# The Effect of Sanitary and Phytosanitary Measures on Uganda's Fish Exports: A gravity model approach

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**Abstract**

This paper examined the effects of Sanitary and Phytosanitary measures on Uganda's fish exports. The study used a gravity model variant that accounts for selection bias (decision to trade) and panel data from 28 countries covering the period between 2001 and 2018. The results revealed that microbiological and parasitic contamination have a negative effect on fish exports while certification about absence of Genetically Modified Organisms (GMOs) has an opposite effect. From a policymaker's perspective, there is need to consider strict legislation concerning the GMO Bill to guarantee the safety of food items including fish. This is would increase overseas consumers' confidence in Uganda's fish products, hence increasing exports. Concerning microbiological and parasitic contamination, there is need to invest in safe production and processing measures given that the country is now expanding the fisheries production by involving smallholder farmers. This would present an opportunity for fish farmers to participate in lucrative fish export markets.

**Keywords:** Fish Exports; GMO; Gravity Model; Sanitary and Phytosanitary
**JEL Classification Codes:** F14, Q02, Q17, Q22

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## 1.0 Introduction

Global demand for fish is increasing due to the global increase in population and health concerns that are changing food consumption habits. Fish[1] has been identified as having a potential to meet some of the growing demand for food (UNCTAD, 2017; FAO, 2020; Emam *et al.,* 2021). According to FAO (2020) world fish consumption stands at an average annual rate of 3.1 percent. Concerning health, fish is now considered a safer source of animal protein compared to other sources like meat, dairy and milk. As such, demand for fish as source of animal protein is increasing at a rate of 2.1 percent per year (ibid). Per capita food fish consumption has also grown from 9.0 kg (live weight equivalent) in 1961 to 20.5 kg in 2018 (ibid). Estimates show that fish consumption accounts for 17 percent of the global population's intake of animal proteins (ibid).

In Uganda, the fish sector is the second biggest foreign exchange earner after coffee contributing about US$200 million per year (Bank of Uganda (BoU), 2019; UNCDF, 2020). In financial year 2018/19, the sector contributed 5.4 percent to agricultural GDP (UBOS, 2020) and 1.7 percent to the country's GDP (BoU, 2019). The sector also directly employs 1.7 million people and another 3.5 million people indirectly (NaFFIRI, 2013; MAAIF, 2017; UNCDF, 2020). These statistics suggest that fish exports have the potential to spur Uganda's long-run economic growth. Fortunately, fish products face few or no tariff barriers in developed country markets and there is preferential market access for processed fish products (UNCTAD, 2017; FAO, 2020). This factor largely explains the expansion of international trade of fish (FAO, 2020).

Despite the relaxation of the tariff barriers, Uganda like other developing countries still struggles with complying with quality and safety standards imposed on fish in major markets abroad. The developing countries find the compliance costs prohibitively high due to lack of the required capacity in terms of technology, infrastructure and expertise. The standards end up pausing another form of barrier that is sometimes worse than the tariff barriers. According to Nimenya *et al*. (2012), the tariff-equivalent price wedge of quality standards for frozen fish fillet exports from East African countries imposes barriers that are often equivalent to tariffs of 100 per cent or more. The most significant quality standards relevant to fish are the Sanitary and Phytosanitary measures (SPSs).
SPSs are defined as 'measures applied to; Protect human, animal, plant life or health from risks arising from entry, establishment or spread of pests, diseases, or disease-causing organisms, additives, contaminants, toxins in foods, beverages or foodstuffs.[2,3](WTO, 2019). SPS measures on fish are so critical because fish is the food category that is most commonly implicated in foodborne-illness outbreaks (Centers for Disease Control and Prevention (CDC), 2018). This justifies the need to look into the safety of both domestic and imported fish.

The impact of SPS measures on trade may be positive or negative depending on the type of measures imposed. SPS measures which are compliance related hinder market access while those related to product features increase trade flows once the standards are met (Crivelli and Groeschl, 2016). Uganda failed to comply to SPS standards, resulting into three fish export bans to EU between 1997 and 2000 due to detection of salmonella in imported products; an outbreak of cholera on some

[1] Throughout this paper, the term fish refers to fish and fish products, unless stated otherwise

[2] The SPS agreement permits countries to set their own standards, provided they are science-based and must be applicable only if it necessitates the protection of human, animal or plant life or health rather than restricting trade.

[3] The requirements and guidelines of the SPS Agreement entail the application of three sets of international standards set by the Codex Alimentarius Commission (CAC) focusing on food safety, International Plant Protection Convention (IPPC) concerning with plant health and Office of International des Epizooties (OIE) animal health and zoonosis.

landing sites and beaches; and suspected incidences of fish poisoning (Keizire, 2006). The ban did not only affect foreign exchange earnings but also led to loss of jobs to an estimated 32,000 people; closure of 3 of the 11 processing factories while the remaining ones had to operate at less than 20% capacity (United Nations Industrial Development.

Organization (UNIDO, 2003). In addition, other auxiliary industries such as packing, the fishnet manufactures, the transport industry and the fuel industry were directly affected by the ban. On the up side, information on the safety and quality of products may increase consumer sureness and confidence in foreign products, reduce fixed costs and increase trade in the long-run.

In this study, we seek to answer two questions: (1) which SPS measure(s) pause(s) a great threat to Uganda's fish exports? (2) which SPS measure(s) present (s) an opportunity for Uganda to increase her fish exports? Our study uses a gravity model variant following the Heckman selection modeling to allow assessing the differences in the effect of SPS measures on the probability to trade and the amount of trade upon market entry. Our findings reveal that SPS measures related to microbiological contaminants and parasites impact trade negatively while those that demand information about absence of GMOs enhances trade for the export countries that manage to provide the information. These findings contribute to the understanding on opposite effects to the different SPS measures.

The remainder of this study is organized as follows. Section 2 covers a brief literature review on effects of SPS measures on agricultural commodities, Section 3covers methodology, Section 4 presents results and discussion, and section 5 is for conclusion and policy recommendations.

## 2.0 Literature review

According to literature, the effect of SPS measures can be two-fold; first, SPS measures whose compliance requires a significant cost outlay reduce trade; second, information on the safety and quality of products can increase consumer sureness and confidence in foreign products, reduce fixed costs and increase trade in the long-run (Murina and Nicita, 2015).

The increasingly stringent SPS requirements in major developed countries, like the EU and USA, have had undesirable impact on exporters of fishery products in developing countries. This is evident in the study by Henson and Mitullah (2004) where they examine the effects of EU's food safety standards requirements on Kenya Nile Perch exports. They found out that Kenya exporters of fish were struggling to meet the required standards due to the high cost of compliance. Consequently, fish exports reduced, concluding that it is important to respond to changing food safety standards requirements in order to gain and increase market access.

Nanyaro (2007) examined the impact of SPS measures on fish in Tanzaniaand found that total fishery products exports declined and the country had to reinvest in measures to address issues of non-compliances. In addition, failure to comply with the SPS measures does not only result into losses but also damage the exporters 'reputation. Henson and Jaffee (2008) found out that some fish exporters in Ghana were forced to leave the market while others voluntarily withdrew in order to keep their reputation.

Similarly, Nguyen and Jolly (2020) studied how compliance with Vietnamese Good Agricultural Practices (VietGAP) and international standards affect the pangasius value chain and spurs altering in the industry structure. They found that the restrictions in form of standards by the US and EU encouraged Vietnamese exporters to look for alternate markets as opposed to adopting the VietGAP which was costly to them. This in turn expanded markets and directed exports to other import markets with less stringent quality requirements.

On the good side of it, countries which have invested in systems to comply with strict SPSs have registered increased export earnings and increased their market access for their products (Henson, 2008; World Bank, 2005). Petterson *et. al*, (2013) examined how SPS measures affect 47 fresh fruit and vegetable product imports from 89 exporting countries for the period 1996--2008. They concluded that whereas the phytosanitary measures limit trade in general terms, the limiting factor diminishes when exporters gain more experience, and ceases to exist once exporters reach a certain point. This is confirmed in a study to examine the effect of SPS measures on Cameroon's cocoa exports, where it was found out that the exports were not sensitive to changes in SPS regulations in importing countries and an explanation for this was that exporters might have adapted to the changes in SPS regulations and taken the necessary steps to ensure adequate compliance before exporting the commodity (Assoua *et al*., 2022).

As such, compliance with SPS measures creates positive opportunities when exporting countries utilize the standards to their competitive advantage and increase their market share in trade (Taglioni and Winkler, 2016). Trade can also increase due to better producer efficiency, where quality boosts the competitiveness of foreign producers who are able to meet strict SPS measures. Furthermore, conformity with SPSs increases exports largely due to the information symmetry which signals quality and safety to consumers (Crivelli and Gröschl, 2012).

Previous empirical studies (Chen, 2014; Henson & Mitullah, 2004; Henson et al., 2000) aggregated the SPS measures and studied the impact. Other studies (Assoua et al., 2022; Thuong, 2018; Anders & Caswell, 2009) examined SPS measures by estimating the variable as dummy. Peterson et al. (2013) attempted to include specific SPS types in empirical model estimation but the study was on fresh fruits and vegetables. The uniqueness in this study is the disaggregation of the different SPS measures and analysing their trade effect individually. To the best of our knowledge no such study has been done. The previous studies have aggregated the SPS measures and studied the impact. We focus on seven SPS measures, namely: maximum residue limits, microbiological contaminants, heavy metals, parasitic infestation, industrial contaminants, organoleptic aspects, genetically modified organisms limits (GMOs) and Hydro carbons.

## 3. Methodology

### 3.1 Model Specification

Our empirical strategy follows Anderson & Van WinCoop (2003), specification, which is based on the framework of Anderson (1979) Constant Elasticity of Substitution (CES). The main building blocks of this gravity model are that all types of commodities are differentiated by their source; and consumer preferences in the destination country j for commodity k are weakly separable and can be represented by a CES sub-utility function specified as:

$$U_{jk} = \left\{\sum_{i=1}^{R} \alpha_{ijk}^{\frac{1}{\sigma_k}} C_{ijk}^{\frac{\sigma_k - 1}{\sigma_k}}\right\}^{\frac{\sigma_k}{\sigma_k - 1}} \tag{1}$$

Where $U_{jk}$ is the level of utility from consumption of commodity$k$ by the representative consumer in country $j$ $R$ is the number of countries; $\alpha_{ijk}$is the preference parameter for commodity $k$ supplied by county $i$ to country $j$; $C_{ijk}$ is the quantity of commodity $k$ supplied by $i$ and consumed by in country $j$; and $\sigma_k$ is the elasticity of substitution between all fish products.The utility is subject to the level of expenditure allocated to consumption of commodity $k(V_{ijk})$ :

$$V_{ijk} = \sum_{i=1}^{R} P_{ijk} C_{ijk} = \frac{\alpha_{ijk} P_{ijk}^{1-\sigma_k} E_{jk}}{\sum_{i=1}^{R} \alpha_{ijk} P_{ijk}^{1-\sigma_k}} \quad (2)$$

Where $P_{ijk}$ is the price of commodity $k$ from country $i$ in country $j$; and $E_{jk}$ is the expenditure on commodity $k$ by country $j$ residents. Prices vary across countries due to varying trade costs that are not directly observable, and the empirical task is to identify these costs. Let $P_i$ be the exporter's supply price, net of trade costs, and let $t_{ij}$ be the trade cost factor between $i$ and $j$. Then $P_{ij} = P_i t_{ij}$. The denominator in equation (2) can be expressed in terms of the price index $(PI_{jk})$ for the CES sub-utility function:

$$PI_{jk} = \left\{\sum_{i=1}^{R} \alpha_{ijk} P_{ijk}^{1-\sigma_k}\right\}^{\frac{1}{1-\sigma_k}} \quad (3)$$

If $t_{ijk}$ represents all trade costs of selling commodity $k$ from country $i$ in country $j$, then producer prices in country $i$ $(PP_{ik})$ are linked to destination prices via the price linkage equation; $P_{ijk} = t_{ijk} PP_{ik}$ . Substituting this expression along with equation (3) in equation (2) yields:

$$V_{ijk} = \frac{\sigma_{ijk} (t_{ijk} PP_{ik})^{1-\sigma_k} E_{jk}}{PI_{jk}^{1-\sigma_k}} \quad (4)$$

Assuming all markets for commodity $k$ clear, then the quantity of commodity $k$ produced in country $i$ will equal the quantity demanded across destination countries, including domestic consumers in country $i$. This implies that the total sales of commodity $k$ produced in country $i$ $(Y_{ik})$ will equal the sum of consumer expenditures (evaluated at the producer price in country $i$) across demand countries:

$$\begin{aligned} Y_{ik} &= \sum_{j=1}^{R} V_{ijk} \quad (5) \\ &= \sum_{j=1}^{R} \frac{\alpha_{ijk} (t_{ijk} PP_{ik})^{1-\sigma_k} E_{jk}}{PI_{jk}^{1-\sigma_k}} \end{aligned}$$

Solving for $PP_{ik}^{1-\sigma_k}$ in equation (5) and substituting into equation (4) yields an extended version of Baldwin & Taglioni (2006) equation 7 that incorporates an explicit commodity dimension for fish products:

$$V_{ijk} = \frac{\alpha_{ijk} t_{ijk}^{1-\sigma_k} Y_{ik} E_{jk}}{\left[\sum_{j=1}^{R} \frac{\alpha_{ijk} t_{ijk}^{1-\sigma_k} E_{jk}}{PI_{jk}^{1-\sigma_k}}\right] PI_{jk}^{1-\sigma_k}} = \frac{\alpha_{ijk} t_{ijk}^{1-\sigma_k} Y_{ik} E_{jk}}{\Omega_{ik} PI_{jk}^{1-\sigma_k}} \quad (6)$$

Trade costs $(t_{ijk})$ consist of all factors needed to get commodity $k$ from producers in country $i$ to consumers in country $j$. In the context of fish products, we assume that the trade cost function is multiplicative in nature (Anderson & Van Wincoop, 2003), and includes the following factors affecting the fish products trade:

$$DM_k = exp(destin_{ijk}^{\alpha_1}) ZDM_k^{\alpha_0} \quad (7)$$

$$trans_{ijk} = dist_{ij}^{\delta_1} exp\left(destin_{ijk}^{\delta_2}\right) Ztrans_{ijk}^{\delta_0} \quad (8)$$

$$PHT_{ijk} = exp\left(\prod_p treat_{pijk}^{\lambda_p}\right) Ztreat_{ijk}^{\lambda_0} \quad (9)$$

Where $DM_k$ denotes transport and trade margins in both country $i$ and $j$ to get commodity $k$ to the border of country $i$ and from the border of country $j$ to consumers; $trans_{ijk}$ denotes international transport margins between $i$ and $j$ for commodity $k$, and $PHT_{ijk}$ is the cost of phytosanitary treatments for commodity $k$ required by country $j$ from country $i$. Note that with the multiplicative specification, all trade cost factors must be measured on a per unit, *ad valorem* basis. For example, $DM_k$ in the country $i$ is defined as one, plus the per-unit trade and transport margin of commodity $k$ divided by $PP_{ik}$ . An additional factor affecting trade costs that is not included in equations (7) through (9) is bilateral tariffs, which we incorporate below.

The trade cost factors in equation (7) through (9) are difficult to observe and measure. However, we can observe whether a destination restriction is in place, the physical distance between countries, and the types of phytosanitary treatments applied, which are related to these unobservable factors. The binary variable $destin_{ijk}$ is equal to one if country $i$ faces a destination restriction on commodity $k$ shipped to country $j$, and zero otherwise. $Dist_{ij}$ is the geographical distance between countries $i$ and $j$; $treat_{pijk}$ treat$_{pijk}$ is a binary variable equal to one if country $i$ must use phytosanitary treatment $p$ on commodity $k$ exported to country $j$, and zero otherwise; and $ZDM_k$, $Ztrans_{ijk}$ and $Ztreat_{ijk}$ are unobserved determinants of trade and transport margins and phytosanitary treatment costs, respectively.

To complete our product line gravity equation, two additional refinements to equation (6) are necessary. Because the Constant Elasticity of Substitution (CES) utility function is homothetic, an increase in $E_{jk}$ will yield a proportional increase in $V_{ijk}$, all else being constant. However, $E_{jk}$ is not directly observable. While in general, $E_{jk}$ is a function of the price indices for each commodity in the weakly separable utility function and income, the price indices for each commodity are also not observable. Thus, we assume that $E_{jk}$ is a function of total income (GDP) in country$j$: $E_{jk} =$

$GDP_j^{\beta}$ Because the overall utility function for the representative consumer in country $j$ need not be homothetic, $\beta$ need not equal to one. Similarly, an increase in the value of production in country $i$ ($Y_{ik}$) will lead to a proportional increase in $V_{ijk}$, all else being constant. We use production quantities ($Q_{ik}$) as a proxy for production value and assume that $Y_{ik} = Q_{ik}^{\phi}$, where the parameter $\phi$ need not be equal to one.

Substituting equations (7) through (9) into equation (6), along with $E_{jk}$ and $Y_{ik}$ yields our baseline gravity model at the product line. Taking the natural log and including time subscripts and one plus the bilateral tariff inclusive of preferential rates $tariff_{ijkt}$ yields:

$$lnV_{ijkt} = ln\alpha_{ijk} + [1-\sigma_k]\left[\sum_p \lambda_p treat_{pijkt} + (\alpha_1+\delta_2)destin_{ijkt} + \delta_1 lndist_{ij} + lntariff_{ijkt} + \lambda_0 lnZtreat_{ijkt} + \alpha_0 lnZDM_{ikt} + \delta_0 lnZtrans_{ijkt} + \theta_0 lnZDM_{jkt}\right] + \beta lnGDP_{jt} + \phi lnQ_{ikt} - ln\Omega_{ikt} - [1-\sigma_k]lnPI_{jkt} \quad (10)$$

The challenge in estimating the model in equation (10) is the prevalence of zero trade flows. Omitting observations with zero flows leads to biased estimates due to sample selection issues (Helpman *et al*., 2008; Jayasinghe *et al*., 2009). We circumvent this challenge by adopting a Heckman selection model (Heckman, 1979) to estimate the impact of SPS measures on trade of fish and fish products. The Heckman model makes it possible to control for possible bias in model estimates arising from omission of observations with zero trade flows. Controlling for zero flows is particularly important because the imposition of some SPS might result into rejection or complete ban in the trade of some products.

The Heckman model allows assessing the differences in the effect of SPS measures on the probability to trade and the amount of trade upon market entry. Both the selection and the outcome equations are estimated simultaneously using the maximum likelihood technique. The maximum likelihood approach has an advantage over the two-step estimation technique because it produces more efficient estimates, preferable standard errors, and likelihood ratio statistics (Wooldridge, 2002). We use the same independent variables in both equations except for the selection variable. Following Helpman *et al*. (2008), we use common colonial master as our selection variable. The selection variable helps to identify the model and the basis of its selection is such that it affects the fixed costs of trade but has no effect on the variable costs of trade. For the selection step, we estimate a binary probit model of the form:

$$Pr(Y_{ijts} > 0) = k\Phi\left[\alpha_0 + \alpha_1(SPS_{ij(t-1)s}) + \alpha_2 \ln(GDP_{jt-1}) + \alpha_3 \ln(POP_{jt}) + \alpha_4 ln(POP_{it}) + \alpha_5 ln(DIST_{ij}) + \alpha_6 ln(PROD_{i,t-1}) + \alpha_7 ln(Priceratio_t) + \alpha_8 comcol + \beta_{\lambda} \lambda(\alpha) + \varepsilon_{ijts}\right] \quad (11)$$

Where Φ(.) is a standard normal distribution function. The outcome equation is specified as:

$$ln(Y_{ijts}|Y_{ijts} > 0) = \beta_0 + \beta_1(SPS_{ij(t-1)s}) + \beta_2 \ln(GDP_{jt-1}) + \beta_3 \ln(POP_{jt}) + \beta_4 ln(POP_{it}) + \beta_5 ln(DIST_{ij})$$

$$+\beta_6 ln\left(PROD_{i,t-1}\right) + \beta_7 ln(Priceratio_t) + \beta_{\lambda} \lambda(\alpha) + \varepsilon_{ijts} \quad (12)$$

Where $Y_{ijts}$ denotes the real export value of fish and fish products from country $i$ (Uganda in our case) to country $j$ in year t; $SPS_{ij(t-1)s}$ denotes an SPS measure reported by country $j$ in year *t-1*[4]; $GDP_{j,t-1}$ is the real GDP of the importing country $j$ in year, *t-1*; $POP_{jt}$ are the populations of the importing countries in year $t$; $POP_{it}$ is the population of Uganda in year $t$; $DIST_{ij}$ is the bilateral distance between Kampala and the capital cities of importing countries; $PROD_{i,t-1}$ is Uganda's total fish production lagged by one year (the production and GDP of importers in current year may be endogenous because they could be influenced by the on-going export opportunities. Therefore, the variables of $GDP_{j,t-1}$ and $PROD_{i,t-1}$ are lagged by one year to avoid potential endogeneity (Wei et al., 2012; Dou et al., 2015)); $Priceratio_t$ is the relative price ratio in year $t$ (it is equal to the price at which country j imports from Uganda divided by the average price in the world. It is included in the model as a proxy for the quality (Baldwin & Harrigan, 2011; Crozet et al., 2011) of fish products); $comcol$ is a binary variable equal to one if importer $j$ has a common colonial master with Uganda and zero otherwise; $\lambda(\alpha)$ is the inverse mills ratio (IMR) which is predicted from equation (11); and $\varepsilon_{ijts}$ is the error term.For SPS measures, we estimated different model: a model for each of the SPS measures and a model for all the SPS measures included in the estimation.

Before model estimation was done, cross-sectional dependence, unit root and cointegration tests were done to ensure that the regression results are reliable. For cross-sectional dependence, given that N (number of cross-sectional units) is large relative to T (time period), we used three tests (Pesaran (2004), Frees (1995) and Friedman (1937)) to test the null hypothesis that the cross-sectional units are independent. Cross-sectional dependence means that the residuals are correlated across units (in our case, countries). It is important to account for cross-sectional dependence because economic theories suggest that, in case of a common shock, the units take actions that lead to interdependence among themselves. In such instances, estimators that are based on the assumption of cross sectional independence may be inconsistent (Hsiao *et al.*, 2007).

For unit root test, we used both the first and second generation tests to arrive at the stationarity conclusion. For first generation, we used the Levin, Lin and Chu (2002) (LLC test) and the Im, Pesaran and Shin (2003) (IPS test). Within the first generation, the former assumes that the cross-sections are homogeneous while the latter accounts for heterogenous cross-sections. Second generation tests account for cross-sectional dependence, which is plausible in reality due to unobserved common factors, externalities, regional and macroeconomic linkages (ibid). In this paper, we relied on the Cross-Sectional Augmented IPS (CIPS) presented by Pesaran (2005). The CIPS statistic is based on the average of individual Cross-Sectional Augmented Dickey-Fuller (CADF) statistics specified as:

$$CIPS = \left(\frac{1}{N}\right)\sum_{i=1}^{N} t_i(N,T); \quad (13)$$

where $t_i(N,T)$ is the t-statistic used for computing the individual ADF statistics. The critical values for the CIPS statistic are tabulated by Pesaran (2005).For cointegration, we used Pedroni (1999),

[4] We use the first lag to circumvent potential reverse causality between exports and SPS measures.

Kao (1999) and Westerlund (2007) based cointegration tests to ascertain a possible long-run relationship between the export value and the explanatory variables. Pedroni and Kao tests test the null hypothesis of no cointegration against the alternative of cointegration. The Pedroni test has an edge over the Kao test as it takes into account heterogeneity by using specific parameters that are allowed to vary across individual countries in the sample. The Westerlund test tests the same null hypothesis but imposes fewer restrictions on the alternative hypothesis, namely, that some (not necessarily all) of the panels are cointegrated.

### 3.2 Data type and sources

Fish and fish product exports and price data were obtained from the United Nations Commodity Trade Statistics Database (COMTRADE) of the United Nations Conference on Trade and Development (UNCTAD). Trade data for fish and fish products was aggregated at the two-digit level of the HS product classification system. GDP and population data was obtained from the World Development Indicators (WDI) of the World Bank. Data on bilateral distances between capital cities was obtained from the Institute for Research on the International Economy (CEPII).

SPSs data were obtained from the WTO Sanitary and phytosanitary Information management system (SPS IMS) and the Rapid Alert System for Foods and Feed (RASFF) portals. RASFF is a portal for European countries only and the information obtained from the portal was reconciled with that obtained from SPS IMS. To get the number of notifications for a given year, we added the number of notifications announced in that particular year plus those that were made in the preceding years (we made sure we considered only the previous notifications that were still active).

We categorised SPS measures by type to understand the types of SPS measures that regions place emphasis on. Worthy to note is that notifications considered as barriers to trade are those that resulted into border rejections of fish and fish products. The SPS measures were categorised into: maximum residue limits (MRLs), microbiological contaminants (microbs), heavy metals (metals), parasitic infestation (parasites), industrial contaminants (contaminants), organoleptic aspects (organo), genetically modified organisms limits (GMOs), Hydro carbons (carbons) and technical regulations (technical).

MRL is the highest level of a pesticide/veterinary medicine residue that is legally tolerated in or on food when pesticides/veterinary medicines are applied. Microbiological contamination refers to non-intended or accidental introduction of infectious material like bacteria, yeast, mould, fungi, virus or their toxins and by-products (Ghiglione *et al*., 2015). Parasites are disease-causing organisms that derive nourishment and protection from their host - humans. Metals are the elements that are naturally present in food or can enter food as a result of human activities such as industrial and agricultural processes. The metals of particular concern in relation to human health are those referred to as “heavy metals” and these include mercury and lead.

### 3.3 Definitions of variables

The definitions of all the variables used in the analysis are presented in Table 1.

**Table 1: Variable names and their definitions**

| Variable name | Variable definition |
|---|---|
| **Dependent variable** | |
| Exports | Real export value of fish and fish products from Uganda (US $) |
| **Explanatory variables** | |
| Micros_pars | 1 if a country announced a notification concerning either microbiological contaminants or parasitic infestation, 0 otherwise |
| Mrls_metals | 1 if a country announced a notification concerning either maximum residue limits or heavy metals, 0 otherwise |
| Organo_hydros | 1 if a country announced a notification concerning either hydro carbons, industrial contaminants or organoleptic aspects 0 otherwise |
| GMO | 1 if a country announced a notification concerning GMOs, 0 otherwise |
| GDP importer | Real GDP of the importing country |
| Population importer | Population size of the importing country |
| Population exporter | Population size of Uganda |
| Production | Total fish production of Uganda (metric tonnes) |
| Colonial | 1 if the importing country has a common colonial master with Uganda, 0 otherwise |
| Distance | The bilateral distance between Kampala and the capital city of the importing country |
| Price ratio | The price at which a country imports from Uganda divided by the average world price |

**Table 2: SPS notifications from 2001 to 2018**

| Region | SPS notifications | | | | | | | | | Mean |
|---|---|---|---|---|---|---|---|---|---|---|
| | MRL | Microbs | Metals | Parasites | Industries | Organo | GMOs | Carbons | Technical | |
| Europe | 0 | 80 | 66 | 18 | 15 | 19 | 0 | 35 | 8 | 26.8 |
| | 0 | (33.2) | (27.4) | (7.5) | (6.2) | (7.9) | 0 | (14.5) | (3.3) | |
| Africa | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.1 |
| | 0 | (100.0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Asia | 24 | 49 | 5 | 0 | 0 | 0 | 0 | 0 | 30 | 12.0 |
| | (22.2) | (45.4) | (4.6) | 0 | 0 | 0 | 0 | 0 | (27.8) | |
| Middle East | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 0 | 41 | 6.6 |
| | 0 | 0 | 0 | 0 | 0 | 0 | (30.5) | 0 | (69.5) | |
| America | 5 | 11 | 0 | 0 | 18 | 14 | 0 | 0 | 12 | 6.7 |
| | (8.3) | (18.3) | 0 | 0 | (30.0) | (23.3) | 0 | 0 | (20.0) | |
| Total | 29 | 150 | 71 | 18 | 33 | 33 | 18 | 35 | 91 | 53.1 |
| | (6.1) | (31.4) | (14.9) | (3.8) | (6.9) | (6.9) | (3.8) | (7.3) | (19.0) | |

Source: Authors' own computation using data from SPS IMS and RASFF; Percentages are shown in parentheses

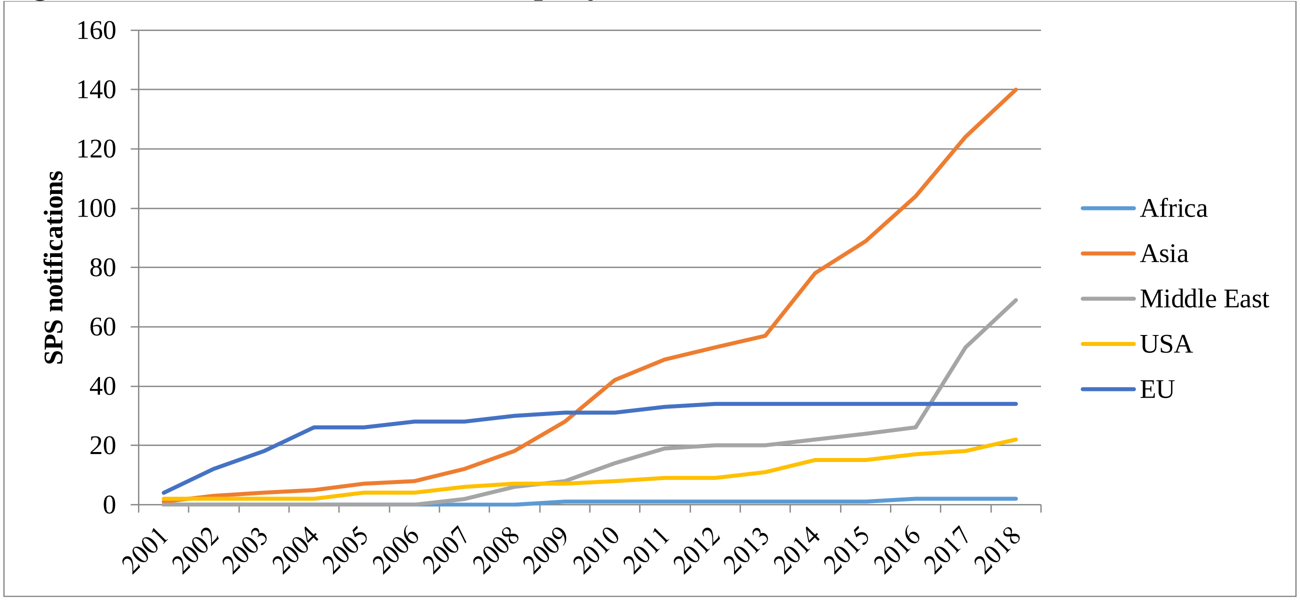
## 4. Results and Discussion

### 4.1 Descriptive Analysis

This section provides descriptive statistics (means, frequencies and percentages) for the variables used in model estimation. The highest number of notifications were related to microbiological contamination (Microbs), constituting 31.4% of the total notifications (Table 2). Technical regulations have the second highest notifications, constituting 19% of the total notifications.. The least number of notifications were related to parasitic infestation and presence of GMOs. Analysis by region shows that, on the overall, Europe had the highest number of SPS notifications (27 on average) followed by Asia (12). In both regions, the highest number of notifications relates to microbiological contamination (33.2% and 45.4% respectively). In America, the highest number of notifications relate to industrial contaminants (30.0%) and organoleptic aspects (23.3%). The only SPS notifications raised by Africa had to do with microbiological contamination. Even then, this number of notifications was the least of all the regions that announced this SPS measure (one notification on average). We also note that SPS measures to do with GMOs were only raised by the Middle East.

A trend analysis shows that the number of SPS notifications has been increasing since 2001 in three regions (Figure 1) especially in Asia, Middle East and USA. Initially, Europe had the highest number of SPS notifications but the number has not changed much since 2004. From 2009 and 2016, number of notification in Asia and Middle East respectively, surpassed Europe. As of 2018, Asia had the highest SPS notifications followed by the Middle East and then Europe. Given this trend, we expect fish exports to be affected most in these regions depending on Uganda's capacity to comply with the standards.

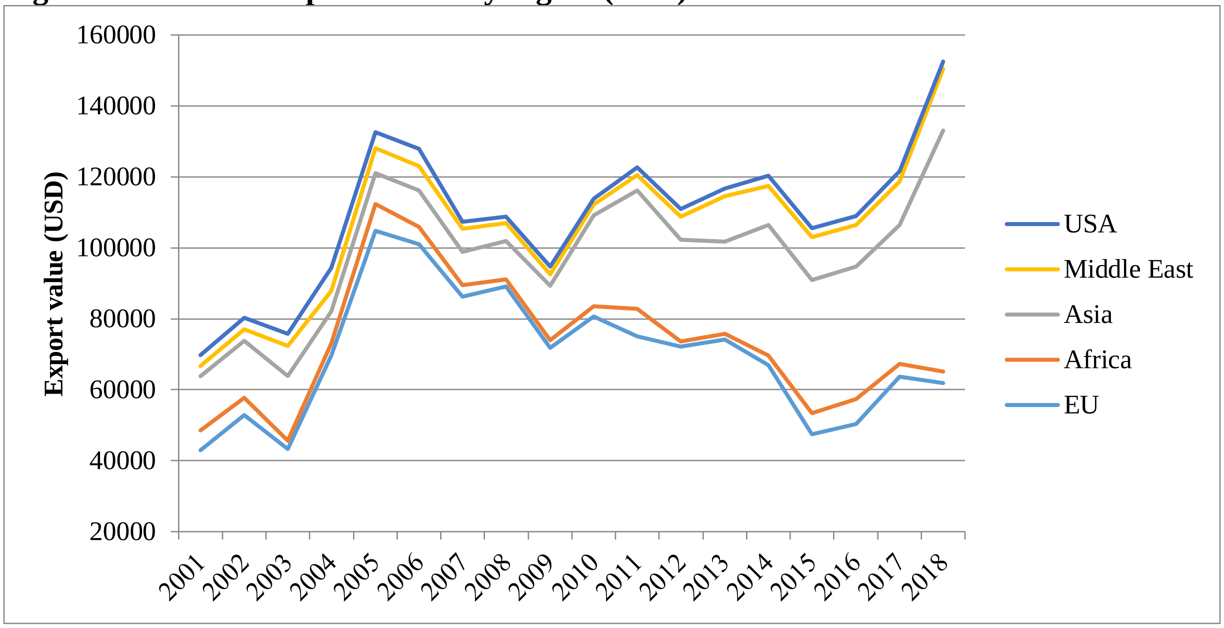
**Figure 1: Number of SPS notifications per year**




Source: Authors' own computation using data from SPS IMS and RASFF

Over the years, USA and the Middle East have been and are still the leading export destinations for Uganda's fish and fish products (Figure 2). The export value to Asia has also been steady since 2005 but lower than that from USA and Middle East. Value of trade to EU and Africa is not only low but has been declining since 2005. The highest number of notifications in the EU could explain why trade with the region is declining. The low number of SPS notifications in USA and Middle East could explain why trade with the two regions has remained high.

**Figure 2: Total fish export values by region (USD)**




Source: Authors' own computation using COMTRADE data

Table 3 shows that Asia imported US$ 13,578.8 worth of fish and fish products in 2018, which was the highest of all continents. The second highest importer was Europe, importing US$ 5151.7 worth of fish and fish products from Uganda. Of all the continents considered, America had the highest GDP (US$ 17,900 billions) in 2018 followed by Asia (US$ 1,470 billions). Similarly, America had the highest population (327 million people) followed by Africa (54 million people).

**Table 3: Variables used in model estimation, 2018**

| Region | Average exports[5] (USD) | GDP (billion USD) | Population (millions) | Distance (km) | SPS notifications[6] | Price ratio |
|---|---|---|---|---|---|---|
| Europe | 5151.7 | 1,310 | 32.9 | 5463.8 | 4.3 | 0.40 |
| Africa | 1684.0 | 119 | 54.0 | 1397.8 | 2 | 0.22 |
| Asia | 13,578.8 | 1,470 | 48.6 | 9498.3 | 23.3 | 4.02 |
| Middle East | 2897.3 | 253 | 9.4 | 3505.3 | 11.5 | 0.88 |
| USA | 2,056 | 17,900 | 327.0 | 11,676.5 | 22 | 1.14 |

Source: Authors' own computation using data from COMTRADE, WDI and CEPII

In terms of distance, USA was the furthest from Kampala (11,676.5 km) followed by Asia (9498). Distance is one of the indicators of trade resistance, implying that the long distance between Uganda (Kampala) to USA and Asian countries might cause some resistance to trade. The highest number of SPS notifications in 2018 was recorded in Asia (23) and Middle East (12). These high

[5] The Averages computed excluding zero export values
[6] The Averages computed excluding zero notifications

notifications could be a hindrance to trade in fish and fish products. The least number of notifications was in Africa.

### 4.2 Cross-Sectional Dependence Tests

First we present the results of the three cross-sectional dependence tests (Table 4). Pesaran's and Friedman's tests fail to reject the null hypothesis of no cross-sectional dependence while Free's test rejects the null. The failure to reject the null, particularly for the Pesaran's test, is that the test adds up positive and negative correlations, hence cancelling the effect of the correlations (De Hoyos and Sarafidis, 2006). Due to this drawback, an Average Absolute correlation (ABS) of the residues option is included while executing the cross-sectional dependence tests. The ABS is 0.486 (Table 3), which is a very high value, suggesting the presence of cross-sectional dependence.

### 4.3 Unit Root Test

Table 4 shows results of unit root tests. Augmented Dickey-Fuller (ADF) test statistics were computed for variables that do not vary across countries (export values, quantity of fish production and Uganda's population). For other variables, panel unit root tests were used (Levin, Lin and Chu (LLC) test and Im, Pesaran and Shin (IPS) test). Cross-Sectional Augmented IPS (CIPS) statistic was also computed to allow for cross-sectional dependence across countries.

**Table 4: Cross-sectional dependence tests**

| Test | Statistic |
|---|---|
| Pesaran's | 0.574 |
| Free's | 5.508*** |
| Friedman's | 23.426 |
| ABS* | 0.486 |

Results in Table 5 reveal that log of exports and log of production were non-stationary in their levels but become stationary after first differencing, hence integrated of order 1 (I(1)). The ADF statistic for log of production was significant at 10 % both at level and first difference. However, the MacKinnon p-value for Z(t) was not significant at level but significant at first difference. Thus, we concluded that log of production is of order 1 (I(1)). Log of Uganda's population, log of GDP and log of population of importing country were stationary both in their levels I(0). The panel unit root test price ratio was not conclusive due to insufficient time periods.

Although log of exports and log of production were non-stationary at level, the variables could be stationary if the sample was large (>70) and time periods were sufficiently longer (T>30). Having a small sample size and few time periods could have affected the unit root test, hence giving a false conclusion. The problem of having fewer time periods was evident while computing the IPS unit root test for price ratio. Therefore, we used the variables in their level form while estimating the model.

**Table 5: Unit root tests**

| | Level I (0) | | | First Difference 1(1) | | | Order |
|---|---|---|---|---|---|---|---|
| | LLC | IPS | ADF/CIPS | LLC | IPS | ADF/CIPS | |
| Log of exports[d] | | | -2.675* | | | -3.470** | I(1) |
| Log of production[d] | | | -2.488* | | | -2.652* | I(1) |
| Log of population of Uganda[d] | | | -4.575*** | | | -3.924*** | I(0) |
| Log of GDP | -3.349*** | 1.972 | -2.222** | -10.506*** | -8.364*** | -2.757*** | I(0) |
| Log of population of importing countries | -9.464*** | -5.171*** | -2.576*** | -2.373*** | -2.829*** | -2.310** | I(0) |
| Price ratio | 1.062 | - | -0.170 | -16.248*** | - | -1.634 | |

Note: The statistics for variables with superscript d are for ADF, otherwise CIPS; dashes indicate statistics could not be computed due to insufficient time periods; *, ** and *** indicate significant at the 1%, 5% and 10% level of statistical significance

**Table 6: Cointegration tests for variables to be used in model estimation**

| Kao test | | Pedroni test | | Westerlund test | |
|---|---|---|---|---|---|
| Test type | t-statistic | Test type | t-statistic | Test type | t-statistic |
| Augmented Dickey-Fuller | 1.593* | Modified Phillips-Perron | 4.274*** | Variance ratio | -2.869*** |
| Unadjusted modified DF t | -4.753*** | Augmented Dickey-Fuller | -7.158*** | | |
| Unadjusted DF | -4.182*** | Phillips-Perron | -8.647*** | | |

Note: *, **, and *** significant at the 1%, 5% and 10% level of statistical significance

### 4.4 Cointegration Test

Three cointegration tests were done and the results are presented in Table 6. All the three tests test the same null hypothesis of no cointegration. However, Kao and Pedroni tests use an alternative hypothesis ($H_a$) of all panels are cointegrated while the Westerlund test uses $H_a$ that some (not necessarily all) of the panels are cointegrated. The results for all the three tests reveal the variables are cointegrated, implying that there is a long run relationship between exports and the other trade variables.

### 4.5 Estimation and Discussion

We begin by justifying the appropriateness of the models before we discuss the main findings. We do this by looking at the correlations presented at the bottom part of Table 7. The first correlation $\left(corr(e.select, e.\ln\_exports)\right)$ is observation-level (country) and the second $\left(corr(select[pid], \ln\_exports[pid])\right)$ is between the random effects. If at least one of the correlations is significantly different from zero, then there is endogenous sample selection, hence making the Heckman selection model appropriate. In our case, the correlation between the random effects is 0.859 and it is significantly different from zero, implying that we have endogenous selection and that unobserved country-level (time-varying) factors that increase the chance of importing tend to increase import volume.

Having established that the Heckman model was appropriate, we accordingly discuss the results. Our interest is more on the outcome model than on the selection model. In addition, we focus on a model that includes all the SPS measures (column 10) because the estimates in individual models are similar (sign and level of significance) to those of the general model. The model results show that microbiological contaminants and parasites have a significant negative effect on fish exports, while GMO has a significant positive effect. The negative effect of microbiological contaminants and parasites implies that countries that impose this type of measures on fish products experience 1.5 percent lower fish trade volumes with Uganda compared to those that do not impose the measures. This is evident in Figure 2 where value of exports to EU is low due to a high number of notifications related to microbiological contaminants and parasites.

The effect of microbiological and parasitic contamination is not surprising given that these are considered the main source for introducing pathogens into fish and fish products (Fernandes *et al.*, 2018). This is true when collaborated with a study done to assess microbiological quality and safety of the fish sold at different landing sites of Lake Victoria and City markets in Kampala, which found out that detection levels were above the locally acceptable standard limits recommended by the Uganda National Bureau of Standards (Muhame *et al.*, 2020). Much of microbiological and parasitic contamination arises due to poor post-harvest processing and handling practices. Potential sources of postharvest contamination include fish contact surfaces (like slicers, conveyor belts, knives), non-fish contact surfaces (like the floor, drains, walls), personnel (aprons, gloves, boots), and others (air, ice, and water) (Sheng and Wang, 2020). Poor hygiene practices and failure to employ hazard analysis critical control point (HACCP) during processing and distribution explain the high contamination (Muhame *et al.*, 2020).

Consistent with our findings, an assessment of fish farms in Uganda for food hazard control measures at potential critical control points (farm siting; farm facilities and premises; facilities for processing and storage; chemical storage; drug storage and waste storage) found out that most of the post-harvest control points had too low a compliance to be acceptable for international trade (Bagumire *et al.*, 2020). During the assessment, most fish farmers indicated that they did not understand food safety issues, which is why compliance was very low. Fish farming is coming up to supplement the dwindling stocks from the natural water bodies coupled with the growing population and demand by the export-oriented fish processing plants. Fish is one of the commodities being prioritised in the current National Development Plan (National Planning Authority (NPA), 2021) to foster Uganda's agro-industrialisation agenda. The country envisages increasing the export value of processed fish. This implies that compliance to the SPS measures will be critical to attain that aspiration.

Worth noting is that microbiological contaminants and parasites do not only influence the value of exports but also the decision to trade. This has implications for Uganda when looking for new trade partners. On the contrary, an SPS measure that prohibits presence of GMOs increases value of fish exports. A country that imposes a GMO measure experiences 1.9 percent more fish trade with Uganda compared to those that do not impose the measure.

This positive effect is consistent with the findings of Crivelli and Groeschl (2016), who also stated that the positive effect can be explained by the fact that an SPS measure that provides information on product safety to consumers enhances consumer trust in the quality of imported goods, hence increasing amount of trade for exporters who manage to overcome the fixed costs of entering the market. They further elaborated that countries which are able to meet such stringent measures gain a bigger market share, which outweighs the costs of complying to the measures. We also note that GMO SPS is imposed only by the Middle East countries (Table 3). The presence of this SPS measure could partly explain why Uganda's fish exports to the Middle East have been growing over time.

This finding has implications on the GMO Bill (also known as the Genetic Engineering Regulatory Bill) that seeks to provide a regulatory framework for development and application of biotechnology, research and release of GMOs. August 2019 marked the second time that the Head of State declined to assent to the Bill into law citing safety and security concerns. The findings in this study highlight the need to be cautious while crafting the contents of the Bill. Whereas Ugandan scientists argue that the Bill would allow them to use new breeding tools to develop crops that are resistant to drought, pests and diseases, the safety of fish would be jeopardized if there is no strict regulation on the use of GMOs.

Besides SPS measures, there are other factors influencing the extent of trade, including: population of the exporter (Uganda), GDP (one year lag) of importing country and price ratio. Population has a negative effect implying that an increase in Uganda's population by 1 percent would reduce fish exports by 2.9 percent. This is so because increase in population increases domestic consumption which subsequently reduces exportable commodity. The GDP of the importing country has a positive effect implying that the increase in GDP of an importing country in the current year by 1 percent increases fish exports by 1 percent the following year. The positive effect of relative price ratio implies that if the ratio increases by 1 percent, fish export value experiences an increase of 0.2 percent. Since we used price ratio as proxy for quality of fish products, the positive results may be due to quality competitiveness of Uganda's fish.

**Table 7: Heckman selection Model estimates**

| VARIABLES | (1) Select | (2) ln_exports | (3) select | (4) ln_exports | (5) select | (6) ln_exports | (7) select | (8) ln_exports | (9) Select | (10) ln_exports |
|---|---|---|---|---|---|---|---|---|---|---|
| Micros_pars | | -1.592*** | | | | | | | -1.664*** | -1.543*** |
| | -1.516*** | (0.351) | | | | | | | (0.561) | (0.353) |
| Mrls_metals | (0.528) | | 1.072 | 0.350 | | | | | 1.250 | 0.510 |
| | | | (0.740) | (0.358) | | | | | (0.906) | (0.352) |
| Organo_hydros | | | | | 0.187 | 0.153 | | | -0.609 | 0.097 |
| | | | | | (1.126) | (0.463) | | | (1.322) | (0.456) |
| GMO | | | | | | | 1.613 | 1.977*** | 1.231 | 1.873** |
| | | | | | | | (1.101) | (0.736) | (1.105) | (0.757) |
| L.ln_gdpimporter | | 1.035*** | 0.116 | 0.717** | 0.212 | 0.757** | 0.380 | 0.743** | 0.556 | 0.950** |
| | 0.463 | (0.381) | (0.363) | (0.346) | (0.403) | (0.352) | (0.433) | (0.359) | (0.502) | (0.383) |
| ln_popnimporter | (0.403) | 0.052 | 0.118 | 0.030 | 0.090 | 0.028 | 0.051 | 0.091 | 0.050 | 0.092 |
| | 0.072 | (0.357) | (0.349) | (0.334) | (0.356) | (0.340) | (0.396) | (0.349) | (0.389) | (0.358) |
| ln_popnexporter | (0.356) | -2.749*** | 2.701* | -2.666*** | 2.915* | -2.600*** | 2.170 | -2.651*** | 1.984 | -2.947*** |
| | 2.947* | (0.902) | (1.636) | (0.935) | (1.620) | (0.935) | (1.664) | (0.929) | (1.728) | (0.907) |
| L.ln_production | (1.641) | 0.060 | -2.254 | -0.952 | -2.354 | -0.900 | -2.187 | -0.930 | -0.626 | -0.123 |
| | -1.163 | (1.074) | (1.985) | (1.097) | (1.965) | (1.096) | (2.000) | (1.093) | (2.059) | (1.080) |
| ln_distance | (1.999) | -1.069 | 0.476 | -0.976 | 0.490 | -1.004 | 0.311 | -0.909 | 0.193 | -0.962 |
| | 0.443 | (0.667) | (0.647) | (0.607) | (0.676) | (0.622) | (0.761) | (0.638) | (0.801) | (0.669) |
| ln_priceratio | (0.694) | 0.268** | -1.723*** | 0.250** | -1.614*** | 0.258** | -1.596*** | 0.235** | -1.731*** | 0.235** |
| | -1.607*** | (0.110) | (0.335) | (0.118) | (0.303) | (0.117) | (0.316) | (0.115) | (0.386) | (0.112) |
| Colonial | (0.311) | | 0.883 | | 0.792 | | 0.824 | | 0.832 | |
| | 0.724 | | (0.857) | | (0.842) | | (0.864) | | (0.860) | |
| var(e.ln_exports) | (0.811) | 1.354*** | | 1.468*** | | 1.463*** | | 1.452*** | | 1.346*** |
| | | (0.110) | | (0.120) | | (0.119) | | (0.118) | | (0.110) |
| corr(e.select,e.ln_exports) | | -0.178 | | -0.248 | | -0.195 | | -0.186 | | -0.214 |
| | | (0.214) | | (0.252) | | (0.230) | | (0.223) | | (0.229) |
| var(ln_exports[pid]) | | 3.335*** | | 2.721*** | | 2.862*** | | 3.075*** | | 3.361*** |
| | | (1.054) | | (0.838) | | (0.881) | | (0.955) | | (1.088) |
| var(select[pid]) | | 1.994* | | 1.602 | | 1.828 | | 2.635* | | 2.430* |
| | | (1.124) | | (0.985) | | (1.124) | | (1.585) | | (1.476) |
| corr(select[pid],ln_exports[pid]) | | 0.800*** | | 0.686*** | | 0.741*** | | 0.850*** | | 0.859*** |
| | | (0.113) | | (0.164) | | (0.138) | | (0.098) | | (0.112) |
| Constant | -51.669*** | 35.244*** | -25.908 | 54.430*** | -30.240* | 51.879*** | -21.608 | 51.517*** | -42.020** | 41.460*** |
| | (18.558) | (10.668) | (16.741) | (10.686) | (16.482) | (10.583) | (17.484) | (10.235) | (19.836) | (11.334) |
| Observations | 392 | 392 | 392 | 392 | 392 | 392 | 392 | 392 | 392 | 392 |
| Number of pid | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 |

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Our results suggest that the probability of bilateral trade with a country imposing measures related to either microbiological contaminants or parasite contamination is about 11.7 percent lower (Cell 1 - Table 8). The marginal effect for the outcome equation indicates that this SPS measure reduces the amount of trade by almost 25 percent (Cell 2 - Table 8). This indicates that this particular SPS measure increases fixed costs of trading and thus constitutes an effective market entry barrier in fish international trade. The marginal effect of GMO for the outcome equation indicates that GMO measure increases the amount of trade by almost 30 percent (Cell 3 - Table 8).

**Table 8: Marginal Effects from Heckman Selection model**

| SPS measure | Selection | Outcome |
|---|---|---|
| Micros_pars | -0.117*** | -0.245*** |
| | (0.038) | (0.060) |
| GMO | 0.086 | 0.297** |
| | (0.078) | (0.124) |

## 5. Conclusion and policy recommendations

There are a number of SPS measures raised by importing countries which have varying effects on Uganda's fish exports. The empirical results suggest that countries imposing the SPS measures related to microbiological and parasitic contamination have much lower fish trade values with Uganda compared to countries that do not impose the measures. Such measures increase fixed costs of trading hence posing a serious barrier to market entry. On the other hand, exporting countries that are able to provide proof that their fish products are free from GMOs trade more than others that do not. Such information is an indicative of product safety to consumers, and hence likely to have a positive effect on the amount of trade. Microbiological contaminants and parasites do not only affect the amount of trade but also the decision to trade.

Overall, our results suggest that microbiological and parasitic contamination (highly responsible for pathogens in fish and fish products) is a significant barrier to trade with European and Asian countries. This is type of contamination is common among the cohorts (fish farmers) that do not about the post-harvest handling food safety practices. On the positive note, Uganda still have an advantage of producing fish and fish products free from GMOs, which provides room to increase fish trade with countries which require GMO-free certification.

We make the following recommendation. First. Uganda needs to deepen its market share in countries where GMO certification is required in order to exploit her advantage of producing fish and fish products that are free from GMOs. At the same time, the policy makers should ensure that the GMO Bill considers strict regulation to the use of GMOs. Once assented to, there should be strict observance of the contents of the Act. Second, in order to maintain and/or expand Uganda's market share in European and Asian countries, there is still need to strengthen compliance to microbiological standards through adequate laboratories and technical personnel capable of carrying out improved risk assessment. More importantly, fish farmers who are coming up to augment fish production need to be trained good post-harvest food safety management practices. This will help to meet the increasingly stringent safety requirements and boost fish exports.

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## Appendix

**Table 1A: Leading importers of Uganda's fish and some economic indicators**

| S/N | Importer | Import value (US$) | GDP (US$) | Population | Distance (km) | SPS notifications (Cumulative, 2001-2018) | Common Coloniser |
|---|---|---|---|---|---|---|---|
| 1 | Australia | 103 | 1.40E+12 | 2.50E+07 | 12421.2 | 14 | 0 |
| 2 | Bahrain | 936 | 3.40E+10 | 1.60E+06 | 3468.95 | 17 | 1 |
| 3 | Beliguim | 14268 | 5.40E+11 | 1.10E+07 | 6219.31 | 4 | 0 |
| 4 | Cyprus | 572 | 2.70E+10 | 1.20E+06 | 3875.88 | 0 | 1 |
| 5 | Egypt | 0 | 2.90E+11 | 9.80E+07 | 3310.45 | 2 | 0 |
| 6 | France | 3 | 2.90E+12 | 6.70E+07 | 6128.94 | 8 | 0 |
| 7 | Germany | 465 | 3.90E+12 | 8.30E+07 | 6077.62 | 13 | 0 |
| 8 | Greece | 3817 | 2.50E+11 | 1.10E+07 | 4289.22 | 2 | 0 |
| 9 | Hong Kong | 54811 | 2.90E+11 | 7.50E+06 | 9134.57 | 1 | 1 |
| 10 | Italy | 6496 | 2.10E+12 | 6.00E+07 | 5044.43 | 1 | 0 |
| 11 | Japan | 1082 | 6.20E+12 | 1.30E+08 | 11538.8 | 106 | 0 |
| 12 | Kenya | 1883 | 6.20E+10 | 5.10E+07 | 506.06 | 0 | 1 |
| 13 | Kuwait | 192 | 1.40E+11 | 4.10E+06 | 3618.88 | 6 | 1 |
| 14 | Malaysia | 0 | 3.80E+11 | 3.20E+07 | 7694.14 | 7 | 1 |
| 15 | Malta | 281 | 1.40E+10 | 483530 | 4376.73 | 0 | 1 |
| 16 | Netherlands | 24702 | 9.50E+11 | 1.70E+07 | 6337.43 | 1 | 0 |
| 17 | Oman | 132 | 7.60E+10 | 4.80E+06 | 3824.52 | 11 | 0 |
| 18 | Portugal | 4848 | 2.50E+11 | 1.00E+07 | 6024.95 | 0 | 0 |
| 19 | Qatar | 416 | 1.80E+11 | 2.80E+06 | 3441.16 | 9 | 1 |
| 20 | Romania | 1764 | 2.20E+11 | 1.90E+07 | 4947.96 | 2 | 0 |
| 21 | Rwanda | 1485 | 1.00E+10 | 1.20E+07 | 376.93 | 0 | 0 |
| 22 | Saudi Arabia | 2551 | 7.00E+11 | 3.40E+07 | 3107.8 | 19 | 0 |
| 23 | Singapore | 289 | 3.30E+11 | 5.60E+06 | 7931.62 | 4 | 1 |
| 24 | Spain | 4548 | 1.50E+12 | 4.70E+07 | 5773.84 | 3 | 0 |
| 25 | UK | 56 | 2.90E+12 | 6.60E+07 | 6469 | 0 | 0 |
| 26 | United Arab Emirates | 13151 | 3.90E+11 | 9.60E+06 | 3570.47 | 7 | 1 |
| 27 | United States of America | 2056 | 1.80E+13 | 3.30E+08 | 11676.5 | 22 | 0 |
| 28 | Viet Nam | 11609 | 1.90E+11 | 9.60E+07 | 8269.63 | 8 | 0 |

Note: import values, GDP and population are for 2018