of the Ramsey test statistic (Prob>chi^2=0.2647), shown in Annex 2 of Appendix VI, meant there was no heteroskedasticity and thus, the model is suitable.

The results shown on Table 7 revealed that productivity ($p<0.01$), importer GDP per capita ($p<0.01$) and stringency index ($p<0.05$) were positively related to trade while exporter GDP per capita ($p<0.10$), tariff ($p<0.05$) and distance from trading partners ($p<0.01$) had negative relationship with trade. A 1% increase in productivity in the importing countries led to 1.47% increase in World cocoa trade. Better yield meant that more cocoa beans were harvested per unit hectare of land and therefore more were available for export. A unit percentage (1%) increase in importer GDP per capita and stringency index increased trade by 0.37% and 0.07% respectively. Value of trade was thus relatively elastic with respect to cocoa yield but inelastic with respect to import standards. Importer GDP per capita result followed Drogué and DeMaria (2012). Stringency of standard in an importing country signified that the country is a serious trade partner with penchant for quality and possibility of higher returns when cocoa beans is exported to such country. With this, exporters strived to meet up with the standard so that it could gain from the market. Thus, higher quality gave better opportunity of increased trade consequent upon market entry. This is line with findings of Crivelli and Groschl (2012).

Conversely, Table 7 shows that 1% increase in exporter GDP per capita was detrimental to trade to the tune of 19.9%. Although, the traditional gravity model posits that higher income countries tend to trade more due to reduced price per unit of good produced and ability to produce for diverse markets (Salvatici, 2013), the effect of GDP per capita did not follow this trend perhaps due to primary nature of cocoa beans. Possible explanation for this result is that higher income per capita truly signifies better living conditions for citizens of the exporting country. With this, the home industry preferred transformation of the cocoa rather than exporting raw beans since consumers had the economic ability to pay for increased price associated with value addition. Cocoa beans export therefore fell. To buttress this explanation, significant transformation of cocoa beans had been taking place in the major exporting countries of Cote d'Ivoire, Ghana and Indonesia (UNCTAD, 2016).Similarly, 1% reduction in tariff increased trade by 0.12% meaning that lower tariff in importing countries encouraged trade as a result of lessened trade barrier. Also, 1% reduction in distance between cocoa trading partners encouraged trade by 0.35%, implying that trade partners that were closer traded more. This is in line with what Anderson (2014) poised.

4.3.5 **Effects of SPS standards on EU cocoa trade (all exporters vs. EU importers)**

Table 8 shows the result of the effect of EU importers' SPS standards on the value of cocoa export. Fixed effect model was also used since it produces more consistent estimates and gives opportunity of specifying country and time effects. The Wald statistics for the model was significant(chi^2=115.28; Prob>chi^2=0.000) and the Ramsey test result (Prob>chi^2 = 0.3295) indicated acceptance of null hypothesis of no heteroskedasticity for the Poisson estimation. The model with GDP per capita alone also performed better with -1662.5 as log-likelihood value.

The results shown on Table 8 revealed that productivity ($p<0.01$), exporter GDP per capita ($p<0.10$), importer GDP per capita ($p<0.01$), stringency index ($p<0.05$) and colonial relationship ($p<0.05$) were positively related to value of trade while distance ($p<0.01$) and language ($p<0.10$) were negatively associated with value of trade. There was 2.28% increase in trade for 1% increase in productivity. For every 1% improvement in national income per capita of exporting countries, trade improved by 0.13% implying that the relatively inelastic individual (farmer's) supply responses in exporting countries played greater role in trade. This positive sign of exporter income per capita is in line with Wilson and Otsuki (2001). For importer GDP per capita, 1% increase in its value improved trade by 0.60%. When comparison is made with World trade, the extent to which income level of consumers in importing countries influenced trade positively was more for EU countries. European Union (EU) countries are developed countries with high GDP per capita.

Table 7: Parameter Estimates for Effect of SPS Standards on Values of World Cocoa Tradewith All Exporters and All Importers

	Fixed-Effects Poisson Panel Regression					
	Model 1			Model 2		
Dep. var.: ln1valuex	Coefficient	Robust std. error	z-statistics	Coefficient	Robust std. error	z-statistics
ln1prdctvy	1.293***	0.500	2.59	1.466***	0.461	3.18
lngdpcx	0.327***	0.113	2.91	-0.199*	0.114	-1.74
lngdpci	-0.864	0.843	-1.03	0.366***	0.134	2.73
lngdpx	-0.164***	0.044	-3.73			
lngdpi	0.903	0.754	1.20			
lnsti	0.049*	0.030	1.67	0.066**	0.034	1.96
ln1tariff	0.028	0.042	0.66	-0.122**	0.055	-2.22
lndist	-0.361***	0.092	-3.94	-0.346***	0.096	-3.60
langd	-0.270	0.213	-1.27	-0.213	0.204	-1.04
colond	0.375	0.296	1.27	0.330	0.292	1.13
log pseudo-likelihood	-3520.178			-3558.625		
Wald chi2	150.62			74.07		
Prob>chi2	0.000			0.000		

No. of observations: 1,131; Number of groups: 19
Significance: ***1%, **5% and *10%.

The consumers had the means to purchase diverse cocoa products and thus the countries were ready markets for cocoa beans. The EU boasts of largest chocolate consumption in the world, witnesses highest cocoa import from developing countries, conducts 40% cocoa grinding globally and possesses largest cocoa port in the world in Amsterdam, Netherlands (CBI, 2016). One percentage (1%) increase in stringency index was associated with 0.04% increase in value of trade in line with the findings of Shingal *etal*. (2017) who submitted that standards encourages trade. Colonial relationship increased trade due to cultural affinity as posited by Ferro *etal*. (2013). On the other hand, distanceimposed cost therefore reduced trade, while exporters traded less with countries of same official language. The negative sign of the coefficient of language variable had also been reported by Disdier *etal*. (2008).

4.3.6 **Effect of SPS standards on ROW cocoa trade (all exporters vs. ROW importers)**

Table 9 shows the effect of SPS standards in non-EU importing countrieson cocoa exporting countries' value of trade. The results show that only two (2) variables, productivity ($p<0.01$) and exporter GDP per capita ($p<0.10$), were significant. Both variables were positively-related to value of trade. Furthermore, trade value was found to be relatively elastic with respect to productivity but inelastic with respect to exporter GDP per capita. The implication of the result is that cocoa export to non-EU countries is affected by the supply-side factors only, and not by importer standard or any other variable.

Table 8: Estimates of the Effects of SPS Standards on Values of EU Cocoa Trade with All Exporters and EU Importers

	Fixed-Effects Poisson Panel Regression					
	Model 1			Model 2		
Dep. var.: ln1valuex	Coefficient	Robust std. error	z-statistics	Coefficient	Robust std. error	z-statistics
ln1prdctvy	1.821***	0.608	3.00	2.282***	0.595	3.84
lngdpcx	0.519***	0.160	3.24	0.129*	0.074	1.74
lngdpci	-0.365	1.919	-0.19	0.598***	0.204	2.93
lngdpx	-0.142***	0.054	-2.64			
lngdpi	0.781	2.006	0.39			
lnstieu	0.012	0.023	0.55	0.037**	0.018	2.06
ln1tariff	0.144***	0.035	4.07	0.050	0.043	1.17
lndist	-1.353***	0.232	-5.84	-1.459***	0.240	-6.07
langd	-0.655**	0.330	-1.98	-0.591*	0.321	-1.84
colond	0.708**	0.304	2.33	0.663**	0.291	2.28
Log pseudo-likelihood	-1649.823			-1662.484		
Wald chi2	282.01			115.28		
Prob>chi2	0.000			0.000		

No. of observations: 596; Number of groups: 10
Significance:***1%, **5% and *10%.

Table 9: Estimates for Effects of SPS Standards on Values of World Cocoa Trade with All Exporters and ROW* Importers

	Fixed-Effects Poisson Panel Regression					
	Model 1			Model 2		
Dep. var.: ln1valuex	Coefficient	Robust std.error	z-statistics	Coefficient	Robust std. error	z-statistics
ln1prdctvy	2.622***	0.777	3.37	2.656***	0.753	3.53
lngdpcx	0.467	0.147	3.18	0.258*	0.143	1.80
lngdpci	-1.039	1.100	-0.94	0.033	0.187	0.18
lngdpx	-0.072***	0.051	-3.73			
lngdpi	0.906	0.918	0.99			
lnsti	0.046	0.134	0.35	0.036	0.147	0.25
ln1tariff	0.071	0.160	0.44	-0.015	0.164	-0.09
lndist	-0.101	0.067	-1.50	-0.081	0.062	-1.30
langd	0.067	0.188	0.36	0.089	0.184	0.48
log pseudo-likelihood	-1713.083			-1718.121		
Wald chi2	182.59			376.93		
Prob>chi2	0.000			0.000		

No. of observations: 535; Number of groups: 9
Significance:***1%, **5% and *10%.
* ROW: Rest-of-the-World

To cap this section, some points are worth noting. The variables used for the analyses showed satisfactory unit root and cointegration properties. The effect of standard on global cocoa trade showed that value of export for Nigeria was influenced by cocoa productivity, exporter GDP, exporter GDP per capita and importer standard. Also, Ghanaian cocoa export value was significantly influenced only by its cocoa productivity while Indonesian's trade value was affected by importer GDP, distance to trade partner and colonial relationship. Cote d'Ivoire was not significantly affected by any of the variables while Cameroonian trade was dictated by its GDP, GDP per capita, importer GDP per capita, same official language variable and importer tariff.

The world cocoa trade equation showed that productivity, importer GDP per capita and stringency index influenced cocoa trade positively while exporter GDP per capita, tariff and distance had significant negative effects. For the EU cocoa trade, coefficients of productivity, exporter GDP per capita, importer GDP per capita, stringency index and colonial affinity were positive. Coefficients of distance and common official language were however negative. Only supply-side variables, productivity and exporter GDP per capita, significantly affected cocoa trade involving ROW countries.

4.4 **Cost implication of Adopting Individual Standardsas against Codex Standard**

This section commencedwiththe disaggregation of EU and World cocoa trades by trading partners.The trade values were thereafter aggregated on exporting country basis after each sub-section. Each table showed trade values at current levels of importer standards, values under Codex standard and the change from Codex trade values whose percentages were presented afterwards.

4.4.1 **EU cocoa trade (disaggregated and aggregated markets)**

This sub-section evaluated exporting countries' trade with EU countries on individual market basis and thereafter gave EU countries' aggregates for each exporter.

a. **Disaggregated EU market for exporting countries**

i. **Nigeria**

Over the 12-year period considered in the study, Nigeria exported cocoa beans worth \$20.7 million to Netherlands, \$12.4 million to Belgium and \$4.5 million to Germany at the current levels of EU countries' standards. These are reported in Table 10. With harmonised standards, export to Netherlands will still maintain the lead at \$109.2 million and the closest would be to Belgium at \$43.5million giving a loss of \$88.5 million and \$31.1 million at present, respectively. At the current importer standard, Nigeria also lost $12.2 million in Germany and $11.5 million in Spain. A high and notable change of 81.2% will occur with sales in Spain to $11.5 million with harmonisation though the current standard's value stood at a low value of $2.7 million. This percentage change from Codex is marginally higherthan that of Netherlands at 81.0%.

ii. **Cote d'Ivoire**

Cote d'Ivoire got highest revenue from Netherlands ($51.0 million), followed by Italy ($39.5 million) and Belgium ($35.7 million) in that order, for the period under study. With harmonisation, the lead revenue from Netherlands will still increase by a factor of 4, indicating that Cote d'Ivoire has strong presence in that section of the EU market. Similarly, although export value of Cote d'Ivoire to Germany was estimated at $16.2 million, harmonisation will jerk up revenue from Germany by 79.5% to almost quadruple at $62.7 million. Thus, judging from Table 11, Germany is a promising market.Similarly, although Cote d'Ivoire's sales in Italy ($39.5 million) was higher than in Belgium ($35.7 million), replacement of importers' standard with Codex standard will lead to almost a doubling of revenue from Belgium to $64.4 million whereas there will be a marginal increase of $416,000 in the Italian market. The low-value markets whose trade will become significantly high with harmonisation are Estonia and Spain which imported cocoa beans worth $11.5 million and $4.7 million respectively and whose import values will move to $30.9 million and $20.2 million in the same order. France will experience marginal increase from $13.0 million to $19.5 million.

iii. **Ghana**

Netherlands also got largest share of Ghanaian export to the tune of $32.7 million at the current importers' standards. The second position was taken by United Kingdom ($16.2 million), third by Belgium ($13.0 million) and fourth by Italy ($10.8 million). Percentage changes from Codex for the four countries were 80.8%, 65.6%, 71.0% and 19.1% respectively. It is obvious that percentage change for Italian market was very small compared to other countries that are also importing significant amount of cocoa beans.The current loss in export value for Ghana in Netherlands, with respect to Codex standard ($137.5 million), is the highest and is higher than the current export value by an approximate factor of 4, as revealed in Table 12. Ghanaianexport losses in United Kingdom and Belgium were $30.9 million and $31.8 million, and these were approximately 2 and 2.4 times the current export values,respectively.

Table 10:Computation of Cocoa Trade Values between Nigeria and EU Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex('000 US$)	% Change from Codex
Belgium	12435.90	43534.30	-31098.40	-71.43
Estonia	159.80	875.91	-716.08	-81.75
France	1937.09	6888.65	-4951.57	-71.88
Germany	4525.83	16735.80	-12209.90	-72.96
Italy	1389.24	4029.34	-2640.10	-65.52
Netherlands	20701.90	109159.00	-88457.30	-81.04
Poland	4.99	33.01	-28.03	-84.91
Spain	2655.29	14136.90	-11481.60	-81.22
Switzerland	710.01	2208.93	-1498.93	-67.86
United Kingdom	2634.06	8623.45	-5989.42	-69.46

Table 11:Computation of Cocoa Trade Values between Cote d'Ivoire and EU Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex ('000 US$)	% Change from Codex
Belgium	35737.30	100134.00	-64396.60	-64.31
Estonia	11512.40	42425.50	-30913.10	-72.86
France	13019.70	32493.60	-19473.80	-59.93
Germany	16160.60	78853.20	-62692.60	-79.51
Italy	39527.70	39944.30	-416.64	-1.04
Netherlands	51031.20	263684.00	-212653.00	-80.65
Poland	2480.54	8361.73	-5881.18	-70.33
Spain	4718.62	24901.80	-20183.20	-81.05
Switzerland	86.37	50.04	36.34	72.62
United Kingdom	7414.33	30913.80	-23499.50	-76.02

Table 12: Computation of Cocoa Trade Values between Ghana and EU Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex ('000 US$)	% Change from Codex
Belgium	13000.70	44814.40	-31813.70	-70.99
Estonia	7082.27	24288.80	-17206.50	-70.84
France	5538.01	26520.50	-20982.50	-79.12
Germany	6063.59	19784.70	-13721.10	-69.35
Italy	10759.20	13305.30	-2546.05	-19.14
Netherlands	32686.60	170138.00	-137451.00	-80.79
Poland	527.26	527.26	0.00	0.00
Spain	3555.91	21401.20	-17845.20	-83.38
Switzerland	117.07	360.02	-242.95	-67.48
United Kingdom	16223.00	47164.20	-30941.20	-65.60

iv. **Indonesia**

Indonesia had little presence in EU cocoa market as could be deducted from the results on Table 13. The little presence was more pronounced in Germany ($891,000), the United Kingdom ($448,000), Belgium ($332,000) and lastly Netherlands ($214,000) in decreasing order. This is not unconnected with the fact that Indonesia sells most of its output to its neighbour, Malaysia, who has transformation industry (CTB-BTC, 2011). The results also showed that there is no room for expansion in the United Kingdom even if the standards are harmonised. High percentage change was got for Netherlands which indicated that though much revenue is not coming from Netherlands at the current level of importer standard, harmonisation will bring better prospects. Germany also had high percentage change from Codex (70.0%) while Belgium had low percentage change (40.0%).

v. **Cameroun**

Cameroun registered better presence in the EU than Indonesia though it is the fifth largest cocoa beans exporter in the world. Netherlands conducted highest cocoa trade with Cameroun among the EU countries for the 12-year period at a value of $20.0 million. It was followed in a distant second by Belgium at $4.4 million and by Spain in a further third position at a low value of $1.8 million. Cameroun is presently losing $133.1 million in trade value from Netherlands at the current individual countries' standards while it is losing $2.7 million in Belgium and $9.8 million in Spain, which are very lowly compared to what obtained in Netherlands. It seems Netherlands is the most viable (if not the only viable) market for Cameroun in the EU in respect of export volume and high prospect under harmonisation, as revealed in Table 14.

Generally, Netherlands consistently imported highest cocoa beans valued at $20.7 million, $51.0 million, $32.7 million and $20.0 million from Nigeria, Cote d'Ivoire, Ghana and Cameroun respectively and there is even better prospect with Indonesia that is not currently exporting much to Netherlands. This is as a result of the presence of the largest cocoa processing activity in the world and the fact that Netherlands houses the largest cocoa port in the world (CBI, 2016). Other importantmarkets were Belgium and Germany.

Table 13:Computation of Cocoa Trade Values between Indonesia and EU Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex ('000 US$)	% Change from Codex
Belgium	332.19	553.96	-221.77	-40.03
Estonia	7.30	29.58	-22.28	-75.32
France	2.17	9.57	-7.39	-77.22
Germany	891.01	2978.65	-2087.65	-70.09
Italy	30.88	78.23	-47.35	-60.53
Netherlands	214.58	1408.72	-1194.13	-84.77
Poland	19.21	19.21	0.00	0.00
Spain	16.55	115.20	-98.64	-85.63
Switzerland	4.42	17.86	-13.44	-75.25
United Kingdom	448.92	448.92	0.00	0.00

Table 14: Computation of Cocoa Trade Values between Cameroun and EU Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex ('000 US$)	% Change from Codex
Belgium	4373.25	7063.70	-2690.46	-38.09
Estonia	20.14	153.36	-133.21	-86.86
France	851.51	2535.91	-1684.41	-66.42
Germany	588.27	4150.41	-3562.12	-85.83
Italy	17.08	127.60	-110.52	-86.61
Netherlands	20023.80	153128.00	-133104.00	-86.92
Poland	0.17	1.28	-1.11	-86.72
Spain	1797.33	11646.90	-9849.62	-84.57
Switzerland	0.00	0.00	0.00	0.00
United Kingdom	173.97	195.36	-21.38	-10.94

b. **Aggregate trade valuesin EU market**

Figure 26 shows the estimated value of EU cocoa trade for the exporting countries. The estimated value for Cote d’Ivoire for the period under study (2005-2016),was $181.7 million. Cote d’Ivoire was followed by Ghana, Nigeria and Cameroun with export values of $95.6 million, $47.2 million and $27.8 million respectively. At the present level of differing standards, exporting countries are losing whooping sums of money when present revenue is compared to what they would have generated under Codex standard. The losses were estimated at $440.0 million, $272.8 million, $159.1 million and $151.2 million for Cote d’Ivoire, Ghana, Nigeria and Cameroun, respectively. The presence of Indonesia was not much registered in the EU cocoa market. This was shown in the export value of approximately $2.0 million.

Cameroun had the highest percentage change of 84.4% from baseline (Codex mirrored) export in the presence of harmonisation followed by Nigeria (77.1%) and Ghana (74.1%) as presented in Figure27. Cote d’Ivoire had percentage change of 70.8% while Indonesia had the least percentage change. This is an indication of the level of gain of each exporter if importers’ standards are harmonised at the level of Codex.

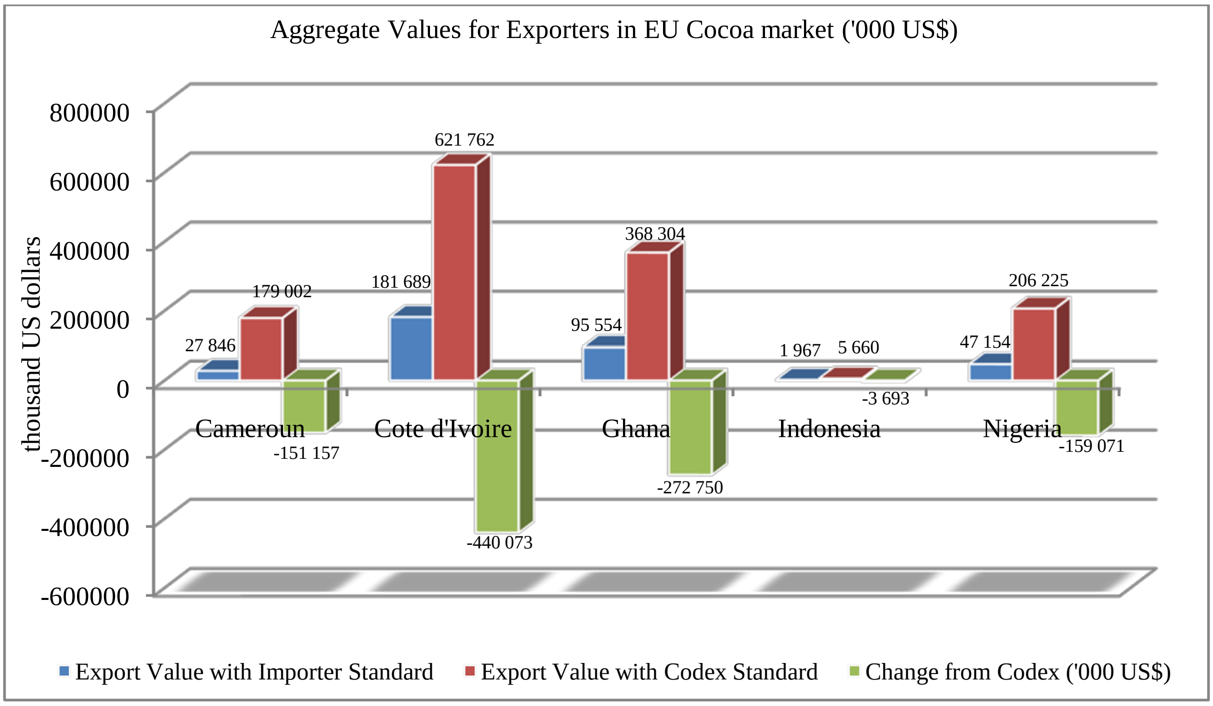


Figure 26: Aggregate values for the exporting countries in the EU cocoa market

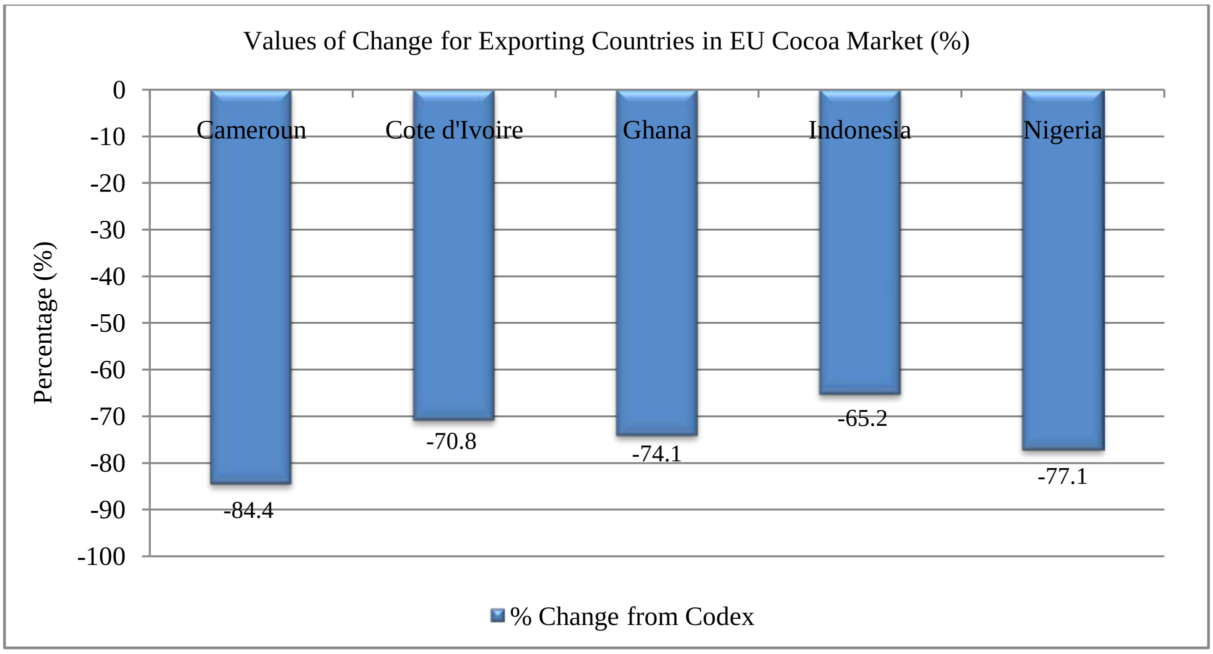


Figure 27: Percentage changes from Codex for exporting countries in EU cocoa market

4.4.2 World trade(disaggregated and aggregated markets)

This sub-section evaluated exporting countries' trades with all importing countries (including the EU) on individual market basis and at aggregate levels.It is in four parts. The first part dealt with disaggregated markets in World cocoa trade while the other three parts focused on aggregates of World trade, aggregates of EU section of World trade and aggregates of other importing countries in World trade for the exporting countries.

a. Disaggregated World trade

i. Nigeria

The results presented in Table 15 showedthat largest Nigerian export had the USA as its destination and this was valued at $93.5 million.It was followed by Netherlands, Canada, Belgium and Singapore in decreasing order with cocoa export values of $35.3 million, $28.7 million, $21.8 million and $11.9 million respectively. At the current importer standard,value of export to China ($8.8 million) was more than to Germany ($8.0 million). In the same vein, export to Malaysia ($6.3 million) was more than the remaining EU countries of UK and Spain ($4.6 million each), France ($3.5 million) and Italy ($2.5 million).The result implied that although traditional importers of Nigerian cocoa were the EU countries and to a lesser degree, the United States of America (Cadoni, 2013), this is in the aggregate. Asian countries are also important when importing countries are considered at disaggregated levels.

In comparison to harmonised standard level, Nigeria's loss of cocoa export to Netherlands was the highest at $161.5 million. Other significant losses were in Belgium ($56.6 million), Germany ($22.2 million) and Spain ($20.9 million). This implied that there will be gains in the afore-mentioned markets with harmonisation. This is in contrast to the situation in the North American market. As a result of low stringency of standards in the USA and Canada, shown in higher number of regulated pesticides than the Codexand even higher disparity between their individual average *mrl* values and Codex value, harmonisation will result in losses in these two countries to the tune of $45.6 million (USA) and $16.8 million (Canada). However, in the end, the gains in Netherlands alone would have offset the anticipated losses.

ii. Cote d'Ivoire

Cote d'Ivoire was a heavy supplier of North American market, especially the USA as shown inTable 16. It exported cocoa beans worth $1.1 billion to USA over the 12-year period considered in this studyat the current importers' standards. Its neighbour and regional counterpart, Canada, received a lowly $81.0 million worth of cocoa beans. In the EU, Belgium took the lead at $250.4 million import value and was the second overall after USA.Netherlands (3rd position), Italy (5th position), Malaysia (6th position) and Germany (7th) position, received $89.1 million, $71.0 million, $43.7 million and $28.4 million worth of cocoa beans, respectively. With current importer standard, $386.3 million in cocoa trade value is being lost in Netherlands and $113.8 million in Germany as compared to Codex level.On the other hand, huge losses are expected in USA ($708.3 million) and Canada ($39.9 million) with harmonisation. Thus, the current importer standard was more advantageous to Ivorian cocoa in the USA, Canada and Belgiumthan the Codexsince current export values will drop by 165.2%, 97.2% and 38.7% respectively when standards are harmonised. This is the positive outcome of low stringency in cocoa import standard in the respective countries.

There was a group of countries that did not absorb much cocoa from Cote d’Ivoire at present but harmonisation will make such market become important in varying degrees. These were Estonia that fetched Cote d’Ivoire $20.4 million but its import will increase by 73.3% to $56.1 million; France,whose trade value will increase from $23.2 million to $35.4 million (60.4%); UK, that will witness rise in trade by 76.6% from $13.1 million to $42.7 million and Spain, which will obtain cocoa beans worth $36.6 million from the meager $8.3 million. These show that EU countries still hold good prospect for Cote d’Ivoire even with harmonisation of standards.

Table 15:Computation of Cocoa Trade Values between Nigeria and World Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex ('000 US$)	% Change from Codex
Belgium	21839.70	78482.20	-56642.50	-72.17
Brazil	132.95	221.62	-88.67	-40.01
Canada	28664.00	11868.80	16795.30	141.51
China	8838.23	8508.71	329.52	3.87
Estonia	273.72	1579.05	-1305.33	-82.67
France	3453.06	12418.70	-8965.62	-72.19
Germany	8009.75	30170.70	-22161.00	-73.45
Italy	2492.34	7264.00	-4771.65	-65.69
Japan	152.03	918.01	-765.97	-83.44
Malaysia	6263.91	15062.00	-8798.01	-58.41
Netherlands	35261.60	196789.00	-161527.00	-82.08
Poland	8.98	59.52	-50.55	-84.93
Russian Fed.	67.14	44.77	22.36	49.94
Singapore	11897.50	17207.20	-5309.67	-30.86
Spain	4565.22	25485.60	-20920.40	-82.09
Switzerland	1279.18	3982.22	-2703.01	-67.88
Thailand	0.00	0.00	0.00	0.00
United Kingdom	4632.01	15546.10	-10914.10	-70.20
United States of America	93463.20	47892.70	45570.50	95.15

Table 16: Computation of Cocoa Trade Values between Cote d'Ivoire and World Partners at the Individual and Harmonised Standard Levels Cote d'Ivoire

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex ('000 US$)	% Change from Codex
Belgium	250434.00	180518.00	69915.50	38.73
Brazil	23724.60	29898.50	-6173.85	-20.65
Canada	80991.80	41068.60	39923.30	97.21
China	7458.42	7457.90	0.52	0.01
Estonia	20423.80	76483.40	-56059.60	-73.30
France	23219.30	58578.40	-35359.10	-60.36
Germany	28359.30	142154.00	-113795.00	-80.05
Italy	70966.40	72010.30	-1043.90	-1.45
Japan	393.83	657.88	-264.05	-40.14
Malaysia	43663.60	76246.10	-32582.50	-42.73
Netherlands	89078.00	475362.00	-386284.00	-81.26
Poland	4409.29	15074.30	-10665.00	-70.75
Russian Fed.	7725.81	7690.90	34.91	0.45
Singapore	4257.94	4258.19	-0.25	-0.01
Spain	8283.54	44892.20	-36608.60	-81.55
Switzerland	155.86	90.20	65.65	72.78
Thailand	0.00	0.00	0.00	0.00
United Kingdom	13071.10	55730.40	-42659.30	-76.55
United States of America	1100000.00	428850.00	708256.00	165.15

iii. **Ghana**

Ghana's target market spread across EU, Asia and North America with bulk flow to the USA at $245.3 million.Netherlands occupied the second position with one-fourth of USA import value. Malaysia, a producer-importer, traded cocoa beans worth $58.6 million to stay at the third position. China followed suite ($30.3 million) and was trailed closely by UK ($29.4 million). Other important markets were Belgium and Japan.The beneficial changes with harmonisation also spread across the different continental markets. The highest was for Netherlands ($248.1 million), followed by Belgium ($57.3 million), UK ($55.6 million), France ($37.8 million), Malaysia ($35.6 million), Spain ($32.1 million), Estonia ($30.9 million) and Japan ($27.3 million) in decreasing order.

The exceptions will be USA, Canada and some Asian countries who are presently gaining beyond what Codex level will offer and will therefore be at disadvantage with harmonisation. The losses will be significantly high in North America: $179.7 million for USA representing 73.2% of the current value and $11.2 million for Canada representing 83.1%. The effect will be low but also significant for China and Thailand at approximately 10.7% and 20.5% of their respective current import values. These will be as a result of higher stringent trade situation for the four countries under harmonisation. All these pieces of information are contained in Table 17.

iv. **Indonesia**

Indonesia exported mostly to Malaysia as revealed in Table 18. The USA followed closely behind whileCanada, another trading partner in North America, experienced a quarter of trade volume that went to USA. Singapore took in a little above one-third of export that went to Malaysia, though occupying the third position. With contrasts a little with Rifin and Nauly (2013) that noted Malaysia and Singapore are largest importers of cocoa from Indonesia due to the presence of transformation industry of capacity of a little below 0.5 million tonnes/year.Other markets in order of decreasing importance were Brazil, China and Thailand. As regards harmonisation, Indonesia is at present gaining in the North American markets over what would've obtained in the presence of Codex standard and will tend to lose 73.5% and 15.6% of its current export value in Canada and USA respectively. On the other hand, Indonesia is presently losing 137% of its current export value to Malaysia in the Southeast Asian marketdue to stringent importer standards. With this dilemma, Indonesia will need to strike a balance between effects of present importers' standards and Codex standard.

v. **Cameroun**

Cameroun exported mostly to Belgium ($36.7 million),Netherlands ($35.1 million)and Malaysia ($11.2 million). As shown in Table 19, Cameroonian export to Netherlands will expand by the highest point (587.5%,representing $206.0 million) while its trade with Malaysia will only increase by 73.7% representing mere $8.3 million,under harmonised global standard regime. On the other hand, export to Belgium will suffer setback to the tune of $24.0 million and trade value of $4.7 millionwill be lost in Thailand.

Table 17:Computation of Cocoa Trade Values between Ghana and World Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex('000 US$)	% Change from Codex
Belgium	23533.10	80790.00	-57256.90	-70.87
Brazil	8313.34	10105.80	-1792.52	-17.74
Canada	13526.90	2288.33	11238.50	491.12
China	30290.60	27041.30	3249.33	12.02
Estonia	12849.70	43787.00	-30937.30	-70.65
France	10053.20	47810.30	-37757.10	-78.97
Germany	10962.10	35667.20	-24705.10	-69.27
Italy	19531.80	23986.40	-4454.60	-18.57
Japan	21892.20	49214.20	-27322.00	-55.52
Malaysia	49163.30	84748.50	-35585.30	-41.99
Netherlands	58603.30	306719.00	-248116.00	-80.89
Poland	950.53	950.53	0.00	0.00
Russian Fed.	0.00	0.00	0.00	0.00
Singapore	3929.93	5848.56	-1918.63	-32.81
Spain	6433.82	38581.30	-32147.50	-83.32
Switzerland	207.50	649.04	-441.54	-68.03
Thailand	9551.73	7585.89	1965.84	25.91
United Kingdom	29415.40	85026.20	-55610.80	-65.40
United States of America	245348.00	65640.50	179707.00	273.78

Table 18:Computation of Cocoa Trade Values between Indonesia and World Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex ('000 US$)	% Change from Codex
Belgium	574.60	998.67	-424.05	-42.46
Brazil	19035.20	31108.90	-12073.70	-38.81
Canada	22907.20	6081.58	16825.60	276.66
China	15416.40	15314.10	102.31	0.67
Estonia	12.89	53.34	-40.44	-75.82
France	3.86	17.26	-13.38	-77.52
Germany	1603.57	5369.86	-3766.26	-70.14
Italy	55.31	141.03	-85.72	-60.78
Japan	167.94	820.43	-652.50	-79.53
Malaysia	94051.90	223126.00	-129074.00	-57.85
Netherlands	381.79	2539.58	-2157.81	-84.97
Poland	34.64	34.64	0.00	0.00
Russian Fed.	39.50	39.50	0.00	0.00
Singapore	35451.90	59207.80	-23755.90	-40.12
Spain	29.72	207.66	-177.94	-85.69
Switzerland	7.97	32.21	-24.22	-75.19
Thailand	11002.80	10611.90	390.92	3.68
United Kingdom	809.31	809.31	0.00	0.00
United States of America	86616.80	73126.20	13490.70	18.45

Table 19:Computation of Cocoa Trade Values between Cameroun and World Partners at the Individual and Harmonised Standard Levels

Importer	Export Value with Importer Standard ('000 US$)	Export Value with Codex Standard ('000 US$)	Change from Codex ('000 US$)	% Change from Codex
Belgium	36715.60	12734.30	23981.40	188.32
Brazil	0.00	0.00	0.00	0.00
Canada	2674.32	0.00	2674.32	491.13
China	1614.53	1363.21	251.32	18.44
Estonia	35.16	276.46	-241.29	-87.28
France	1526.76	4571.66	-3044.88	-66.60
Germany	1047.30	7482.19	-6434.90	-86.00
Italy	29.83	230.04	-200.21	-87.03
Japan	18.56	113.11	-94.57	-83.61
Malaysia	11211.60	30690.10	-19478.60	-63.47
Netherlands	35052.90	276054.00	-241001.00	-87.30
Poland	0.30	2.30	-2.00	-86.96
Russian Fed.	33.45	33.45	0.00	0.00
Singapore	1966.04	1942.67	23.35	1.20
Spain	3176.44	20996.80	-17820.30	-84.87
Switzerland	0.00	0.00	0.00	0.00
Thailand	7584.22	2932.39	4651.84	158.64
United Kingdom	313.42	352.18	-38.76	-11.01
United States of America	81.99	61.48	20.50	33.34

b. **Aggregate trade values in World market**

Figure28 shows the estimated values of World cocoa trade for the exporting countries. Cameroun had the least export valued at $103.1 million while Cote d'Ivoire exported most at an estimated value of $1.8 billion. This was a moderate value going by the estimated €4.0 billion cocoa beans import value by the EU in 2014. Also, export of Cote d'Ivoire grew annually by 1.4% between 2010 and 2014 whereas other major suppliers experienced decline: Ghana, -2.5%; Cameroun, -6.6% and Nigeria, -9.0% in the same period partly due to diminished harvest and partly due to EU *mrl* regulation (CBI, 2016). Ghana's export was valued at above $0.55 billion, Indonesia's at $0.29 billion and Nigeria's at $0.23 billion. The amount that Nigeria lost with the current level of importers' standards was $10.9 million more than it got in export value for the period under study. Cameroun also lost $50.6 million more than double the value of export. Indonesia will gain approximately half of its value of sales with harmonisation.

Highest possible gain in the presence of harmonisation was observed for Cameroun as shown in Figure 29. Nigeria had the second position with approximately 50% (average) gain in relation to what obtained with importer standard while gains for Ghana and Indonesia fell below average. On the other hand, Cote d'Ivoire showed a possible loss of 5.9% if harmonised Codex standard were to be in place. This loss is indicative of the fact that Cote d'Ivoire is presently operating at very high-quality standard as the lead exporter in the world.

The World cocoa trade was dichotomised into EU and Rest-of-the-World (ROW) components. Test of difference of mean was carried out on the major market variables to verify if the division is justified. The result of the test, presented in Annex 3 of Appendix VI, showed thatanalyses and explanations done for the two separate sub-markets are correct.

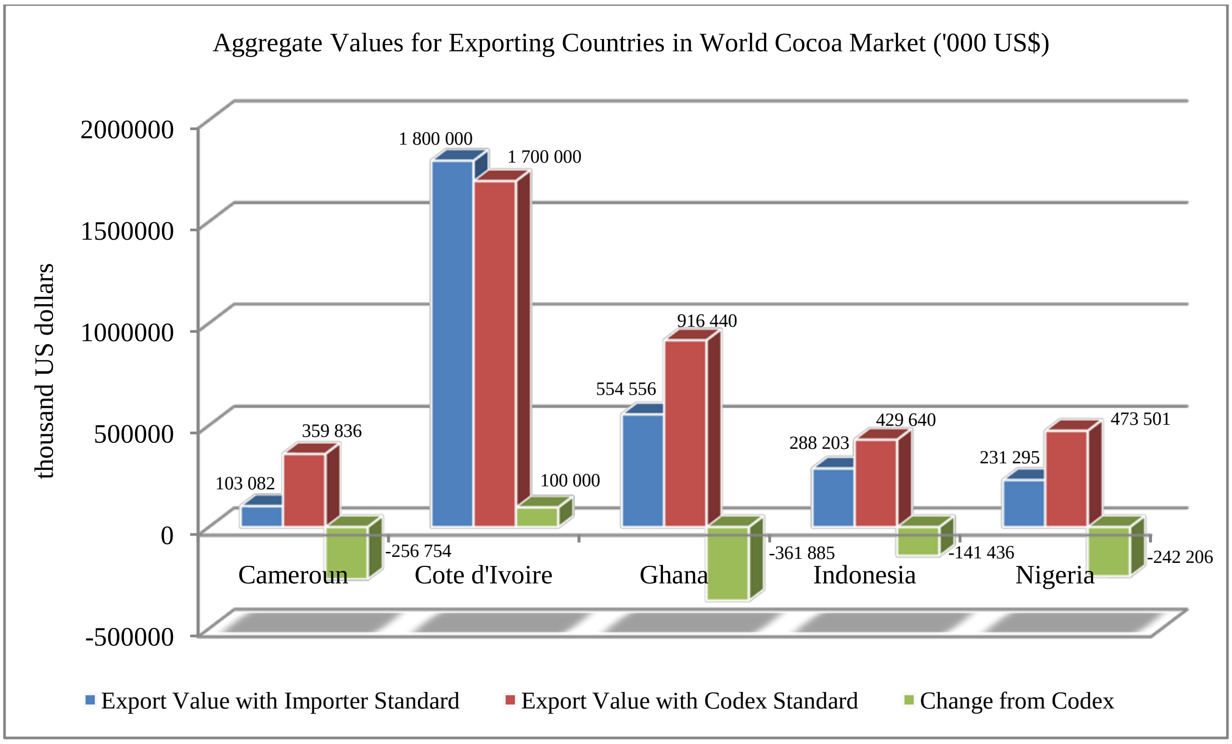


Figure 28:Aggregate values for exporting countries in world cocoa market

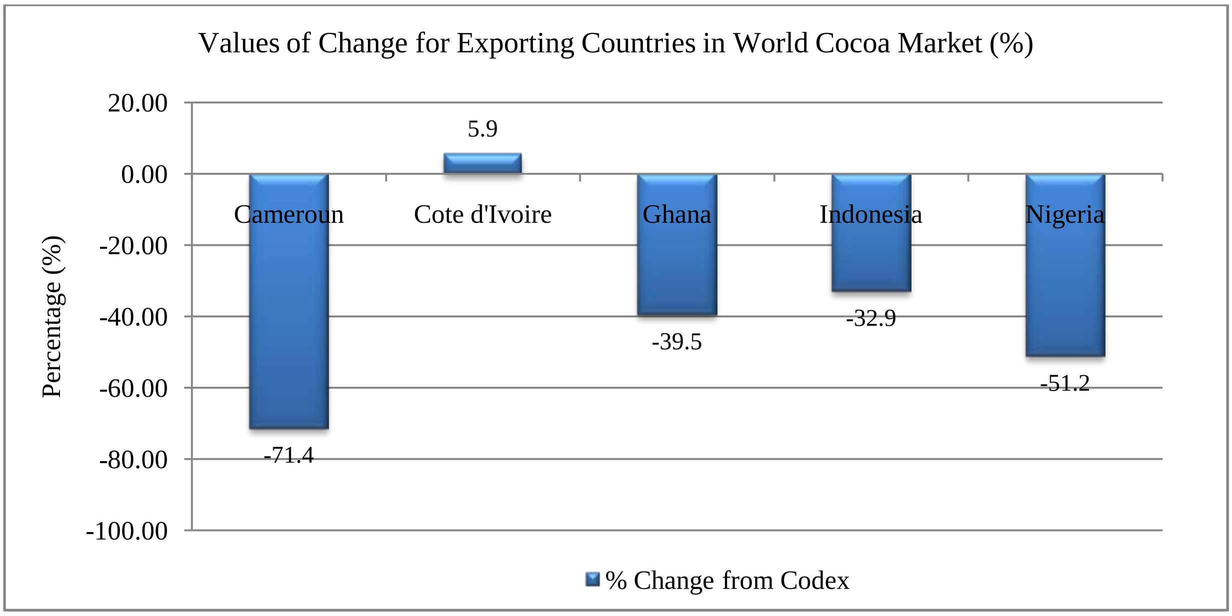


Figure 29: Percentage changesfrom Codex for exporting countries in World cocoa market

i. **Aggregate for EU in World trade**

Export values shown in Figure 31 revealed that Cameroun got three-quarter of its total cocoa export revenue from the EU with total sum of $77.9 million. This contrasted with the situation of Indonesia wherein only one-hundredth of its export between 2005 and 2016 (valued at $3.5 million) was EU sourced. This showed very poor presence of Indonesia in EU market. With respect to other countries, Ghana exported approximately one-third of its produce estimated as $172.5 million to the EU, Cote d'Ivoire exported a little below one-third (but with a high value of $508.4 million) while Nigeria exported above one-third ($81.8 million).

As regards export value changes from Codex, Cote d'Ivoire took the lead with projected value of $591.6 million. Other high earners under harmonisation were Ghana - $491.4 million, Nigeria - $290 million and Cameroun - $244.8 million. Percentage changes, in decreasing order, were observed for Nigeria, Cameroun, Ghana and Indonesia (Figure 31) implying that their current losses are decreasing in that order. Cote d'Ivoire had the least projected gain though it exported more to the EU than other countries in the last 12 years.

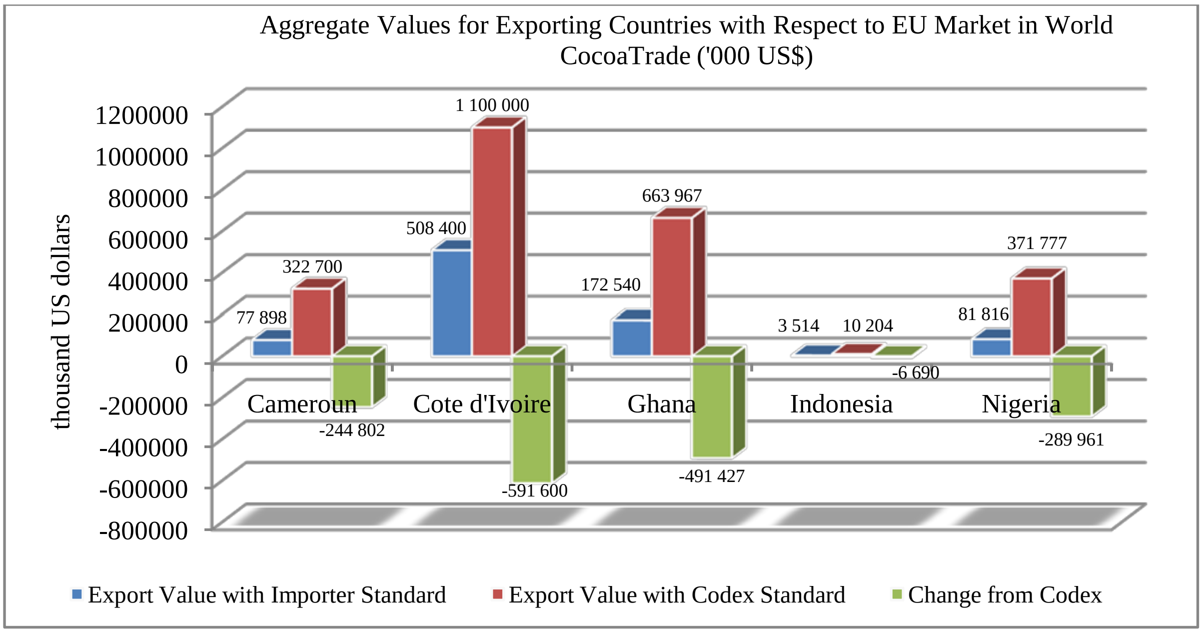


Figure 30: Aggregate values for exporting countries with respect to EU market in World cocoa trade

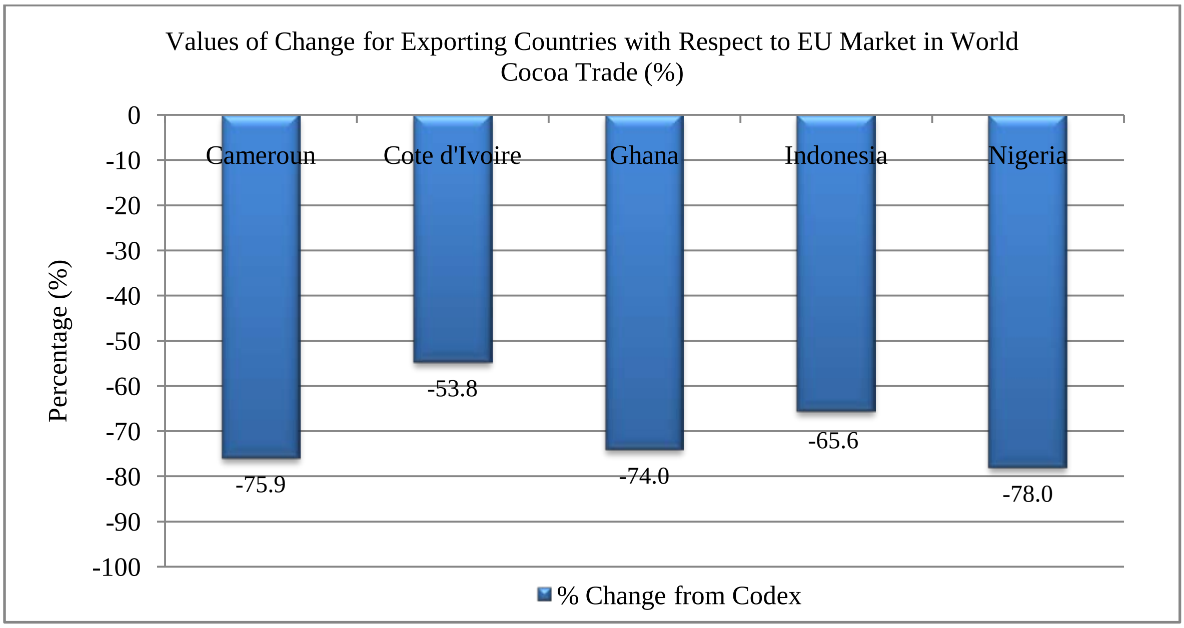


Figure 31: Percentage changes from Codex for exporting countries in EU section of World market

ii. **Aggregate trade valuesfor ROWinWorld trade**

At the current importers' standards, Cote d'Ivoire's export to other regions apart from EU was valued at $1.29 billion. It was followed by Ghana with cocoa export worth of $382.0 million and Indonesia at $284.7 million. Nigeria's cocoa export stood at $149.5 million. Indonesia's total export to the world market was valued at $288.2 million (Figure 28) out of which $284.7 million, representing 98.9% of the aggregate, was from non-EU section of the market as shown in Figure 32.

At the present level of standard, Cote d'Ivoire, Ghana and Nigeria are gaining more than what they would have gained if Codex was in operation. Harmonisation will reduce the gains for these respective countries by 116.7%, 51.3% and 47.0% judging from the current export level. On the other hand, Cameroun and Indonesia will benefit equally at 32.0% (Figure 33).

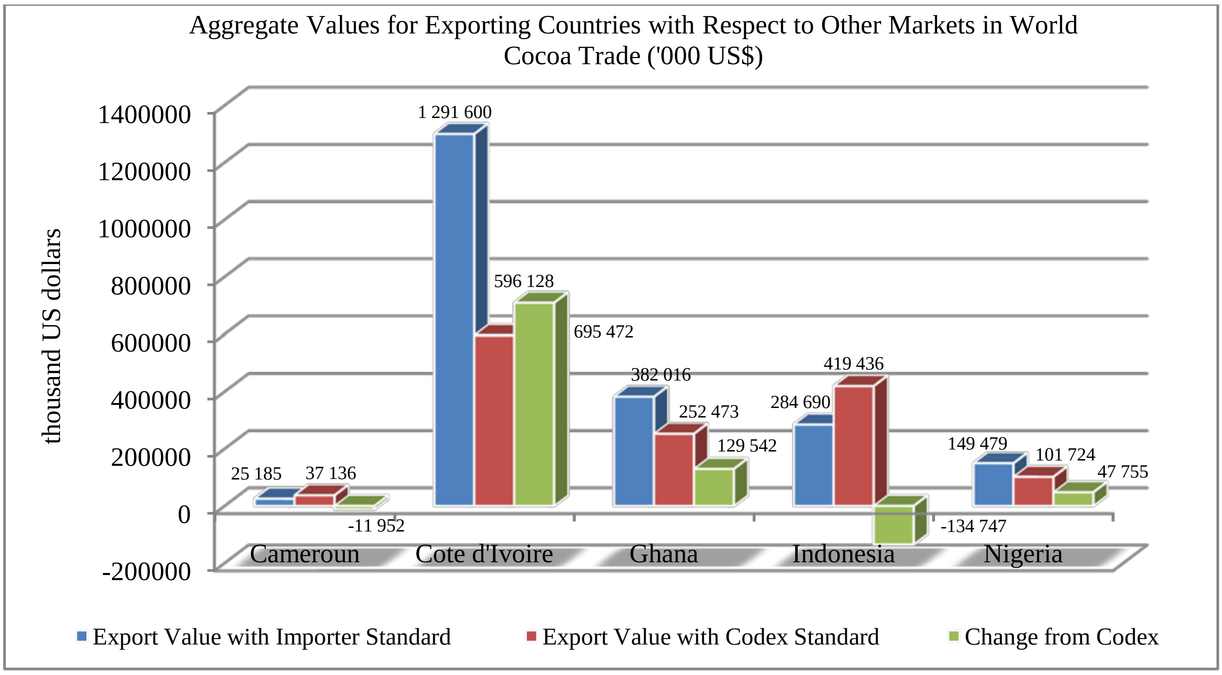


Figure 32: Aggregate values for exporting countries with respect to other markets in world cocoa trade

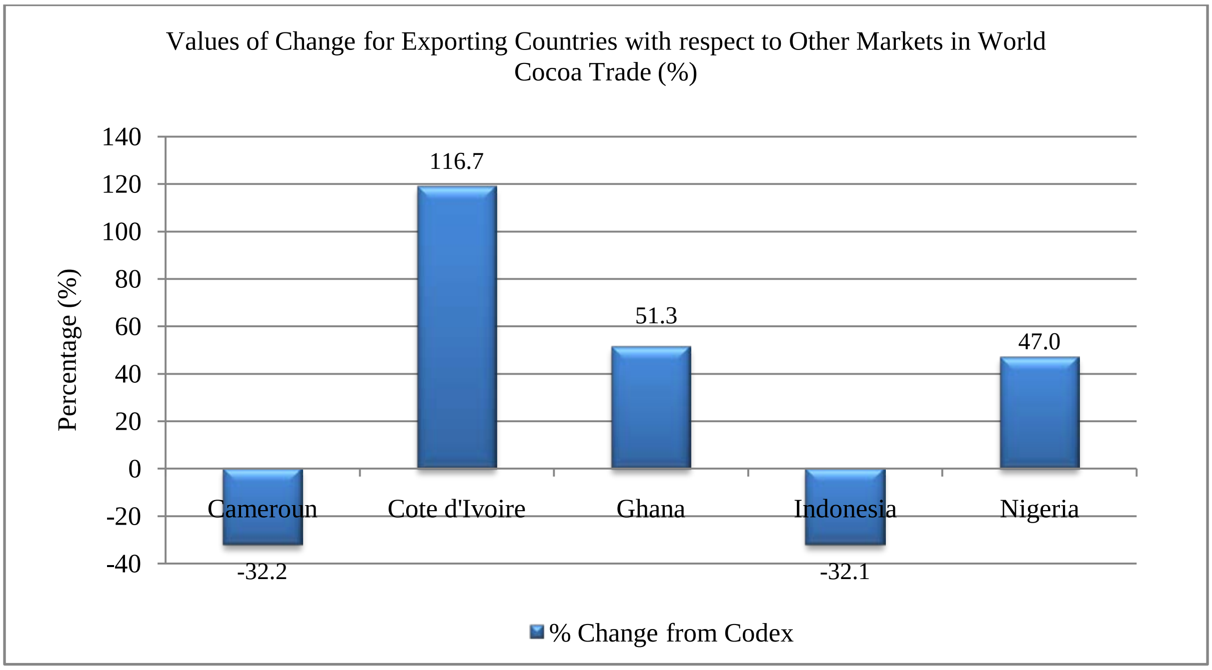


Figure 33: Percentage changes from Codex for exporting countries in ROW section of World market

c. **Average trade values**

Average trade values were calculated for each exporting country with respect to both EU and World trades. This was achieved by finding the mean of trade values under current and harmonised standard situations in the market blocs for each exporter. Cote d'Ivoire, Ghana, Nigeria, Cameroun and Indonesia had average trade values of \$630.5m, \$321.2m, \$170.0m, \$134.7m and \$108.8m,respectively.

4.4.3 Harmonisation Effects on Exporters

To cap this section (4.4),the effects of harmonisation of standards were assessed using three (3) methods: (i) shares of each exporters' cocoa trade going to the EU and ROW, (ii) aggregate trade values of all the exporters, and (iii) share of each exporter in EU and World markets. The first two (2) methods were referred to as supply-side harmonisation effect while the third method was named demand-side harmonisation effect.

a. **Supply-side harmonisation effect**

Figure 34 showed that at the current level of importers' standard, approximately one-third of volume of cocoa beans from Nigeria, Ghana and Cote d'Ivoire, found its way to the EU bloc while three-fourths of global cocoa trade of Cameroun is with the EU bloc. On the other hand, almost all Indonesian cocoa trade was with countries outside the EU bloc. With harmonisation, all the exporting countries' trades doubled with the exception of Cameroun.

Figure 35 shows aggregate trades under current individual countries' standards and the harmonised standard. Results from Figure 35 indicated that though the volume of World cocoa trade is understandably more under both standard scenarios, the current loss to the exporting countries in the EU market is higher: \$1.0 billion (EU) to \$902.3 million (World). By extension, the higher percentage change for EU trade (73.3%) compared to World trade (23.3%) meant that there is better potential in the EU market for the exporters if standards are harmonised. These positive outcomes of harmonisation are supported by the findings of Foletti and Shingal (2014a).

Harmonisation Effects on Exporting Countries (Supply-side)

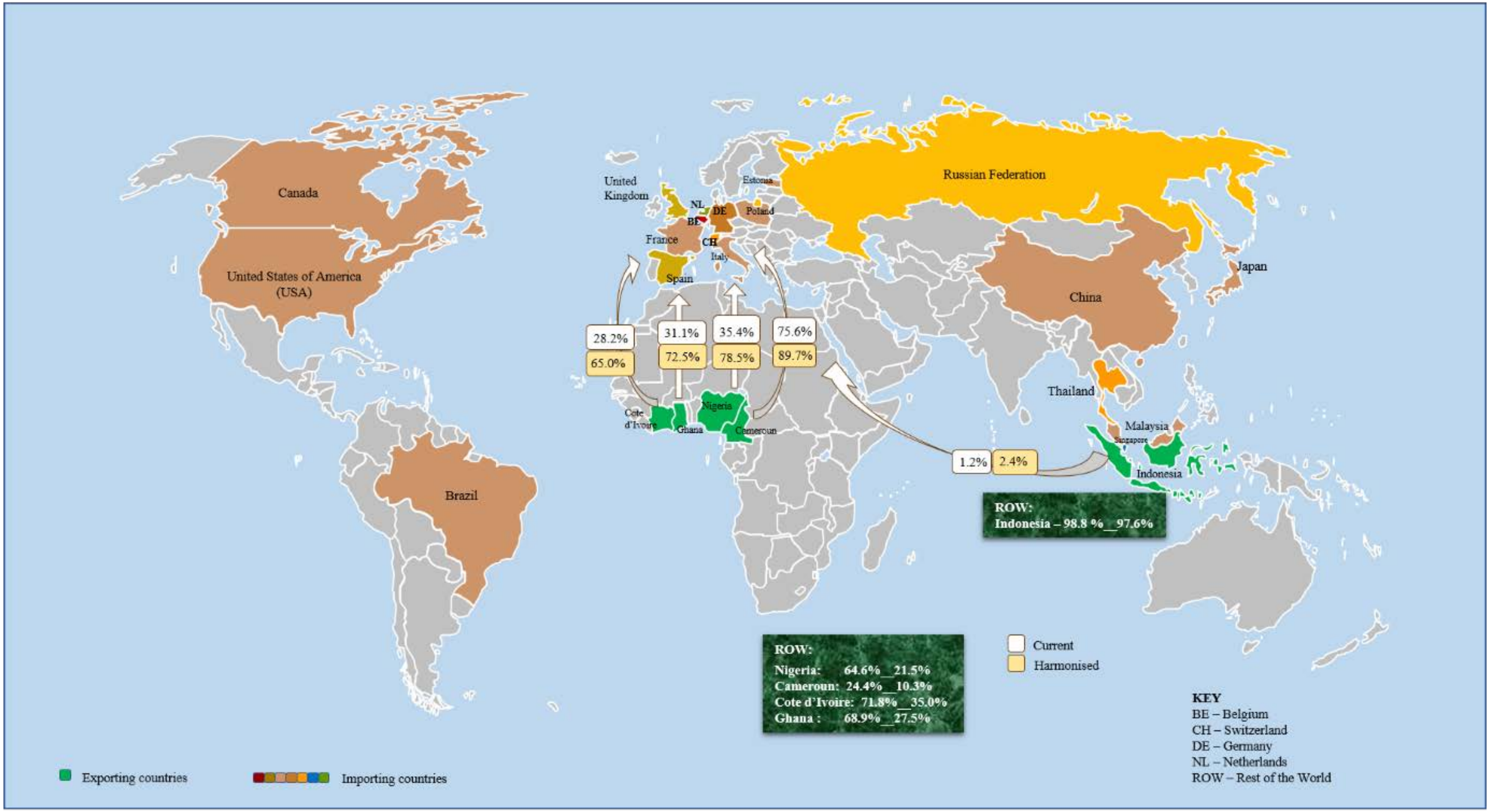


Figure 34: Percentage of each exporter's total World trade going to EU and ROW sections

c. **Demand-side harmonisation effect**

From Figure 36, only the share of Cameroun in the total EU trade increased substantially with harmonisation whereas Nigeria obtained marginal increase. In Figure 37, Cameroun, Ghana, Indonesia and Nigeria got increased World cocoa trade shares with the implementation of harmonised standards. These differing effects of harmonisation are in line with the submission of Moenius (2006). The implication is that though harmonisation is advantageous to the exporting countries in the aggregate, there may be need for market and country-specific strategies by each exporting country.

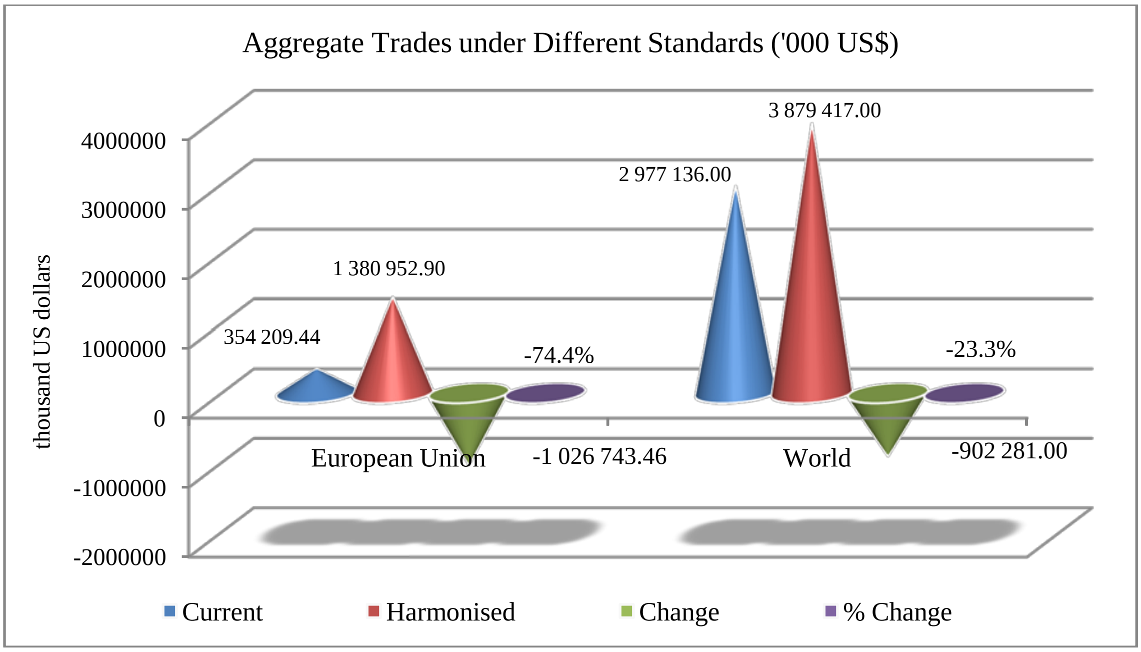


Figure 35: Aggregate EU and World trades under different standards

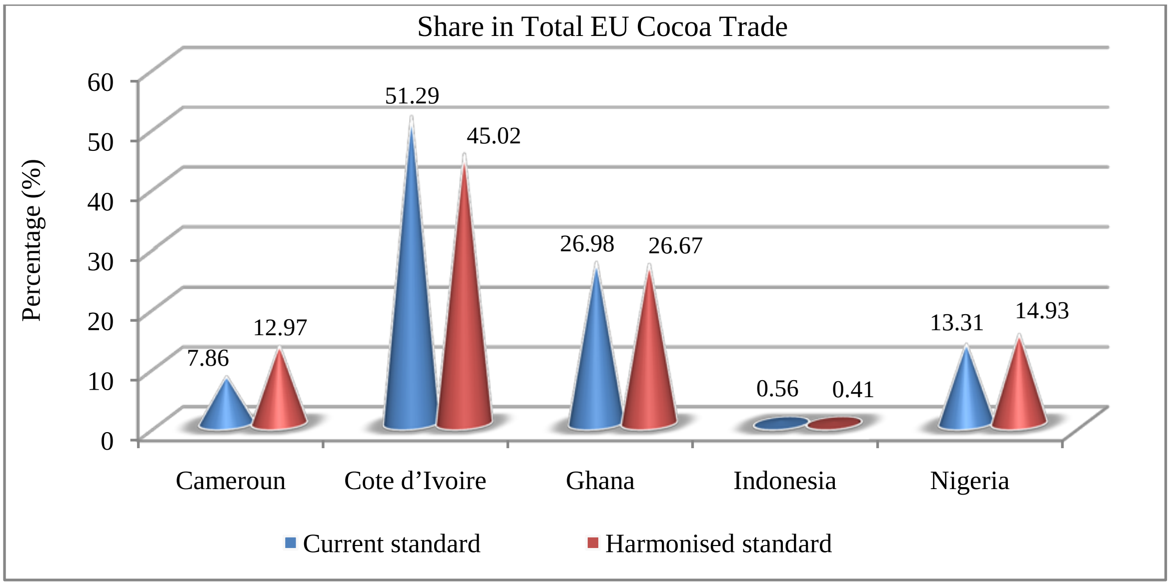


Figure36: Percentage share of each exporter in total EU cocoa trade

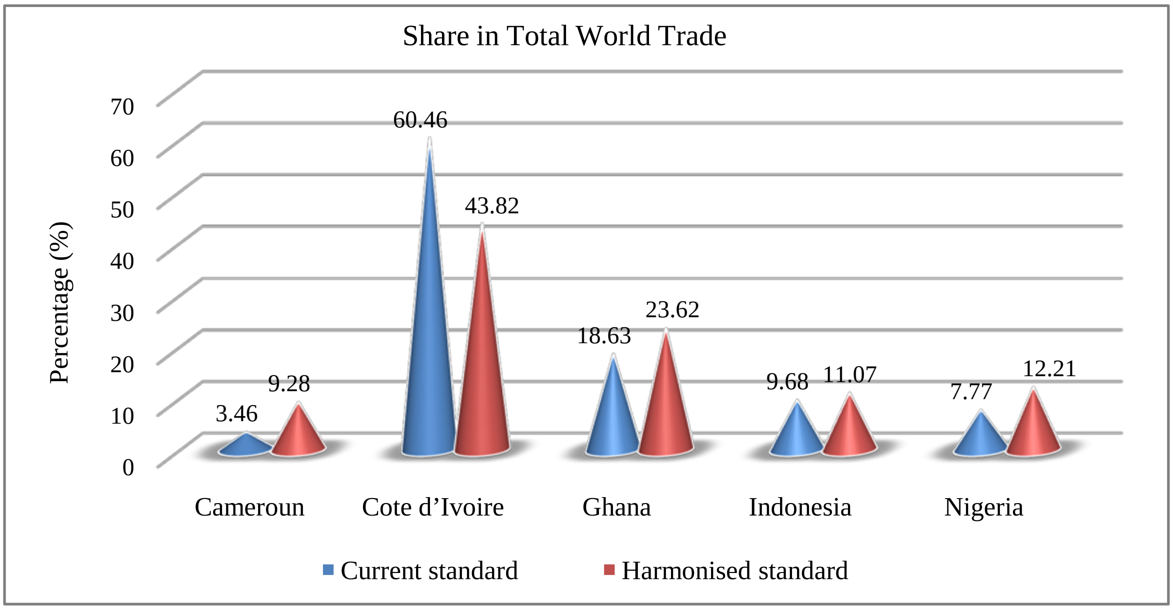


Figure37: Percentage share of each exporter in total World cocoa trade

4.5 Competitiveness of Exporters

Competitiveness of the exporters was assessed based on monetary values and percentage changes. The monetary values include two items: exporters' revenue at the current level of individual importing countries' standards and the difference between it and the projected revenue under harmonised standard. The third item is the percentage change of the difference (Item 2) from Codex, which is the baseline.

4.5.1 Competitiveness in EU trade

Each exporter was ranked using the three criteria and average of the rank values (RS) was taken. The higher the rank, as denoted by decreasing average rank value, the higher the level of competitiveness. Using this method, Cameroun had RS score of 3.0 and CS of 0.25; Cote d'Ivoire: RS=2.0, CS= 0.33; Ghana: RS=2.3, CS=0.30 Indonesia: RS=5.0, CS=0.20 and Nigeria: RS=2.7, CS=0.27. Thus, Cote d'Ivoire was the most competitive in the EU cocoa trade while Indonesia was the least competitive. Ghana, Nigeria and Cameroun were in-between the two countries in decreasing order of competitiveness. This is shown in Figure 38.

4.5.2 Competitiveness in World trade

Cote d'Ivoire had the first position followed by Ghana and Indonesia in succession considering the first criterion: value of export. Ghana ranked first, followed by Cameroun and Nigeria with respect to change from CODEX in monetary terms. Each of these countries were given positive values as ranks for each criterion depending on their positions with the exception of Cote d'Ivoire that was given negative rank value (-1) for monetary and percentage changes from CODEX because the current value of export superseded the obtainable under harmonisation. With these, the average rank values for the exporters were as follows: Cameroun, 2.67; Cote d'Ivoire, - 0.33; Ghana, 2.00; Indonesia, 3.67; Nigeria, 3.00. Therefore, their level of competitiveness with respect to World trade, in decreasing order, went thus: Cote d'Ivoire, Ghana, Cameroun, Nigeria and Indonesia (Figure 38).

i. Competitiveness in EU section of World market

In the EU bloc of World market, Nigeria, Ghana and Cote d'Ivoire had the same rank score of 2.33 and consequently were at the same level of competitiveness with 0.30 value. The rank score of Indonesia was more than that of Cameroun (4.67>3.33), therefore it was less competitive. In all, Indonesia showed least competitiveness with respect to EU section of world market. This result is fully in line considering Indonesia's focus on countries outside the EU block such as Malaysia which happened to import Indonesia cocoa for processing. In addition, none of the five (5) major importers from Indonesia was from Europe as shown by this study.

ii. **Competitiveness in ROW section of World market**

In the non-EU bloc of World market, Cameroun had rank score of 2.67; Cote d'Ivoire, -1.67; Ghana, -0.67; Indonesia, 1.67 and Nigeria 0.67. The maximum negative number for the rank scores was more than one, therefore two (2) was used as factor to satisfy the condition i>|Rs| if Rs<0. These average rank scores translated to competitiveness scores of 0.21, 3.03, 0.75, 0.27 and 0.37 for Cameroun, Cote d'Ivoire, Ghana, Indonesia and Nigeria respectively. This means that Cote d'Ivoire was the most competitive with respect to ROW cocoa trade, then Ghana, followed by Nigeria, Indonesia and Cameroun in succession.

One would expect that since Indonesia exported cocoa beans mostly to other market sections apart from EU, it should be more competitive in this section of the market. However, this was not so. Although Indonesia exported in large quantity to the high-end chocolate-manufacturing destinations (USA and Singapore) apart from its neighbour, Malaysia, its cocoa might have failed to attract premium like West African cocoa that combines fat and flavour, a desirable property that chocolate manufacturers prefer (Panlibuton and Meyer, 2004).

4.5.3 **Average competitiveness scores (CS) of the exporters**

The competitiveness scores of each main cocoa-exporting country were averaged across the two main market blocs (EU and World). Average trade value was also estimated from trade values under current and harmonised standards for EU and World trades. The results for competitiveness showed Cote d'Ivoire having highest average score of 0.91, followed by Ghana with 0.32. Nigeria and Cameroun had 0.26 score each while Indonesia had the least average score of 0.19.Table 20 showed that countries with high competitiveness scores also had high standard-scaled trade values. This implied that high value of trade was borne out of high competitiveness as defined by high level of compliance with SPS standards set by cocoa-importing countries.

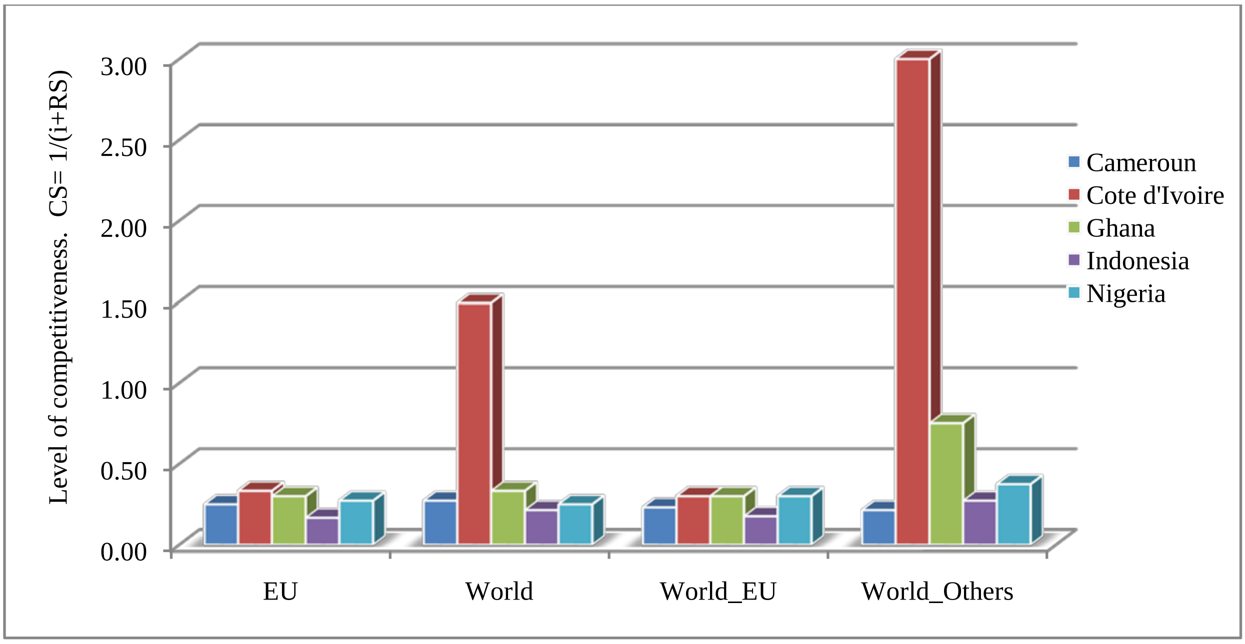


Figure38: Level of competitiveness of the importers in the different market bloc

Table20: Average Competitiveness Scores (CS) and Average Trade Values of Exporters

	Exporting country	Average Cocoa Trade Values (US$)	Average Competitiveness
1.	Cote d'Ivoire	630.45	0.91
2.	Ghana	321.23	0.32
3.	Indonesia	108.83	0.19
4.	Nigeria	169.95	0.26
5.	Cameroun	134.73	0.26

CHAPTER FIVE

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Summary of Major Findings

Import standards are very essential in international agricultural trade and their usage had been on the increase because of the health and environmental benefits. However, there are complaints that the standards are becoming more stringent and therefore acting as impedance to trade. The multiplicity of the standards had also been seen as standing in the way of true competitiveness of cocoa exporters. Against this background, this study focused on the effect of stringency of cocoa standards in importing countries on cocoa trade and assessed competitiveness of the exporters based on their current export values and the extent to which harmonisation of cocoa standards at Codex level will affect their trade. Gravity model with Poisson Maximum Likelihood Estimator was applied to data on five (5) major cocoa exporters and nineteen (19) importing countries. The data were sourced from various local and international organisations for the period 2005-2016.

The mean number of regulated pesticides was higher for EU countries group than ROW group while the average *mrl* value was lower for EU than ROW. The distribution of STI values based on EU cocoa trade revealed that more countries were at the upper end of the highly unequally distributed bimodal kernel line plot. By contrast, countries were slightly unequally distributed at the two modes with more countries found at the lower end, when STI values with world cocoa trade were considered. Regression line fitted showed positive relationship between stringency index values and value of trade for both global and EU cocoa trades.

Exporting-country level analysis of the effect of standard on global cocoa trade showed that value of export for Nigeria was influenced by cocoa productivity, exporter GDP, exporter GDP per capita and importer standard. Also, Ghanaian cocoa export value was significantly influenced only by its cocoa productivity while Indonesian's trade value was affected by importer GDP, distance to trade partner and colonial relationship. Cote d'Ivoire was not significantly affected by any of the variables while Cameroun had six (6) significant variables. These were its GDP and GDP per capita, importer GDP per capita, same official language variable and importer tariff.

The World cocoa trade equation involving all the exporting and importing countries showed that productivity, importer GDP per capita and stringency index influenced cocoa trade positively at 1%, 1% and 5% levels respectively, while exporter GDP per capita, tariff and distance had significant negative effects at 10%, 5% and 1% levels. For world trade, USA was the largest single importer from Nigeria, Cote d'Ivoire and Ghana with aggregate trade valued at $1.44 billion. Aggregate value for world trade at the current importer standard stood at $1.8 billion for Cote d'Ivoire, $554.6 million for Ghana, $288.2 million for Indonesia, $231.3 million for Nigeria and $103.1 million for Cameroun. At present, the following values were lost by the respective countries as a result of non-implementation of global harmonised standard: $361.9 million (Ghana), $256.8 million (Cameroun), $141.4 million (Indonesia) and $242.2 million (Nigeria). On the other hand, Cote d'Ivoire will lose trade to the tune of $100 million under harmonised standards. The rank scores were 2.67, -0.33, 2.00, 3.67 and3.00 while competitiveness scores were 0.27, 1.49, 0.33, 0.21 and 0.25 for Cameroun, Cote d'Ivoire, Ghana, Indonesia and Nigeria, respectively.

For the EU cocoa trade, coefficients of productivity, exporter GDP per capita, importer GDP per capita, stringency index and colonial affinity were positive and significant at 1%, 10%, 1%, 5% and 10% respectively. Coefficients of distance and common official language were however negative and significant at 1% and 10% respectively. Netherlands was the highest importer in the EU cocoa trade. It imported produce worth $20.7 million from Nigeria, $51.0 million from Cote d'Ivoire, $32.7 million from Ghana and $20.0 million from Cameroun. Aggregate trade values for each exporter for the 12-year period studied was $181.7 million (Cote d'Ivoire), $95.6 million (Ghana), $47.2 million (Nigeria), $27.8 million (Cameroun) and $2.0 million (Indonesia). The respective countries lost $440.0 million, $272.8 million, $159.1 million, $151.2 million and $3.7 million. The competitiveness indices for the exporters were: Cameroun, 0.25; Cote d'Ivoire, 0.33; Ghana, 0.30; Indonesia, 0.20 and Nigeria, 0.27.

The ROW cocoa trade analysis showed the importance of only the supply side factors (productivity and exporter GDP per capita) which were positively related to the value of trade and significant at 1% and 10% levels, respectively. The USA was the largest importer of cocoa beans among the ROW countries. Aggregate export values were $1.29 billion (Cote d'Ivoire), $382.0 million (Ghana), $284.7 million (Indonesia) and $149.5 million (Nigeria). Cameroun had very little trade with ROW countries and was valued at $25.2 million.

Harmonisation will lead to losses for Cote d'Ivoire, Ghana and Nigeria while Indonesia and Cameroun will gain. The levels of competitiveness of the exporters, in decreasing order were, Cote d'Ivoire=3.03; Ghana= 0.75; Nigeria= 0.37; Indonesia=0.27 and Cameroun=0.21.

Average trade values were $630.5m, $321.2m, $170.0m, $134.7m and $108.8m, while average competitiveness scores were 0.91, 0.32, 0.26, 0.26 and 0.19 for Cote d'Ivoire, Ghana, Nigeria, Cameroun and Indonesia, respectively.Analysis of the effect of harmonisation on aggregate performance of the exporting countries revealed that though higher volume of cocoa was involved in World trade, present loss in the absence of harmonisation and percentage trade change from Codex were more for EU cocoa trade. There is also differing effects of harmonisation on the exporting countries.

5.2 **Conclusion**

Generally, there had been increase in global stringency of individual cocoa beans import standard particularly in the EU countries. However, the stringent standard did not impede trade but rather improved it. High stringent standard was encouraging export as a result of higher price gain attached to compliance. Also, large non-EU cocoa processing countries lowered their import standard for volume accumulation while emerging markets tried to register their presence in the world cocoa trade. High productivity in exporting countries was making more produce to be available for export. High income level in importing countries signified consumptive ability of the citizens for cocoa products which encouraged more import for product transformation. It is informative that global cocoa beans trade was not hindered by cultural differences, being a global phenomenon with interconnected functioning among different continents of the world. Furthermore, processing was taking place in exporting countries and this was being assisted by income levels of residents leading to reduction in volume available for export.

For the EU trade, increase in trade volume was dependent upon individual (farmer's) supply level. This was dictated by their income levels which showed positive relationship with value of trade. Trade increased between countries that had colonial relationship but countries speaking different official languages traded more than those with same languages. This was somewhat buttressing the insignificance of cultural barriers in cocoa trade. Large volumes of trade were conducted between cocoa exporting and importing countries, but huge losses were also sustained in the absence of standard harmonisation. There is better prospect for the exporters in the EU when standards are harmonised and each exporting country might consider specific strategies as a result of differing effects of harmonisation.

Trade competitiveness was dependent on the type of market and scale of trade. Average trade values and competitiveness scores (CS) were positively correlated in that exporting countries with high volume of trade were more competitive which implies they complied better to importers' SPS standards. Cote d'Ivoire had highest standard-scaled average trade value and competitiveness score followed by Ghana.This pattern is similar to that of global raw trade ranking.Nigeria and Cameroun occupied third and fourth positions, respectively, though with the same competitiveness scores. On the other hand, Indonesia wasnot able to secure its global third position with respect to competitiveness, apparently as a result of inability to meet up with the quality standards. Exporting countries' competitiveness was generally improvedunder harmonised trade standard regime due to occurrence of higher volume of trade.

5.3 Policy Recommendations

The following policy recommendations are put forward based on the results of the study:

a. The stringent international cocoa standards did not affect trade values but rather encouraged it.Thus, there is need for proper monitoring of cocoa quality by specialised agencies especially in Nigeria where quality was observed to have been jeopardisedbecause maintaining quality standard is key to getting and sustaining market access.

b. Competitiveness was found to depend on trade values as dictated by ability to comply with standard requirements.Capacity of firms in the exporting countries should be enhanced through Public-Private-Partnership (PPP) efforts so that there will be increased volume of trade.

c. Competitiveness of the exporting countries varied across market blocs. As a result, each country should solidify its hold in the market where it has competitive advantage while trying to make headway in other markets.

d. Harmonisation of standards at Codex level is desirable to the exporting countries in the aggregate. Cocoa exporting countries should therefore engage in focusednegotiations at the level of the World Trade Organisation (WTO).

e. Notwithstanding the aggregate advantage of harmonisation, differing effects on exporting countries suggest that market and country-specific approaches are viable options.

f. The negative relationship between productivity and value of trade is a pointer to the importance of increasing cocoa output through sustainable means and taking care of factors that could hinder yield.

g. Since the study showed that global cocoa trade transcends cultural differences, exporters should target differing markets, such ascountries engaged in large processing activities andemerging markets,as export destinations.

h. Based on the importance of per capita GDP in explaining trade flow, growing the economy for better national income level should be the priority for governments of the exporting countries. Increased per capita income level will afford the citizens opportunity of paying for locally-processed cocoa products and thus assist the transformation industry.

5.4 **Areas of Further Study**

The following areas are suggested for further study:

a. Dynamic modeling of effects of SPS measures on value of cocoa trade.

b. Extension of the analysis to other cocoa products like cocoa butter, cocoa powder and cocoa mass whenever processing factors (PF) are published.

c. Consideration of other quality-related variables in addition to the number and maximum residue level (*mrl)* of pesticides in the generation of SPS variables (Stringency Indices).

d. Analysis of intra-trade of cocoa beans and its products.

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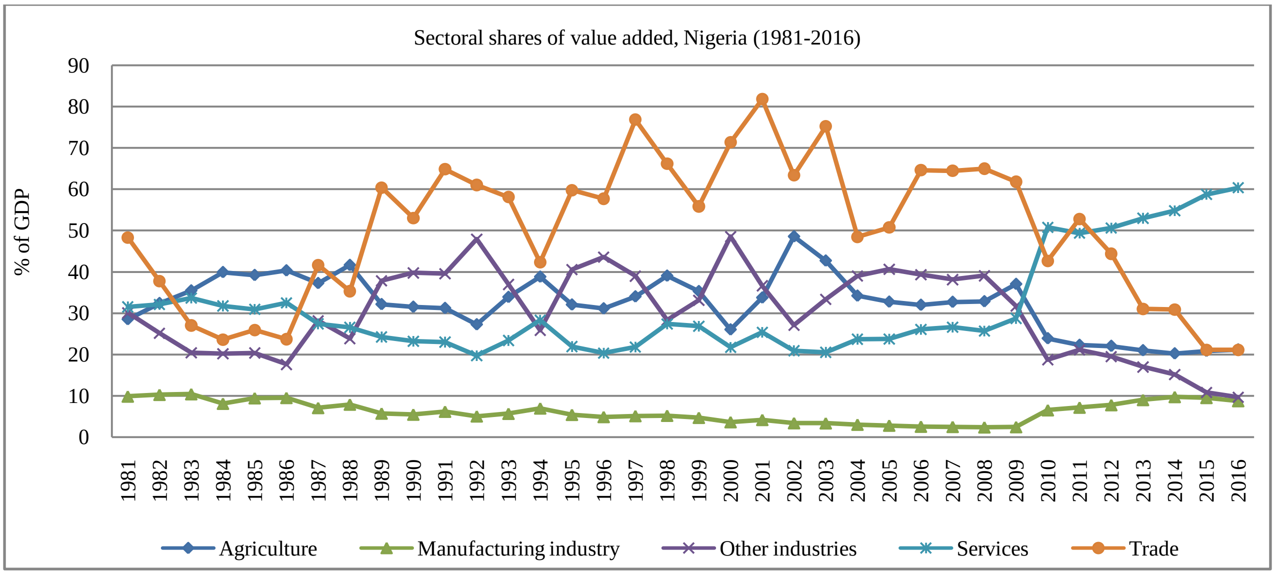
Appendix I: Value Added Contributions of Sectors to the GDP in the Major Cocoa Exporting Countries



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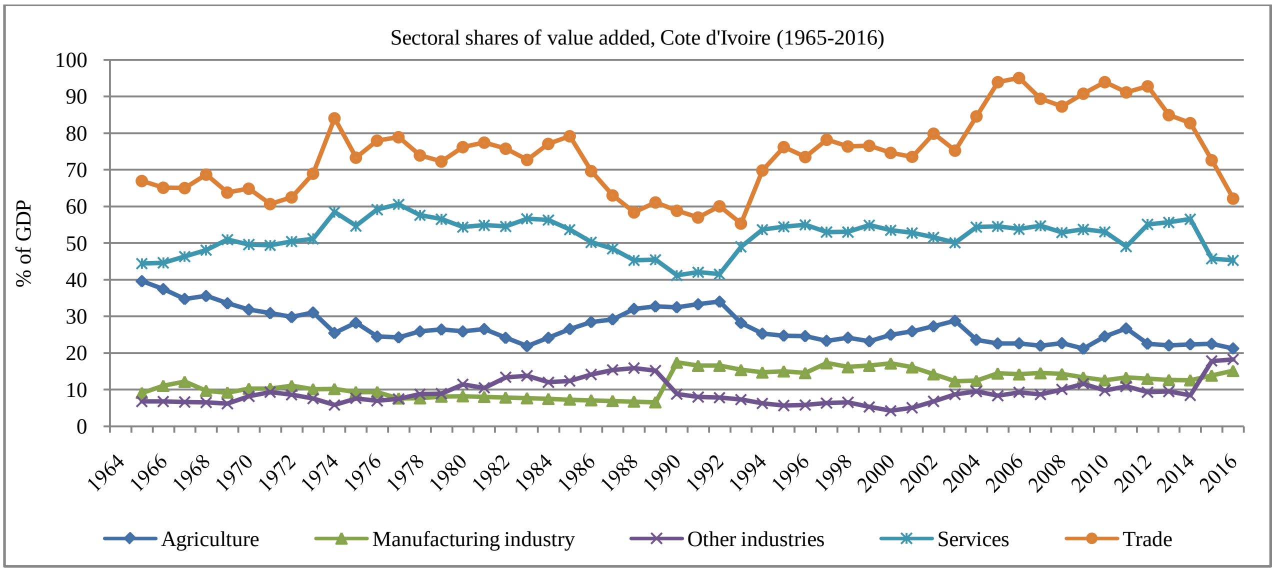

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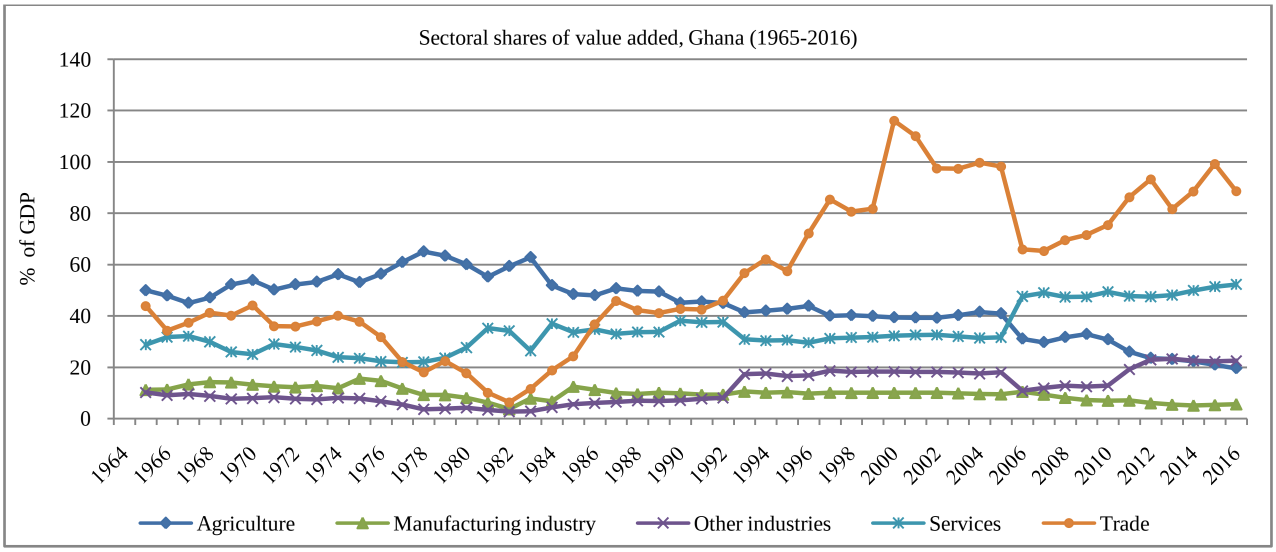

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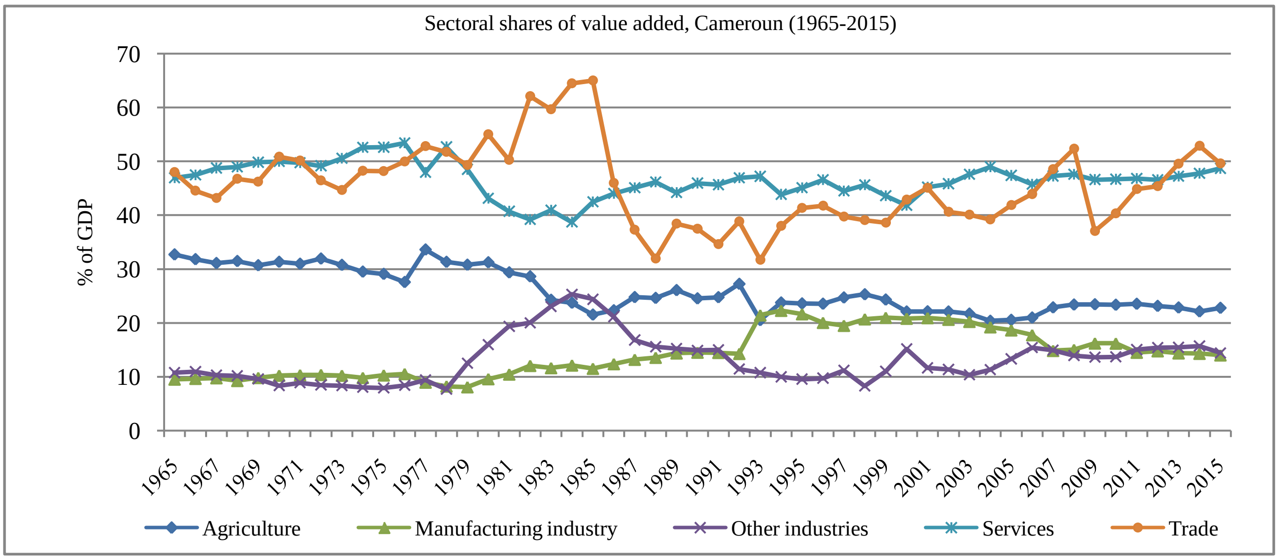
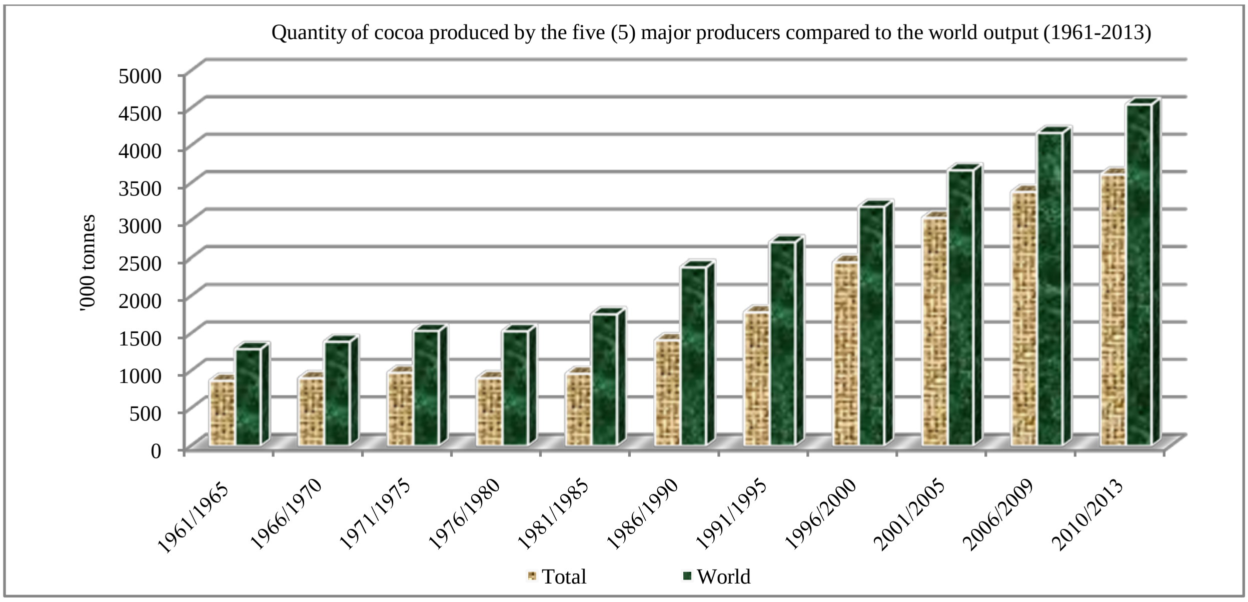
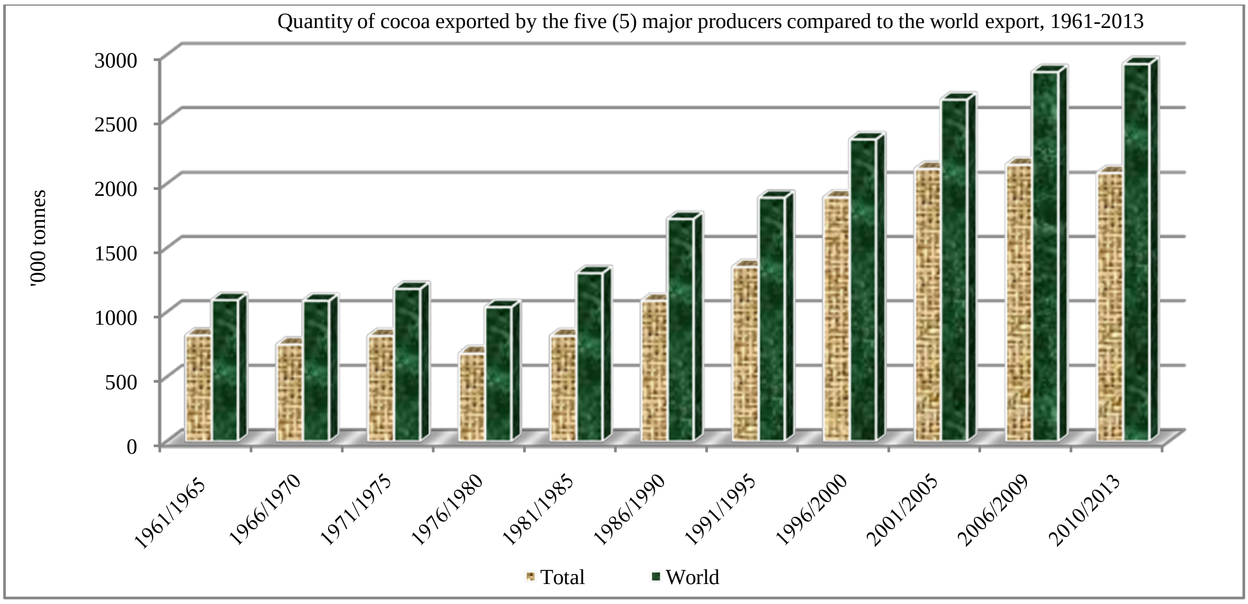
DataSources: WDI (2016, 2017)



Data Sources: WDI (2017)

Appendix II: Cocoa Beans Output and Export for Major Producers Compared to Global Values (1961-2013)





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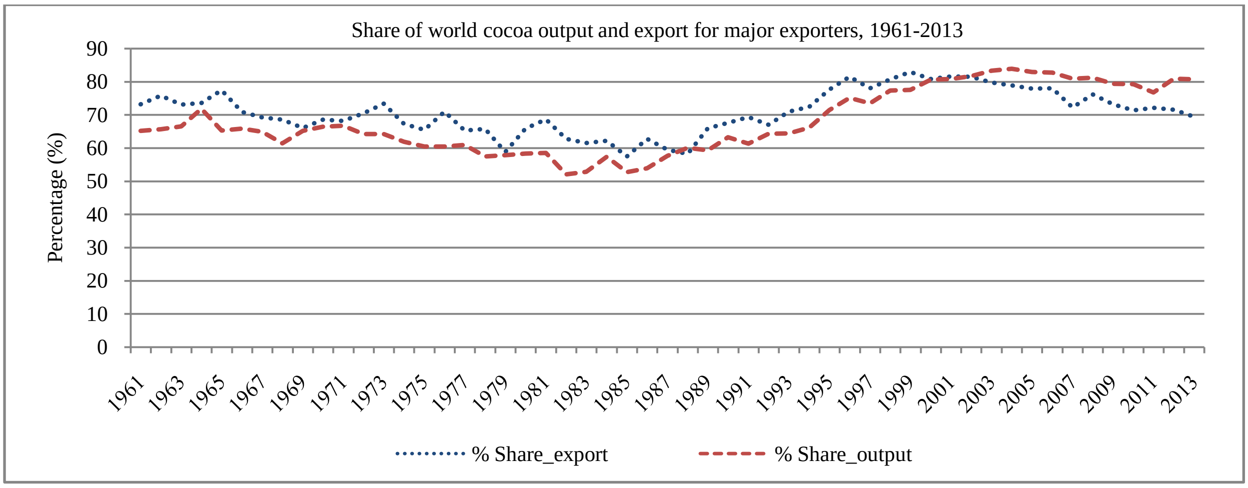

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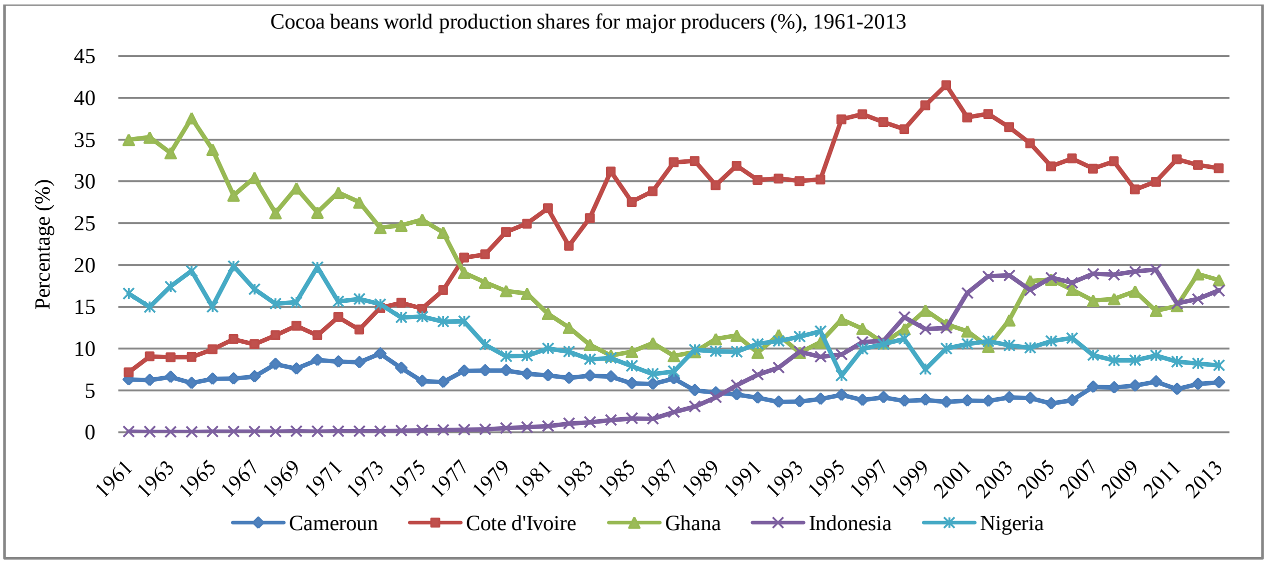

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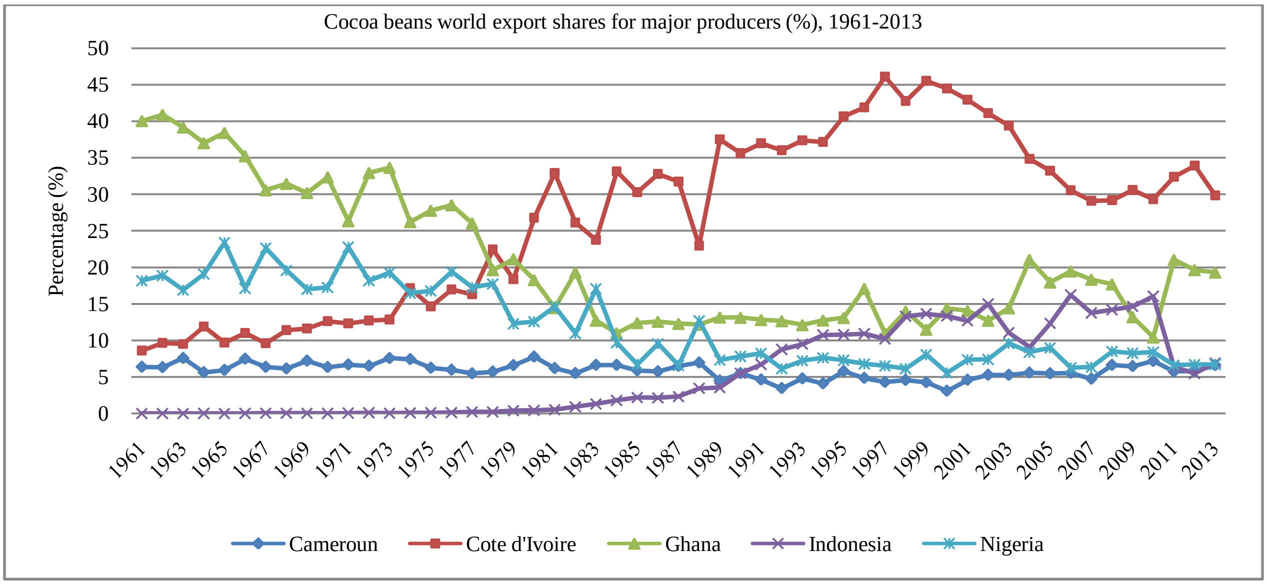
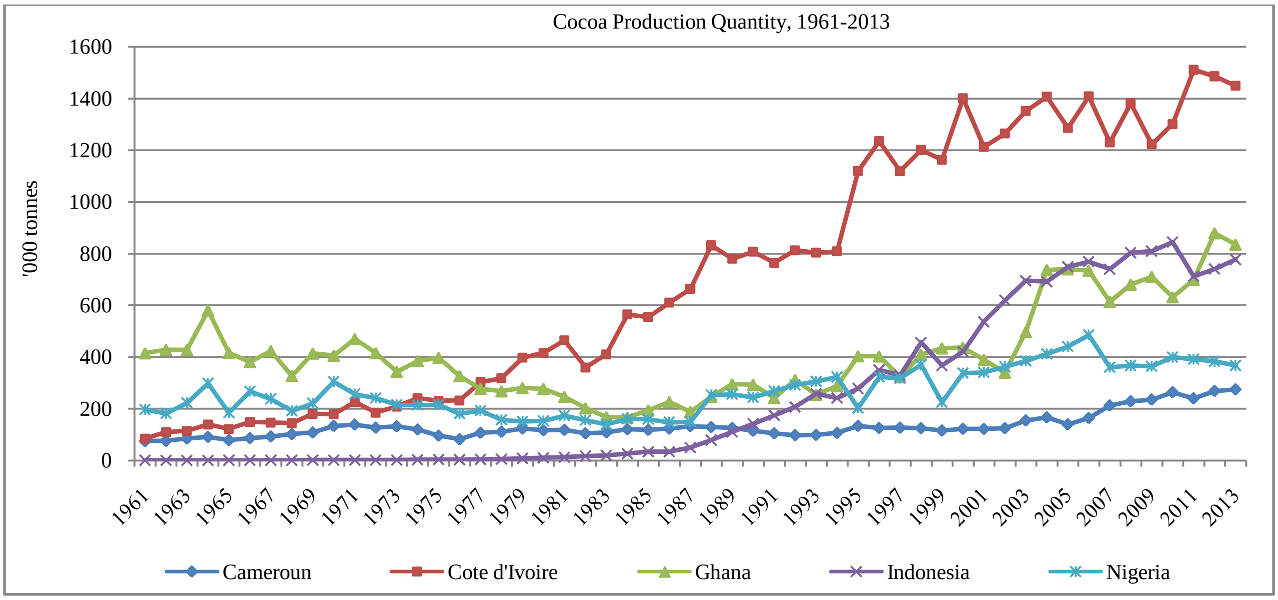


Data Source: FAOSTAT (2016)

Appendix III: Quantity of Cocoa Produced, Area Harvested, Yield and Producer Prices for Major Exporters



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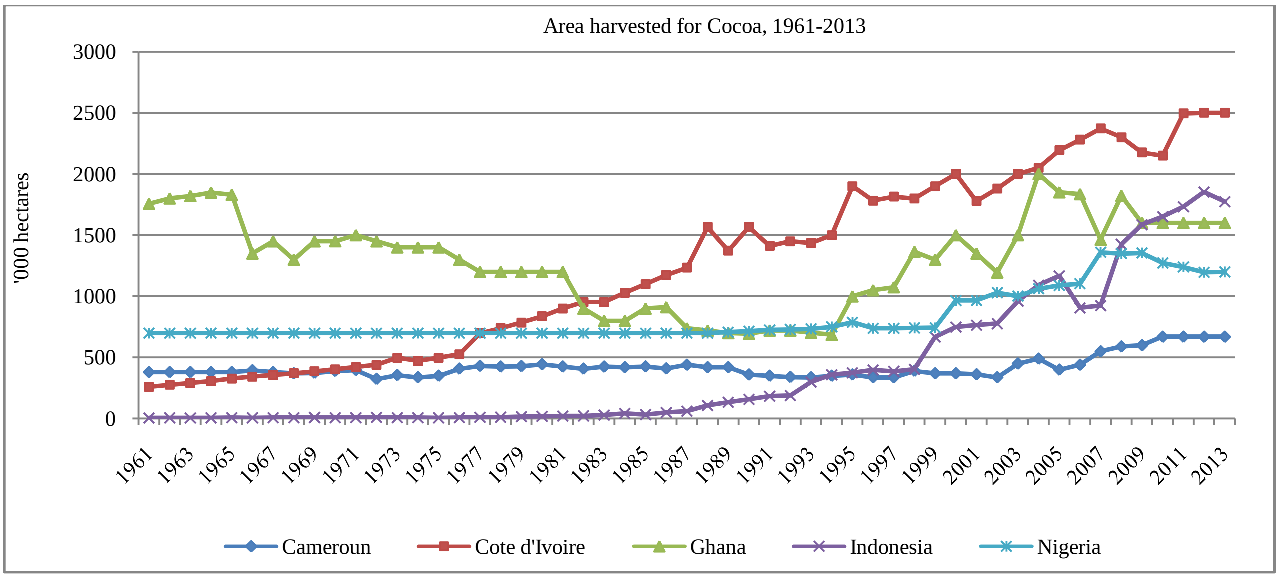

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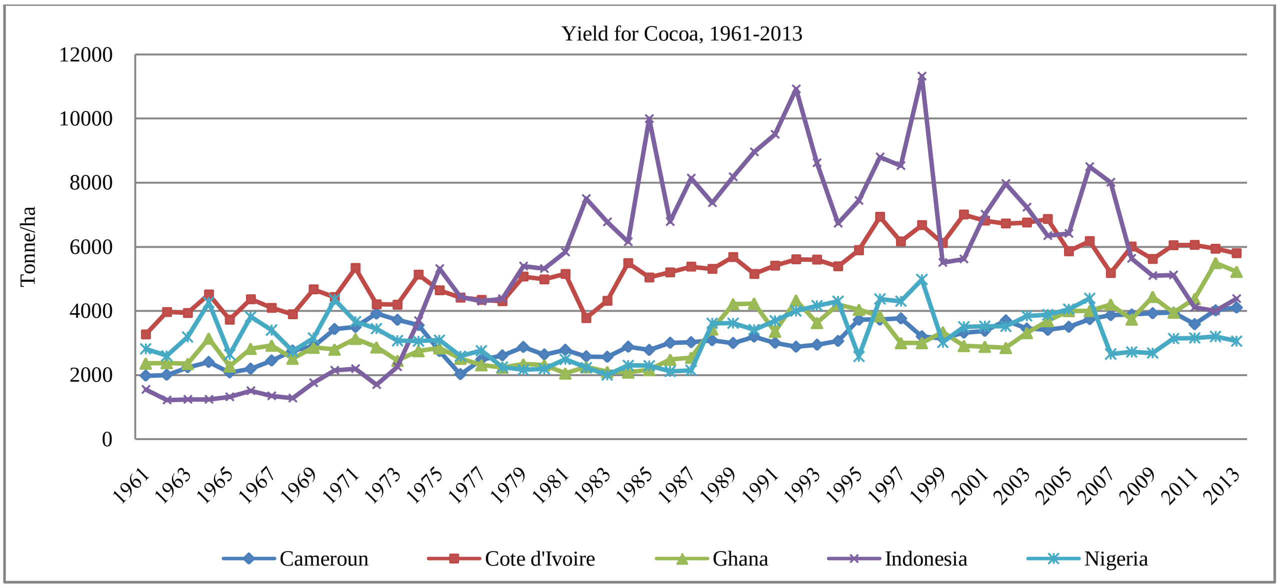

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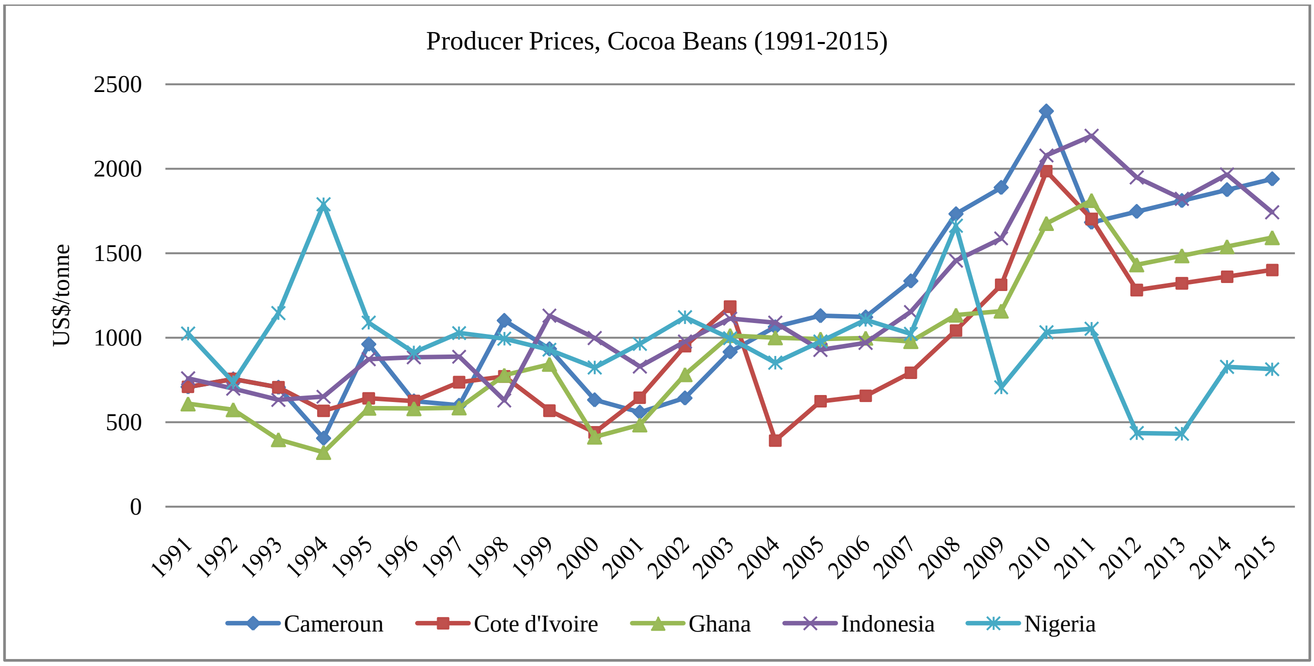
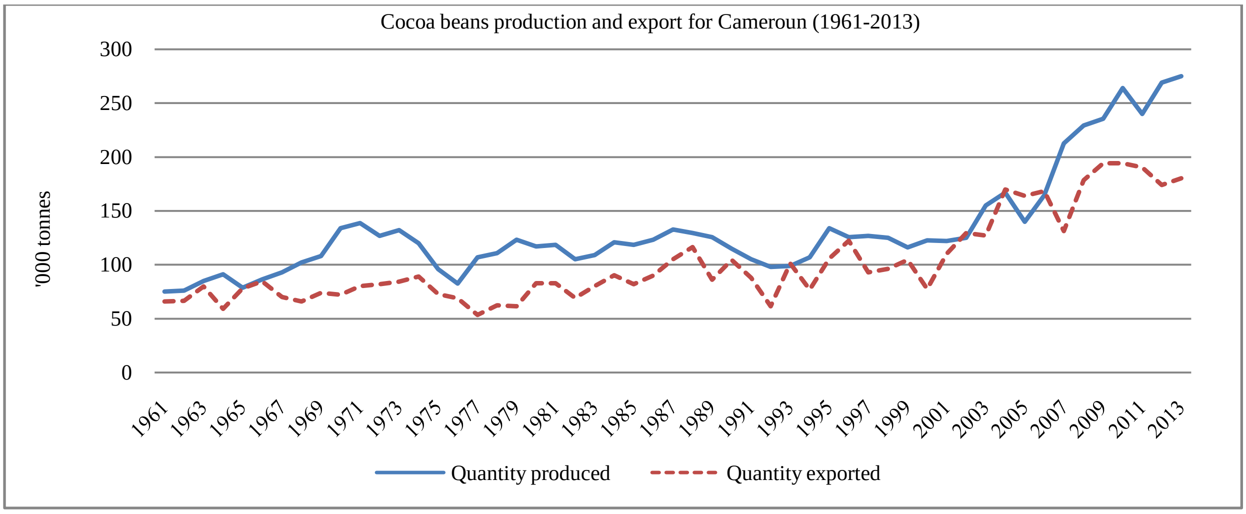


Data Source: FAOSTAT (2016)

Appendix IV: Quantity of Cocoa Produced and Exported for Each of the Major Producers (1961-2013)



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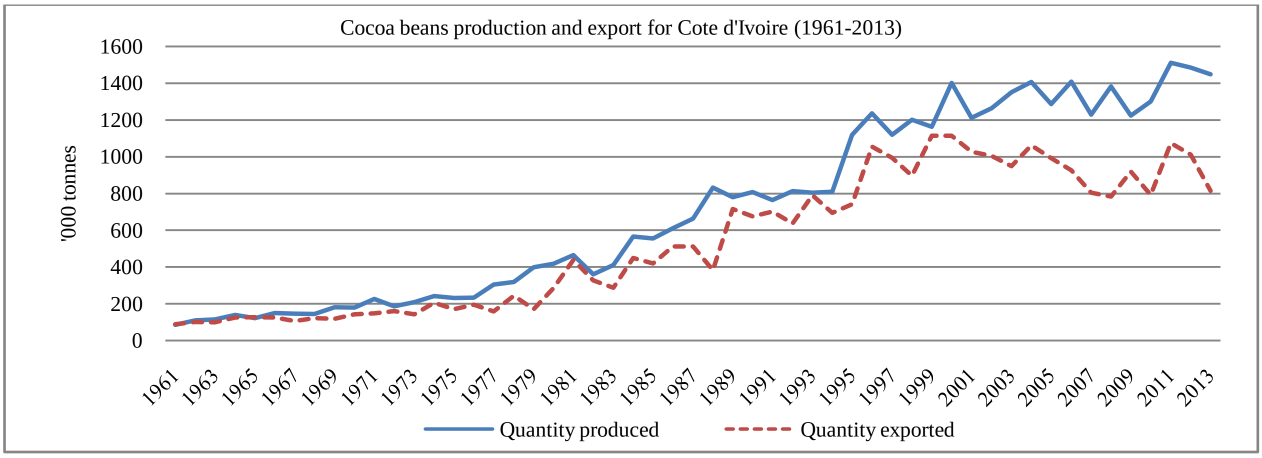

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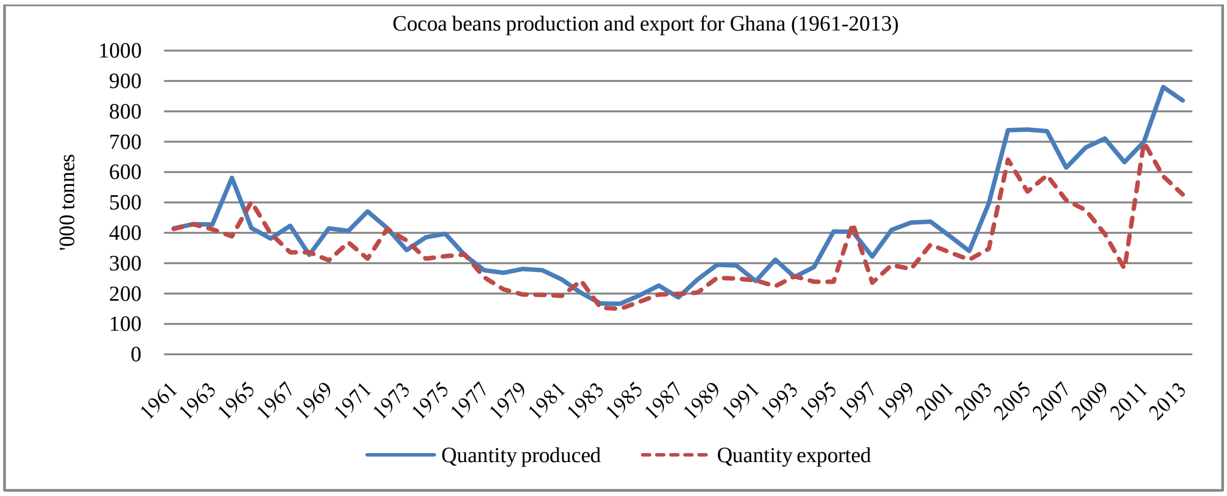

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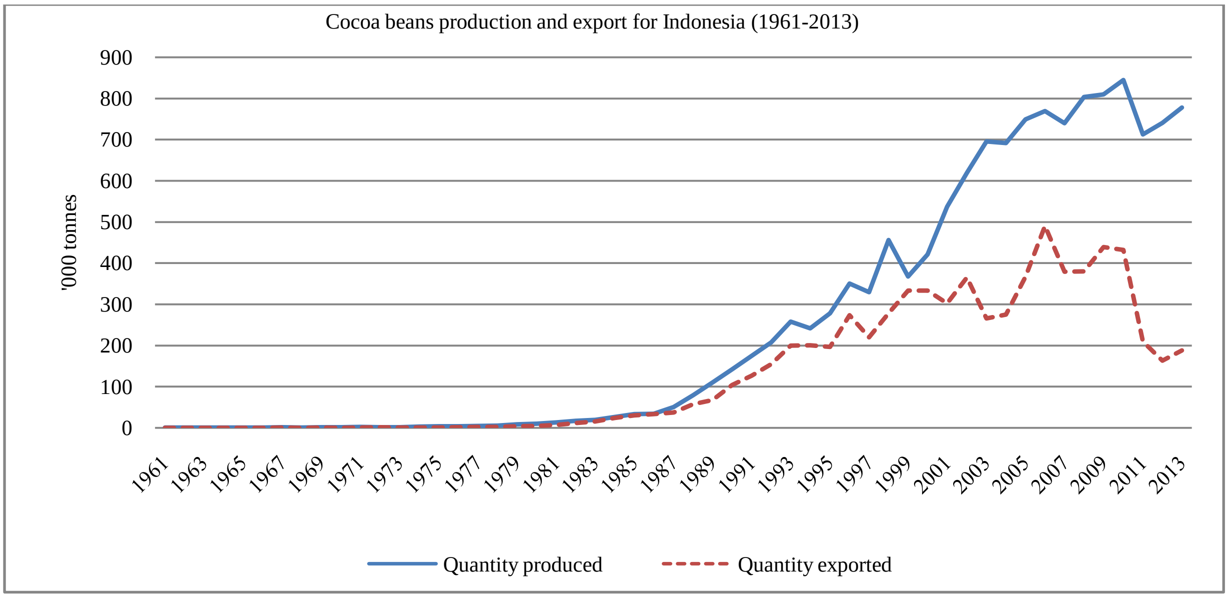

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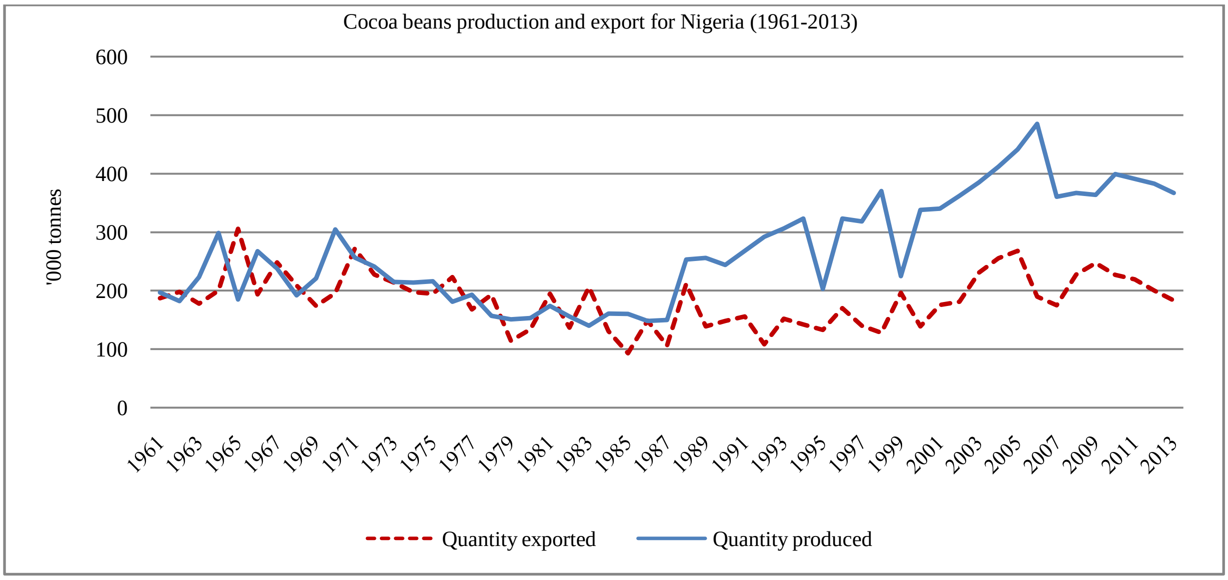


Data Source: FAOSTAT (2016)

Appendix V

Annex A: Number of Regulated Pesticides for Cocoa Importers

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Belgium	4	440	4	444	444	444	553	565	526	533	1115	1095
Brazil	15	15	15	14	14	14	14	14	5	3	22	23
Canada	3	7	6	6	6	6	7	7	7	7	11	12
China	4	4	4	3	3	3	3	5	5	3	3	3
Estonia[1]	4	4	4	524	517	527	553	565	526	533	1115	1095
France[2]	181	181	4	13	13	13	553	565	526	533	1115	1095
Italy	6	7	6	5	5	5	553	565	526	533	1115	1095
Japan	12	7	179	174	172	133	628	628	633	649	660	703
Malaysia	4	4	40	40	40	40	40	42	42	42	43	43
Netherlands	54	516	556	577	577	577	553	565	526	533	1115	1095
Russian Fed.	4	4	4	5	5	5	5	5	7	16	16	15
Singapore	4	4	4	3	12	12	12	12	12	12	12	12
Spain	4	546	540	534	534	534	553	565	526	533	1115	1095
Switzerland	55	55	55	55	55	214	215	355	356	385	390	433
Thailand	4	4	4	3	3	3	3	6	6	13	13	13
USA	9	9	14	14	15	16	16	16	15	15	15	15
EU-Harmonised	.	.	.	524	517	527	553	565	526	533	1115	1095
CODEX	4	4	4	3	3	3	3	5	5	5	6	6

Data Source: Homologa Agrobase-Logigram (2017)

[1]Same values for Germany, Poland and UK from 2005 to 2016
[2]Same values for Belgium, Italy, Netherlands and Spain from 2011 to 2016

Annex B: Average MRL for Active Ingredients of Cocoa Pesticides Regulated by the Importing Countries

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Belgium	14.0250	0.4885	14.0250	0.4722	0.4722	0.4722	0.3448	0.7292	0.7087	0.6955	0.5453	0.5538
Brazil	0.0773	0.0773	0.0773	0.0793	0.0793	0.0793	0.0793	0.0793	0.0900	0.6000	0.1414	0.1357
Canada	11.3333	8.7200	6.0067	6.0067	6.0067	6.0067	5.1629	5.1629	5.1629	5.1629	7.8431	7.2062
China	0.0900	0.0900	0.1150	0.1367	0.1033	0.1367	0.1367	0.0900	0.0900	0.1367	0.1367	0.1367
Estonia[3]	0.0900	0.0900	0.1150	0.3769	0.3805	0.3635	0.3448	0.7292	0.7087	0.6955	0.5453	0.5538
France[4]	0.1233	0.1233	0.1150	0.0650	0.0650	0.0650	0.3448	0.7292	0.7087	0.6955	0.5453	0.5538
Italy	0.0750	0.0671	0.0750	0.0500	0.0500	0.0500	0.3448	0.7292	0.7087	0.6955	0.5453	0.5538
Japan	0.2857	0.2857	2.2287	2.2916	2.3180	2.9896	0.6618	0.6597	0.6359	0.6197	0.6092	0.5733
Malaysia	0.0900	0.0900	0.9415	0.9415	0.9415	0.9415	0.9415	1.0181	1.0181	1.0181	1.0177	1.0177
Netherlands	0.9619	0.2635	0.6972	0.2813	0.2813	0.2813	0.3448	0.7292	0.7087	0.6955	0.5453	0.5538
Russian Fed.	0.0900	0.0900	0.1150	0.2340	10.1340	10.1340	10.1340	10.1340	7.3814	3.2114	3.2114	3.4250
Singapore	0.0900	0.0900	0.1150	0.1167	0.5667	0.5667	0.5667	0.5667	0.5667	0.5667	0.5667	0.5667
Spain	0.0900	0.2586	0.2609	0.2631	0.2631	0.2631	0.3448	0.7292	0.7087	0.6955	0.5453	0.5538
Switzerland	1.0355	1.0355	1.0355	1.0355	1.0355	0.3513	0.3497	0.4775	0.4762	0.4400	0.4405	0.7467
Thailand	0.0900	0.0900	0.1150	0.1167	0.1167	0.1167	0.1167	0.0350	0.0350	0.0600	0.0600	0.0600
USA	35.9550	35.9550	30.6979	30.6979	23.3180	21.8656	21.8656	21.8657	20.0847	20.0847	19.9900	19.9900
EU-Harmonised	.	.	.	0.3769	0.3805	0.3635	0.3448	0.7292	0.7087	0.6955	0.5453	0.5538
CODEX	0.0900	0.0900	0.1150	0.1367	0.1033	0.1367	0.1367	0.0900	0.0900	0.0900	0.9083	0.9083

Data Source: Homologa Agrobase-Logigram (2017)

[3]Same values for Germany, Poland and UK from 2005 to 2016
[4]Same values for Belgium, Italy, Netherlands and Spain from 2011 to 2016

Annex C: List of Pesticides Approved for Use and the Commonly Used by Cocoa Farmers in the Exporting Countries

SN	Nigeria[a]	Cote d'Ivoire[b]	Ghana[c]
1.	4-Cyclohexane Dicarboxymide	Abamectin	Acetamiprid
2.	Acetamiprid	Acetamiprid	Aldrin
3.	Aluminium phosphide (Phosphine gas)	Alpha cypermethrin	Alpha-cypermethrin
4.	Chlorpyrifos	Aluminium phosphide	Aluminium phosphide
5.	Copper	Benanaxyl-M	Bifenthrin
6.	Copper hydroxide	Bifenthrin	Chlorfenviphos
7.	Copper sulphate	Chlorpyrifos	Chlorpyrifos
8.	Cupric oxide	Copper hydroxide	Chlorpyrifos-ethyl
9.	Cuprous oxide	Copper oxychloride	Cupric hydroxide
10.	Cypermethrin	Cuprous oxide	Cuprous hydroxide
11.	Deltamethrin	Cymoxanil	Cuprous oxide
12.	Diazinon	Deltamethrin	Cypermethrin
13.	Dioxacarb	Dimethomorph	DDT
14.	Endosulfan	Emamectine	Deltamethrin
15.	Fenitrothion	Imidacloprid	Diazinon
16.	Glyphosphate	Lambda-cyhalothrin	Endosulfan
17.	Isoprocarb	Mancozebe	Fenitrothion
18.	Lime (CaO)	Mandipropamid	Fenvalarate
19.	Lindane (gamma-BHC)	Metalaxyl	Imidacloprid
20.	Metalaxyl	Metalaxyl-M	Lambda-cyhalothrin
21.	Metalaxyl-M	Novaluron	Lindane
22.	Phosphine	Phosphine	Malathion
23.	Propoxur	Spinetoram	Metalaxyl
24.	Pyrimiphos-methyl	Teflubenzuron	Metalaxyl-M
25.	Thiacloprid	Thiamethoxam	Methyl-thiopanate
26.	Thiamethoxam		Permethrin
27.			Phosphine
28.			Pirimiphos-methyl
29.			Promecarb
30.			Thiamethoxam

Sources:

a. Asogwa and Dongo (2009); Ogunjimi and Farinde (2012); Asogwa (2015); Bateman (2013 & 2015).

b. African Cocoa Initiative-Feed the Future, Final Report: Cote d'Ivoire (USAID/WCF) (2012a); African Cocoa Initiative-PERSUAP (USAID/WCF) (2012b); Soro *et al.* (2014).

c. Boakye (2012); Ansah (2015); Antwi-Agyakwa *et al.* (2015); Denkyirah *et al.* (2016); Okoffo *et al.* (2016); Afrane and Ntiamoah (2011).

Annex D: List of Pesticides Approved for Use and the Commonly Used by Cocoa Farmers in the Exporting Countries (+Pesticides prohibited for use on cocoa beans by importers)

SN	Indonesia[d]	Cameroon[e]	Prohibited pesticides[f] (EU/Japan)
1.	Acetamiprid	Acetamiprid	Aldrin
2.	Aluminium phosphide	Aluminium phosphide	Benomyl
3.	Azoxystrobin	Benanaxyl	Carbaryl
4.	Beta-cyfluthrin	Benomyl	Carbofuran
5.	Chlorpyrifos	Bifenthrin	Carbosulfan
6.	Chlorpyrifos ethyl	Cartap	Cartap
7.	Copper hydroxide	Chlorpyrifos	Chlorfenvinphos
8.	Copper sulphate	Chlorpyrifos-ethyl	Copper sulphate
9.	Cuprous oxide	Copper	Cyhalothrin
10.	Cyfluthrin	Copper hydroxide	DDT
11.	Cypermethrin	Copper sulphate	Diazinon
12.	Deltamethrin	Cuprous oxide	Dichlorvos (DDVP)
13.	Dichlorvos/DDVP	Cypermethrin	Dieldrin
14.	Fenitothrion	Deltamethrin	Dioxacarb
15.	Fipronil	Diazinon	Diuron
16.	Glyphosphate	Dimetomorph	Endosulfan
17.	Imidacloprid	Endosulfan	Fenitrothion
18.	Lambda-cyhalothrin	Fenobucarb	Fenobucarb
19.	Metalaxyl	Glyphosphate	Fenvalerate
20.	Methomyl	Imidacloprid	Lindane (a.k.a. gamma-BHC, gamma-HCH)
21.	Phosphine	Lambda-cyhalothrin	Isoprocarb
22.	Pirimiphos-methyl	Mancozebe	Malathion
23.	Thiamethoxam	Mandipropamide	Methomyl
24.		Maneb	Methamidophos
25.		Metalaxyl	Monocrotophos
26.		Metalaxyl-M	Parathion
27.		Methyl-parathion	Parathion-methyl (Methyl-parathion)
28.		Paraquat	Permethrin
29.		Phosphine	Phosphamidon
30.		Profenofos	Profenofos
31.		Propoxur	Promecarb
32.		Thiacloprid	Propoxur
33.		Thiamethoxam	Tetramethrin
34.			Tridemorph

Sources:

d. Hafid, Neilson, Mount and McKenzie (2012); Cocoa Sustainability Partnership (2013);USAID/Indonesia PERSUAP (2013); Bateman (2015); PERSUAP, Timor-Leste (2015).

e. African Cocoa Initiative-PERSUAP (USAID/WCF) (2012b); Mahob *et al.* (2014); Cameroun Cocoa Pesticide Handbook, www.icco.org 08-04-17.

f. PAN (2008); African Cocoa Initiative-Feed the Future, Final Report: Cote d'Ivoire (USAID/WCF) (2012a); Mahob *et al.* (2014); Asogwa (2015); Bateman (2015).

Annex E: Stringency Indices (STI) for Individual *mrl* values in EU and World market(s)

	Indiv_*mrl*	EU_*mrl*_min	EU_*mrl*_max	All_*mrl*_min	All_*mrl*_max	EU_sti	All_sti
2005	0.005	0.010	50	0.010	300	1.000100	1.000017
2006		0.010	50	0.010	300	1.000100	1.000017
2007		0.010	50	0.0001	300	1.000100	0.999984
2008		0.005	70	0.0001	300	1.000000	0.999984
2009		0.005	70	0.0001	300	1.000000	0.999984
2010		0.005	70	0.001	300	1.000000	0.999987
2011		0.005	70	0.001	300	1.000000	0.999987
2012		0.005	70	0.001	300	1.000000	0.999987
2013		0.005	70	0.001	300	1.000000	0.999987
2014		0.005	70	0.001	300	1.000000	0.999987
2015		0.005	70	0.001	300	1.000000	0.999987
2016		0.005	70	0.001	300	1.000000	0.999987
2005	0.008	0.010	50	0.010	300	1.000040	1.000007
2006		0.010	50	0.010	300	1.000040	1.000007
2007		0.010	50	0.0001	300	1.000040	0.999974
2008		0.005	70	0.0001	300	0.999957	0.999974
2009		0.005	70	0.0001	300	0.999957	0.999974
2010		0.005	70	0.001	300	0.999957	0.999977
2011		0.005	70	0.001	300	0.999957	0.999977
2012		0.005	70	0.001	300	0.999957	0.999977
2013		0.005	70	0.001	300	0.999957	0.999977
2014		0.005	70	0.001	300	0.999957	0.999977
2015		0.005	70	0.001	300	0.999957	0.999977
2016		0.005	70	0.001	300	0.999957	0.999977
2005	0.01	0.010	50	0.010	300	1.000000	1.000000
2006		0.010	50	0.010	300	1.000000	1.000000
2007		0.010	50	0.0001	300	1.000000	0.999967
2008		0.005	70	0.0001	300	0.999929	0.999967
2009		0.005	70	0.0001	300	0.999929	0.999967
2010		0.005	70	0.001	300	0.999929	0.999970
2011		0.005	70	0.001	300	0.999929	0.999970
2012		0.005	70	0.001	300	0.999929	0.999970
2013		0.005	70	0.001	300	0.999929	0.999970
2014		0.005	70	0.001	300	0.999929	0.999970
2015		0.005	70	0.001	300	0.999929	0.999970
2016		0.005	70	0.001	300	0.999929	0.999970
2005	0.02	0.010	50	0.010	300	0.999800	0.999967
2006		0.010	50	0.010	300	0.999800	0.999967
2007		0.010	50	0.0001	300	0.999800	0.999934
2008		0.005	70	0.0001	300	0.999786	0.999934
2009		0.005	70	0.0001	300	0.999786	0.999934
2010		0.005	70	0.001	300	0.999786	0.999937
2011		0.005	70	0.001	300	0.999786	0.999937
2012		0.005	70	0.001	300	0.999786	0.999937
2013		0.005	70	0.001	300	0.999786	0.999937
2014		0.005	70	0.001	300	0.999786	0.999937
2015		0.005	70	0.001	300	0.999786	0.999937
2016		0.005	70	0.001	300	0.999786	0.999937

NB: STI values were also calculated for the following *mrl* values but are not shown on the table: 0.03, 0.05, 0.10, 0.15, 0.20, 0.50, 1.00, 2.00, 5.00, 20.00, 40.00 and 50.00.
Data Source: Homologa Agrobase-Logigram (2017)

Annex F: Sample STATA code [5](+output) to calculate aggregate yearly[6] STI values for each importing country with respect to each exporting country

```
. use "C:\Users\dell\Desktop\PhD
mrl_STI_latest_260717\Nigeria\Nigeria_EU.dta", clear

. br

. do "C:\Users\dell\AppData\Local\Temp\STD04000000.tmp"

. recode acetamiprid
(0=0)(0.01=1.000000)(0.05=0.999200)(0.1=0.998200)if
year==1|year==2|year==3, gen(ac
> etamiprid_1)
(4 differences between acetamiprid and acetamiprid_1)

. recode acetamiprid
(0=0)(0.01=0.999929)(0.05=0.999357)(0.1=0.998643)if
year==4|year==5|year==6|year==7
> |year==8|year==9|year==10|year==11|year==12, gen(acetamiprid_2)
(79 differences between acetamiprid and acetamiprid_2)

. recode acetamiprid_1 (.=0),gen(acetamiprid_1_)
(99 differences between acetamiprid_1 and acetamiprid_1_)

. recode acetamiprid_2 (.=0),gen(acetamiprid_2_)
(33 differences between acetamiprid_2 and acetamiprid_2_)

. gen Neu_acetamiprid = acetamiprid_1_ + acetamiprid_2_

. recode aluminiumphosphide (0=0)(0.01=1.000000)(0.05=0.999200)if
year==1|year==2|year==3, gen(aluminium
> phosphide_1)
(6 differences between aluminiumphosphide and aluminiumphosphide_1)

. recode aluminiumphosphide (0=0)(0.01=0.999929)(0.05=0.999357)if
year==4|year==5|year==6|year==7|year==
> 8|year==9|year==10|year==11|year==12, gen(aluminiumphosphide_2)
(70 differences between aluminiumphosphide and aluminiumphosphide_2)

. recode aluminiumphosphide_1 (.=0),gen(aluminiumphosphide_1_)
(99 differences between aluminiumphosphide_1 and
aluminiumphosphide_1_)
```

[5]Two (2) sets of codeswere run for each exporting country to get STI values for world and EU trades, making a total of ten (10). One of the code sets for Nigeria (for EU trade) is shown here.
[6] Years 1-12 refer to 2005-2016.

```
. recode aluminiumphosphide_2 (.=0),gen(aluminiumphosphide_2_)
(33 differences between aluminiumphosphide_2 and
aluminiumphosphide_2_)

. gen Neu_aluminiumphosphide = aluminiumphosphide_1_ +
aluminiumphosphide_2_

. recode chlorpyrifos (0=0)(0.05=0.999200)(0.1=0.998200)if
year==1|year==2|year==3, gen(chlorpyrifos_1)
(8 differences between chlorpyrifos and chlorpyrifos_1)

. recode chlorpyrifos (0=0)(0.05=0.999357)(0.1=0.998643)if
year==4|year==5|year==6|year==7|year==8|year=
> =9|year==10|year==11|year==12, gen(chlorpyrifos_2)
(82 differences between chlorpyrifos and chlorpyrifos_2)

. recode chlorpyrifos_1 (.=0),gen(chlorpyrifos_1_)
(99 differences between chlorpyrifos_1 and chlorpyrifos_1_)

. recode chlorpyrifos_2 (.=0),gen(chlorpyrifos_2_)
(33 differences between chlorpyrifos_2 and chlorpyrifos_2_)

. gen Neu_chlorpyrifos = chlorpyrifos_1_ + chlorpyrifos_2_

. recode copper (0=0)(20=0.600120)(40=0.200040)(50=0.000000)if
year==1|year==2|year==3, gen(copper_1)
(4 differences between copper and copper_1)

. recode copper (0=0)(20=0.714337)(40=0.428602)(50=0.285735)if
year==4|year==5|year==6|year==7|year==8|y
> ear==9|year==10|year==11|year==12, gen(copper_2)
(26 differences between copper and copper_2)

. recode copper_1 (.=0),gen(copper_1_)
(99 differences between copper_1 and copper_1_)

. recode copper_2 (.=0),gen(copper_2_)
(33 differences between copper_2 and copper_2_)

. gen Neu_copper = copper_1_ + copper_2_

. recode copperhydroxide (0=0)(20=0.600120)(50=0.000000)if
year==1|year==2|year==3, gen(copperhydroxide_
> 1)
(2 differences between copperhydroxide and copperhydroxide_1)

. recode copperhydroxide (0=0)(20=0.714337)(50=0.285735)if
year==4|year==5|year==6|year==7|year==8|year=
```

```
> =9|year==10|year==11|year==12, gen(copperhydroxide_2)
(49 differences between copperhydroxide and copperhydroxide_2)

. recode copperhydroxide_1 (.=0),gen(copperhydroxide_1_)
(99 differences between copperhydroxide_1 and copperhydroxide_1_)

. recode copperhydroxide_2 (.=0),gen(copperhydroxide_2_)
(33 differences between copperhydroxide_2 and copperhydroxide_2_)

. gen Neu_copperhydroxide = copperhydroxide_1_ + copperhydroxide_2_

. recode coppersulphate (0=0)(1=1)(20=0.600120)(50=0.000000)if
year==1|year==2|year==3, gen(coppersulpha
> te_1)
(2 differences between coppersulphate and coppersulphate_1)

. recode coppersulphate (0=0)(1=1)(20=0.714337)(50=0.285735)if
year==4|year==5|year==6|year==7|year==8|y
> ear==9|year==10|year==11|year==12, gen(coppersulphate_2)
(0 differences between coppersulphate and coppersulphate_2)

. recode coppersulphate_1 (.=0),gen(coppersulphate_1_)
(99 differences between coppersulphate_1 and coppersulphate_1_)

. recode coppersulphate_2 (.=0),gen(coppersulphate_2_)
(33 differences between coppersulphate_2 and coppersulphate_2_)

. gen Neu_coppersulphate = coppersulphate_1_ + coppersulphate_2_

.
. //For cupricoxide, only zero like cyclohexanedicarboxymide//
.
. recode cuprousoxide (0=0)(50=0.000000)if year==1|year==2|year==3,
gen(cuprousoxide_1)
(1 differences between cuprousoxide and cuprousoxide_1)

. recode cuprousoxide (0=0)(50=0.285735)if
year==4|year==5|year==6|year==7|year==8|year==9|year==10|year
> ==11|year==12, gen(cuprousoxide_2)
(45 differences between cuprousoxide and cuprousoxide_2)

. recode cuprousoxide_1 (.=0),gen(cuprousoxide_1_)
(99 differences between cuprousoxide_1 and cuprousoxide_1_)

. recode cuprousoxide_2 (.=0),gen(cuprousoxide_2_)
(33 differences between cuprousoxide_2 and cuprousoxide_2_)

. gen Neu_cuprousoxide = cuprousoxide_1_ + cuprousoxide_2_
```

```
. recode cypermethrin (0=0)(0.05=0.999200)(0.1=0.998200)if
year==1|year==2|year==3, gen(cypermethrin_1)
(7 differences between cypermethrin and cypermethrin_1)

. recode cypermethrin (0=0)(0.05=0.999357)(0.1=0.998643)if
year==4|year==5|year==6|year==7|year==8|year=
> =9|year==10|year==11|year==12, gen(cypermethrin_2)
(80 differences between cypermethrin and cypermethrin_2)

. recode cypermethrin_1 (.=0),gen(cypermethrin_1_)
(99 differences between cypermethrin_1 and cypermethrin_1_)

. recode cypermethrin_2 (.=0),gen(cypermethrin_2_)
(33 differences between cypermethrin_2 and cypermethrin_2_)

. gen Neu_cypermethrin = cypermethrin_1_ + cypermethrin_2_

. recode deltamethrin (0=0)(0.03=0.999600)(0.05=0.999200)if
year==1|year==2|year==3, gen(deltamethrin_1)
(26 differences between deltamethrin and deltamethrin_1)

. recode deltamethrin (0=0)(0.03=0.999643)(0.05=0.999357)if
year==4|year==5|year==6|year==7|year==8|year
> ==9|year==10|year==11|year==12, gen(deltamethrin_2)
(85 differences between deltamethrin and deltamethrin_2)

. recode deltamethrin_1 (.=0),gen(deltamethrin_1_)
(99 differences between deltamethrin_1 and deltamethrin_1_)

. recode deltamethrin_2 (.=0),gen(deltamethrin_2_)
(33 differences between deltamethrin_2 and deltamethrin_2_)

. gen Neu_deltamethrin = deltamethrin_1_ + deltamethrin_2_

. recode diazinon (0=0)(0.02=0.999800)(0.05=0.999200)(1=1)if
year==1|year==2|year==3, gen(diazinon_1)
(10 differences between diazinon and diazinon_1)

. recode diazinon (0=0)(0.02=0.999786)(0.05=0.999357)(1=1)if
year==4|year==5|year==6|year==7|year==8|yea
> r==9|year==10|year==11|year==12, gen(diazinon_2)
(0 differences between diazinon and diazinon_2)

. recode diazinon_1 (.=0),gen(diazinon_1_)
(99 differences between diazinon_1 and diazinon_1_)

. recode diazinon_2 (.=0),gen(diazinon_2_)
(33 differences between diazinon_2 and diazinon_2_)

. gen Neu_diazinon = diazinon_1_ + diazinon_2_
```

```
. recode dioxacarb (0=0)(0.05=0.999200)(1=1)if
year==1|year==2|year==3, gen(dioxacarb_1)
(3 differences between dioxacarb and dioxacarb_1)

. recode dioxacarb (0=0)(0.05=0.999357)(1=1)if
year==4|year==5|year==6|year==7|year==8|year==9|year==10|
> year==11|year==12, gen(dioxacarb_2)
(0 differences between dioxacarb and dioxacarb_2)

. recode dioxacarb_1 (.=0),gen(dioxacarb_1_)
(99 differences between dioxacarb_1 and dioxacarb_1_)

. recode dioxacarb_2 (.=0),gen(dioxacarb_2_)
(33 differences between dioxacarb_2 and dioxacarb_2_)

. gen Neu_dioxacarb = dioxacarb_1_ + dioxacarb_2_

. recode endosulfan
(0=0)(0.05=0.999200)(0.1=0.998200)(0.2=0.996199)(1=1)if
year==1|year==2|year==3, gen
> (endosulfan_1)
(22 differences between endosulfan and endosulfan_1)

. recode endosulfan
(0=0)(0.05=0.999357)(0.1=0.998643)(0.2=0.997214)(1=1)if
year==4|year==5|year==6|year
> ==7|year==8|year==9|year==10|year==11|year==12, gen(endosulfan_2)
(9 differences between endosulfan and endosulfan_2)

. recode endosulfan_1 (.=0),gen(endosulfan_1_)
(99 differences between endosulfan_1 and endosulfan_1_)

. recode endosulfan_2 (.=0),gen(endosulfan_2_)
(33 differences between endosulfan_2 and endosulfan_2_)

. gen Neu_endosulfan = endosulfan_1_ + endosulfan_2_

. recode fenitrothion
(0=0)(0.05=0.999200)(0.1=0.998200)(0.5=0.990198)(1=1)if
year==1|year==2|year==3, g
> en(fenitrothion_1)
(12 differences between fenitrothion and fenitrothion_1)

. recode fenitrothion
(0=0)(0.05=0.999357)(0.1=0.998643)(0.5=0.992928)(1=1)if
year==4|year==5|year==6|ye
> ar==7|year==8|year==9|year==10|year==11|year==12,
gen(fenitrothion_2)
(0 differences between fenitrothion and fenitrothion_2)

. recode fenitrothion_1 (.=0),gen(fenitrothion_1_)
(99 differences between fenitrothion_1 and fenitrothion_1_)

. recode fenitrothion_2 (.=0),gen(fenitrothion_2_)
(33 differences between fenitrothion_2 and fenitrothion_2_)

. gen Neu_fenitrothion = fenitrothion_1_ + fenitrothion_2_

. recode glyphosphate (0=0)(0.1=0.998200)if year==1|year==2|year==3,
gen(glyphosphate_1)
(5 differences between glyphosphate and glyphosphate_1)

. recode glyphosphate (0=0)(0.1=0.998643)if
year==4|year==5|year==6|year==7|year==8|year==9|year==10|yea
> r==11|year==12, gen(glyphosphate_2)
(77 differences between glyphosphate and glyphosphate_2)

. recode glyphosphate_1 (.=0),gen(glyphosphate_1_)
(99 differences between glyphosphate_1 and glyphosphate_1_)

. recode glyphosphate_2 (.=0),gen(glyphosphate_2_)
(33 differences between glyphosphate_2 and glyphosphate_2_)

. gen Neu_glyphosphate = glyphosphate_1_ + glyphosphate_2_

. //isoprocarb has values 0 and 1, no need for recoding//

. recode limecao (0=0)(0.01=1.000000)if year==1|year==2|year==3,
gen(limecao_1)
(0 differences between limecao and limecao_1)

. recode limecao (0=0)(0.01=0.999929)if
year==4|year==5|year==6|year==7|year==8|year==9|year==10|year==1
> 1|year==12, gen(limecao_2)
(18 differences between limecao and limecao_2)

. recode limecao_1 (.=0),gen(limecao_1_)
(99 differences between limecao_1 and limecao_1_)

. recode limecao_2 (.=0),gen(limecao_2_)
(33 differences between limecao_2 and limecao_2_)

. gen Neu_limecao = limecao_1_ + limecao_2_

. recode lindanegammabhc (0=0)(0.01=1.000000)(0.1=0.998200)(1=1)if
year==1|year==2|year==3, gen(lindaneg
> ammabhc_1)
(6 differences between lindanegammabhc and lindanegammabhc_1)
```

```
. recode lindanegammabhc (0=0)(0.01=0.999929)(0.1=0.998643)(1=1)if
year==4|year==5|year==6|year==7|year=
> =8|year==9|year==10|year==11|year==12, gen(lindanegammabhc_2)
(0 differences between lindanegammabhc and lindanegammabhc_2)

. recode lindanegammabhc_1 (.=0),gen(lindanegammabhc_1_)
(99 differences between lindanegammabhc_1 and lindanegammabhc_1_)

. recode lindanegammabhc_2 (.=0),gen(lindanegammabhc_2_)
(33 differences between lindanegammabhc_2 and lindanegammabhc_2_)

. gen Neu_lindanegammabhc = lindanegammabhc_1_ + lindanegammabhc_2_

.
. recode metalaxyl
(0=0)(0.05=0.999200)(0.1=0.998200)(0.2=0.996199)if
year==1|year==2|year==3, gen(metal
> axyl_1)
(25 differences between metalaxyl and metalaxyl_1)

. recode metalaxyl
(0=0)(0.05=0.999357)(0.1=0.998643)(0.2=0.997214)if
year==4|year==5|year==6|year==7|ye
> ar==8|year==9|year==10|year==11|year==12, gen(metalaxyl_2)
(92 differences between metalaxyl and metalaxyl_2)

. recode metalaxyl_1 (.=0),gen(metalaxyl_1_)
(99 differences between metalaxyl_1 and metalaxyl_1_)

. recode metalaxyl_2 (.=0),gen(metalaxyl_2_)
(33 differences between metalaxyl_2 and metalaxyl_2_)

. gen Neu_metalaxyl = metalaxyl_1_ + metalaxyl_2_

.
. recode metalaxylm (0=0)(0.05=0.999200)(0.1=0.998200)if
year==1|year==2|year==3, gen(metalaxylm_1)
(5 differences between metalaxylm and metalaxylm_1)

. recode metalaxylm (0=0)(0.05=0.999357)(0.1=0.998643)if
year==4|year==5|year==6|year==7|year==8|year==9
> |year==10|year==11|year==12, gen(metalaxylm_2)
(78 differences between metalaxylm and metalaxylm_2)

. recode metalaxylm_1 (.=0),gen(metalaxylm_1_)
(99 differences between metalaxylm_1 and metalaxylm_1_)

. recode metalaxylm_2 (.=0),gen(metalaxylm_2_)
(33 differences between metalaxylm_2 and metalaxylm_2_)

. gen Neu_metalaxylm = metalaxylm_1_ + metalaxylm_2_

. recode phosphine
(0=0)(0.01=1.000000)(0.05=0.999200)(0.1=0.998200)if
year==1|year==2|year==3, gen(phos
> phine_1)
(24 differences between phosphine and phosphine_1)

. recode phosphine
(0=0)(0.01=0.999929)(0.05=0.999357)(0.1=0.998643)if
year==4|year==5|year==6|year==7|y
> ear==8|year==9|year==10|year==11|year==12, gen(phosphine_2)
(89 differences between phosphine and phosphine_2)

. recode phosphine_1 (.=0),gen(phosphine_1_)
(99 differences between phosphine_1 and phosphine_1_)

. recode phosphine_2 (.=0),gen(phosphine_2_)
(33 differences between phosphine_2 and phosphine_2_)

. gen Neu_phosphine = phosphine_1_ + phosphine_2_

.
. recode propoxur (0=0)(0.05=0.999200)(1=1)if
year==1|year==2|year==3, gen(propoxur_1)
(8 differences between propoxur and propoxur_1)

. recode propoxur (0=0)(0.05=0.999357)(1=1)if
year==4|year==5|year==6|year==7|year==8|year==9|year==10|y
> ear==11|year==12, gen(propoxur_2)
(0 differences between propoxur and propoxur_2)

. recode propoxur_1 (.=0),gen(propoxur_1_)
(99 differences between propoxur_1 and propoxur_1_)

. recode propoxur_2 (.=0),gen(propoxur_2_)
(33 differences between propoxur_2 and propoxur_2_)

. gen Neu_propoxur = propoxur_1_ + propoxur_2_

. recode pyrimiphosmethyl (0=0)(0.05=0.999200)if
year==1|year==2|year==3, gen(pyrimiphosmethyl_1)
(7 differences between pyrimiphosmethyl and pyrimiphosmethyl_1)

. recode pyrimiphosmethyl (0=0)(0.05=0.999357)if
year==4|year==5|year==6|year==7|year==8|year==9|year==1
> 0|year==11|year==12, gen(pyrimiphosmethyl_2)
(73 differences between pyrimiphosmethyl and pyrimiphosmethyl_2)

. recode pyrimiphosmethyl_1 (.=0),gen(pyrimiphosmethyl_1_)
```

```
(99 differences between pyrimiphosmethyl_1 and pyrimiphosmethyl_1_)

. recode pyrimiphosmethyl_2 (.=0),gen(pyrimiphosmethyl_2_)
(33 differences between pyrimiphosmethyl_2 and pyrimiphosmethyl_2_)

. gen Neu_pyrimiphosmethyl = pyrimiphosmethyl_1_ +
pyrimiphosmethyl_2_

. recode thiacloprid (0=0)(0.02=0.999800)(0.05=0.999200)if
year==1|year==2|year==3, gen(thiacloprid_1)
(6 differences between thiacloprid and thiacloprid_1)

. recode thiacloprid (0=0)(0.02=0.999786)(0.05=0.999357)if
year==4|year==5|year==6|year==7|year==8|year=
> =9|year==10|year==11|year==12, gen(thiacloprid_2)
(80 differences between thiacloprid and thiacloprid_2)

. recode thiacloprid_1 (.=0),gen(thiacloprid_1_)
(99 differences between thiacloprid_1 and thiacloprid_1_)

. recode thiacloprid_2 (.=0),gen(thiacloprid_2_)
(33 differences between thiacloprid_2 and thiacloprid_2_)

. gen Neu_thiacloprid = thiacloprid_1_ + thiacloprid_2_

. recode thiamethoxam
(0=0)(0.01=1.000000)(0.02=0.999800)(0.05=0.999200)if
year==1|year==2|year==3, gen(
> thiamethoxam_1)
(5 differences between thiamethoxam and thiamethoxam_1)

. recode thiamethoxam
(0=0)(0.01=0.999929)(0.02=0.999786)(0.05=0.999357)if
year==4|year==5|year==6|year=
> =7|year==8|year==9|year==10|year==11|year==12, gen(thiamethoxam_2)
(85 differences between thiamethoxam and thiamethoxam_2)

. recode thiamethoxam_1 (.=0),gen(thiamethoxam_1_)
(99 differences between thiamethoxam_1 and thiamethoxam_1_)

. recode thiamethoxam_2 (.=0),gen(thiamethoxam_2_)
(33 differences between thiamethoxam_2 and thiamethoxam_2_)

. gen Neu_thiamethoxam = thiamethoxam_1_ + thiamethoxam_2_

. //To generate STI for EU importing countries with respect to Nigeria//

. gen Nigeria_STIeu = (cyclohexanedicarboxymide + Neu_acetamiprid + Neu_aluminiumphosphide + Neu_chlorpy
> rifos + Neu_copper + Neu_copperhydroxide + Neu_coppersulphate + cupricoxide + Neu_cuprousoxide + Neu_c
> ypermethrin + Neu_deltamethrin + Neu_diazinon + Neu_dioxacarb + Neu_endosulfan + Neu_fenitrothion + Ne
> u_glyphosphate + isoprocarb + Neu_limecao + Neu_lindanegammabhc + Neu_metalaxyl + Neu_metalaxylm + Neu
> _phosphine + Neu_propoxur + Neu_pyrimiphosmethyl + Neu_thiacloprid + Neu_thiamethoxam)/26

. end of do-file

. save "C:\Users\dell\Desktop\PhD mrl_STI_latest_260717\Nigeria\Nigeria_EU.dta", replace
file C:\Users\dell\Desktop\PhD mrl_STI_latest_260717\Nigeria\Nigeria_EU.dta saved
```

Appendix VI

Results of Tests

Annex 1: Model Selection Criteria (Individual Exporters in World Trade)

	Hausman Test (Fixed vs. Random)		Breusch-Pagan (BG) Test (Random vs. OLS)	
	chi2 value	Prob>chi2	chibar2	Prob>chibar2
Nigeria	12.70	0.08	123.04	0.00
Cote d'Ivoire	14.29	0.05	439.00	0.00
Ghana	9.09	0.25	646.28	0.00
Indonesia	3.44	0.84	243.32	0.00
Cameroun	2.82	0.90	533.42	0.00

Annex 2: Result of the Ramsey Test for the Suitability of Poisson Model

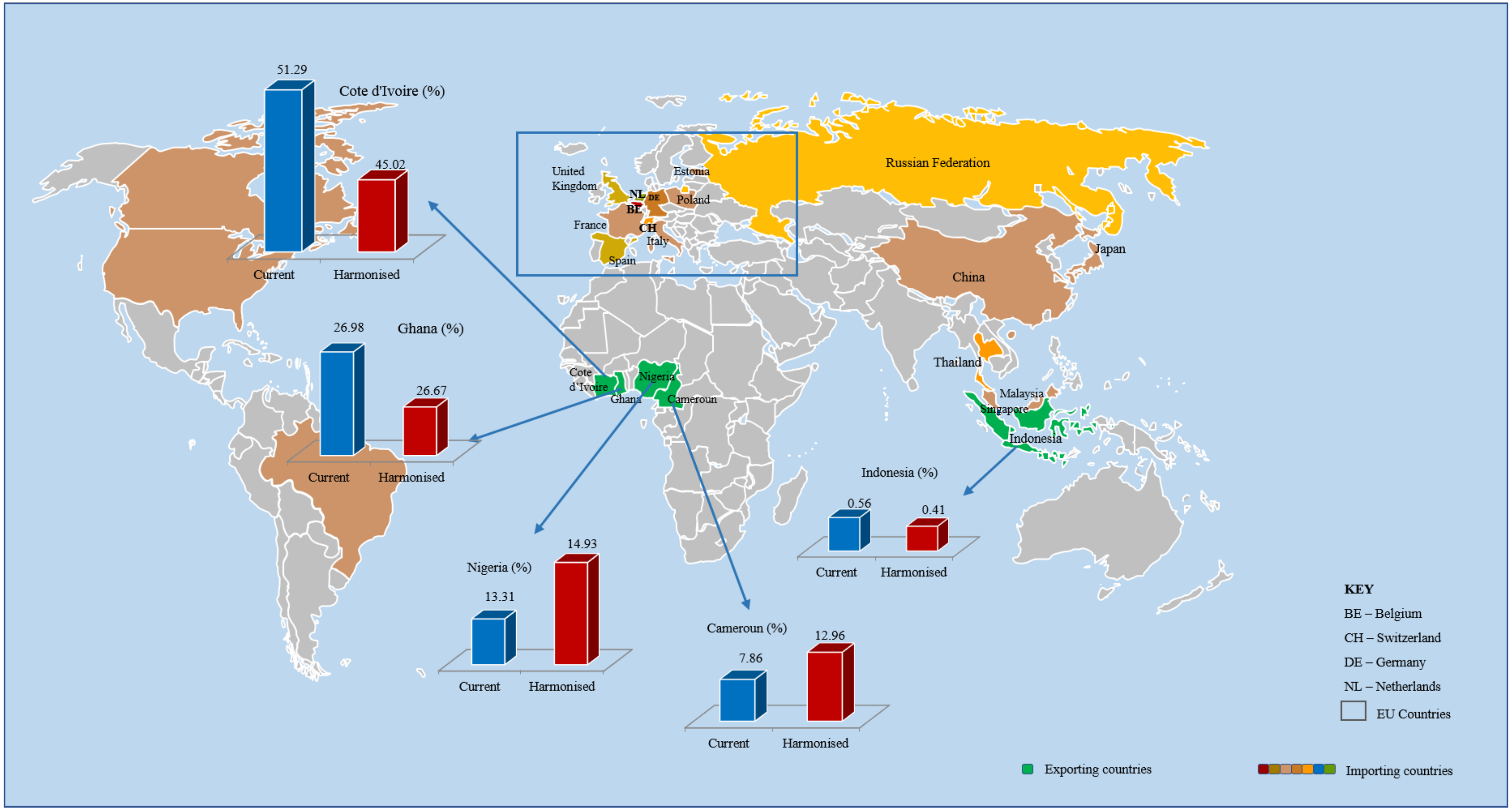
World Cocoa Trade	**EU Cocoa Trade**
… test fit_2=0	… test fit_2=0
(1) [ln1valuex]fit_2 = 0	(1) [ln1valuex]fit_2 = 0
$chi^2(1) = 1.24$	$chi^2(1) = 0.95$
Prob > chi^2 = 0.2647	Prob > chi^2 = 0.3295

Annex 3: Result of test of mean difference between World trade categories

	Log of variables	Group	Mean	Standard deviation	t-statistics	P > | t |
1.	Value of Trade	World_eu	7.130	4.730	-3.117	0.002
		World_row	6.247	4.827		
2.	Importer GDP	World_eu	27.471	1.418	6.948	0.000
		World_row	28.060	1.443		
3.	Importer GDP/capita	World_eu	10.473	0.521	-16.279	0.000
		World_row	9.719	0.992		
4.	Stringency index	World_eu	-0.657	0.856	-28.348	0.000
		World_row	-2.049	0.788		

Appendix VII: Maps

Harmonisation Effects on Exporting Countries (Demand-side)



Harmonisation Effects on Exporting Countries (Demand-side)