The effect of sanitary and phytosanitary measures on Cameroon's cocoa exports: An application of the gravity model

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ABSTRACT

There is growing concerns about food quality and food safety standards along the agricultural value chain in recent years. This study seeks to analyse the effect of changes in food policy regulations, particularly sanitary and phytosanitary measures on Cameroon's cocoa exports and to explore the compliance strategy to sanitary and phytosanitary measures adopted by institutional actors in the cocoa sub-sector. To achieve this, the study used a mixed methodological approach, consisting of both qualitative and quantitative approaches using business surveys and gravity-based models respectively. Key informant interviews were conducted with major institutional actors in the cocoa sub-sector and the data were analysed using the thematic content analysis. The study used panel data on Cameroon's cocoa trade with 10 major importing countries between 2001 and 2017 using the gravity model. The results indicate that institutional actors had adopted both reactive and proactive compliance strategies to sanitary and phytosanitary measures in importing markets. Also, the result suggests that cocoa export from Cameroon is not significantly influenced by sanitary and phytosanitary measures in major importing markets. Other factors such as gross domestic product, common language, and population were significant in influencing trade flows. The results also point to the limited supply-side capacity of the export commodity. These findings necessitate the need to strengthen Cameroon's standards-setting institutions and the regulatory framework to improve Cameroon's capacity to comply with sanitary and phytosanitary measures and to improve the export quality. Also, it is important to implement policies to address supply-side constraints and low productive capacity in the cocoa sub-sector.

1. Introduction

Cocoa (Theobroma cacao L.), the “food of the gods” is a perennial cash crop that is primarily cultivated in 3 continents, i.e. Africa, Asia, and Latin America. According to the World Cocoa Foundation (WCF), Ivory Coast, Ghana, Nigeria, and Cameroon account for about 70 percent of global cocoa production. Cameroon is the world's fifth cocoa producer behind, Ivory Coast, Ghana, Indonesia, and Nigeria and the fourth in Africa. Cocoa production and exports account for about 62 percent of the economy's trade in agricultural products and together with the coffee sub-sector, accounts for 3 percent of the Gross Domestic Product (GDP) (National Institute of Statistics [NIS], 2018). Cameroon currently produces approximately 290,000 tonnes of cocoa annually (Food and Agriculture Organisation [FAO], 2019). Cocoa production and exports contribute significantly to Cameroon's national currency and remain an important source of income for approximately 1.4 million people. The growing of cocoa is dominated by smallholder farmers, on farm plots of about 2–3 ha.

There has been a steady decline in Cameroon's cocoa export market share in recent years as the country's cocoa exports have faced stiff competition from other major cocoa-producing countries in Africa such as the Ivory Coast, Ghana, and Nigeria as well as other exporting countries such as Indonesia. This has contributed to shrinking the market share of Cameroon's cocoa exports in the key market destinations. This decline in Cameroon's cocoa export market share is in part due to the challenge for Cameroon's cocoa to meet quality standards as individual importers and regulatory authorities are demanding higher quality cocoa beans with specific quality specifications. This has resulted to cases of export rejection in recent years due to violation of sanitary and phytosanitary standards.

According to the International Trade Centre [ITC] (2018), from 2010–2017, The Netherland remained the main market destination of

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Cameroon’s cocoa, accounting for about 70 percent of total exports value during that period while Malaysia and Indonesia remain important destination markets in the Asian continent. The increasing trend observed from 2014 to 2015 to the Rest of the World (ROW) may be explained by increased demand for Cameroon’s cocoa in importing markets, the penetration into new markets in Asia, the expansion in area harvested, and an increase in yield recorded during that period. Sanitary and phytosanitary (SPS) \(^1\) measures introduced by individual importers or public standards set by the regulatory authorities will have significant effects on Cameroon’s cocoa exports.

In recent years, the quality of cocoa beans has been a major call for concern among stakeholders in the cocoa sub-sector in Cameroon. Perhaps it is due to the poor quality of cocoa that Cameroon seldom receives any premium from its exports and farmers find it difficult to sell their annual production through forward contracts and in niche markets. In the case of Cameroon, there have been situations of rejection in cocoa export consignment notably from the European Union [EU] when it was found to have violated SPS standards. The EU recently introduced a series of sanitary and phytosanitary measures regarding the use of certain pesticides, fungicides, fermentation, and drying of cocoa beans destined to the EU market. For instance, on the 1\(^{st}\) September 2012, the EU regulation (EU) 853/2011 of 19 August 2011 on maximum levels for polycyclic aromatic hydrocarbons (PAH) in food came into force. It called for broader testing of cocoa beans and derived products for the presence of carcinogenic PAHs. This resulted in the rejection in December 2012 of a 2,000 tonnes consignment of cocoa beans from Cameroon, after sanitary inspectors found high levels of polycyclic aromatic hydrocarbons concentrations.

Also, in April 2013, the EU strengthened its regulation on cadmium in cocoa beans (and rice); following a January 2012 report by a European Food Safety Authority (EFSA) scientific panel, which recommended that cocoa imports containing more than 0.2 mg/kg of cadmium be rejected \(^2\). While this mostly affects cocoa from Latin America, Cameroon, and to a lesser extent, Ghana is also affected (see Agritrade Executive Brief, October 2013). According to the National Cocoa and Coffee Board and the Cocoa and Coffee Inter-professional Council, Cameroon’s cocoa

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\(^1\) According to the Uruguay Round Agreement on Agriculture (URAA), SPS measures are meant to protect human, animal, and plant life from foodborne hazards related to contaminants, additives, chemicals, toxins, diseases carried by plants or animals; and also, to protect animals and plants from pests and diseases, prevent entry and contain the spread of pests and diseases in a territory or foreign territory.

\(^2\) Cadmium (Cd) is a heavy metal found as an environmental contaminant naturally and from industrial and agricultural sources (EFSA, 2009). Cadmium has been classified by the International Agency for Research on Cancer as a human carcinogen.

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**Table 1. Top 10 cocoa importing countries of Cameroon’s cocoa (selected data on share and growth rate of export value 2001–2017).**

| Rank | Importers  | Average annual export value (000 USD) | Share of total export value (%) | Cumulative percentage of export value (%) | Average annual growth rate of export value (%) |
|------|------------|--------------------------------------|---------------------------------|------------------------------------------|---------------------------------------------|
| 1    | Netherland | 285,569.2                            | 74.4                            | 74.4                                     | 11.81                                       |
| 2    | Malaysia   | 31,810.1                             | 6.61                            | 81.01                                    | 260.14                                      |
| 3    | Spain      | 21,536.5                             | 5.05                            | 86.06                                    | 35.69                                       |
| 4    | Belgium    | 18,393.7                             | 4.42                            | 90.46                                    | 434.06                                      |
| 5    | Turkey     | 7,678.6                              | 2.61                            | 93.07                                    | 57.67                                       |
| 6    | Indonesia  | 7,528.1                              | 1.56                            | 94.63                                    | 136.93                                      |
| 7    | Germany    | 7,499.1                              | 1.48                            | 96.11                                    | 192.93                                      |
| 8    | France     | 4,147.3                              | 1.31                            | 97.42                                    | 4804.64                                    |
| 9    | China      | 1,150.1                              | 0.21                            | 97.63                                    | 15.38                                       |
| 10   | Italy      | 466.3                                | 0.14                            | 97.77                                    | 162.89                                      |

Source: Authors’ calculation, selected data from Trade Map (www.trademap.org) based on UNCOMTRADE statistics; ITC, 2018.
Table 2. Zero truncated PPML models.

|                          | (1)     | (2)     | (3)     | (4)     | (5)     |
|--------------------------|---------|---------|---------|---------|---------|
| Production (log)         | −0.0247 | 0.00906 | 0.105   | −0.525**| −0.760***|
|                          | (0.112) | (0.0854)| (0.114) | (0.162) | (0.148) |
| GDP Importer (log)       | 0.0580  | 0.371***| 0.834*  | 0.150***| 0.139***|
|                          | (0.0722)| (0.0897)| (0.365) | (0.0352) | (0.0326) |
| GDP Exporter (log)       | 0.813   | 0.0616  |         |         |         |
|                          | (1.654) | (1.477) |         |         |         |
| Population exporter (log)| −1.536  |         |         |         |         |
|                          | (4.041) |         |         |         |         |
| Population Importer (log)| −0.156* | −0.368***| −0.502  | −0.154***| −0.140***|
|                          | (0.0660)| (0.0729)| (1.278) | (0.0327) | (0.0302) |
| SPS dummy                | −0.108  | 0.0234  | 0.0318  | 0.0333  | 0.0467  |
|                          | (0.0938)| (0.0517)| (0.171) | (0.0446) | (0.0334) |
| Exchange Rate (log)      | 1.012   | 0.460   |         |         |         |
|                          | (1.851) | (1.748) |         |         |         |
| Agriculture, Value Added (log)| −0.0529| −0.0328| 0.0267  | 0.125**| 0.0591  |
|                          | (0.0656)| (0.0594)| (0.0801)| (0.0400)| (0.0605) |
| Inflation (log)          | −0.0185 | −0.0209 | −0.0260 | 0.0225  | −0.0216 |
|                          | (0.0286)| (0.0290)| (0.0634)| (0.0177)| (0.0364) |
| Arable Land (log)        | 0.240   | 0.0949  | 0.134   | −0.114  |         |
|                          | (0.238) | (0.133) | (0.345) | (0.101) |         |
| Common Language          | −0.125  | 0.260** | 0.503   | 0.128***| 0.117***|
|                          | (0.0817)| (0.0981)| (0.958) | (0.0295) | (0.0287) |
| Colonial-tie             | −0.0491 | −0.0662 | −0.686  | 0.00172 | −0.00637|
|                          | (0.124) | (0.0708)|(2.552)  | (0.0193) | (0.0173) |
| Distance (log)           | 0.188   | 0.983** |         |         |         |
|                          | (0.127) | (0.217) |         |         |         |
| cons                     | −34.62  | −29.37  | −28.39  | 106.3*  | 8.784***|
|                          | (23.91) | (61.46) | (105.8) | (49.47) | (1.976) |
| N                        | 142     | 142     | 70      | 127     | 127     |
| R²                       | 0.396   | 0.630   | 0.494   | 0.778   | 0.805   |
| AIC                      | 642.5   | 622.8   | 300.8   | 550.0   | 544.4   |
| BIC                      | 675.0   | 652.4   | 309.7   | 581.3   | 570.0   |
| df                       | 131     | 132     | 66      | 116     | 118     |

Source: Authors' analysis based on data. Notes: (i) Dependent Variable: value of exports. Estimator: Zero Truncated Poison pseudo-maximum likelihood (ii) Robust standard errors are in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001.

seldom receives a premium and cannot penetrate niche markets compared to cocoa from other competitors due to the challenge to meet these quality standards.

Cocoa was chosen because together with coffee, they represent more than 60 percent of Cameroon’s agricultural exports, thus contributing significantly to the country’s foreign exchange earnings; also, cocoa represents an important source of income for both smallholder farmers and exporting firms, and employs millions of Cameroonians. The study considered the top 10 importing countries of Cameroon’s cocoa bean given the fact that these countries make up above 80 percent of Cameroon’s cocoa exports for the period under study; also coupled with the fact that some major importing countries have recently imposed very stringent food safety measures on cocoa which have resulted to the rejection of some consignments. The study does not consider other importing countries since they accounted for a smaller volume of Cameroon’s cocoa exports.

The effect of non-tariff measures (NTMs)3 such as food safety standards on trade in agricultural and food products has been a subject of intense debate and also of high policy relevance in recent years. With the formation of the World Trade Organization and subsequent dismantling of traditional trade barriers such as tariffs, food safety standards have become a major tool in regulating trade in agricultural and food products. Despite an increased interest in food policy regulations globally (Didier et al., 2008; Murina and Nicita, 2015; Crivelli and Groeschl, 2016; Kareem et al., 2017; Kareem, 2016; Wilson and Otsuki, 2004; Henson and Loader, 2001; Otsuki et al., 2001a,b; Henson and Jaffee, 2008; Henson and Loader, 1999; Henson et al., 2000a,b), to the best of our knowledge, there is a paucity of empirical research on the impact of food policy regulations on Cameroon’s agricultural trade. To our knowledge, no study has investigated the impact of Sanitary and phytosanitary measures on Cameroon’s cocoa exports at the 6-digit HS level. Moreover, a knowledge gap exists not just in quantifying the effect of food policy regulations such as SPS measures on Cameroon’s major agricultural exports, but also to explore the compliance strategy to sanitary and phytosanitary measures adopted by frontline institutional actors in the cocoa sub-sector. This study combines a qualitative and quantitative approach using the case of cocoa production and exports. The objectives of this paper are to elaborate on the compliance strategies adopted by institutional actors in the cocoa sub-sector and to analyse the effect of changes in food policy regulations on Cameroon’s cocoa export. The remainder of the paper is structured as follows: section 2 presents the literature review and stylized facts. Section 3 discusses the research methods and data. Section 4 presents the results and discussion and section 5 draws the conclusion and some policy implications.

3 The terms ‘non-tariff measure’ (NTM) and ‘non-tariff barrier’ (NTB) are often used interchangeably. The term NTM simply identifies the measure whereas the term NTB indicates that the measure is trade-restricting.
of development and technology in exporting countries, the sectors covered, and the choice of standards and product used in the empirical analysis.

Nabeshima et al. (2021) found that regulatory burdens were trade-impeding at the extensive margin of trade and had a negative net impact on the intensive margin of trade. A study by Curzi et al. (2020) focused on standards with varying degrees of restrictiveness, such as specific trade concerns (STCs) raised on the most stringent Non-tariff measures (NTMs), and to the upgrading of product quality. The findings suggest that only the most restrictive NTMs impeded agri-food exports for Peruvian firms, affecting both the extensive and intensive margin of trade, firms’ exit, and the volume of exports meanwhile regular SPS measures are found to be trade-enhancing. Wongmonta (2021) finds evidence that non-arbitrary and informative sanitary and phytosanitary measures imposed by China on Thai fruit exports have a trade propelling effect. In addition, Kareem and Martínez-Zarzoso (2020) investigated how the regulatory margin in food standards affects Africa’s fish exports and weak regulatory and institutional framework. A study by Santeramo and Lamonaca (2019) reports that the effects of NTMs vary across types of NTMs, the proxies

Table 3. Zero inflated PPML models for cocoa exports.

|                  | (1)         | (2)         | (3)         | (4)         | (5)         |
|------------------|-------------|-------------|-------------|-------------|-------------|
| Production (log) | −0.0247     | −0.347      | −0.170      | −1.442***   | −2.431*     |
|                  | (0.112)     | (0.280)     | (0.331)     | (0.412)     | (1.137)     |
| GDP Importer (log) | 0.0580      | 0.563***    | −0.991      | 0.160       | 0.122       |
|                  | (0.0722)    | (0.167)     | (1.504)     | (0.0872)    | (0.0803)    |
| GDP Exporter (log) | 0.813       | 0.431       |             |             |             |
|                  | (1.654)     | (2.532)     |             |             |             |
| Population exporter (log) | −1.536     |             |             |             |             |
|                  | (4.041)     |             |             |             |             |
| Population Importer (log) | −0.156*     | −0.596***   | −3.362      | −0.214**    | −0.182**    |
|                  | (0.0660)    | (0.115)     | (2.548)     | (0.0684)    | (0.0679)    |
| SPS dummy        | −0.108      | −0.0497     | 0.148       | 0.0427      | 0.0303      |
|                  | (0.0938)    | (0.128)     | (0.305)     | (0.0671)    | (0.0524)    |
| Exchange Rate (log) | 1.012       | −0.0886     |             |             |             |
|                  | (1.851)     | (2.950)     |             |             |             |
| Agriculture, Value Added (log) | −0.0529     | 0.0637      | 0.0991      | 0.162       | 0.257       |
|                  | (0.0656)    | (0.0670)    | (0.130)     | (0.121)     | (0.199)     |
| Arable Land (log) | 0.240       | −0.0893     | −0.906      | 0.0100      |             |
|                  | (0.238)     | (0.480)     | (1.016)     | (0.413)     |             |
| Common Language  | −0.125      | 0.561*      | −2.273      | 0.229       | 0.197       |
|                  | (0.0817)    | (0.228)     | (2.335)     | (0.124)     | (0.116)     |
| Colonial-tie     | −0.0491     | −0.0706     | 6.609       | 0.0703      | 0.0798      |
|                  | (0.124)     | (0.238)     | (6.123)     | (0.142)     | (0.126)     |
| Distance (log)   | 0.188       | 1.481**     |             |             |             |
|                  | (0.127)     | (0.450)     |             |             |             |
| Inflation (log)  | −0.0185     | −0.0123     | −0.0309     | 0.0525      | −0.00356    |
|                  | (0.0286)    | (0.0419)    | (0.0855)    | (0.0436)    | (0.0707)    |
| cons             | −34.52      | −9.319      | 442.3       | 47.89       | 34.24       |
|                  | (23.91)     | (136.4)     | (317.7)     | (140.5)     | (20.41)     |
| N                | 142         | 169         | 86          | 139         | 139         |
| R²               | 0.396       | 0.531       | 0.535       | 0.603       | 0.649       |
| AIC              | 640.5       | 903.6       | 436.1       | 675.5       | 663.0       |
| BIC              | 670.1       | 934.9       | 448.3       | 704.8       | 689.4       |
| df               | 132         | 159         | 81          | 129         | 130         |

Source: Author’s computation based on data. Notes: (i) Dependent Variable: value of exports. Estimator: Zero Truncated Poison pseudo-maximum likelihood (ii) Robust standard errors are in parentheses. *p < 0.05, **p < 0.01, ***p < 0.001.

2. Literature review and stylized facts

2.1. Literature review

Several studies (Otsuki et al., 2001a,b; Henson et al., 2000a,b; Henson and Loader, 2001; Henson and Loader 1999; World Bank, 2005) have pointed to the fact that non-tariff measures such as SPS requirements can act as a disguised restriction to trade especially for developing countries. This is due to the inadequate technical and financial resources to comply with new laws, different methods of ensuring the protection of food, animals, compliance requirements on exporters which impose costs such as the cost of modernizing the production system, processing, storage, and quality control equipment (Otsuki et al., 2001b; Henson et al., 2000a,b; Neeliah et al., 2012; Neeliah et al., 2013).

Two distinctive paradigms are identified in the empirical literature namely: the standards as barriers versus the standards as catalyst paradigm. A review of empirical studies indicates that there are three schools of thought in the literature. The first strand opines that food safety standards are a disguised restriction to trade and are therefore trade impeding especially in the short run as exporters incur an increase in trade cost in trying to comply with imposed standards; the second note that they can act as a trade catalyst, improve competitiveness and market access; and the third strand is of the view that it could either propel or impede trade depending on the compliance and stringency levels, levels of development and technology in exporting countries, the sectors covered, and the choice of standards and product used in the empirical analysis.

Nabeshima et al. (2021) found that regulatory burdens were trade-impeding at the extensive margin of trade and had a negative net impact on the intensive margin of trade. A study by Curzi et al. (2020) focused on standards with varying degrees of restrictiveness, such as specific trade concerns (STCs) raised on the most stringent Non-tariff measures (NTMs), and to the upgrading of product quality. The findings suggest that only the most restrictive NTMs impeded agri-food exports for Peruvian firms, affecting both the extensive and intensive margin of trade, firms’ exit, and the volume of exports meanwhile regular SPS measures are found to be trade-enhancing. Wongmonta (2021) finds evidence that non-arbitrary and informative sanitary and phytosanitary measures imposed by China on Thai fruit exports have a trade propelling effect. In addition, Kareem and Martínez-Zarzoso (2020) investigated how the regulatory margin in food standards affects Africa’s fish exports to the EU and found that relative to the international standards, EU fish standards were found to be non-trade restrictive. The rejected fish exports from Africa by the EU due to non-compliance with EU standards does not point to the overly restrictive nature of the measures but rather suggests the poor quality of Africa’s fish exports and weak regulatory and institutional framework. A study by Santeramo and Lamonaca (2019) reports that the effects of NTMs vary across types of NTMs, the proxies
used for NTMs, and levels of detail of studies with the estimated effects greatly influenced by methodological issues. Grundke and Moser (2019) found that there is an increase in trade cost for poorer countries due to non-compliance with U.S. product standards and the trade impeding effect of the stringent product standards emanates from non-OECD countries, whereby an increase in rejections leads to a decrease in exports from developing countries in the short and long term. Nabeshima and Obashi (2021) using the additional compliance requirement indicator report that regulatory burdens were trade-impeding with varying effects across sectors and countries. In analysing the impact of NTB on production, trade and prices on chicken imports into Russia, Min Soon and Thompson (2020) used a cointegration approach to test the hypothesis that NTB are trade impeding. The results suggest that removing the NTB decreases domestic production by 4–5 percent and domestic price by 27 percent to 34 percent, while imports increase by 326–423 thousand tonnes annually for the period 2015–2019.

Mai Ha et al. (2020) investigated the relationships among information acquisition about food incidents, institutional trust, and risk perception and found that food incident information resulted in a lower level of institutional trust and negative information about food safety heightened risk perceived of common foods, of hazards and indirectly increased the perception of food safety risk. Nguyen and Jolly (2020) examined how compliance with VietGAP and international standards influence pangasius value chain and serves as a catalyst in altering the industry structure. The findings suggest that the imposition of standards by the US and EU bolstered Vietnamese exporters to search for alternative markets and there has been improvement in marketing and a shift in exports to other import markets with less stringent quality requirements. Farmers see the adoption of VietGAP as cost incurring with little benefits to them.

The study by Chen et al. (2008) attempts to measure the effect of food safety standards (Chlorpyrifos MRL and Oxytetracycline MRL) on China’s vegetable exports. The study suggests that food safety standards imposed by importing countries are statistically significant and have negative effect on China’s export. Other studies have examined heterogeneity indexes for estimating the extra costs for exports due to differences in NTMs regulations between countries (Sunesen et al., 2009; Vigani et al., 2010). They highlighted that the most noticeable types of NTMs in agricultural products are related to differences or divergent technical regulations and SPS standards between the exporting and importing countries. In addition, Jordaan (2017) observes that the perceived advantage of the substantial reduction in tariffs has been eroded progressively and replaced by NTMs globally. He notes that NTMs seem to be very important in limiting the flow of imports between trading countries, albeit the difficulties in capturing the impact of such measures. He notes that Mauritius’ volume of export flows are much lower due to the NTMs imposed by its importing trading partners. Furthermore, Cadot and Gourdon (2016) investigated the relationship between preferential trade agreements and NTMs and argue that there is a progressive phasing out of command-and-control instruments such as quantitative restrictions in many countries and also suggest that sanitary and technical regulations have now substituted for them as trade-restrictive interventions.

### 2.2. Stylized facts

According to the National Cocoa and Coffee Board [NCCB] (2019), the Southwest region is the leading cocoa producing region accounting for about 43.40 percent of total cocoa production, followed by the Centre region accounting for approximately 36.81 percent while the South, East, Littoral, West and Northwest regions account for the remainder 19.79 percent of total production. As shown in Figure 1, production and exports of cocoa have followed an increasing and a declining trend which more often corresponds to both endogenous and exogenous factors e.g. the stagnant growth of area harvested, poor seedlings, aging plantations, aging farmers, climate change and variability, pests and diseases, the structural adjustment programs, agricultural trade liberalization, fluctuation in world prices, etc.

In 1961 Cameroon produced 75,100 tonnes of cocoa. By 1980, production levels had reached 117,053 tonnes. This period was marked by an increase in the price of cocoa in the world market, growth of the area harvested, and state subsidies to farmers. Production plummeted to 97,835 tonnes in 1992 and witnessed a slight increase to 99,000 tonnes in 1993; this period was marked by a fall in the price of cocoa in the world market, a decrease in the area harvested, dismantling of state subsidies, and agricultural trade liberalization. Official figures show cocoa production to have stagnated within the range of 98,000 to 134,000 tonnes per annum from 1990 to 2002. Production peaked at 166,754 tonnes in 2001.

### Table 4. Summary statistics.

| Variables                  | Mean   | Std.Dev. | Min    | Max    |
|----------------------------|--------|----------|--------|--------|
| Export                     | 8.856  | 2.199    | 2.708  | 13.282 |
| Production (log)           | 12.271 | 0.290    | 11.713 | 12.613 |
| Log of Importers’ GDP      | 27.622 | 0.988    | 25.426 | 30.041 |
| Log of exporter’s GDP      | 23.913 | 0.335    | 23.062 | 24.277 |
| Population exporter (log)  | 16.817 | 0.128    | 16.584 | 17.017 |
| Population importer (log)  | 17.826 | 1.175    | 16.146 | 21.044 |
| SPS dummy                  | 0.261  | 0.440    | 0      | 1      |
| Exchange rate (log)        | 6.272  | 0.118    | 6.104  | 6.597  |
| Agriculture, Value Added (log) | 14.315 | 1.037    | 13.096 | 17.429 |
| Inflation (log)            | 0.539  | 0.829    | −1.454 | 1.675  |
| Arable land (log)          | 156.210| 0.196    | 156.006| 156.401|
| Common language            | 0.317  | 0.467    | 0      | 1      |
| Colonial-tie               | 0.197  | 0.399    | 0      | 1      |
| Distance (log)             | 8.702  | 0.347    | 8.351  | 9.306  |

Source: Authors’ Computation.

Coefficients estimates are interpreted as elasticities, as the model is estimated in its linearized form. All the coefficient signs are not as expected and not all variables are significant for the various specifications. Production is expected to have a positive influence on trade flows; contrary to our expectations, Cameroon’s cocoa production (with a one-year time lag) is not, as generally expected, positive across all specifications (columns 1, 4, and 5). As economic theory suggests, the coefficients are positive for the second and third specifications (columns 2 and 3) but, are insignificant. This result is somewhat counterintuitive as the elasticities of estimated production are negative but statistically significant (columns 4 and 5).
2004, then increased sharply, breaking through 235,500 tonnes in 2009 and totalling an estimated 264,077 tonnes and 240,000 tonnes in 2010 and 2011 harvest respectively. Recent cocoa harvests hover at 291512 tonnes in 2016. Overall, cocoa exports from Cameroon have doubled since the 1970s and 1980s, increasing sharply between 2001 and 2010–109796 tonnes and 193881 tonnes respectively. In 2013, export quantity stood at 179933 tonnes.

Cameroon's major cocoa market destinations by region are Asia, Europe, and the Middle East. European Union countries are the leading export destination amidst growing demand potential from Asia particularly in China, Malaysia, and Indonesia. Table 1 shows the top 10 importing countries of cocoa from Cameroon for the period 2001–2017. The Netherlands is the largest importer accounting for approximately US$280 million yearly export or equal to 74.4 percent of total cocoa exports from Cameroon. Malaysia is the second export destination country and the major buyer of Cameroon's cocoa in Asia with an average value of exports of approximately US$30 million per year.

3. Materials and methods

Previous studies have either used the qualitative approach or the quantitative approach in analyzing the effect of food safety regulations on trade flows. However, the novelty of this study is that it combines both the business survey approach and the gravity-based approach using both primary data and secondary data respectively. Most studies have either used a quantitative approach, or a qualitative approach. Seldom have previous works used both quantitative and qualitative approaches. The study uses both quantitative and qualitative techniques to quantify the impact of sanitary and phytosanitary measures and explore the compliance strategies adopted by frontline institutional actors in the cocoa sub-sector.

Neeliah et al. (2012) posit that analysis based on firm-level data allows for detailed investigation of how relevant stakeholders (public and private) react to regulations and is therefore appropriate to study the effects of SPS measures. To explore the compliance strategies to SPS measures adopted by institutional actors in the cocoa sub-sector, the study used the business survey approach using structured and non-structured interviews and questionnaires (Neeliah et al., 2012, 2013; Nguyen and Jolly, 2020). This approach consisted of an in-depth qualitative key informants’ interview (KII) with representatives from institutional actors.

This research borrows and adopts the methodological approach from Neeliah et al. (2012, 2013), Henson and Loader (1999), Henson et al. (2000a,b), and Nguyen and Jolly (2020). Face-to-face interviews using open-ended questionnaire were conducted with key informants in the cocoa sub-sector through in-depth structured and non-structured interviews with representatives from institutional stakeholders in the cocoa sub-sector namely: the Deputy Director of Internal Commercialisation at the National Cocoa and Coffee Board (NCCB); the Head of Service, Chemical and Organoleptic Analysis of the Central Laboratory for Analysis, Department of Quality and Sustainability of the NCCB; the Head, Development Department of the Cocoa and Coffee Inter-professional Council (CCIC); and the Head, Regional Delegation of the Ministry of Commerce (MINCOMMERCE) for the South West Region. These interviews were conducted in person, between January and March 2021. Borrowing from Neeliah et al. (2012, 2013), after the in-depth KII, the raw data were transcribed into text using both the interviewer’s words and the interviewee’s words. The qualitative data were analyzed using the thematic content analysis technique.

In the literature, international trade is primarily explained by three classic approaches: the Ricardian model, the Heckscher-Ohlin model, and the Helpman and Krugman (1985) model. These three classic models together with Anderson’s (1979) microeconomic trade theory constitute the theoretical foundations of the gravity model. The theoretical foundation is based on seminal papers from several scholars such as Anderson (1979); Anderson and van Wincoop (2003); the neo-classical Heckscher-Ohlin framework (Berghstrand, 1985); the classical Ricardian framework of Eaton and Kortum (2002); entry of heterogeneous firms, selection into markets (Helpman et al., 2008); a sectoral Armington-model (Anderson and Yotov, 2016); a sectoral Ricardian model (Costinot et al., 2012); and a dynamic framework with asset accumulation (Olivero and Yotov, 2012).

To analyse whether changes in food safety regulations affect Cameroon’s cocoa export, the study used the gravity model approach. The gravity model was first applied in international trade by Tinbergen (1962) and Poyhonen (1963). Since then, the gravity model has been used extensively to evaluate trade flows between countries and more recently in agricultural trade to estimate the impact of food safety standards on trade flow. Its origin goes back to Newton’s law of gravity in physics propounded by Isaac Newton in 1687, which describes the gravitational force between two masses in relation to the distance that lies between them.

For trade, the forces represent the factors that make countries want to trade with each other, such as the countries’ GDP and the distance between them.

3.1. Model specification and estimation techniques

Gravity model has been used extensively to evaluate trade flows between countries and more recently in agricultural trade to estimate the impact of food safety standards on trade flow. Based on the trade literature, the basic gravity model can be expressed as follows:

$$X_{ijt} = \alpha \frac{GDP_i}{D_{ijt}^{\beta_1}} \frac{GDP_j}{D_{ijt}^{\beta_2}} \frac{D_{ijt}}{D_{ijt}^{\beta_3}} \frac{D_{ijt}}{D_{ijt}^{\beta_4}}$$

Where $X_{ijt}$ is the value of bilateral trade flow between trading countries $i$ and $j$; $\alpha$ is the constant factor; $\gamma_i$ and $\gamma_j$ represents the economic mass (GDP) of countries $i$ and $j$; $D_{ijt}$ is the geographical distance between the trading countries’ capital cities; $\beta_1$, $\beta_2$ and $\beta_3$ are the parameters to be estimated. The basic gravity model of bilateral trade connotes that the volume of trade between two countries is directly proportional to their masses (GDP) but inversely related to the distance between them.

In line with economic theory and empirical literature (Thuang, 2018; Ferro et al., 2015; Marina and Nictia, 2015), this study employs the gravity model of international trade. This leads to the following logarithmic specification of the augmented gravity equation:

$$\ln(\text{REXR}_{ijt}) = \beta_0 + \beta_1 \ln(\text{GDP}_i) + \beta_2 \ln(\text{GDP}_j) + \beta_3 \ln(\text{POP}_i) + \beta_4 \ln(\text{POP}_j) + \beta_5 \ln(\text{PROD}_{i,t-1}) + \beta_6 \ln(\text{SPS}_{ijt}) + \beta_7 \ln(\text{COI}_i) + \beta_8 \ln(\text{REXR}_{ijt}) + \beta_9 \ln(\text{LANG}_i) + \beta_{10} \ln(\text{INF}_{ijt}) + \beta_{11} \ln(\text{AVAll}_{ijt}) + \epsilon_{ijt}$$

Where $ijt$ denotes exporting country (Cameroon), importing countries, and trade year respectively. The parameters $\beta$ are coefficients of explanatory variables to be estimated and $\epsilon_{ijt}$ is a log-normally distributed error term with $\epsilon_i \sim N(0, \sigma^2)$. $X_{ijt}$ denotes the export value of cocoa from Cameroon to country $j$ in year $t$. $\text{GDP}_i$ is measured in thousands of US dollars. $\text{GDP}_j$ is the real gross domestic product of the importing country $j$ in year $t$, measured in billions of US dollars. $\text{GDP}_{ijt}$ is the real gross domestic product of the exporting country $i$ in year $t$, measured in billions of US dollars. The GDP captures the market size, size of the economies, and the demand and supply-side effect of cocoa trade. In line with Shepherd and Wilson (2013) and Nugroho (2014), the variables $X_{ijt}$ and GDP are expressed in nominal values as Nugroho (2014) notes that...
“deflating exports or GDP using different price indices, such as the CPI or the GDP deflator, would not adequately capture the unobserved multilateral resistance terms, and could produce misleading results”.

POP$$_j$$ is the population of importing country $$j$$ in year t, which captures the market size of importers. DIST$_{it}$ represents the geographical distance between the capital cities of Cameroon and importers, and is measured in kilometres; it is incorporated in the model as a resistance factor. POP$$_i$$ is the population of exporting country i in year t and captures domestic consumption. PROD$_{t-1}$ denotes Cameroon’s total cocoa production lagged one year, measured in thousands of tonnes. This variable captures the supply-side effect (productive capacity) of Cameroon’s cocoa trade.

Some studies have suggested that production in the current year could be endogenous since it could be affected by the ongoing export opportunities (Thuong, 2018; Wei et al., 2012; Dou et al., 2015). Consequently, the variable PROD$_{t-1}$ is lagged by one year to address the potential endogeneity. REXR$_{ij}$ is the real exchange rate between countries i and j at time t. COL$_{ij}$ is the colonial tie dummy that captures the existence of a colonial relationship between the two trading countries i and j. LAND$_{i}$ is the language dummy that captures the existence of a common official language between countries i and j. INF$_{i}$ is the rate of inflation of exporting country i in year t and captures the general price level at time t.

SPS$_{ij}$ is the sanitary and phytosanitary measure. Some studies have captured the SPS variable as a dummy variable having two modalities which is equal to 1 if importing countries impose or notify SPS measures, and 0 otherwise; Others have employed frequency measures, coverage ratios, and prevalence score ratios for SPS measures, while others have used the MRLs (Otsuki et al., 2001a,b) of the specific element used to regulate the trade flow of agricultural commodities. Given the data availability and limitations, in this research, SPS$_{ij}$ is a binary variable equal to one if importer j imposes SPS measures on cocoa imported from Cameroon and zero otherwise (Thuong, 2018; Nugroho, 2014; Curzi et al., 2020). AVA$_{i}$ is used as a proxy for the total public expenditure on agriculture in Cameroon in year t. LAND$_{r}$ represents the total arable land of the exporting country i in year t. It is hypothesized that when the exporting country expands its arable land, it could increase production and productivity which may lead to an increase in cocoa exports from Cameroon. $${f}_{ij}^{\theta}$$ is a log-normally distributed error term with $${\epsilon}(ln {e}_{ij}) = 0$$.

The gravity literature suggests that estimating trade flows using structural gravity models has a couple of inherent modeling and econometric challenges (Xiong and Beghin, 2013; Yotov et al., 2016). Traditionally, various forms of structural gravity models have been estimated using the traditional OLS estimator as the estimation technique. However, Yotov et al., 2016 note that one major setback of the OLS approach is that it does not account for zero trade flows values, since observations with zero trade flow values are simply dropped from the estimation sample in the log-linear version of the trade values$^4$, resulting to sample selection bias. In the context of this study, zero trade flows can occur in cocoa exports for Cameroon when bilateral distance may limit cocoa trade between countries in particular years. Second, cocoa is a perennial crop that is very sensitive to climate change and variability; production or harvest deficit can take place due to climate variability and disease, which may result in a reduction in the ability to export for Cameroon. Still, some of the zeros may be attributed to statistical zeros due to rounding up or missing data points in the United Nations Commodity Trade (UN COMTRADE) database (Kareem and Martinez-Zarzoso, 2020). Yotov et al. (2016) opine that a convenient method to handle the presence of zero trade flows is to estimate the gravity model in multiplicative form instead of logarithmic form, by applying the PPML estimator advocated by Santos-Silva and Tenreyro (2006, 2011) to estimate the gravity model. The PPML estimator is widely acclaimed because of its intuitiveness and other inherently good qualities it possesses when applied to gravity trade modeling (Shepherd and Wilson, 2013).

However, Burger et al. (2009) suggest that due to overdispersion and pervasive zero trade values, the conditional variance could be greater than the conditional mean. They propose the “modified” Poisson models namely: The Negative Binomial Pseudo Maximum Likelihood estimator (NBPPML), the Zero Inflated Poisson Pseudo Maximum Likelihood model (ZIPPML), and the Zero-Inflated Negative Binomial Pseudo Maximum Likelihood model (ZINBPML) in estimating gravity models in the presence of pervasive zero trade flows. Also, Xiong and Beghin (2013) suggest that PPML tends to overestimate the impact of most variables because the “PPML model takes all zeros as generated from the Poisson process; to accommodate these excessive zeros, the estimates are biased upward (the predicted dependent variable is always non-negative)”.

To solve this problem, they advocate the use of ZIPPML because PPML overestimates the impact of most variables and the PPML estimator is “constrained by its inability to distinguish the rounding zeros and true zeros” (Xiong and Beghin, 2013). Based on the desirable qualities of these methods, this study employs the modified PPML estimators namely the Zero Truncated (ZTTPML), and the ZIPPML advocated by Xiong and Beghin (2013) and Yotov et al. (2016). Taking into account the problem of zero trade flows and heteroscedasticity (Santos-Silva and Tenreyro, 2006), the Poisson estimation can be specified as follows:

$$X_{ijt} = exp\{\beta_1 \ln (\text{GDP}_i) + \beta_2 \ln (\text{GDP}_j) + \beta_3 \ln (\text{POP}_i) + \beta_4 \ln (\text{POP}_j) + \beta_5 \ln (\text{DIST}_{ij}) + \beta_6 \ln (\text{PROD}_{t-1}) + \beta_7 \ln (\text{REXR}_{ij}) + \beta_8 \ln (\text{AVAK}_i) + \beta_9 \ln (\text{AVAJ}_j) + \beta_{10} \ln (\text{LANDAK}_i) + \beta_{11} \ln (\text{LANDAJ}_j) + \theta_i + \theta_j + \epsilon_{ijt}\}$$

(3)

Where $${\lambda}_i$$, $${\phi}_j$$, and $${\theta}_i$$ are the exporter, importer, and year fixed effects respectively.

### 3.2. Data needs and sources

Quantitative data between Cameroon and its major import partners were collected from different sources. Data on key macroeconomic indicators such as GDP, exchange rate are from the World Development Indicator (WDI) database of the World Bank and the PENN World Table version 9.1 respectively. Information on Cameroon’s cocoa production is collected from the Food and Agricultural Organisation statistical database (FAOSTAT). Data on cocoa exports are sourced from Trade Map of the International Trade Centre (ITC), which is based on the United Nations Commodity Trade Statistics Database (UN COMTRADE) of the United Nations Conference on Trade and Development (UNCTAD). Population data is obtained from the WDI database of the World Bank. Cocoa bean, HS1801 is the main commodity for the study. The geographical distance between the capital cities of Cameroon and importer countries is sourced from the Institute for Research on the International Economy (CEPII, 2020) database. Data on agriculture value-added, total arable land and data on inflation are sourced from the World Development Indicator (WDI) database of the World Bank. The SPS data is obtained from the WTO Integrated Trade Intelligence Portal (I-TIP), and other pesticide databases of importing countries.

### 4. Results and discussions

#### 4.1. Strategic responses adopted by institutional actors in the cocoa sub-sector

The government’s response compliance strategies with SPS measures in importing countries to ensure the sustainability of the cocoa sub-sector

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$^4$ When the trade values are transformed into a logarithmic form, zero trade flows values are dropped from the sample, since the logarithm of zero is unspecified, giving rise to missing data points and sample selection bias (Heckman, 1979).
has been both reactive and proactive. In this section, this study presents some of the reactive and proactive compliance strategies that have been adopted by the institutional actors.

4.1. Reactive compliance strategies

The government took a series of trade facilitation measures to ensure the harmonization of various standards and conformity to SPS measures. According to officials from the MINCOMMERCE: “The government has established a single-window environment, known in French as Guichet Unique. The government established the single-window or one-stop-shop which is a mechanism that allows different government ministries and agencies such as the Ministry of Agriculture and Rural Development (MINADER), the SPS inquiry point, the NCCB, the CCIC, and private sector operators involved in the cocoa and coffee trade to lodge standardized information and documents with a single entry point to fulfill all trade declaration, standards, and certification related requirements. All these agencies are connected to an electronic platform where they share and access vital information and documents. This has helped to simplify procedures and processes and to enhance compliance with SPS measures in the cocoa and coffee sub-sectors.”

Also, officials from the NCCB alluded that: “The government has reinforced its collaboration with both local stakeholders and international partners under the cocoa and coffee sub-sector sustainability program. This includes the establishment of the Academy of Cooperative Management, capacity building workshops and seminars on GAPs via Farmer Field School (FFS), the adoption of the coffee sector development strategy (2010–2015) financed by the European Commission, in collaboration with the International Trade Centre (ITC), the United Nations Conference on Trade and Development (UNCTAD), World Bank, FAO, and The Common Fund for Commodities. As part of its collaborative programs, the government via the MINCOMMERCE and other cocoa-producing nations such as Nigeria and Ghana is engaged in an ongoing “all-inclusive dialogue” with the European Commission and the Member States, non-governmental organizations (NGOs), and the chocolate industry on the sustainability of the cocoa sector.”

According to a representative of the NCCB, the government via the Institute of Agricultural Research for Development (IRAD) and the Ministry of Scientific Research and Innovation (MINRESI) has established local breeding programs (genetic type) known as “Fine and Flavour” to develop improved high yield varieties which are resistant to diseases and pests and having good quality attributes.

4.1.2. Proactive compliance strategies

As for the proactive compliance strategies, the government has taken several measures in the cocoa sub-sector, one can note the government’s investments to upgrade the food quality and safety infrastructure, and the provision of annual incentives to cocoa farmers to promote good agricultural practices. One can also note private sector initiatives such as the creation of the Association of Cocoa and Coffee Exporters known in French as the Groupement des Exportateur.

MINCOMMERCE: “The government has created “Centres of Excellence” for post-harvest management, known in French as “Centres d’Excellence” across the major cocoa and coffee production basins in Cameroon. These centres of excellence are to serve as major quality promotion hubs to promote Good Agricultural Practices (GAPs) and good quality attributes of cocoa and coffee beans. The government intends to create more of such centers in the nearest future.”

NCCB: “The government in collaboration with local and international partners, is working on a project on geographical indication and appellation of origin in the cocoa and coffee sub-sectors, as part of the government’s proactive compliance strategies to guarantee the quality of the cocoa and coffee bean and to promote the Cameroonian label in the international market. The goal is to identify cocoa and coffee bean or products that originate from a specific geographical locality and possess specific quality attributes (e.g. flavour, taste, size, etc.) attributable to their geographical origin. This may eventually be granted protection under intellectual property to avoid any infringements or unauthorized use of a name or logo of the product. The goal is to promote the brand image and the commercial value of products originating from specific regions in Cameroon.”

Furthermore, the Department of Quality and Sustainability of the NCCB was set up with a well-equipped central laboratory for analysis, to carry out physical, chemical, and organoleptic analysis of cocoa and coffee beans and the by-products sold in the domestic and foreign markets. The Department works in collaboration with other accredited quality control firms to deliver export-related certificates.

The government also undertook legal and regulatory reforms in the marketing of cocoa and coffee. Law No. 2004/025 of 30th December 2004 was adopted by the National Assembly and enacted by the President of the Republic to amend and supplement certain provisions of Law No. 95/11 of 27 July 1995 to organize the marketing of cocoa and coffee.

4.2. Estimating the effect of SPS measures on Cameroon’s cocoa exports

The results for the modified Poison models that correct for excess zeros, zero trade flow are presented in Tables 2 and 3 in which the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) have been used to compare the different estimators. Given that the specification of the gravity model includes variables such as distance, common language, and colonial relationship that are time-invariant, the use of time effects and country-specific effects is used to address the potential problem of endogeneity which produces bias and inconsistent estimates of the gravity model. Tables 2 and 3 report the ZTPPML and ZIPPML estimators for a series of specifications respectively. Specification (1) consists of the ZTPPML model with no effects. The time effects and country-specific effects are analyzed in specification 2 which include the exporter time, importer time, and country pair time-varying effects. The time effect accounts for cyclical fluctuations in the business cycle in terms of booms and slumps that could affect global trade flows. The country-specific effects account for country-specific characteristics such as the trade infrastructure, trade facilitation, and multilateral resistance term (Jagdambe and Kannan, 2020). Specifications (3)–(5) include the lag of the dependent variable and year dummies. Table 4 reports the summary statistics.

The coefficient estimates of the production variable are not positive in all the specifications as expected, except in specifications (2) and (3) in the ZTPPML model. As presented in Table 2, the elasticities of estimated production are statistically significant and equal to −0.525 and −0.760 respectively (columns 4 and 5) in the ZTPPML model and are statistically significant and equal to −1.442 and −2.431 in columns 4 and 5 respectively in the ZIPPML model. The result of the production variable indicates that production negatively influences trade flows, meaning an additional percentage increase in cocoa production, does not lead to higher cocoa export. The result suggests that a 1 percent increase in cocoa production will lead to a decrease in the commodity export by say −0.760. The result does not corroborate the findings of Nugroho (2014) and Thuong (2018) who found that production significantly influenced the export value of bilateral trade. This result is in part due to the black market trade for cocoa resulting in illegal cross border trade where part of the cocoa produced in Cameroon is smuggled to neighboring countries such as Nigeria for re-export; this illegal cross border trade is not officially recorded and represents an export leakage and a significant revenue loss for Cameroon; secondly, a possible explanation for this is that production in the previous year will carter for the demand in the domestic and foreign markets for that period, thus, increase in production

5 These tables report the ZTPPML and ZIPPML estimators for a series of specifications respectively. The AIC, the BIC, the goodness of fit test (RESET test) the specification test (Linktest), and the model variation test are used to test for the performance of ZTPPML and ZIPPML to select the appropriate model. However, the specifications of the ZTPPML estimator show the lowest AIC and BIC results, meaning that the ZTPPML should be preferred over the ZIPPML.
in the current period may be insufficient to satisfy growing demand in both domestic and foreign markets.

Another plausible explanation for this result is the rise in domestic industrial and semi-industrial processing of the cocoa bean into chocolate, cocoa butter, liquor, and other by-products; an increase and significant volume of cocoa is processed into other by-products locally as Cameroon seeks to add value by processing the cocoa bean locally. According to the NCCB, in the 2019/2020 season, the quantity of by-products from processed cocoa increased by 167,654 kg, representing about 0.34% compared to the 2018/2019 campaign. In the 2019/2020 campaign, a total of 60,248,924 kg was used in industrial processing compared to 58,377,019 kg in 2018/2019. The major industrial processors include SIC-CAACOS (89.12%) CHOCOCAM (2.58%), FERRERO (1.19%), and NEO INDUSTRY (7.12%).

The coefficients estimate for importer's GDP is positive across all five specifications except for column 3 in the ZIPPM model, thus, reflecting the wealth effect of buyers (Otsuki et al., 2001a). The sign is consistent with the prior expectation and the results show importer's GDP has a positive effect on cocoa exports. The coefficients estimate of importer's GDPs are positive and significant (columns 2, 3, 4, and 5) as expected in the ZIPPM model. The result is highly significant in specifications 2, 4, and 5 with elasticities of estimated GDP equal to 0.371, 0.150, and 0.139 respectively; however, it is statistically insignificant in the ZIPPM model except for column 2 where it has a significant trade effect. This variable accounts for the purchasing power, the market size, size of the economies, and demand-side effect (consumption capacity) of importing countries, and hence, this result is consistent with prior expectations. The result of importing countries' GDP shows that it is a significant factor affecting the trade flow of the export commodity. The result suggests that growth in importers' purchasing power (consumption capacity) would be followed by an increase in cocoa exports from Cameroon. This result contradicts the findings of Thuong (2018) but corroborates the findings of Jagdambe and Kannan (2020), Nugroho (2014), Krishnan (2016), and Otsuki et al. (2001a, 2001b), Wilson and Otsuki (2004), and Gebrehiwet et al. (2007) who found a positive effect on trade flows.

The coefficient estimate of exporting country's GDP is also positive but insignificant (columns 1 and 2). The effect of exporter's GDP is positive but less significant (columns 1 and 2), corroborating the findings of Gebrehiwet et al. (2007), and Wilson and Otsuki (2004). This result may be explained by the fact that the exporting country's GDP plays a relatively less significant role in determining the trade flow of the export commodity. This implies that an increase in exporting country's GDP will not lead to a significant increase in cocoa exports. The fact that the GDP of exporting country is not significant supports the notion of a limited supply-side capacity (productive capacity) of the export product. Cameroon currently produces an estimated 295,000 tonnes of cocoa annually, which is considered far below the country's productive potential of 600,000 tonnes annually.

The effect of exporting country's population is insignificant and negative (column 1) in both models. The population variable of the exporting country was omitted in the second, third, fourth, and fifth specifications (columns 2, 3, 4, 5) to mitigate the collinearity with the GDP variable. The result of the exporting country's population corroborates the findings of Wilson and Otsuki (2004) and Gebrehiwet et al. (2007) suggesting that the exporting country's population plays a less significant role in determining trade flows of the export commodity. Hence, the current study did not find any evidence for the influence of Cameroon's population on cocoa exports. The coefficients estimate of exporting country's population which accounts for the demand side effect on Cameroon's cocoa export is negative across all five specifications and significant (columns 1,2,4 and 5) in both models. The result of the population variable of the importing country which determines the market size of importers corroborates the findings of Wilson and Otsuki (2004) and Gebrehiwet et al. (2007) suggesting that an additional percentage increase in the population of importers will decrease the trade flow of the export commodity.

Concerning standards, the results show negative effects on Cameroon's cocoa exports that are not significant in columns 1 and 2 in both models. The estimated elasticity for the SPS variable is positive (columns 2,3,4, and 5) and statistically insignificant across all specifications in the ZIPPM model, suggesting that changes in SPS regulations in some markets did not significantly hinder cocoa exports to these foreign markets. The estimated elasticity for the SPS variable has the expected positive sign (columns 2, 3, 4, and 5) and is in line with Otsuki et al. (2001a, 2001b), Gebrehiwet et al. (2007), Wilson and Otsuki (2004), and Scheepers et al. (2007) but is not statistically significant across the four specifications. This is indicative that cocoa exports were not sensitive to changes in SPS regulations in major importing markets. A possible explanation for this is that exporters and other actors that support the sub-sector might have adapted to these changes in SPS regulations and taken the necessary steps to ensure adequate compliance before exporting the commodity. Also, this may be explained by the fact that SPS regulations are usually less stringent for agricultural commodities compared to the agri-food trade involving processed or semi-processed products. This result suggests that though SPS regulations could be trade impeding, it is indicative that exports of cocoa are not significantly affected by changes in SPS measures in major importing markets. As such the study takes a less pessimistic stance and concludes that SPS measures in importing countries may not constitute a trade barrier but are meant to protect plant and animal life from pests and diseases. Thus, the non-compliance by cocoa exporters with sanitary and phytosanitary measures in importing countries and consequent rejection in cocoa exports may rather indicate the weak capacity of domestic standards and inadequate scientific and technical expertise.

The Exchange rate was not shown to be significant and is positive, contrary to prior expectations. Results had shown a positive relationship between exports and exchange rate in line with Krishnan (2016) but are not significant suggesting that variations in the exchange rate will not have a significant impact on export. For example, the depreciation of the FCFA by 50 percent in 1994 had a slightly positive but not a significant impact on cocoa export. Agriculture, value added which is a proxy for total expenditure on agriculture is positive (columns 3, 4, and 5) and significant (column 4). The results show that an increase in value-added for agriculture would attract higher exports. This is indicative that a 1 percent increase in value-added in agriculture, on average, will lead to an increase in export by 0.125 percent. Common language positively affects the value of cocoa exports except for columns 1 and 3 where it produces a negative trade effect in both models. The coefficients are positive (columns 2,3, 4, and 5) and significant (columns 2,4, and 5) in the ZIPPM model. This is consistent with theory suggesting that linguistic and cultural assimilation affect trade patterns between Cameroon and its trading partners. Common language was shown to be significantly influencing cocoa exports, thus conforming to the theory that Cameroon is likely to trade more with countries having similar official languages as this tends to reduce trade cost such as the cost of translating documents. This result corroborates the idea of Murina and Nicita (2015) and Didier et al. (2008).

The effect of the colonial tie dummy is negative (columns 1, 2, 3, and 5) but positive in column 4 and is not statistically significant across the specifications, suggesting that cocoa exports are not affected by past colonial ties. This is indicative that the bulk of Cameroon's cocoa exports is not destined to countries with past colonial ties. For example, Cameroon's top six cocoa importing countries are the Netherlands, Malaysia, Spain, Belgium, Turkey, and Indonesia. These countries do not have any previous colonial ties with Cameroon. Germany and France that have previous colonial ties with Cameroon occupy the 7th and 8th positions respectively. Britain does not feature in the list of the top 10 cocoa importing countries of Cameroon's cocoa, albeit the previous colonial tie between the two countries. The growing importance of South-South trade and growing demand in emerging markets particularly in Asia could explain these changes in trade patterns. In sum, the results may suggest that colonial ties do not appear to have important implications.
for trade in Cameroon's cocoa exports. Contrary to our expectations, the trade costs proxy by distance is positive (column 1 and 2), and statistically significant (column 2) in both models. The result contradicts theory which states that as distance increases, exports decline due to an increase in transport cost.

5. Conclusion and policy implications

This study investigates the effect of changes in sanitary and phytosanitary measures in importing countries on Cameroon's cocoa export at the 6-digit HS level between 2001 and 2017. The study uses two non-linear estimation approaches applying the gravity model of trade. Our results suggest that cocoa export from Cameroon is not significantly influenced by sanitary and phytosanitary measures in major importing markets. Other variables such as the GDP of importing countries, and production of cocoa play an important role in the export of cocoa. The results also point to the limited supply-side capacity (productive capacity) of the export product. In this light, the study argues that SPS measures are not de facto trade impeding as some studies have suggested, they could enhance trade and market access in agricultural products if exporting countries such as Cameroon take the necessary steps to ensure adequate compliance with these measures before exporting to foreign markets.

To address the hurdles created by the weak capacity to comply with changes in sanitary and phytosanitary measures, measures can be taken to strengthen Cameroon's standard-setting institutions, especially the regulatory and institutional framework. This can be achieved by undertaking institutional reforms that are best adapted and aligned to best practices at the global level. This will ensure that Cameroon is well equipped in areas of policy response mechanism, access to market information, and access to compliance resources. In addition, the government needs to intensify its partnership with stakeholders, including farmers, farmer-based organizations, exporting firms, local and institutional actors to implement and enforce adequate response measures to improve the food safety architecture. Investments in areas of science and technology, high levels of awareness on quality parameters, education and training programs through agricultural advisory services as well as increasing the current financial and technical assistance to farmers and exporters will ensure compliance with sanitary and phytosanitary measures in importing markets.

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Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article.

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Appendix

List of importing countries: Netherlands, Malaysia, Spain, Belgium, Turkey, Indonesia, Germany, France, China, Italy.

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