SANITARY AND PHYTOSANITARY MEASURES AND THEIR EFFECTS ON AGRICULTURAL TRADE

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Abstract

Sanitary and phytosanitary measures (SPS) can be either trade barriers or trade facilitators. Therefore, the present study assesses their impact on world agricultural imports between 2000 and 2016 and determine whether their effects differ for advanced countries, using a gravitational model. The results indicated that regular SPS measures generated significant and positive effects for countries' exports, although to a lesser extent for advanced countries. Therefore, the results demonstrated 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; Gravitational trade model.

JEL: **F13; F14**

1 INTRODUCTION

For a very long time, prior to the multilateral negotiations that began following the end of the Second World War, tariff barriers were the trade protection mechanisms used most often by countries to protect their domestic market for goods. They advocated, among other arguments, the need to protect the domestic producer, particularly the nascent industry, in addition to arguing that the protection of the domestic market could be seen as a response to domestic crises. Yet, international trade also offers many advantages, such as a greater variety and availability of goods, technology transfer, a better allocation of resources and expanded consumption possibilities (Krugman; Obstfeld; Melitz, 2015).

Accordingly, in 1947, the General Agreement on Tariffs and Trade (GATT) was signed, a multilateral agreement that proposed rules for international trade and was the precursor to the creation of the World Trade Organization (WTO) in 1995. This agreement sparked a surge of tariff reductions around the world that has continued to the present day. In contrast, the use of nontariff measures (NTMs) has intensified in recent decades (OMC, 2012).

Data from the Integrated Trade Intelligence Portal (I-TIP/OMC, 2021) indicate that sanitary and phytosanitary (SPS) measures, which are intended to protect the consumer and the environment, are among the measures used most frequently around the world by WTO member countries; 19983 notifications have been initiated or are in force, as of December 31, 2020, second only to technical measures (technical barriers to trade - TBT), with 28822 measures.

Although they pursue legitimate objectives, the impact of these measures on international trade is still the subject of debate in the economic literature. While they can be adopted to protect a country's domestic industry by imposing measures that increase the compliance costs of imported products (OMC, 2012) and are thus barriers to trade, they can also set high quality standards that reduce information asymmetry and increase consumer confidence and are therefore trade facilitators (Corrêa & Gomes, 2018).

The use of these instruments can also have a different impact depending on a country's degree of development. For developing countries, product compliance costs may be high relative to the scale of their operation and the financial means available to them. This increased cost may consequently act as a barrier to trade between those countries and developed countries, the latter of which set high quality standards by virtue of having a scientific and technical infrastructure capable of establishing those norms (Martens & Swinnen, 2015).

To this end, the objective of this paper is to evaluate the effect of adopting SPS measures on the agricultural imports of countries, differentiating them by degree of development. The focus is on the trade of agricultural products, as they are subject to a greater incidence of nontariff measures, primarily of the SPS type, than are other goods (Banco Mundial; FMI, 2008). The period under analysis spans the years 2000 to 2016, which are those with data available. The method used, gravitational model, is the most recommended for estimations with bilateral trade flows and real variables, providing the most robust results (Yotov et al., 2016).

SPS measures are expected to have different effects, compared to the overall average, on imports from advanced countries[1], as they tend to have fewer

1 The countries are separated using the classification of the International Monetary Fund (FMI, 2022). According to this classification, countries can be divided into advanced and emerging. This analysis is performed from an economic perspective but includes different variables and can vary according to the country analyzed; in short, it includes 1) the level of *per capita* income; 2) export diversification; and 3) degree of integration into the global financial system. See the sample countries grouped using this classification at https://www.imf.org/en/Publications/WEO/weo-database/2022/April/select-aggr-data.

difficulties related to product compliance. These measures are thus expected to be trade facilitators for advanced countries but barriers for countries in general. Furthermore, it is expected that the latter will adopt more measures, given that, according to the principle of national treatment (OMC, 1994), a country cannot be more demanding of its trade partners than it is domestically, which limits the possibilities of imposing rules.

The work of Disdier et al. (2008) lends some plausibility to this hypothesis, since their results suggest that SPS and TBT agricultural measures significantly reduce exports from developing countries to Organization for Economic Co-operation and Development (OECD) countries, but do not affect trade between OECD members.

SPS measures are an important trade policy instrument that ensure the quality and safety of a country's imported goods. In an increasingly connected world, quality assurance and reduced information asymmetry are important for increasing consumer confidence, in addition to providing governments with data on trade-offs they may face when designing this type of policy. This paper thus aims to broaden the discussion of this topic in the literature by identifying the effects of these measures over the period analyzed at the global level as well as the degree of impact based on a country's level of development.

After this introduction, Section 2 presents the theoretical framework, with a brief summary of trade policies, the SPS agreement and its applications, and the theoretical approach of the gravitational model. Then, the methodology used in the paper is presented in Section 3, followed by a descriptive and econometric analysis of the results in Section 4. Finally, the conclusions are presented in Section 5.

2 THEORETICAL ASPECTS

2.1 Trade policies

In recent decades, the number of trade liberalization agreements has increased due to incentives from intergovernmental bodies such as the WTO. Consequently, the number of tariffs on the international trade of goods has decreased. Conversely, the number of NTMs, primarily of the SPS type, has increased both in terms of the number of countries affected and their scope. This is because there is a greater incidence of SPS measures on agricultural products than on manufactured goods, which face fewer trade restrictions in high-income countries, while imposing a greater number of restrictions on agricultural products that are more prominent in the import basket of developing countries (Banco Mundial; FMI, 2008; OMC, 2012). SPS measures are intended to protect the human, animal and plant health of a country against risks from additives, toxins, contaminants and organisms that may be present in imported products (UNCTAD, 2015).

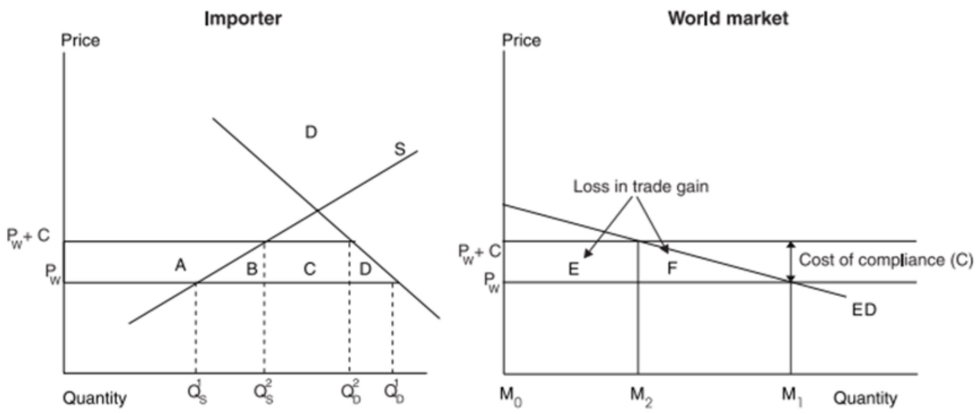
According to Thilmany and Barrett (1997), NTMs threaten trade between countries for the following reasons: 1) technical complexity – because they are technical-scientific in nature, these measures can easily be used for protectionist purposes, as they tend to receive less attention from the media and the general population, in contrast to tariffs, which receive immediate attention from the mainstream media when adopted; 2) incentives for corruption – the authors argue that government regulations can often create a great deal of uncertainty in the market, which leaves room for agents to use corrupt means to obtain undue advantages, due to the difficulty of complying with the rules established by the regulations in force (the entry of low-quality products that are able to circumvent the regulations proposed by NTMs also affects consumer confidence, influencing the market balance of these products) and 3) difficulty of measurement – As discussed in the introduction to this paper, NTMs are difficult to measure compared to tariffs. For this reason, despite progress in reducing quotas and tariffs, technical NTMs still spark intense debates in the context of international trade.

The imposition of an SPS measure may be the result of political pressure or occur in response to a specific event, such as bird flu. These events create great uncertainty for exporters, even if the measures are later repealed. Nevertheless, there is evidence that NTMs used for specific events, such as avian influenza and bovine brucellosis, among others—which were justified in order to contain the spread of those events—had positive effects on world trade (Almeida et al., 2014)

To quantify the magnitude of those effects on the international trade of agricultural goods, Roberts, Josling and Orden (1999) proposed a theoretical model that identifies important aspects of the impacts of those measures on international trade. Figure 1 illustrates the effects of an NTM from the perspective of an importing country, according to the model proposed.

Figure 1

Effects of Imposing a Restrictive Measure on Trade



Source: Roberts, Josling and Orden (1999).

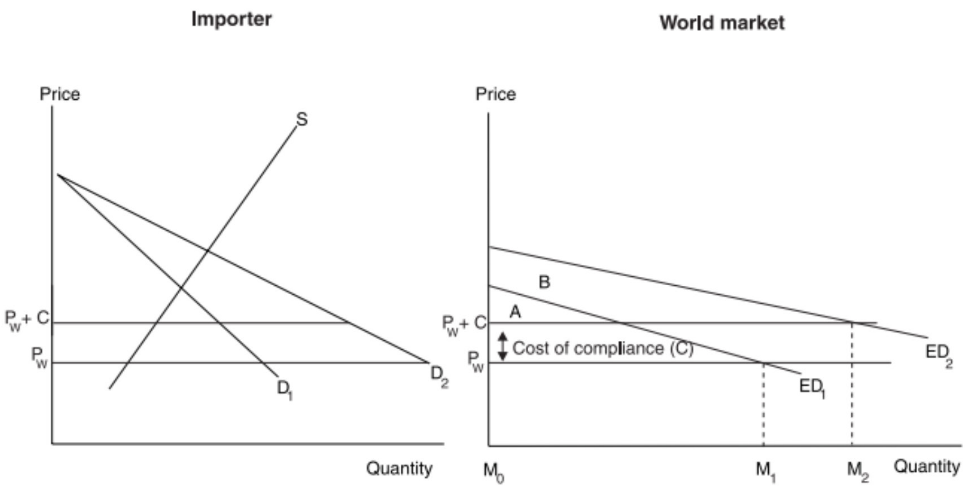
The chart on the left shows the interaction between the supply (S) and demand (D) of a given market according to the world price, P_w, faced by domestic producers and consumers. At this price, the quantity demanded by consumers is given by Q_D^1, while the quantity supplied is represented by Q_s^1. The difference between these quantities represents imports on the world market M_1.

If the importer in this market adopts a universal restrictive regulatory measure, the price of this product in the importing country increases to P_w +C due to the costs of complying with this measure, which concomitantly decreases the quantity imported by the world market to M_2. Although the domestic producer has an increase in its surplus in the size of trapezoid A, the consumer loses in surplus the equivalent of the area of A+B+C+D, and world trade loses the equivalent of the area of E+F, represented in the "World" chart, where it is formed by the intersection between the excess demand (ED) curve and the new price P_w +C.

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

Figure 2

Effects of Imposing an Informative Measure



Source: Roberts, Josling and Orden (1999).

Since in this case the measure was informative, the demand curve moves from D_1 to D_2, which increases the quantity demanded. Thus, in contrast to a restrictive measure, there is an increase in world imports because of this measure, from M_1 to M_2. In this respect, the measure was responsible for generating trade gains, represented by the area of A+B and by the increase in the quantity demanded.

2.2 The gravitational model

According to Baldwin and Taglioni (2006), the popularity of gravitational model in the study of different fields and its wide use in the study of trade between countries are based on three factors: first, international trade flows are a key factor in every type of economic relationship; second, the data needed to estimate it is easily accessible today; and finally, there are many high-quality academic papers that have established standard practices for working with it, which satisfy the needs of many empirical studies.

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

$$X_{ij} = G\frac{M_i M_j}{D_{ij}} \quad (1)$$

where X_{ij} is the value of trade between country i and country j; G is a constant of proportionality; M_i and M_j are the economic masses (GDP) of country i and j respectively; and D_{ij} represents the distance between the two countries.

The first paper to contribute to the theoretical and statistical grounding of this model was Anderson (1979), which was based on the following assumptions: preferences with constant elasticity of substitution (CES); the countries produce both tradable and nontradable goods; and goods are differentiated by region of origin. Subsequently, other studies have 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) gave greater theoretical and statistical quality to the model with the inclusion of multilateral resistance terms, giving theoretical status to the gravitational model and achieving great success in academia.

Porto and Canuto (2004) define trade resistances as being of two types: artificial and natural. Natural resistances are those related to transportation time and transportation cost, among others, while artificial resistances are those imposed by the government, such as import tariffs, exchange controls, nontariff measures, etc. However, these measures can be resistance in some cases and constitute trade facilitations in others. As such, to account for the impact of factors that were not considered in the initial model proposed, variables and dummies that reflect cultural, geographical and economic aspects that can explain trade flows between countries were added to the model.

In short, multilateral resistance is the effect that the exporting and importing countries' position in the global market and their economic situation have on their own bilateral trade. According to Yotov et al. (2016), it is the effect of the price of the other products from all countries on bilateral trade. Thus, Anderson and van Wincoop (2004) developed the following theoretical equation for the gravitational model (simplified here):

$$lnX_{ijt} = \alpha + \delta_1 lnGDP_{it} + \delta_2 lnGDP_{jt} + \delta_3 lnd_{ij} + \Sigma^{M}_{m}=_{1\Upsilon m} lnZ_{mijt} + \mu_{it} \quad (2)$$

where X_{ij} is the exports (or imports) from country i to country j; GDP_i and GDP_j represent the GDPs of countries i and j respectively; d_{ij} is the measure of the distance between countries i and j; Z_{mij} is a set of variables that impact international trade, whether barriers or trade facilitation, including multilateral resistance; and µ is the error term.

The model above was used in this paper to measure the effect of SPS measures on world imports of agricultural goods.

3 METHODOLOGY

First, SPS notifications issued by WTO member countries affecting agricultural products were collected for the period 2000 to 2016, as it was the period with all data available. These measures are available on the Integrated Trade Intelligence Portal (I-TIP/OMC, 2020). SPS measures can be either regular or emergency measures, i.e., the time until the measure enters into force may vary. Regular measures are notified with a deadline before they enter into force, as there is a period during which comments and amendments can be made, and emergency measures may have the consultation time reduced or eliminated due to the urgency of implementation. With these data, a broad descriptive analysis was performed, providing a better view of the use of the agreement by countries.

Subsequently, data on imports of agricultural goods were collected, for all countries with data available, for the period in question. This was done using the International Trade and Production Database for Estimation (ITPD-E), a bilateral trade flow database developed by Borchert et al. (2021) that contains data on international and intranational trade across different sectors. The database includes 243 countries (only WTO members were used), 170 sectors[2] and 26 agricultural industries, which were condensed into a single large sector. It was thus possible to verify the effects of adopting SPS measures on the trade of agricultural products through the following empirical gravitational equation:

$$Y_{ijt} = \alpha + \beta_1 lnSPSregular_{it} + \beta_2 lnSPSemergency_{it} + \beta_3 SPSregdum + \beta_4 SPSemergdum + \varepsilon_{it} + \delta_{jt} + \gamma_{ij} + \mu \quad (3)$$

Where Y_{ijt} is imports from country i to j, in year t; α is the gravitational constant; SPSregular[3] represents the number of regular SPS notifications initiated by country i in year t; SPSemergency is the emergency measures initiated by country i in year t; SPSregdum is the multiplication of lnSPSregular by a binary variable that takes a value of 1 if the country is considered advanced and 0 if not; SPSemergdum is the multiplication of lnSPSemergency by the same dummy; ε and δ are the country-year fixed effects that control for the multilateral resistance terms; μ is the country-pair fixed effects and; μ is the error term. The binary interaction variables were included to check whether the effect of the measures differs between advanced and countries overall.

Piermartini and Yotov (2016) emphasize that, despite a solid theoretical foundation and remarkable empirical success, the gravitational model has been and still is often applied without theoretical grounding and without considering the econometric challenges that can lead to biased and inconsistent estimates.

Accordingly, Yotov et al. (2016) present the main recommendations for the efficient, robust and unbiased estimation of gravitational models: 1) when 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, thereby making it possible to adjust

2 See the list of countries and sectors in Borchert et al., 2021.

3 Due to the large number of zeros, the decision was made to transform SPSregular and SPSemergency = (number of SPS measures initiated + 0.01) to avoid losing observations when applying the logarithm. Bellego, Benatia and Pape (2019) note that many papers use this solution without even mentioning it because it seems innocuous, but the choice of the constant is discretionary and may bias the estimates of the coefficients. However, in the case of discrete explanatory variables, the bias tends to be negligible.

to changes in trade policy; 3) intranational trade data should be included, constructed as the difference between gross production value data and total exports, making it possible to include nondiscriminatory policies; 4) directional time-varying (country-year) fixed effects should be included in the panel data to control for multilateral resistance (this means that GDP data are not included due to collinearity) 5) country-pair fixed effects should also be included, correcting for endogeneity between trade policy and exports (thus, time invariant data such as distance, common language and contiguity is excluded due to collinearity) and 6) the Poisson pseudo maximum likelihood (PPML) estimator should be used to prevent sample selection bias and correct for unobservable heteroscedasticity.

When employing the above recommendations, it is no longer necessary to perform traditional econometric tests. The use of PPML ensures the correction of heteroscedasticity; the adoption of time intervals prevents autocorrelation (also the clustering of standard errors); the inclusion of multilateral resistance terms and country pairs explain most of the trade by capturing the effect of different observable and unobservable factors, avoiding the bias of omitted variables, and finally, the theoretical design of the model ensures that it should be estimated by fixed effects.

Time intervals were used, as indicated by Yotov et al. (2016), to allow for the necessary adjustment following changes in trade policies, with the most statistically robust configuration being the one with the years 2000, 2004, 2008, 2012 and 2016.

Notably, most SPS measures are nondiscriminatory, i.e., when issued by a given country, they affect trade with all countries. There are, however, measures that affect only one (or some) trading partner(s). This has been taken into consideration when organizing the database, with the result that not all trading partners are affected by the same number of measures in the final grouping.

The estimation of the empirical model (equation 3) was performed using the PPML method, as recommended by Yotov et al. (2016), but using the package developed by Correia et al. (2020) for STATA software, PPMLHDFE, which is most efficient in the presence of large fixed effects (large number of cross sections).

It was thus possible to verify whether SPS notifications, initiated in the period from 2000 to 2016, were informative measures, i.e., trade facilitators, or restrictive measures, i.e., trade barriers.

4 RESULTS AND DISCUSSION

During the period under analysis, a total of 8,222 SPS measures were issued, of which approximately 19% were emergency measures and 81% were regular measures. Three Latin American countries are among the countries that issued the most MNTs: Peru, Brazil and Chile. Martin (2018) notes that since the 1990s, domestic production and trade in developing countries has grown substantially compared to that in developed countries. In response to the growth of the consumer market in those countries, there is increased demand for higher quality products as well as an increase in the flow of foreign direct investment, particularly in the retail sector (Maertens and Swinnen, 2015).

Among developed countries, as expected, the United States, China, Canada, New Zealand, Japan, and European bloc countries appear in the chart. Developed countries have higher trade restrictions on agricultural products than on manufactured goods. The Tariff Trade Restrictiveness Index (TTRI) for high-income countries, which represents the tariff equivalent of measures imposed on their imports, is approximately 12.4 percent for agricultural products and approximately 1.4 percent for manufactured goods (Banco Mundial; FMI, 2008).

Table 1 below presents the econometric estimation results.

Table 1

Results of the estimation of equation 3

Variable	Coefficient	Standard errors
lnSPSregular	0.1135573***	0.008965
lnSPSemergency	-0.0252533**	0.0077017
SPSregdum	-0.0186365**	0.010511
SPSemergdum	-0.0029665ns	0.0087224
Constant	10.51232***	0.0034094
Pseudo R2	0.9964	
Wald chi2	173.29***	
No. of observations	96033	
Exporter-year FE	Yes	
Importer-year FE	Yes	
Country-pair FE	Yes	

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

Source: the authors.

The estimated model has overall statistical significance and a very high degree of fit of 99.64% (Pseudo R^2), which translates into parsimony in the estimates. However, this high degree of fit always occurs in the presence of multilateral resistance terms, which explain most of the trade. The Wald Chi^2 test confirms that the set of independent variables are collectively significant for the model.

Based on the results, it is possible to observe a positive and statistically significant relationship between regular SPS measures and global imports of agricultural goods. This indicates that in the period analyzed, these measures were trade facilitators, a finding that is consistent with the results reported by Alves et al. (2014) and Santeramo et al. (2019). In the case of emergency measures, the coefficient was also statistically significant but negative.

An increase of 10% in regular SPS notifications issued by countries in the period generated, on average, an increase of 1.13% in imports, and the same increase in emergency measures generated a reduction of about 0.25% in imports. One possible explanation for these results is that the regular measures met consumer requirements and decreased information asymmetry for the respective products traded in the period, as illustrated in Figure 2. However, emergency measures were barriers to trade in the short term. The main hypothesis for this difference is that emergency measures are adopted immediately, i.e., countries do not have time to adapt, as in the case of regular measures. This is in line with Gourdon et al. (2020), who showed that some technical measures within the overall SPS and TBT category can have both a trade enhancing effect while also raising trade costs.

The estimated coefficient for the *spsregdum* interaction dummy was statistically significant and negative, showing that the positive effect of regular SPS measures is smaller for advanced countries. An increase of 10% in regular SPS measures generated a decrease of about 0.186% in imports from advanced countries compared to those from countries overall. The difference between the effects of these measures according to a country's degree of development is corroborated by Santeramo and Lamocana (2022), who found a positive relationship between the number of SPS measures implemented by developing countries and imports from those countries. The *spsemergdum* variable was not significant, and it was not possible to verify differences with respect to emergency measures according to a country's degree of development.

Finally, as noted by Corrêa and Gomes (2018), in many cases, the benefits of NTMs (in this case, SPS measures) outweigh the evils, for the following reasons: product standardization increases product safety and consumer confidence; given the principle of national treatment, countries that impose a measure must also bring their products in line with it, facilitating a country's exports by setting better quality standards; the sharing of information through measures can help a country improve its products and assessment processes; and finally, there is an international spillover effect, as countries that incorporate a measure can make their products better for both the countries that buy them and for their domestic consumers.

Accordingly, the results of this paper provide evidence of the importance of the SPS agreement, not only for safeguarding the quality of products and the safety of both consumers and the environment but also for stimulating the international trade of agricultural goods. The agreement is thus an important instrument for strengthening and encouraging international trade. When used legitimately, it enables a country to achieve those objectives. It is hoped that these results can contribute to the discussion on the subject and to the formulation of public policies that encourage greater integration among countries, in order to incentivize the standardization of norms and regulations and to strengthen the dialog among WTO member countries.

Given the benefits of the SPS measures demonstrated here, it is hoped that the quest to standardize products worldwide will lead to global benefits in trade and production. As such, policies and actions are needed to bring firms into line with the latest international standards.

5 CONCLUSIONS

Despite their scientific nature and the fact that their primary objective is to protect human health and the environment, SPS measures can be trade barriers, hindering trade between countries and different trade liberalization initiatives and proposals. Conversely, they can be great allies to international trade, acting as trade facilitators due to product standardization and the consequent quality assurance.

Given the ambiguous nature of the effects of SPS measures, the objective of the present paper was to assess their impact on world imports of agricultural products during the period from 2000 to 2016 as well as whether their effects differ for countries considered advanced and emerging. The hypothesis considered was that these measures stimulated imports from developed countries and not developing countries.

The descriptive analysis of the data showed that during the period, SPS measures followed an upward trend. There was a predominance of regular measures that were nondiscriminatory in scope, affecting all WTO member countries. In terms of the countries that issued the most measures, major exporters of agricultural commodities, such as Brazil, and developed countries, along with the European bloc and China, were the most prominent.

With respect to the estimation of the gravitational model, the results showed that contrary to expectations, the estimated coefficient for regular measures was statistically significant and positive for both advanced and emerging countries. One possible explanation for this result is that standardization raises consumer confidence in products and reduced information asymmetries. As a consequence, demands increased relatively more than compliance costs. With regard to the difference between advanced and overall countries, this can be explained by the fact that products from advanced countries are already more trustworthy than those from emerging countries, and the information gain is smaller with SPS measures.

International trade is becoming increasingly more important in an increasingly interdependent and globalized world. As a result, nations, governments, companies and even individuals must adapt to this new environment. This process has provided opportunities for all countries to expand their markets, enter previously unexplored areas and acquire all types of knowledge and technology. These opportunities come with new quality standards and consumer demands that must be met. Consequently, the SPS agreement is a tool for making these opportunities a reality as well as for expanding and improving world trade.

MEDIDAS SANITÁRIAS E FITOSSANITÁRIAS E SEUS EFEITOS SOBRE O COMÉRCIO INTERNACIONAL AGRÍCOLA

Resumo

Medidas sanitárias e fitossanitárias (SPS) podem ser barreiras ou facilitadoras de comércio. Portanto, o presente estudo avalia seus impactos sobre as importações agrícolas entre 2000 e 2016 e determina se seus efeitos diferem para os países avançados, usando um modelo gravitacional. Os resultados indicaram que as medidas SPS regulares geraram efeitos positivos para as exportações dos países, embora em menor grau para os países avançados. Portanto, os resultados demonstraram a importância do acordo SPS, não apenas para proteger a qualidade dos produtos e a segurança dos consumidores e do meio ambiente, mas também para estimular o comércio internacional agrícola.

Palavras-chave: Comércio agrícola; medidas sanitárias e fitossanitárias; modelo gravitacional.

JEL: F13; F14

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