SANITARY AND PHYTOSANITARY MEASURES AND THEIR EFFECTS ON WORLD AGRICULTURAL EXPORTS

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Abstract: Sanitary and Phytosanitary measures (SPS) can be either trade barriers or trade facilitators, because they can raise production costs and/or reduce information asymmetries between countries and increase demand. Therefore, the present study aimed to assess their impact on world agricultural products' exports, between 2000 and 2016, and whether their effects differ for the countries considered advanced and emerging, using a gravity model. The results showed that regular SPS measures generated significant and positive effects for both advanced and emerging countries' exports, although to a lesser extent for the former. One possible explanation for this result is that standardization increases consumer confidence in products, as well as reducing information asymmetries. As a consequence, demands have increased relatively more than adequacy costs. With respect to the difference between advanced and emerging, this can be explained by the fact that products from advanced countries would already be more reliable than those from emerging countries, with less SPS information gain. Therefore, the results showed the importance of the SPS agreement, not only to safeguard the quality of products and the safety of consumers and the environment, but also to stimulate international trade in agricultural goods.

Keywords: Agricultural trade; Sanitary and Phytosanitary measures; Gravity trade model.

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1. Introduction

For a long time, tariffs were the trade protection mechanisms most used by countries to protect their domestic goods market. These defended, among other arguments, the need to protect the domestic producer - mainly the nascent industry - in addition to justifying that the protection of the internal market could be seen as a response to internal crises (KRUGMAN, OBSTFELD AND MELITZ, 2015).

Krugman et al (2015) cite the United States as an example during the 1930s, which considerably increased barriers to foreign trade in order to mitigate the effects of the great depression. The idea behind the imposition of tariffs was to protect domestic industry by stimulating domestic demand for goods. Initially, these rates were well received, due to the general bankruptcy of companies and even banks that the country was facing. However, this strategy did not have the expected effect in the long run. The result was an even greater worsening of the crisis, due to the reduction in foreign trade, due to the retaliation of affected countries. Thus, afterwards, many countries concluded that a global reduction in applied tariffs was necessary, since protectionism did not generate the expected response to domestic crises, in addition to hindering the great advantages that international trade brings, such as: greater variety and availability of goods, technology transfers, better allocation of resources, expansion of consumption possibilities, among others.

Thus, in 1947, the General Agreement on Tariffs and Trade (GATT) was signed, a multilateral agreement that proposed rules for international trade and was a precursor to the creation of the World Trade Organization (WTO) in 1995 This agreement generated a great wave of tariff reductions worldwide, which continues today. In contrast, the use of Non-Tariff

Measures (NTMs) has intensified in recent decades (WTO, 2012), however, these measures do not always constitute barriers to trade, and can be facilitators of it.

According to the WTO (2012), NTMs are instruments of trade policy, other than tariffs, that can affect trade between goods and services. This type of measure ranges from quantitative restrictions on imports, such as quotas, to defense measures, such as safeguards and anti-dumping measures. In addition, they also cover technical and sanitary and phytosanitary measures (TBT and SPS respectively, acronym in English), which follow scientific parameters for their adoption and aim to guarantee the quality of products and safety of the consumer and the environment. Among the different types of non-tariff measures, the last two stand out as the most used in the current context of international trade.

Data from the Integrated Trade Intelligence Portal (I-TIP / WTO, 2021) show that SPS measures are among the most used in the world by member countries. There are 19,983 notifications initiated or in force until December 31, 2020, behind only the TBT measures with 28,822 measures. It should be noted that SPS refer only to goods of animal and vegetable origin, while TBT can be applied to any product.

TBT and SPS measures aim to reduce information asymmetry and correct market distortions between products sold by countries. Through TBT measures, countries set standards for quality, standardization and inspection. SPS measures are used in order to protect human and animal health from risks arising from contaminants, additives and pollutants harmful to biotic life in general, in order to conserve the fauna and flora of the respective countries which emit them and preserve consumer health. Despite following legitimate public policy objectives, governments often resort to such measures in order to create disguised protectionism to strengthen their domestic industries (WTO, 2012). However, NTMs do not necessarily negatively affect trade. Therefore, the current literature has increasingly used the term measures instead of barriers, as the latter comprises those that negatively affect trade (CARNEIRO, 2015).

The benefits and harms of NTMs, as may be the case with TBT and SPS, are explained by Corrêa and Gomes (2018). As harm, we can point out the costs of adapting products to the imposed requirements, in addition to the disguised protectionism already mentioned. However, the standardization of products, the adaptation of national products to the rules imposed by them, the exchange of information between countries and the increase in the level of quality and reliability for the trading partner countries, are benefits that often outweigh the harm.

The dubious nature of the impact of SPS measures on trade in goods is the subject of study for several studies that seek to verify whether they have a reducing or stimulating effect. Works such as Moenius (2004), Disdier, Fontagné and Mimouni (2008), Alves et al. (2014) and Santeramo et al. (2019) address this ambiguity.

Moenius (2004), through the application of a gravitational model, found that specific NTMs (applied by countries in imported manufactured products) tend to promote trade between them. This is justified because, in many cases, the cost of adapting products is less than the cost of information. In this way, NTMs provide necessary information for exporters to adapt their products to foreign markets. In such cases, there is a positive effect between trade and the use of specific standards. Although this evidence does not apply to non-manufactured products, such as agricultural products, which have a higher incidence of SPS measures, the author also tests the hypothesis that the volume of trade is higher among countries that share more standards with each other. According to the estimated regressions, this hypothesis is confirmed. The justification is that the more measures countries share with each other, the less they need to adapt their products, or inspection processes, when these products are traded with each other.

The negative effects of SPS measures on agricultural products are pointed out by Disdier, Fontagné and Mimouni (2008). According to the model estimated by the authors, these measures negatively affect exports from developing countries that are members of the Organization for Economic Cooperation and Development (OECD), whose members are high-income countries. However, the study points out that this negative effect is not only due to the nature of this type of agreement. Much is also due to the difficulty of these countries in adapting to this type of measure, mainly related to cost. Evidence was also found that measures imposed by member countries of the European Union are more restrictive to trade than those imposed by OECD member countries. Peripheral and emerging countries suffer the most, in general, from the effects of non-tariff measures, especially SPS, when used for protectionist purposes. One of the factors that influence is the cost of adapting to this type of measure.

On the other hand, Alves et al. (2014) verified the effect of SPS and TBT measures on Brazilian grape exports from 1995 to 2009. Measures issued by the main fruit importers during that period - Argentina, the United States and the European Union - were considered. The inventory analysis showed a positive effect between the increase in the number of notifications and the growth in the number of imports in the period. The gravitational model pointed out that SPS measures contributed positively to the increase in Brazilian exports, while TBT had no impact. One of the factors pointed out that justify this result was the decrease in information asymmetry due to the adoption of these measures.

In the same sense, in a recent article, Santeramo et al. (2019) investigated how specific NTMs issued by the main exporters, importers and producers of wine influenced global imports of this product in the period from 1991 to 2016. Among the results found, it was found that the SPS measures applied were responsible for an increase in imports of this product in the studied period.

Regarding the view of direct participants in international trade, Henson and Loader (2001) present a survey conducted with low and middle income countries to identify the greatest impediments to exports of agricultural products from these countries to the European Union. It was found that the main impediment was SPS measures, followed by TBT measures, export costs and, finally, tariffs and quantitative restrictions. Subsequently, another survey carried out with developing economies (WTO, 2012) corroborated that SPS measures are the most costly for exporters in these countries.

Given the importance of international trade for the countries and the considerable ambiguous impacts of NTMs, it is important to assess the effects of the adoption of SPS measures on trade in agricultural products. This sector is the object of study because it is the target of SPS measures, which, as mentioned, are among the most used in the world. Therefore, the objective of this work is to measure, through the estimation of a gravitational model, if the SPS measures imposed on the world trade in agricultural goods have acted as barriers to trade or facilitators, that is, whether they work by reducing or increasing the sector's exports.

The analyzed period comprises the years 2000 to 2016, which are those with available data. The method used - gravitational model - according to Yotov et al. (2016), is the most recommended for estimates with bilateral trade flows and real variables, bringing the most robust results.

SPS measures are expected to have different effects on exports from advanced and emerging[1] countries, as the difficulties faced by the latter in the adequacy of products tend to be greater. Thus, the expectation is that such measures will constitute barriers for emerging countries and facilitate for advanced countries. In addition, the former are expected to adopt more measures since, due to the principle of national treatment, a country cannot be more demanding with its trading partners than it is domestically, limiting the possibilities of imposing rules (WTO, 1994).

In addition to this introduction, section 2 presents the theoretical framework, which will cover a brief summary of trade policies, the agreement on tariff measures and their applications and the gravitational econometric model. Then, in section 3, the methodology used in the work will be presented, while in section 4, the descriptive and econometric analysis of the results. Finally, in section 5 the conclusion is presented.

[1] Countries are separated according to the classification of the International Monetary Fund (IMF, 2020). According to this, countries can be divided into advanced and emerging. This analysis occurs from an economic perspective, but includes several variables and may vary according to the country analyzed, but, in summary, it includes: 1) the level of income per capita; 2) export diversification; and 3) degree of integration into the global financial system. See at: https://www.imf.org/external/pubs/ft/weo/2020/02/weodata/groups.htm.

2. Theoretical framework

2.1 Commercial Policies

In recent decades, with the encouragement of intergovernmental bodies, such as the WTO, the number of trade liberalization agreements between countries has increased. As a consequence, the number of tariffs has been reduced (HOEKMAN AND NICITA, 2011). On the other hand, the number of NTMs has also increased, among which, as mentioned in the introduction, SPS and TBT are included.

As defined in the introduction, SPS measures, specifically, are a type of commercial policy that aims precisely to protect against these externalities associated with the production and consumption of a good. Specifically, they are concerned with correcting inefficiencies that, in themselves, are not corrected by the market independently.

According to Roberts, Josling and Orden (1999), the effects of TBT and SPS measures on the flow of goods between countries are, for the most part, indirect when compared to other types of NTMs, as they affect the costs of adapting these products to a standard. As a result, as these measures affect the production functions and consumption decisions of individuals, the demand and supply curves for a certain good can be shifted as a result of the imposition or withdrawal of a standard. However, unlike the other NTMs, these effects do not always imply a decrease in demand.

Thilmany and Barrett (1997) present some general reasons why regulatory barriers, especially SPS, can be threatening to trade, being: 1) Technical complexity. Because these measures have to have a scientific justification for their adoption, those that are used for protectionist purposes tend to receive less attention from the media and the general population, unlike tariffs, which receive immediate attention from the main media outlets. when adopted; 2) Incentives for corruption. The authors argue that government regulations can often generate many uncertainties in the market, which opens up a lot of scope for agents to use corrupt means to obtain undue advantages due to the difficulty of adapting to the rules established by the current regulation. The entry of these low quality products that manage to circumvent the regulations proposed by the NTMs also affects consumer confidence, which influences the market balance of these products; 3) Difficulty in measuring. As discussed in the introduction to this paper, NTMs are difficult to measure compared to tariffs. Because of this, despite progress in reducing quotas and tariffs, technical NTMs are still responsible for intense debates in the context of international trade.

The imposition of an NTM may be the result of political pressure, or in response to a specific event, such as avian influenza. These events create great uncertainties for exporters, even if these measures are subsequently revoked. Despite this, there is evidence that NTMs used in specific events, such as Avian Flu, Brucellosis Bovine, among others, whose justification was to contain the dissemination of these events had positive effects on world trade (ALMEIDA, GOMES E SILVA, 2014).

To quantify the magnitude of these effects on the international trade in agricultural goods, Roberts, Josling and Orden (1999) proposed a theoretical model that points out important aspects of the impact of these measures on international trade. The proposed model employs three components in its structure: regulatory protection, supply shift and demand shift.

Figure 1 illustrates the effects of a NTM from the perspective of an importing country according to the proposed model.

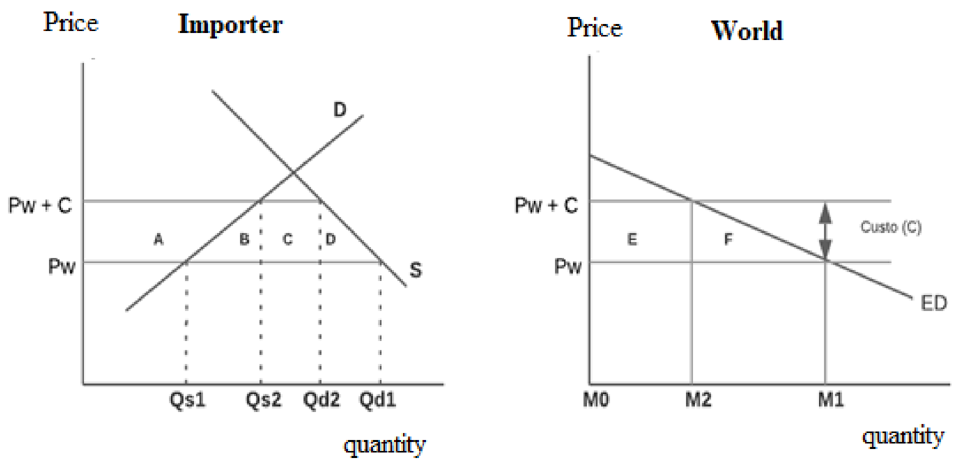


Figure 1: Effects of the imposition of a restrictive measure on imports.

Source: addapted from Roberts, Orden and Josling (1999).

The graph on the left shows the interaction between supply and demand according to the world price, P_w, that producers and domestic consumers face. In this price, the quantity demanded by consumers is given by Q_D^1, while the quantity offered is represented by Q_D^1. The difference between these quantities represents the import on the M_1 world market.

If the importer in this market adopts a universal restrictive regulatory measure, the price of this product in the importing country increases due to the costs of adapting to this measure, which simultaneously reduces the quantity imported to M_2. Although the domestic producer has a surplus increase in A, the consumer loses in surplus the equivalent of B + C + D.

On the other hand, if the measure is responsible for a decrease in information asymmetry for consumers, it may be responsible for an increase in the quantity imported. Roberts, Josling and Orden (1999) represented this situation in the demand displacement model, as shown in Figure 2.

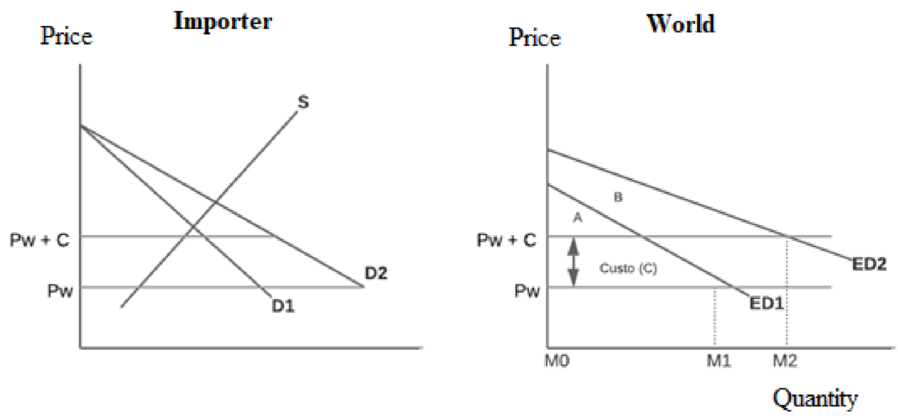


Figure 2: Effects of imposing an information measure.

Source: Roberts, Orden and Josling (1999).

In the graph on the right, M_1 represents the quantity imported by consumers in case of little information available about the product. In the presence of an information measure, domestic demand tends to increase, from D_1 to D_2. Due to the measure, product costs also tend to increase to $P_w + C$. However, as the demand curve D_2 is more steep, as it is more elastic, total imports increase to M_2 due to the imposition of this measure.

2.2 The Sanitary and Phytosanitary Measures Agreement and its implications

According to Baena (2005), multilateral negotiations on trade liberalization, as mentioned above, started in 1947 with the creation of GATT, however, a specific agreement that dealt with SPS-type measures only emerged in 1994, in the Uruguay Round. This is because agricultural liberalization was only structured in this round, which resulted in measures aimed at minimizing the effects of restrictions on agricultural trade. The pillars of agricultural liberalization advocated in this round of negotiations were: access to the market; domestic support; export subsidy; and sanitary and phytosanitary measures.

Therefore, in parallel to the Agreement on Agriculture, the Sanitary and Phytosanitary Measures Agreement (SPS) emerged, which aims to discipline the use of regulations relevant to the protection of human, animal and plant health. Through this agreement, the government's right to use SPS measures was recognized and its use was prohibited for protectionist and discriminatory purposes in relation to the other countries participating in the agreement (LAMPREIA, 1995).

According to article 1, annex A, of the agreement, an SPS measure will be governed by the same if: a) protecting, in the Member's territory, animal or plant life or health, from the risks resulting from the entry, establishment or dissemination of pests, diseases or pathogenic or disease-bearing organisms; b) protect, in the Member's territory, human or animal life or health, from risks resulting from the presence of additives, contaminants, toxins or pathogenic organisms in food, beverages or animal feed; c) protect, in the Member's territory, human or animal life or health, from risks resulting from pests transmitted by animals, plants or products derived from them or from the entry, establishment or spread of pests; and d) prevent or limit, in the Member's territory, other damages resulting from the entry, establishment or spread of pests (WTO, 1994).

According to the WTO (2014), in order to adapt to the reality of adequacy of developing countries that are signatories to the agreement, which, for reasons such as financial limitations, for example, find it difficult to adapt their products to what is established by the measures, article 10 establishes special and differential treatment of these countries. The Committee, in this case, has the right to allow specific exceptions with limited deadlines for these countries to adapt to the measures. The agreement states that the signatory countries must encourage and facilitate the participation of those countries in the agreement.

2.3 The Gravity Model

The Gravity Model is an analogy to Newton's Law of Universal Gravitation which establishes that the attraction between two bodies is directly proportional to the product of the masses of each body and inversely proportional to the square of the distance between them. In the case of international trade, trade flows between two countries are directly proportional to Gross Domestic Products (GDPs) and inversely to the distance between the two (KRUGMAN, OBSTFELD AND MELITZ, 2015, p. 10).

According the autors, what justifies the functioning of this model is that countries with large gross incomes tend to spend more on imports due to having a higher income in comparison, in addition to also exporting more, as they produce a wide range variety of products. With regard to distance, closer countries tend to trade more with each other compared to the more distant ones. This can be explained by the fact that transport costs are directly proportional, in some cases, to the distance between countries.

Baldwin and Taglioni (2006) explains that the popularity of this model in the study of several fields, and its wide use in the study of trade between countries, is based on three factors: first, international trade flows are a key factor in all types of economic relations ; second, the data needed to estimate it are easily accessible today; and lastly, there are many contributions from high quality research that have established standard practices for working with it, which satisfy the needs of many empirical researches.

In general terms, the relationship between GDP and distance in the gravity model is presented as follows:

$$X_{ij} = G \frac{M_i M_j}{D_{ij}} \tag{1}$$

where X_{ij} is the value of trade between country i and country j; G is a proportionality constant; M_i *and* M_j are the economic masses (GDPs) of countries i and j respectively; and D_{ij} represents the distance between the two countries. In linear form, we have the basic equation of the gravitational model:

$$ln\, X_{ij} = \alpha + \delta_1 lnM_i + \delta_2 lnM_j + \eta lnD_{ij} + \mu_{ij} \tag{2}$$

The variables remain the same as in model (1), with a single substitution of G for α.

The first work to use this model to analyze the flow of trade between countries was that of Tinbergen (1962). However, in the beginning, this model lacked a theoretical basis. The first work to contribute to the theoretical basis of this model was Anderson (1979), which started from the following assumptions: preferences with constant elasticity of substitution (CES); countries produce both tradable and non-tradable goods, and; goods are differentiated by region of origin. Later, other works added variables that impact international trade based on this model (ANDERSON and VAN WINCOOP, 2003, 2004; DEARDORFF, 1998; WINCHESTER, 2009).

Anderson and van Wincoop (2004) conferred greater theoretical and statistical quality to the model with the inclusion of terms of multilateral resistance, managing to obtain theoretical status to the gravity model and achieving great success in the academic environment.

Sá Porto and Canuto (2004) define commercial resistance as of two types: artificial and natural. The natural resistance would be that related to transportation time, transportation cost, among others, while the artificial ones would be those imposed by the government such as import tariffs, exchange controls, non-tariff measures, etc. However, these measures can be resistance in some cases, and if they constitute facilities for trade in others. Therefore, in order to take into account the impact of factors that were not considered in the proposed initial model, variables and dummies were added to the model that take into account cultural, geographical and economic aspects that can explain trade flows between countries.

In summary, multilateral resistance is the effect that the position of exporting and importing countries in the global market and their economic situation has on their own bilateral trade. According to Yotov et al. (2016), is the effect of the price of other products from all countries on bilateral trade. Thus, by Anderson and van Wincoop (2004), the following equation (here simplified) originated:

$$lnX_{ij} = \alpha + \beta_1 lnPIB_i + \beta_2 lnPIB_j + \beta_3 lnd_{ij} + \sum_{m=1}^{M} \quad \gamma_m lnZ_{mij} + \mu_{ij} \tag{3}$$

where X_{ij} are exports from country i to country j; PIB_i and PIB_j which represents countries i and j GDPs', respectively; d_{ij} which is the measure of the distance between countries i and j; Z_{mij} which are proxies that capture the effects of trade barriers; and μ_{ij}, which is the equation's error term.

Piermartini and Yotov (2016) point out that, despite solid theoretical foundations and remarkable empirical success, the gravity model was and still is frequently applied without theoretical basis and without taking into account the econometric challenges that can lead to biased and inconsistent estimates.

Thus, Yotov et al. (2016) summarize the main recommendations for efficient, robust and unbiased estimation of gravity models: 1) Whenever available, panel data should be used as it allows for greater variability in the sample; 2) Panel data with intervals (2, 3 or 5 years) should be used instead of data grouped by consecutive years, thus allowing adjustment for changes in explanatory variables, as well as correction of serial autocorrelation; 3) Intranational trade data should be included, constructed as the difference between the raw data on the value of production and the total of exports, making it possible to correctly assess the effects of trade policies; 4) Directional fixed effects of temporal variation (country-year) should be included in the panel data to control multilateral resistance, which ends up eliminating GDP data by collinearity; 5) Fixed country pair effects should also be included, correcting for endogeneity between trade policy and exports, and thus time-invariant data such as distance, common language and contiguity are excluded by collinearity; 6) The Poisson Pseudo Maximum Likelihood (PPML) estimator should be used to avoid the sample selection bias and correct the unobservable heteroskedasticity, which occurs because, in addition to dealing with the issue of null trade flows, it also corrects the unobservable heteroscedasticity, arising from peculiarities inherent to cross sections.

The Poisson estimator is known as the standard approach for modeling discrete data. However, it has gained popularity as a viable alternative for estimating multiplicative models where the dependent variable is non-negative. Typically, these models are estimated by linear regression applied to a dependent variable transformed into a log. But, as in OLS, the only necessary assumption for the consistency of the Poisson estimator is the correct specification of the conditional average of the dependent variable (GOURIEROUX et al., 1984). Thus, the Poisson's estimator becomes the PPML estimator.

Correia et al. (2020) state that, in the presence of non-negative data with many zeros, PPML is the safest bet. This situation is likely to occur in many areas of research, especially when working with highly disaggregated data (for example, when modeling a company's R&D expenses, patent citation counts, daily sales of products in stores and, as the present study, bilateral trade).

Finally, this model was used in this work to measure the effect of SPS measures on world exports of agricultural goods.

3. Metodology

First, SPS notifications issued by WTO member countries from 2000 to 2016 were collected, as it was the one with all available data. Such measures are available on the Integrated Trade Intelligence Portal (I-TIP / WTO, 2020). SPS measures can be regular or emergency, that is, the time for the measure to take effect may vary. Regular measures are notified with a deadline before they come into force, as they have a period for which comments and amendments can be made to them, while emergency measures may have the consultation time reduced or eliminated due to the urgency of implementation. With these data in hand, a broad descriptive analysis of the data was carried out, allowing a better view of the use of the agreement by the countries.

Subsequently, imports of agricultural goods were collected, for all countries with available data, in the period in question. The bilateral trade flow database International Trade and Production Database for Estimation (ITPD-E), developed by Borchert et al. (2020), which contains data on international and intranational trade covering various sectors. The base covers 243 countries[2] (only WTO members were used) and 170 sectors, 26 agricultural industries, which have been condensed into a single large sector. Thus, it was possible to verify the effects of the adoption of SPS measures on the trade of agricultural products through a gravitational equation.

This method was selected because it is the most used and most efficient for assessing the effects of trade policies (including sanitary and phytosanitary measures) on international goods flows, as stated by Yotov et al. (2016), since it brings the most robust and consistent results. Thus, we have:

$$Yijt = \alpha + \beta_1 lnSPSregular_{it} + \beta_2 lnSPSemergency_{it} + \beta_3 SPSregdum_{it} + \beta_4 SPSemergdum_{it} + \varepsilon_{it} + \delta_{jt} + \gamma_{ij} + \mu \quad (4)$$

where Yijt are imports from country i to j, in year t; α is the gravitational constant; SPSregular represents the number of regular SPS notifications[3] initiated by country i in annotation t; SPSemergency are those emergencies initiated by country i in year t; spsregdum is the multiplication of regular lnSPSregular by a binary variable that assumes a value of 1 if the country is considered advanced, 0 otherwise; spsemergdum is the multiplication of

[2] See the list of countries and sectors at https://usitc.gov/publications/332/working_papers/itpd-e_usitc_wp.pdf.
[3] Due to the large number of zeros, it was decided to transform SPSregular and SPSemergencial = (number of SPS measures started + 0.01) to avoid losing observations when applying the logarithm. Bellégo and Pape (2019) affirm that many works use this solution without even mentioning it because it seems harmless, however, the choice of the constant is discretionary and can skew the estimates of the coefficients. However, in the case of discrete explanatory variables, the bias tends to be insignificant.

lnSPSemergency by the same dummy; ε and δ are the country-year fixed effects that control the terms of multilateral resistance; γ are the fixed effects of country pairs and; μ is the error term. Binary interaction variables were included in order to verify whether the effect of the measures differs between advanced and emerging (under development).

Time intervals were used, as indicated by Yotov et al (2016), to allow the necessary adjustment after changes in commercial policies, with the most efficient configuration being the one that maintained the years 2000, 2004, 2008, 2012 and 2016.

It is important to note that most SPS measures are non-discriminatory, that is, when they are issued by a particular country, they affect trade with all countries. However, there are measures that affect only one (or a few) trading partners. This was taken into account when organizing the database, and not all business partners are affected by the same number of measures in the final cluster.

The estimation was performed by Poisson Pseudo Maximum Likelihood (PPML), as recommended by Yotov et al. (2016), however using the command developed by Correia et al. (2020) for STATA software, PPMLHDFE, which is more efficient in the presence of large fixed effects (large number of cross sections).

In this way, it was possible to verify whether the SPS notifications, initiated in the period from 2000 to 2016, characterized informative measures, that is, facilitating trade, or restrictive, that is, trade barriers.

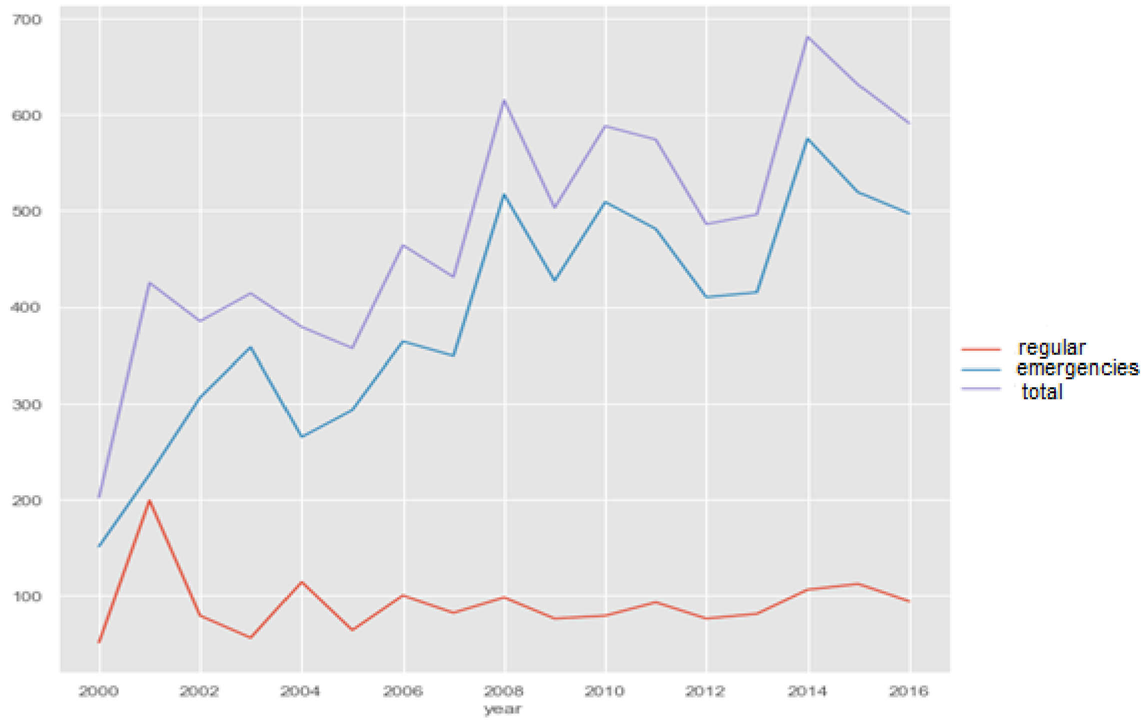
4. Results and discussion

In this section, will be performed a descriptive analysis of the data used and the results obtained through the estimation of the econometric model.

4.1 Descriptive Analysis

During the analyzed period, a total of 8,222 SPS measures were initiated, of which about 19% were emergency and 81% regular. Graph 1 below shows the evolution in the number of measures issued over the period analyzed.

Graph 1: Evolution of measures over the period.

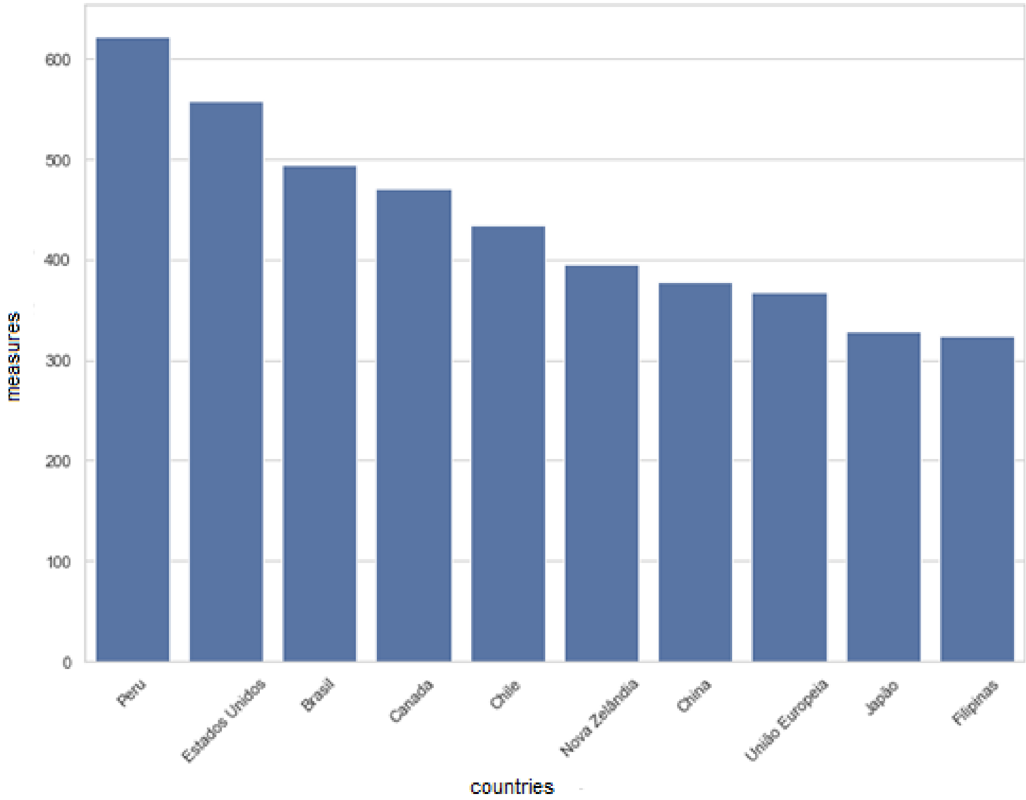


Source: own elaboration.

It should be noted that during the period, there is a growing trend in the number of regular measures, while emergencies follow a constant trend. It appears that 2014 was the year with the highest number of notifications, 681, a percentage increase of about 37% compared to the previous year. 2000 was the year with the lowest number of notifications issued, 202 in total. In relation to the percentage increase, from 2000 to 2001, there was an increase of about 110% in the number of measures.

As for the countries that issued these measures, Graph 2 below shows the ten countries that issued the most measures during the period.

Graph 2: The 10 countries that most issued measures during the period.



Source: own elaboration

Among developing countries, Latin American such as Peru, Brazil and Chile can be highlighted. As a large part of the trade in these countries corresponds to agricultural goods, they were expected to be present on that list.

In relation to developed countries, such as the United States, Japan, Canada and New Zealand, as well as the European bloc, the greater number of measures may indicate a higher level of demand on the part of consumers in relation to quality standards, which can be also apply to China, which has a large population. Another explanation pointed out by Hoeckman and Nicita (2011) is that the number of NTMs increases according to the degree of development of a country, which would explain this high number of measures for these countries.

Regarding the scope of these measures, 797 discriminatory measures and 7425 non-discriminatory measures were issued. Non-discriminatory measures are those that affect all WTO members without distinction, while discriminatory measures affect a country or group of countries. It can be seen that most of the measures issued in the period were non-discriminatory, that is, they affected all members of the WTO. A possible explanation for the reduced number of discriminatory measures is that, as the measures are scientific in nature, the rules for verification or standardization of a certain product must be applied regardless of its origin. Furthermore, the SPS agreement encourages multilateralism.

4.2 Econometric Analysis

In this section, will be presented the results of the gravitational econometric model estimated by Poisson Pseudo Maximum Likelihood - PPML. Table 1 presents these results.

Table 1: Estimation of the model by PPMLhdfe

Variable	Coefficient	Standard errors
lnSPSregular	0.1135573***	0.008965
lnSPSemergency	-0.0252533**	0.0077017
SPSregdum	-0.0186365**	0.010511
SPSemergdum	-0.0029665^{ns}	0.0087224
Constante	10.51232***	0.0034094
Pseudo R2	0.9964	
Nº of observations	96033	
FE exporter-year	Yes	
FE importer-year	Yes	
FE country-pairs	Yes	

***, **, * and ns represent, respectively, 1%, 5%, 10% significance and not significant. Standard errors are robust and clustered by country pairs. FE = fixed effects.

Source: own elaboration.

From the results, there is a positive and significant relationship between regular SPS measures, negative and also significant relationship between emergency SPS measures, and the international trade in agricultural goods. This indicates that, in the analyzed period, regular measures facilitated trade, which is in line with results found by authors such as Alves et al. (2014) and Santeramo et al. (2019). Despite this, emergency measures proved to be barriers. Because they exist in a much smaller number, this fact is less relevant.

An increase of 10% in regular SPS notifications issued by importers in the period generated, on average, an increase of 1.13% in exports, while the same increase in emergency measures generated a reduction of about 0.25% in exports. The justification for these results is that regular measurements met the requirements of consumers and reduced the information asymmetry for the respective products marketed in the period, as illustrated in graph 2 by Roberts, Josling and Orden (1999). However, the emergency ones, because they do not allow time for adaptation, characterized barriers in the short term.

The spsregdum interaction dummy was significant and negative, showing that the positive effect of regular SPS measures is less for advanced countries. Thus, a 10% increase in their emissions generated an increase of 0.95% in exports from countries considered developed (while 1.13% for emerging countries). This can be explained by the fact that products from advanced countries would already be more reliable than those from emerging countries, with less information gain with SPS measures. The spsemergdum variable was not significant, and it is not possible to verify differences in relation to emergency measures. Furthermore, differently from what was expected, the effect of SPS measures (regular) was also positive, as well as greater, for emerging countries, showing that they are able to adapt to and take advantage of changes.

Finally, as highlighted by Corrêa and Gomes (2018), in many cases, the benefits of NTMs (in this case, SPS) outweigh these evils, and it is very important to highlight the finding that they can facilitate trade, due to the following facts: 1) it acts in the standardization of products, bringing greater security for the consumer, for the environment and greater reliability in the products, constituting a benefit for consumers in all countries; 2) given the rules of the agreement (principle of national treatment), domestic producers are obliged to also follow what is determined in a technical measure established by their country, that is, the rule for the external product cannot be stricter than for the national product. Therefore, this is a way of making national goods and production processes reach an international standard of quality, in addition to signaling this to the whole world, which can facilitate exports from the country that imposed the measure; 3) it provides exchange of information and learning between countries because, when a country issues a notification, everyone has access to it; 4) it is possible to have an international overflow effect when a country adopts a measure. If a country adopts a new requirement, all those countries that import this affected good, from the same partners as the country that imposed the measure, will benefit from its better quality or reliability. That is, when partners in that country need to adapt to a new export requirement, they end up making their products better for all their partners.

Therefore, the results of this work served to prove the importance of the SPS agreement, not only to safeguard the quality of products and the safety of consumers and the environment, but also to stimulate international trade in agricultural goods.

5. Conclusions

Despite their scientific character and main objective of protecting human health and the environment, Sanitary and Phytosanitary measures (SPS) can characterize trade barriers, which hinder trade between countries and the various initiatives and proposals for trade liberalization. On the other hand, they can be great allies to international trade, presenting themselves as facilitators of trade due to the reduction of information asymmetry about products originating from different countries.

Given this ambiguous nature of the effects of SPS measures, the present study aimed to assess their impact on world exports of agricultural products during the period 2000 to 2016 and whether their effects differ for the countries considered advanced and emerging, through a gravitational model. These measures were expected to be restrictive for emerging countries and facilitate for advanced.

The descriptive analysis of the data showed that, during the period, SPS measures followed an increasing trend, there was a predominance of measures of the regular type and non-discriminatory scope, that is, the majority affected all member countries of the World Trade Organization (WTO). In relation to the main issuers of measures, large exporters of agricultural commodities stood out, such as Brazil, and developed countries, together with the European bloc, in addition to China.

Regarding the gravitational regression, the results showed that, contrary to expectations, the measures were significant and positive for both advanced and emerging countries, although to a lesser extent for the former. One possible explanation for this result is that standardization increases consumer confidence in products, as well as reducing information asymmetries. As a consequence, demands have increased relatively more than adequacy costs. With respect to the difference between advanced and emerging, this can be explained by the fact that products from advanced countries would already be more reliable than those from emerging countries, with less information gain with SPS measures.

The importance of international trade is growing in an increasingly interdependent and globalized world. Thus, nations, governments, firms and even people need to adapt to this new situation. This process brought opportunities for all countries to expand their markets, enter previously unexplored areas and acquire all kinds of knowledge and technology. Such opportunities are accompanied by new quality standards and consumer demands, which need to be followed. Therefore, the SPS agreement proves to be a tool for the realization of these opportunities, as well as for the expansion and improvement of agricultural world trade.

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