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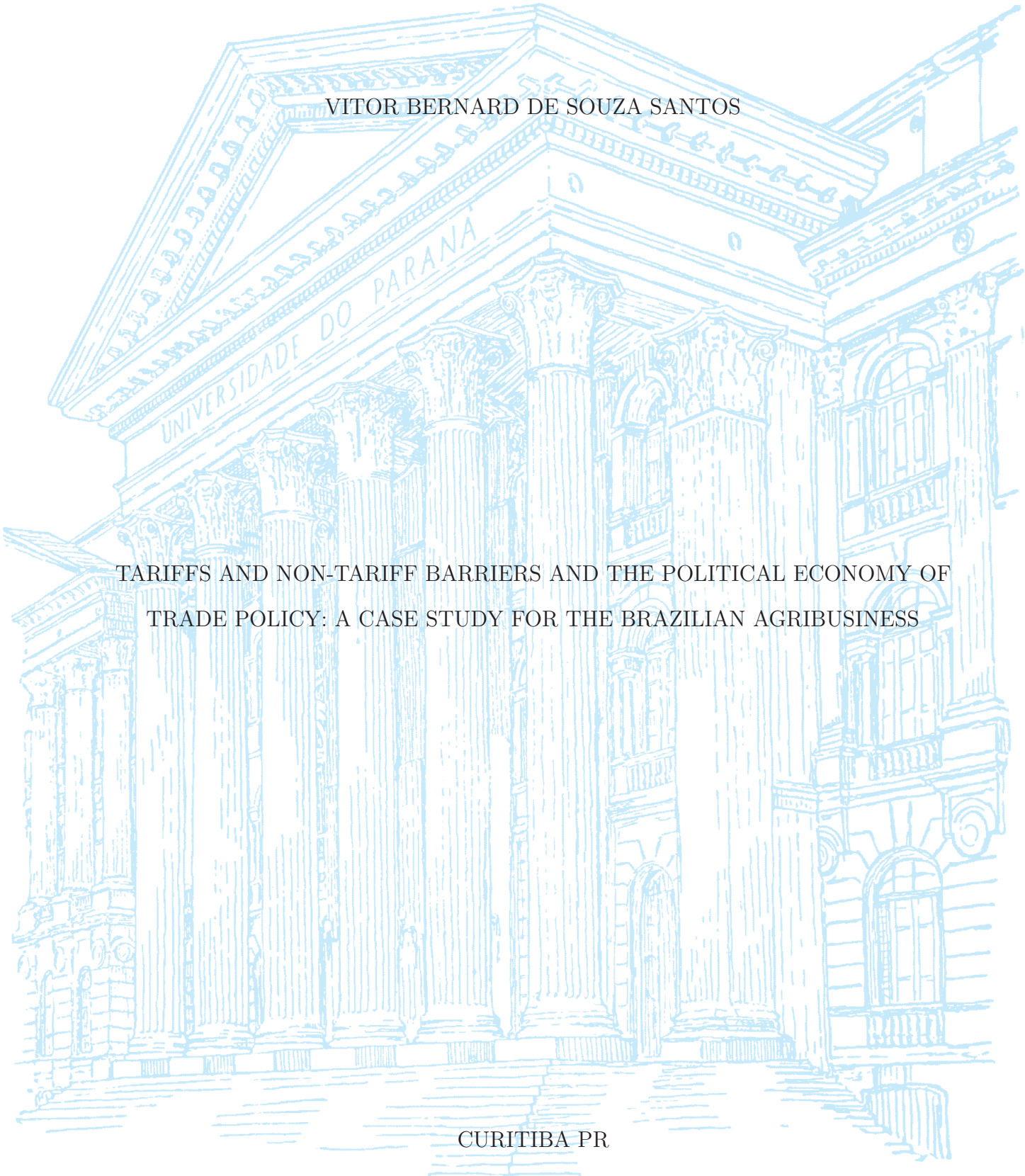

TARIFFS AND NON-TARIFF BARRIERS AND THE POLITICAL ECONOMY OF TRADE POLICY: A CASE STUDY FOR THE BRAZILIAN AGRIBUSINESS

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TARIFFS AND NON-TARIFF BARRIERS AND THE POLITICAL ECONOMY OF TRADE POLICY: A CASE STUDY FOR THE BRAZILIAN AGRIBUSINESS

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Os membros da Banca Examinadora designada pelo Colegiado do Programa de Pós-Graduação DESENVOLVIMENTO ECONÔMICO da Universidade Federal do Paraná foram convocados para realizar a arguição da Dissertação de Mestrado de **VITOR BERNARD DE SOUZA SANTOS** intitulada: **Tariffs and non-tariffs barriers and the political economy of trade policy: A case study for the Brazilian agribusiness**, sob orientação do Prof. Dr. MAURICIO VAZ LOBO BITTENCOURT, que após terem inquirido o aluno e realizada a avaliação do trabalho, são de parecer pela sua APROVAÇÃO no rito de defesa.

A outorga do título de mestre está sujeita à homologação pelo colegiado, ao atendimento de todas as indicações e correções solicitadas pela banca e ao pleno atendimento das demandas regimentais do Programa de Pós-Graduação.

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To my family.

All theory depends on assumptions which are not quite true. That is what makes it theory. The art of successful theorizing is to make the inevitable simplifying assumptions in such a way that the final results are not very sensitive.
*(**Robert Solow**)*

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É interessante olhar para trás e ver o quanto avancei, as dificuldades superadas e momentos que na parede da memória, são os que me trazem mais alegria. Ao mesmo tempo, olhando para além do horizonte, os desafios mostram-se cada vez maiores e complexos. É estranho pensar que muitas vezes é apenas você e seu computador numa noite solitária, brigando para sair uma linha de raciocínio que faça sentido. Ir dormir sabendo que fez o melhor naquele dia. Acordar e repetir o processo.

Tenha uma boa leitura!

RESUMO

Este ensaio tem por objetivo estudar o comportamento do agronegócio brasileiro nos mercados internacional e doméstico. O agronegócio vem aumentando sua importância no funcionamento da economia brasileira, se tornando um importante *player* no mercado internacional, bem como sendo um dos maiores produtores agrícolas do mundo. A análise é baseada na inserção do agronegócio nos mercados externos e como as medidas comerciais aplicadas por outros países podem afetar a dinâmica e performance do setor, bem como de toda economia brasileira. Este trabalho emprega uma abordagem teórica construida para estudar as importações de produtos agrícolas do Brasil. Os resultados obtidos são muito heterogêneos, se observando muita variação entre os setores, e sugerindo que as medidas não tarifárias tem um considerável impacto nas importações bilaterais ainda não mensurado.

Palavras-chave: Comércio Internacional. Barreiras Comerciais. Política Comercial.

ABSTRACT

This essay aims to study the behavior of the Brazilian agribusiness on international and domestic markets. The agribusiness has been increasing its importance in the operation of the Brazilian economy, becoming and playing an important role on the international market as the one of the main producers of agricultural products. The analysis is based on the insertion of the national agribusiness sector on foreign markets, and how trade barriers applied by other countries can affect the dynamics and performance of the sector, as well as of the whole Brazilian economy. This work employs a single-export setup model to study the Brazilian agricultural sector, through gravity equation. The results are very heterogeneous across sectors, suggesting that NTM's have a considerable impact on bilateral imports, as well as the tariffs.

Keywords: International Trade. Trade Barriers. Trade Policy.

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1.1 INTRODUCTION

Although the low insertion of the Brazilian economy into the international trade scenario, it is possible to observe a strong advance of the agricultural sector in the country. The rapid growth of the sector made the Brazilian products gain space in foreign market, becoming one of the largest producers and exporters in the world. Since the 90's, Brazilian economy experienced a liberalization process in their production facilities in several sectors. However, it was in the agribusiness sector that Brazil appears as major player in the international market. In 2020 Brazil became the largest producer of soy-bean, by Embrapa (2022), and is responsible for just over one-third of this market. Also, Brazil is the biggest sugar and coffee producer, and plays an important role in the corn, meat, and cotton markets. All this considered, it is not hard to note the importance of the agribusiness in the Brazilian economy.

The study of trade policy often highlights two behaviors between developed and developing countries: developed countries are less inclined to use tariffs, but more attracted to the use of non-tariff measures (NTM's), while developing countries having the opposite behavior (Bown and Crowley, 2016). The larger use of tariffs as main tool of trade policy by developing countries can be explained by the need for more revenues. By the other hand, developed countries are so integrated to global economy that non-tariff measures turn up to be the most efficient tool to make trade policy.

Brazil, regarded as a developing or emerging country, suffers from measures from developing and developed countries. The agribusiness sector faces high tariffs from developing countries, while facing highly restrictive measures from developed countries. Yet, the agricultural sector has a different legislation, with countries committing to follow the *Agreement on Agriculture* (WTO, 1995), given that the agricultural sector is one of the main sectors that receive some kind of protectionist policy, (Bown and Crowley, 2016; Ederington and Ruta, 2016), and creates a situation that Brazil's agribusiness products are highly affected by these policies.

This research investigates what is the impact of the tariffs and NTM's imposed against Brazilian agribusiness products by its the major trade partners. Countries can apply any kind of barrier to the Brazilian products if they consider that the competition is not fair and Brazil has lower prices due to more flexible regulations in relation to sustainability or labor laws, for example. The application of the NTM's against the main Brazilian agricultural products by the main trade partners affects directly the performance of the trade sector, and, consequently, the whole Brazilian economy.

This investigation collects and classifies the tariffs and NTM's applied against the Brazilian agribusiness products, which allows us to understand which are the main kinds of trade measures that affect the agribusiness, as well as the most affected agricultural products. This classification will be made following the Haveman et al. (1999) definitions. Also, this essay aims to measure the impact of such measures on the bilateral trade agribusiness sector among Brazil and the 20 main Brazilian importers.

The research concentrates on two areas: data collection and the theoretical model. First, I show that through some different approaches in the model, as well as in the

empirical strategy, the range of analysis in trade works grows exponentially, especially when dealing at the most disaggregated level of products. Second, I advance in the theoretical approach, modifying the Haveman et al. trade model to a single-exporter setup, instead of using the traditional gravity models. In this approach, I split the tariff and NTM's into three effects: reduction, compression and diversion.

Two kinds of regressions are estimated: joint regressions, when the products are estimated together without sectoral distinction; and individual regressions for each of the 25 sectors. All estimations are made through the Poisson Pseudo Maximum Likelihood (PPML), proposed by Correia et al. (2020). The results suggest that the reduction effect for tariffs is in line with which already is observed in the literature, a negative effect of tariffs on bilateral imports. The compression effect is positive for all specifications and across sectors, which indicates that fixed costs are important and tends to concentrate the imports of Brazilian agribusiness products into the largest importers. The diversion effect for tariffs does not show statistical significance and robustness across specifications. For NTM's, the results are very heterogeneous, changing from sector to sector, as well as the coefficient signs are mixed.

1.2 LITERATURE REVIEW

The value of tariffs has been decreasing over time, mainly after the conversion of the GATT into WTO (Clemens and Williamson, 2004). However, the non-tariff barriers (NTB's) become an important tool to regulate and impose restrictions in determined sector or product, mainly in developed countries (Lee and Swagel, 1997). So, the effects of a NTB removal can open markets and reduce protectionism, which was the focus since the Tokyo Negotiations Round (Quambusch, 1977; Harrigan, 1993). It is necessary to highlight what is the definition and difference from a tariff barrier to a non-tariff barrier. In simplistic terms, a tariff barrier can be understood as a trade-flow restriction imposed against a country-sector or product, such as import duties and anti-dumping duties.

The initial definition of a non-trade barrier is related to the fact that it is a political act, generated by pressures from private groups and industries for protection against foreign competitors. Thus, we can have three types of NTB's (Quambusch, 1977): legislative, administrative, and emotional protectionism. The first concerns about quantitative restriction on foreign products, such as import and export embargoes. The second is related to more 'bureaucratic' questions, like market regulations to protect the consumers, protection of human rights and natural environment, safety regulations, and so on. The third kind of protectionism evokes a patriot feeling on the consumers part, proposing boycotts to the foreign products.

Some kind of barriers are imposed to standardize the quality of the product imported, but other types of barriers try to equalize the internal and foreign regulations, for instance, these barriers can take the form of a sanitary or phytosanitary barrier (SPS). Technical barriers to trade (TBT) can be harsher than traditional quantitative barriers, in a way that the manner in which the technical barrier will be implemented reflects their goal. Initially used by the policy makers as a tool to ensure quality of the products, it becomes a source of political decisions, with the domestic market pressuring local regulators for protection (Quambusch, 1977; Summer and Lee, 1997; Roberts, 1999)

There are four reasons to adopt the NBT's: 1) to avoid negative externalities from the imported product; 2) high information costs about the health, hedonistic, and ethical attributes of the products. Most of these attributes are unknown or with information

asymmetrically distributed; 3) enable an industry to reach their potential and have economies of scale; 4)environmental resources. Then, despite the protectionist aspect of the NTB's, which is not their goal, in many cases these barriers are imposed to protect the welfare of the importer consumer (Roberts, 1999).

Nowadays, it is common to use the term non-trade measures (NTM's) instead of non-trade barriers (NTB's). Despite similarities, the terms are not synonymous. NTB is related to at-the-border policies, and imply in a direct restriction of trade, such as import bans, quotas, export subsidies, and import license. NTM is related to both behind-the-border and at-the-border policies, which in turn not necessarily means a restrictive measure to trade. As NTM's include a wide range of measurement that can be applied, its effects are often indeterminate, since they can be quotas or a guideline that specifies how the logistics must be made. Thus, studies that work with NTB's and others with NTM's, can differ methodologically, but the results can be jointly assessed.

Countless papers address the tariffs and non-tariffs barriers and its effects on the most diverse areas of the economy. Harrigan (1993) did not find expressive effects of the NTB's on gross imports, but significant effects of tariffs and transport costs on trade flows. Lee and Swagel (1997) results suggest that NTB's proves to be a more critical barrier to imports than tariffs. The achieved results can imply that trade barriers decrease trade flow, but is not possible to distinguish which is more damaging: NTB's or tariffs (Lee and Swagel, 1997). Across industries, tariffs and NTB's have a significant and negative impact on trade, and its efficiency may be influenced by the import demand elasticity, and the degree of products differentiation (Haveman et al., 1999). More recently, Hoekman and Nicita (2011) results corroborate the previous findings of the literature: distance, common language, and size are robust determinants of bilateral trade.

Ederington and Ruta (2016) conducted a literature survey to identify the major impacts of NTM's on trade. In general, the results summarized by the authors indicate that NTM's have a negative effect on trade and its ad valorem tariff equivalent (AVE) is usually higher than tariffs. Getting into the specifics of the applied measures it is possible to note that the effect is not uniform across products and across countries, even analyzing the same NTM. Chen (2004) found that the TBT's are significant to explain the "border effect", affecting negatively intra-trade and international trade in European Union. Sithamaparam and Devadason (2011), looking the effects within the NTM's, found that the technical barriers to trade are more restrictive than other measures, such as sanitary/phytosanitary.

Turning to the agricultural sector, the decades of 1980s and 1990s were marked by the reduction of tariffs, but the increase of NTB's, mainly in the form of technical barriers to trade, as well as the sector experiencing a drop in such barriers less than other sectors (Summer and Lee, 1997; Mattson et al., 2004; Hoekman and Nicita, 2011; Mendes et al., 2019; Nonnenberg et al., 2020). Having a closer look at the Brazilian agribusiness, since the re-democratization process in the mid-1980's, it is possible to note a growing international insertion and an increase in the role of Brazil in many agricultural products, such as soybean, sugar, coffee, and meat (Aragão and Contini, 2021). Yet, the agribusiness sector reached 27% of the Brazilian GDP (CEPEA, 2022).

Haveman and Thursby (2000) uses all the theoretical and econometric background developed by Haveman et al. (1999) to focus specifically on the agricultural markets. They found that the country pair effects, such as distance, common language, or common border, are significantly different over time and by the stage of development of the country, as well as a significant effect from developing countries of compressing its imports into the

largest suppliers. Roberts (1999) and Weyerbrock and Xia (2000) noted that restrictions blocked billions of dollars in trade between US and other countries, affecting directly the performance of the US agricultural sector and the trade flow between the economies.

Ederington and Ruta (2016) survey shows that, in general, the papers that studied the NTM's report a negative effect of these measures on trade. Also, the majority of these papers focused on the effect of SPS. Schlueter et al. (2009) found that the type of SPS measure affects distinctly the trade on meat sector, for instance, "disease prevention measures" affects trade positively, while "production process requirements" affects negatively. Yet, some measures can be positive for developed countries, while negative for developing countries. Ferrantino (2012) and Essaji (2008) show that technical regulations highly affect poor countries, mainly through the costs of compliance that tend to be high.

Nonnenberg et al. (2020) shows that, during the period 1970-2017, the number of NTM's applied against the Brazilian agribusiness products has been growing over time, and that the major NTM faced by Brazilian products is the SPS. Bovine and poultry meats and soy bean are the products most affected by foreign regulations. Relatively to other countries, Brazil does not receive a high amount of barriers, however, the countries which receives the largest number of NTM's also have a low participation in the export share of these products, while Brazil often is the biggest exporter. Taking everything into account, it is not hard to note the importance of the agribusiness in the Brazilian economy, so that the implementation and prevalence of the trade barriers over the agribusiness products affects the national economy as a whole.

Studies for Brazilian agricultural sector are scarce. De Miranda and Barros (2015) analyzed the effects of the NTM's on Brazilian beef exports from March 1995 to September 2000, and found that only two interventions, out of a total of thirteen, were significant and had a negative effect on sector exporters. Ferraz et al. (2017) applied the gravity equations to estimate the effect of tariffs and NTM's on bilateral imports of Brazilian products, by dividing the NTM's into sanitary/phytosanitary and technical barriers to trade. The results obtained vary across specifications, but they were positive for the most part of regressions. Nonnenberg et al. (2020) analyzed the Brazilian agribusiness sector exports from 2002 to 2017, and did not found a clear relation between the number of NTM's and bilateral trade flow.

1.3 THEORETICAL MODEL

Nonnenberg et al. (2020) argues that the NTM's can not be treated equal to tariffs, being necessary a different approach that distinguishes the goal of that barrier applied, as well as the approach for NTM's needs improvements to provide better information in empirical models. Thus, I follow Haveman et al. (1999) baseline model. The model is characterized as an economy with bilateral trade among countries i and j and the commodity k, in a setup of monopolistic competition. This model is appropriate for both homogeneous and differentiated products. The model described below has some changes, since I work in a single-exporter setup.

Let's begin through the foreign economy, the demand side. The utility function of each importer is defined as

$$U = \prod_{i=1}^{n} x * v_i, \tag{1.1}$$

such that x is the quantity that each importer consume for each variety, v_i is the number of varieties produced by i, and n is the total number of countries that the importer trades.

Two statements are made here: (i) the number of varieties produced by i is directly proportional to the size of the country; (ii) nothing can be said about the size of the importers.

Starting by (ii), a country may not be prominent in the subset of imported varieties, when looking for the whole, consumption market becomes larger, which implies that a particular country can import substantial share of each variety and is a major importer for the whole set of production on exporter view. But, a country can specialize in importing a certain subset of varieties that the exporter offers. This means that even though this importer may be significant within that subset, when considering the entire set of imported varieties, this importer is small compared to others. The statement (i) is more direct and keeps the proportionality between the country size (e.g. production capability) and the number of varieties produced by the country. A country that is smaller in size, does not have structure to produce more varieties than its production capability allows.

The total utility of the economy is defined as an aggregation over the K sectors in this economy,

$$U = f(U_1, ..., U_K),$$

and the sub-utility for each sector is an aggregator, CES type, over the varieties in that sector, given by

$$U_k = \left(\sum_l X_{kl}^{\theta} \right)^{\frac{1}{\theta}}, \tag{1.2}$$

such that $\theta = \frac{\sigma - 1}{\sigma}$. σ is the elasticity of substitution over varieties. The i imports from j for a unique variety of product k is

$$m_{ij} = Y_i \frac{(t_{ij} p_j)^{-\sigma}}{P_i} \tag{1.3}$$

such that Y_i is the income of country i, t_{ij} is the exporter-specific tariff, and P_i is a price index in country i defined as

$$P_i = \left(\sum_j (t_{ij} p_j)^{1-\sigma} \right).$$

The equations 1.2 and 1.3 describes the operation of consumption side in the economy. it is possible to note that the equation 1.3 gives us the bilateral imports from j to i, when the demand is a single variety of product k. To allow more than one variety in this economy, it is necessary to describe the behavior of production side. There are four equations:

$$L_j = a + bX_j \tag{1.4}$$

$$P_j = \theta^{-1}(bW_j) \tag{1.5}$$

$$X_j = \frac{a}{b} \frac{\theta}{(1-\theta)} \tag{1.6}$$

$$n_j = \frac{L_j}{a(1-\theta)} \tag{1.7}$$

Equations 1.4 to 1.7 address the behavior of production side in the exporter country. Equation 1.4 refers to the technology of production. Equation 1.5 refers to the markup over marginal costs, since we are working in a monopolistic competition and the supply price is a function of the product of marginal production and firms markup

(Anderson and Van Wincoop, 2004). Equation 1.6 gives us the quantity of each variety that is produced. Equation 1.7 determines the number of varieties that exist.

Thus, the import demand over all varieties n_j is

$$M_{ij} = n_j Y_i \frac{(t_{ij} p_j)^{-\sigma}}{P_i} \tag{1.8}$$

such that the index price described previously is now defined as

$$P_i = \left(\sum_j n_j (t_{ij} p_j)^{1-\sigma} \right). \tag{1.9}$$

Making the substitution in the equation system, we get the bilateral imports of good k over all varieties available in the economy. Formally:

$$M_{i,j}^k = \alpha_i^k \gamma_j^k Y_i Y_j \frac{(p_j^k t_{ij}^k)^{-\sigma}}{P_i^k} \tag{1.10}$$

such that M_{ij} is the value of the bilateral imports among trade partners i and j; Y_j is the income of country j; α_i^k is the share of good k in country i consumption; γ_i^k is the production share of the good k in country j; p_j^k is the commodity k price in country j. P_i^k is the domestic price index for the commodity k, now defined as

$$P_i = \left(\sum_l \gamma_i^k Y_i (t_{ij} p_j)^{1-\sigma} \right).$$

As it is, the model predicts the elasticity of substitution between the domestic and foreign varieties to be the same, as stated in equation 1.2. Modifying 1.2 to incorporate a different elasticity of substitution between foreign and domestic varieties, gives

$$U_k = \left\{ \left[\left(\sum_l X_{kl}^\theta \right)^{\frac{1}{\theta}} \right]^\delta + \left[\left(\sum_r X_{kr}^\theta \right)^{\frac{1}{\theta}} \right]^\delta \right\}^{\frac{1}{\delta}} \tag{1.11}$$

such that l indexes foreign varieties and r domestic varieties. $\delta = \frac{\rho - 1}{\rho}$, where ρ is the elasticity of substitution between domestic and foreign varieties. Now, the utility in each sector address the fact that consumers can have preference for home varieties. Deriving an equation to describe country i expenditure on foreign varieties, we have

$$M_{i,j}^k = \left[\frac{(P_i^k \tau_i^k)^{-\rho}}{\Gamma_i^k} \right] \alpha_i^k \gamma_j^k Y_i \tag{1.12}$$

such that τ_i^k is the average tariff on commodity k and

$$\Gamma_i^k = (P_i^k \tau_i^k)^{1-\rho} + (P_i^{k*})^{1-\rho}$$

is a price index covering domestic and foreign varieties already defined. Including this modification in equation 1.10, the model is defined as

$$M_{i,j}^k = \left[\frac{(P_i^k \tau_i^k)^{-\rho}}{\Gamma_i^k} \right] \alpha_i^k \gamma_j^k Y_i Y_j \frac{(p_j^k t_{ij}^k)^{-\sigma}}{P_i^k} \tag{1.13}$$

and transforming the model specified in equation 1.13 into logarithmic form, we have:

$$ln(M_{i,j}^k) = -\rho ln\tau_i^k - \sigma t_{ij}^k + ln(\alpha_i^k) + ln(\gamma_j^k) + ln(Y_i) + ln(Y_j) - \sigma p_j^k - ln\Gamma_i^k - \rho P_i^k \quad (1.14)$$

The model captures the intuition that the imposition of an uniform tariff will lead an uniform contraction of each exporters trade, and the reduction in tariffs leads to a redistribution among exporters. Trade costs are significant for the determination of the trade patterns, mainly when the country who faces considerable fixed costs tends to concentrate the trade in a small group of large importers, such that the benefit to trade outweighs the costs to trade.

Thus, the model holds two kind of effects, the reduction (τ_i) and the diversion effect (t_{ij}). The first one is related to the reduction of exporter's trade, due to an import tariff applied by the importer i. The second one is related to the relative redistribution of imports between the exporters. The more a country suffers from trade measures, the more the importers tend to diversify the imports from countries that suffer less from these measures. Therefore, it is expected that a greater differential of tariffs leads to a greater diversification.

A third effect appears from the fixed costs, such as infrastructure and transport costs, which is nominated as compression effect. This effect is fully modified in this work, since the model is built to be a single exporter-model. In the Haveman et al. (1999), fixed costs would have an effect of concentrate the imports into the largest suppliers, given the fixed costs are increasing in the value of the exports. Thus, here the proposition of this effect loses its meaning. Thus, this effect here is built to capture that the bigger the fixed costs embedded in the commercial transaction, the more the exporter tends to restrict its trade into the largests importers, with lower opportunity cost to trade.

As previously highlighted, , the great difficult to include NTM's in trade equations is the way in which they are modeled. Some papers work with dummies and others with the quantity of NTM's applied to that sector/product. Here, I follow Haveman et al. (1999) approach, by splitting the NTM's into four categories: price, license, quantity, and quality. This differentiation among the NTM's is necessary in an attempt to capture the essence of the NTM, not only its general and aggregated effect. Thus, I do not distinguish between sanitary, technical barrier, or other measure, since I analyze their likely final effect.

Price refers to NTM's that the main objective is to affect the competition through prices, like subsidies to export or price controls. License refers to NTM's that impose bureaucratic requirements to allow trade, such as a licensing anchored in the local production or for political reasons given the origin country. Quantity refers to NTM's that impose a quantitative restriction to import/export some product, for instance, quotas or embargo. Quality refers to NTM's that, in some way, impose a measure based on the product quality or requires specific features in that product. So, the NTM's are applied over four l categories.

In addition to the tariffs and NTM's effects, trade costs are a range of factors that have considerable effects on bilateral trade. The way in which trade costs are modeled affects directly the outcomes of the model, but in general, the functional form is specified in an *ad hoc* way, according to Anderson and Van Wincoop (2004). The literature already has well established some observable-factors that affect the bilateral trade between trade partners. Some of these are: distance, trade agreements, borders, language, infrastructure,

and others (Bougheas et al., 1999; Limão and Venables, 2001; Anderson and Van Wincoop, 2004; Anderson, 2011; IMF, 2018; Nonnenberg et al., 2020).

However, in a single-exporter model some of these variables are no longer required to be part of the model. Applying the fixed-effects that the model requires, some of these variables become redundant and/or time-invariant if worked in a panel dataset, even in a cross-section. Thus, the possibility to include these variables into empirical specification is discussed in the following sections.

1.4 DATA

1.4.1 Sources and sample

The database is constructed using two main data-sources: the TRAINS-UNCTAD (United Nations Conference for Trade and Development), and the World Integrated Trade Solutions (WITS-UN COMTRADE). Also, the World Bank Database is used to get more information to the empirical specification. Table 1.2 summarizes the sources, selected variables, and the labels of these variables that are contained in the empirical model.

Our sample data refers to the period 2000-2017, focusing on the main Brazilian agribusiness trade partners, disposed on table 1.1. The time cut-off ensures homogeneity in data availability, and saves time in the treatment required. It is necessary to highlight the great difficulty to get information about trade barriers. Even with the advance of data availability, tariffs and non-tariff measures requires a great effort, given the large amount of data necessary for the study. Notwithstanding the difficulty to obtain the data, a deep treatment was necessary to clean it[1].

Table 1.1: Sample Analysis

Panel A: Countries used in the sample			
Algeria	Egypt	Mexico	Saudi Arabia
Argentina	European Union	Pakistan	South Korea
Bangladesh	Indonesia	Russia	United Arab Emirates
Chile	Iran	Thailand	United States of America
China	Japan	Turkey	Vietnam
Panel B: Top 12 agricultural exporters in 2018			
Australia	China	Indonesia	Russia
Brazil	European Union	Mexico	Thailand
Canada	India	New Zealand	United States of America

Source: Prepared by the author.

Usually, in multilateral trade models, the selection of the countries that will be part of the study is important to avoid a massive presence of zero flows on the database, and also to assure that our study reflects the main dynamics of the analyzed sector. In a single-exporter setup, with sample restriction, this selection becomes more important since it is expected that not all countries imports the Brazilian agricultural products. Thus, I focus on the countries that together sum up to around 90% of the total export destination of the sector.

In this study, I work with the European Union as a single economy. This choice occurs due to the fact that the NTM's and tariffs are applied by the EU as a whole, thus this variables are equal across all Bloc members. Additionally, the original intention was to work with Taiwan and Hong Kong as one of the top importer countries, since they are

[1]Appendix C has a detailed explanation on the approaches and methods used to treat the datasets.

individually great importers of Brazilian agricultural products. However, as some of the data relative to these countries are not available (tariffs, for instance), much because of the One China Policy, these countries were replaced by Iran and Egypt.

The bilateral imports trade-flow database contains information for 33 sectors[2] at HS-2[3], with a total of 624 products at HS-6, in which the frequency of the data is determined by the data availability for each importer.

Table 1.2: Data source, variables and label

Variable	**Label**	**Data source**
TAR	Simple average tariff rate	WITS-TRAINS
M	Bilateral imports trade-flow at currents $ dollars.	WITS-UN COMTRADE
NTM	Non-tariff barriers by NTM code	TRAINS
GDP	Importer nominal GDP	World Bank
DEAL	If the country has a trade agreement	Author

Source: Prepared by the author.
Notes: The column 'Variable' also refers to the name of the variables used in the estimations.

The analysis occurs at the disaggregated 6-digits HS on products. By equation 1.15, M_{ij}^{k} is the trade value of the bilateral imports from the countries listed on table 1.1(j) and Brazil (i) for each HS-6 code (k). A characteristic of trade studies in the literature is that some products have zero trade-flow for countries that belong to the sample. Following Haveman and Thursby (2000), two approaches are employed:

Avoiding bias and inconsistency from omission: If a product is traded with any other country over the period of analysis, which is in the sample, this observation is not excluded.
Avoiding error from keeping non-representative trade information: If the product is not traded with any country in the sample, this observation is dropped.

1.4.2 Tariff and Non-Tariff Measures approach

The treatment of the tariffs and NTM's differs because the structure of the tariff report is different. The data for applied tariffs obtained presents the information at 6-digits HS, while NTM's are collected at 2, 4, and 6 digits HS. As the imports' trade flows are obtained at H0 classification, and the tariffs and NTM's data are in distinct HS nomenclature (from H0 to H5), all data is converted into H0 nomenclature, which might be related to only one H0 code.

While converting all information to H0 code at product level, sometimes there is a duplication of the observation due to the fact that two products at H5 classification refers to only one H0 code. For tariffs, the observed tariff for each product is calculated as a simple weighted average of all tariffs on that product. By construction, missing tariffs for a given year are replaced by the tariff of the previous year. However, for a given bilateral import information that do not have information on tariff for the whole period in the sample, it is dropped.

[2]Table A.1 presents the products and its description.

[3]According to the UN Statistics Wiki, the Harmonized System (HS) is an international nomenclature for the classification of the products, whereby 6-digits is the highest level of disaggregation of products.

The NTM data presents the barriers applied against Brazilian agribusiness products. As in the tariff data, the NTM's are reported by up to 6-digits HS and are identified by the NTM code associated. The NTM's can be classified by the policy instrument. In the line, there are the import bans, technical specifications, and information remedies. On the scope, the nature of the barrier is analyzed according to the range of this barrier, that can affect the domestic products, the imports, or both[4]. The NTM's can arise from many instruments and distinct objectives, which makes their classification and measurement more difficult, in such way that the econometric approach becomes more complicated as far as new propositions of barriers are incorporated into the model (Summer and Lee, 1997; Mattson et al., 2004).

The NTM's are identified into four categories: direct price effects (*PRICE*), quantitative restrictions (*QUANT*), quality restrictions (*QUALY*), and the necessity of a license (*LICEN*) (Haveman and Thursby, 2000). Assign which category that each NTM code is associated is somewhat arbitrary. I follow the UNCTAD Classifications of Non-Tariff Measures to assign for which category the NTM's goes to[5]. In the cases that the NTM's have an ambiguous definition or are purely bureaucratic, they are categorized as *LICEN*.

As the database is disaggregated at HS-6, the number of NTM's applied against Brazilian products is substantially different from previous works. Yet, the TRAINS provides information on NTM's applied by countries to the "world", which means that all countries are targets of these measures. Also, there are multilateral and bilateral NTM's. As tariffs, I have duplicated observations on NTM's due to the conversion of the H1-H5 codes to H0, which was previously discussed. In the case of the NTM's, I drop the duplicated observation, since the same measures are applied for the same product more than once, by the same country in the same year, which is not possible.

Proceeding on the treatment of the NTM information, there are two dimensions of time. I have the time regarding to the year of the NTM application, and the year concerning to the end of the NTM imposition. However, the year relative to the end of the NTM is often reported as 31-12-9999 or blank, with few NTM having the repeal date between a reasonable time horizon. To address this problem, two approaches are applied. First, all the NTM's which the repeal date are different from the implementation date are "replicated" over the years. For instance, a NTM applied in 2000, where the repeal date is in 2008, is repeated every year from 2000 to 2008. Consequently, if a NTM is applied until 9999, it is repeated until 2017. This approach preserves the fact that the NTM is still active over time, given that taking into account only the implementation date leads to error in a variable calculation.

The second approach refers to the time reported as blank in the database. Two possible solutions are raised to address this issue: replace the blank date by 9999 or use the last year of collection as repeal date. Starting the analysis by the latter, the problem is that the year of collection only reports the year that the NTM was included in the TRAINS database, and not necessarily represents the year of repeal, for instance, a NTM applied in 2000, repealed in 2001, but with the year collection in 2014. Replacing the repeal date by 9999, leads to a similar error. As both leads to similar error, the first solution was used due to its simplicity.

Tariff and NTM variables are built on the kind of effect that they have on the bilateral imports: *reduction*, *diversion*, and *compression* (Haveman et al., 1999). Unlike

[4]Figure A.1 presents the major categories of NTM's according to three different sources

[5]Table A.3 shows the classification for each NTM code into the four categories of NTM's.

Haveman et al. (1999) and Haveman and Thursby (2000) in which has more than one exporter in the sample, in this present work I have Brazil as the unique exporter, rightly to capture the effect of tariffs and NTM's on the Brazilian products, which entails in some modifications.

The reduction effect reflects the reduction in total trade due to the imposition of the measure, and is calculated as a simple average of the bilateral tariffs imposed by the trade partner i against the 6-digits HS product k ($TARred_i^k$). For the NTMs, the $NTMred_{il}^k$ is calculated as a trade weighted average NTM coverage, for each l category. The NTM coverage ratio is calculated as

$$NTMcr_{jlt}^k = \frac{\sum_k NTM_{jklt} * M_{ijt}^k}{\sum_k^K M_{ij}^K} * 100,$$

such that NTM is a variable dummy that assumes value 1 for the l categories of NTM's. The simple average tariff rate is calculated as

$$TAR_{jt}^k = (1 + \tau_{jt}^k).$$

The diversion effect capture shifts in trade patterns between the exporters, and is calculated as the difference between the tariff that Brazil faces at each 2-digit HS code k and the averaged tariff that other exporters faces ($TARdiv_i^k$). For NTM's, I change the approach to standardize the measurement. The NTM diversion effect ($NTMdiv_{il}^k$) is calculated as the difference between the NTM Coverage ratio that Brazil faces for the product k, and the average NTM Coverage ratio faced by other exporters. To calculate the $TARdiv_i^k$ and the $NTMdiv_{il}^k$, the exporters are based on the top twelve agricultural exporters for 2018 year (FAO, 2020), displayed in table 1.1.

The choice to work at 2-digit HS to calculate the variables is due to the lack of data that Brazil and the main exporters have at TRAINS database. Numerous products have no tariff information for some years, even for the whole period in the study. Thus, when calculating the variable related to diversion effect, mainly for tariffs, many observations are lost because the tariff is zero for Brazil and exporters at 6 digits.

The modeling of the compression effect here has a distinction from the original purpose of Haveman et al., given that the seminal formulation of the effect loses its meaning. Initially, the variable was projected to capture changes in the imports concentration, more directed to the largest suppliers, due to the presence of the fixed costs. In this work, the compression effect is constructed to capture the concentration of the imports into the largest importers, as discussed at the end of section 1.3.

The compression effect for both tariffs and NTM's ($TARcom_i^k$, $NTMcom_{il}^k$) is calculated in a similar way as the product of the $TARred_i^k$ - $NTMred_{il}^k$ - and the importer import potential at the 4-digit MTN[6] level. Also, there is the mitigation effect, measured as the interaction between the tariffs and NTM's reduction effect ($TARred_i^k * NTMred_i^k$), and it is expected to capture the tariff behavior when applied to a sector that already was imposed a NTM.

As the model is substantially modified in comparison with the seminal papers and has little empirical approach to support the model results, some observations are necessary regarding the expected sign and interpretation of the variables' coefficients. The reduction

[6]The Multilateral Trade Negotiations categories refer to the previous HS classification, which was introduced in Tokyo Round and adapted to HS into Uruguay Round.

effect, previously built, keeps its original interpretation, where an implementation or an increase in the tariffs has a negative effect on bilateral trade-flow, thus, the expected coefficient sign must be negative. The diversion effect, which captures shifts in trade pattern according to the differential measures applied against the exporter, implies into diversion from one variety of good, given the country of origin. For tariffs, the sign of diversion effect is negative. On the compression effect, the expected sign is positive, given the compression of Brazilian exports into the largest importers tends to rise the value of trade, since the fixed costs are increasing in trade value and they overcome the import-tariff effect.

Although the NTM's variables are modeled qualitatively in the same way as the tariffs, nothing can be assured about the signs of the estimated coefficients. The way in which the NTM's affects trade, they can either increase or decrease the traded value between the countries. Haveman and Thursby (2000), Ferraz et al. (2017), and Nonnenberg et al. (2020) already showed that mixed results are expected. The former, shows that the four categories for NTM's may have different effects across agricultural sectors.

Yet, a comment is necessary about the NTM database. Six countries only have information from a specific year, that is, there is no information for these countries in 2000. Bangladesh, Indonesia, and Pakistan have information only from 2002; Russia from 2004; Vietnam from 2008; and European Union from 2009. Since there is information for trade, any NTM variable created is zero, which causes bias in the database construction, and consequently on the econometric estimation. Therefore, any information relative to these countries were dropped prior to the inclusion of the NTM information into the database.

1.4.3 Model Controls

It is included a sector dummy (H_k) to mitigate possible bias from differences across and within the agricultural sectors. H_k is assumed to capture the γ_j^k in equation 1.14. H_k is constructed as a dummy for each of the 33 sectors at 2-digit HS. Following Ferraz et al. (2017), building this dummy at 2-digit, it is expected that it will capture variations over sectors. In a single-exporter setup, Y_j is redundant and, therefore, it is excluded of the empirical model. Since there is no public database that provides price information for all k commodities for all time periods, an exporter fixed-effect (I_i) is used to capture country-size, price levels, and other idiosyncrasies to the importer. It is important to observe, in addition to the inclusion of this fixed-effects,that the log of exporter GDP is also included, since it captures the demand-side behavior and controls for country size.

A dummy is also included to identify whether Brazil and the trade partner i has some trade agreement or preferential treatment ($DEAL_{ij}$). As Brazil belongs to the Mercosur, and this organization has very restrictive clauses for its members to sign bilateral agreements with other economies, the construction of $DEAL_{ij}$ is based on the agreements that the Common Market has with other economies, mainly free trade and preferential agreements. As derived from a theoretical model, components of trade costs are significant for trade. Following the literature, a dummy is included to identify if the importer share a common border with Brazil ($FRON_{ij}$), and also the distance between the importer and Brazil ($DIST_{ij}$). In the database, only Argentina borders with Brazil. However, in a single-exporter setup these variables become time-invariant, since the distance and the borders between Brazil and its trade partners do not change. Thus, when controlling by the fixed-effect, these variables are dropped.

Yet, transport costs and infrastructure are important components of trade costs and consequently to trade. However, as discussed in section 1.3, the notion of fixed costs

takes into account the presence of these two items when modeled and the compression effect was modeled to capture this effect on bilateral imports[7].

1.5 TRADE, BARRIERS, AND THE BRAZILIAN AGRIBUSINESS

Digging deeper into the data, it is possible to take away some evidences that characterize the Brazilian agribusiness trade over 2000-2017 period, starting with some stylized facts about the Brazilian trade. The descriptive on trade-flow, tariffs, and non-trade measures are not restricted by the countries sample in the table 1.1, in order to get a macro trade scenario.

The graph at left in figure 1.1 exhibits the evolution of bilateral imports by three main WTO categories: agricultural, industrial, and oil products, with each category containing 649, 4182, and 2 products, respectively. The industrial products show a cyclical pattern, a deep fall in 2008 during the global crisis, recovering until 2011, when the sector has gone into decline. Opposite to this, agricultural products show relatively constancy over time.

Focusing in the agricultural trade, the graph at right in figure 1.1 display the evolution of total imports of the aggregated products by selected countries and the main economic regions/blocs The notorious fact is the China's role in this process, coming out of almost negligible trade-flow to the main importer. The reverse process is observed for United States and European Union, with the former losing places for imports from the Mercosur countries. It is important to note the relevance of intra-regional trade for the Brazilian trade, with Mercosul taking the second place in the ranking. Other economic regions, such as the Asia and the Middle East countries show a similar pattern over time.

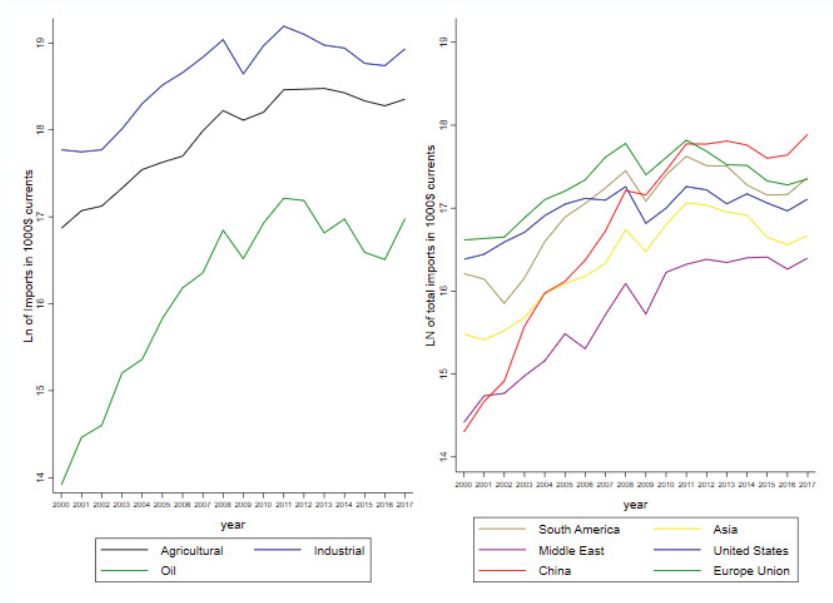
Exploring the data of imports of the Brazilian agricultural products further, figure 1.2 displays the evolution of these imports by selected partners and aggregated at HS-2. The graph at left shows that China becomes the main partner of the Brazilian agribusiness, overcoming the European Union which was the main importer for at least eleven years. In third place, as largest importer, appears the countries of Middle-East. These countries have in Brazil an important source of products, since they need special cuts for poultry meat due to religious issues, and Brazil provides it.

The graph at right splits the imports of the Brazilian agricultural products into six aggregated categories. Oil Seeds appears as the main traded product, followed by meat and sugar sectors. This path shows how Brazil becomes the second largest soybean producer in 2017, and in 2020 the largest producer. It is worth noting the path taken by Brazilian agribusiness, which has achieved significant gains in both production scale and scope. Nevertheless, the fact that Brazil becomes a major player in the agricultural product markets, can also reflect that other countries are losing market-share for the Brazilian products, which makes these countries to seek more protection to their products from this external competition.

As discussed earlier, the traditional tool to address this issue is tariffs. Figure 1.3 shows the averaged unweighted tariff rates applied against the Brazilian products. It is possible to note, in the graph at left, that the Brazilian agribusiness products suffer a little more with tariffs than the average Brazilian products. Despite having a minor tariff bound, the most-favored nation and preferential tariffs on Brazilian agricultural

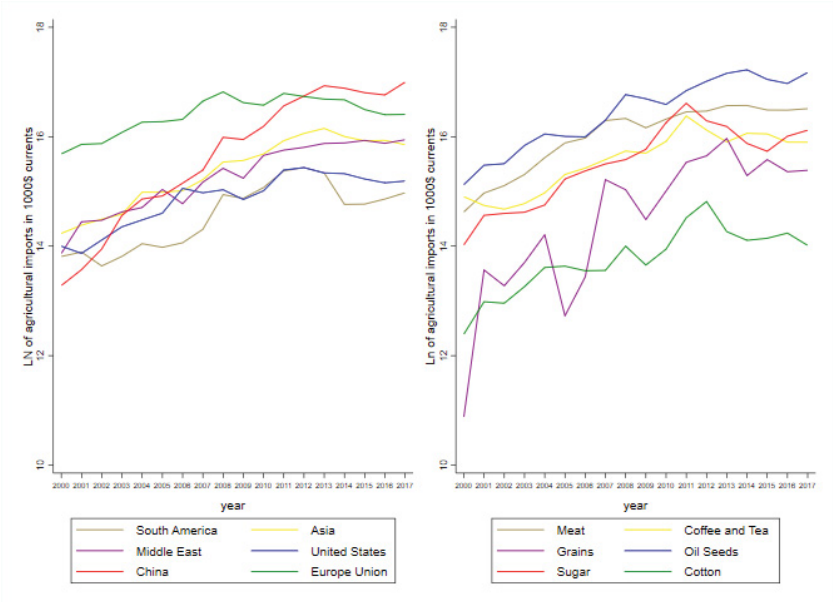
[7]It is necessary to note that there is no database, that I am aware of, which provides reliable and robust information for these factors, especially for transport costs, at 6-digits HS. For this one, the closest is the dataset provided by the *UNCTADstat* only for 2016 year.

Figure 1.1: Brazilian products imports aggregated by WTO category (left) and selected trade partners (right)



Notes: Prepared by the author with data from WITS-UN COMTRADE. South America: Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, Paraguay, Uruguay, and Venezuela. Asia: Hong-Kong, Japan, Singapore, South Korea, and Taiwan. Middle-East: United Arab Emirates, Bahrain, Egypt, Iran, Iraq, Israel, Lebanon, Jordan, Kuwait, Oman, Palestine, Qatar, Saudi Arabia, Syria, Turkey, and Yemen. Europe Union: The 27 member states.

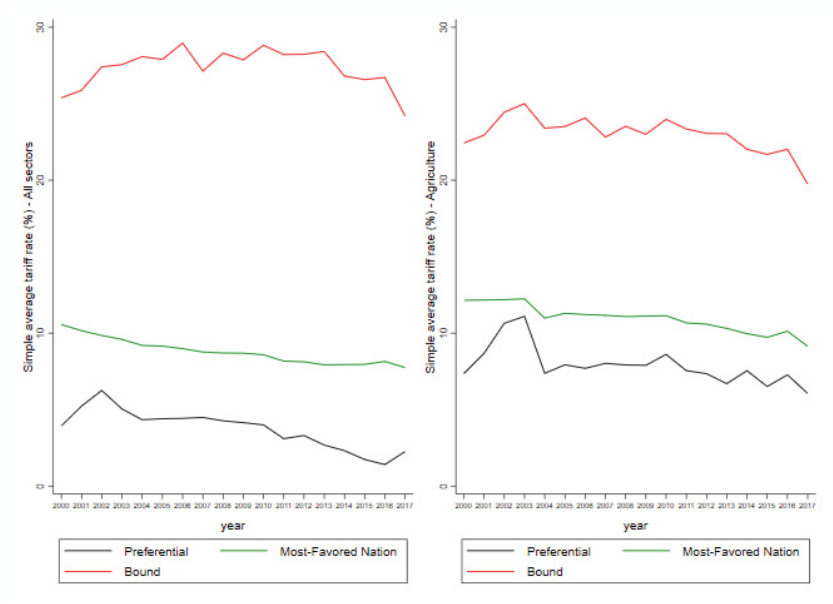
Figure 1.2: Imports of Brazilian agricultural products by selected trade partners(left) and selected sectors at 2-digits HS (right)



Notes: Prepared by the author with data from WITS-UN COMTRADE.

products are higher than the average. The graph at right shows that the importers have a considerable margin to raise tariffs against the agricultural products. Even looking at the MFN as the lower bound, there is a tariff water around 10%.

Figure 1.3: Simple average tariff rates against Brazilian products by types of tariffs over all sectors (left) and over only agriculture (right)



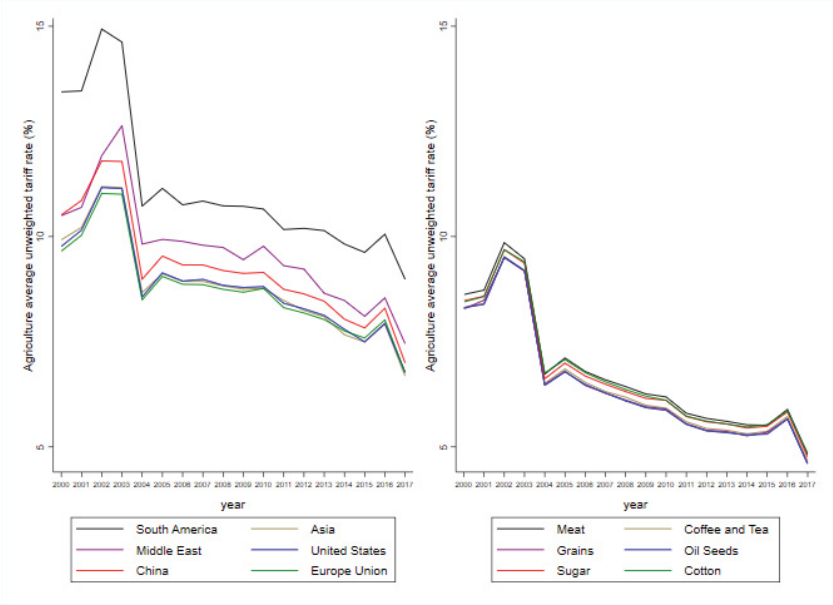
Notes: Prepared by the author with data from WITS-TRAINS.

The graph at left in figure 1.4 shows the simple average tariff rate suffered by all the Brazilian products according to the trade partner. It is possible to see that the Mercosur countries appear to be the main protectionists against the Brazilian products, followed by Middle East countries, and China. By this graph, it is possible to note that in 2003 occurred a sudden increase in the tariffs against the Brazilian agribusiness products, which has been in downward trend since then. The graph at right, in figure 1.4, shows the average unweighted effective applied tariff rate disaggregated by 2-digit HS sector. The pattern observed over time is that the effective applied tariff have dropped in a similar way for all products.

As much highlighted in the introduction, the non-tariffs measures becomes the most important tool of trade policy over time, mainly to control the flow of foreign varieties in the national market. As Brazil is one of the largest agribusiness producers, it is expected that it will suffer from these measures. Figure 1.5 shows this first look at the NTM's statistics. The subjective nature of these measures allows that countries use this tool as a trade policy instrument, aiming to affect the trade, especially, the entry of Brazilian products. It is clear that some countries that import an specific product can focus their measures on that product. For instance, Brazil is one of the most important producers of poultry with specific cuts that are requested by the Arabian countries due to religious constrains, Therefore, these countries apply numerous NTM's to guarantee that the imported good is in line with the religious demands.

The graphic in first row at left shows that the technical barriers to trade (TBT's) are widely used by the United States, European Union and China, affecting the Brazilian products, while the Middle East countries focus more on sanitary/phytosanitary (SPS's)

Figure 1.4: Simple average tariff rates against Brazilian agribusiness products by 2-digit HS sectors (left) and selected trade partners (right)



Notes: Prepared by the author with data from WITS-TRAINS.

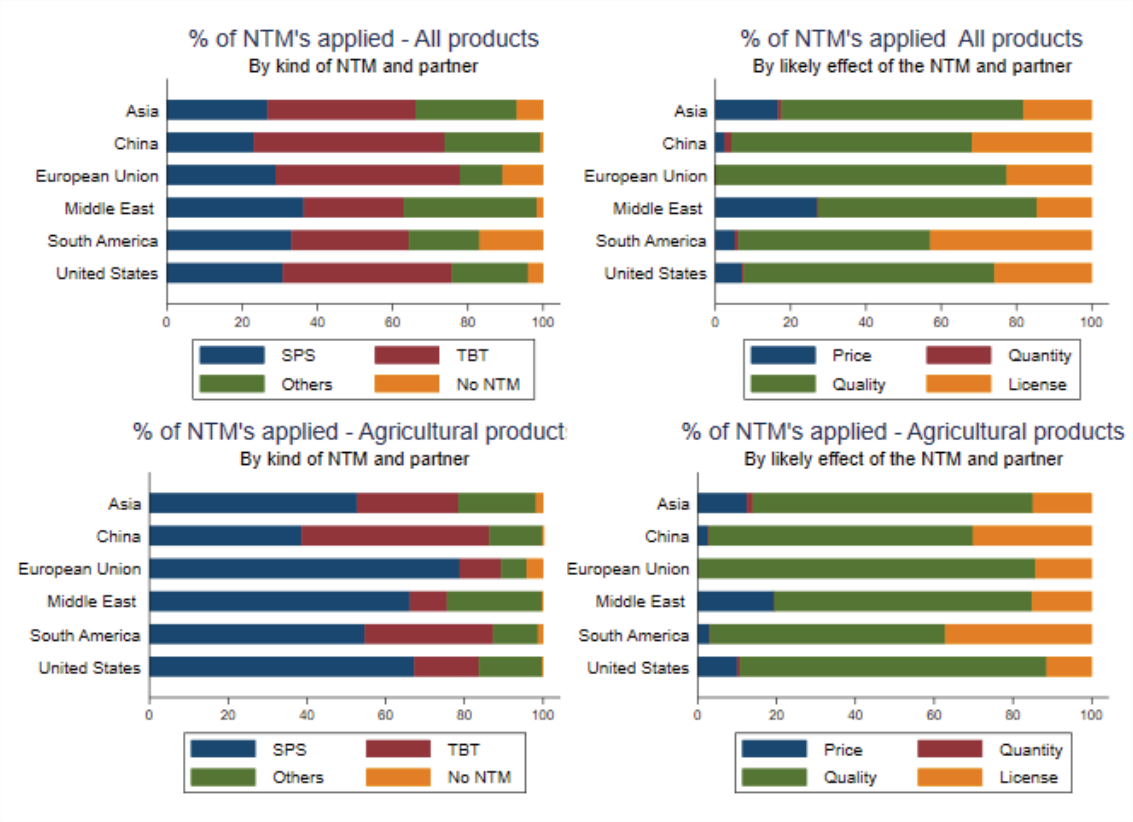
and other measures. If we take a special look, the technical measures (SPS + TBT) are the most applied measures against the Brazilian products. In general, the countries of South America make less use of TBT's, varying through SPS's and non-technical measures. Looking for the graph in the first row at right in figure 1.5, we can see the distribution of NTM according to the likely effects that have been derived from the theoretical model. Here, the pattern is more clear than looking for the different types of NTM. NTM's classified as "quality" are widely used by all partners. License NTM's are also used by countries, most notably by South American countries. The predominance of the quality NTM's is not a surprise, since this category is related to every aspect of the product which the importer may modify requirements to hinder the entry of these products into their markets.

Looking at the second line of the figure 1.5, we see the distribution of the NTM's only for agricultural products. The pattern changes dramatically for the type of NTM. For agricultural products, the SPS's becomes the major kind of NTM applied against the Brazilian products. For instance, the European Union jumps from 35% when looking at all products to almost 80% for agricultural products. The distribution according to the effects derived from theoretical model (likely effect) has only marginal changes. Yet, figure 1.5 shows that the likely effect of the NTM, derived from theoretical model, is homogeneous, in such way that this approach keeps the qualitative information across products specification.

1.6 ECONOMETRIC STRATEGY

As often highlighted in trade literature, due to the fact that part of bilateral trade flows are equal zero, it is necessary to work with a estimator non-sensitive to this database's characteristic. Restricting the countries sample to the main trade partners, the amount of

Figure 1.5: Distribution of applied NTM's by type, likely effect, and partner



Notes: Prepared by the author with data from TRAINS. SPS are Sanitary and Phytosanitary Barriers; TBT are the technical barriers to trade; Other refers to the non-technical measures (chapters C to P).

zero trade flows can be severally reduced, but still high. With three-fourths of the sample composed with zero flows, when large part of the data is concentrated at one point - the "corner", the estimation through OLS will lead to inconsistent parameters of the equation 1.15, given the $E[M|\mathbf{X}]$ is not characterized by a linear relation in the covariates ($\mathbf{X}$) and the parameters, which allows us to use other kind of estimators, such as Pseudo-Poisson (Silva and Tenreyro, 2006) or Binomial Negative, and the Tobit estimator (Haveman et al., 1999; Nonnenberg et al., 2020).

As showed by Silva and Tenreyro (2006), the choice of the estimator can lead to different coefficients with the Tobit and OLS upward biased, and these two may suffer from the *incidental parameters problem*. The Poisson Pseudo Maximum Likelihood (PPML) can be estimated through both fixed effects or random effects. As described in section 1.4.3, dummies that do not vary over time will be included to address specific issues of the model, which are absorbed by the model (Correia et al., 2020). One significant difference between the PPML and Tobit/OLS is that the former does not need any transformation in the dependent variable, since the exponential procedure preserves the zeros in the left-side, as well as the log-transformation on the right-side. Then, the coefficients of PPML are interpreted as elasticities or semi-elasticities[8]. Given the great number of observations and the amount of fixed effects, two, Hayakawa (2013) argues that problems with the convergence of log-likelihoods may arise. If this occur, it will be reported in the respective

[8]For semi-elasticities, the coefficients θ are interpreted as $100 * \left(exp^{(\theta)} - 1\right)$ %

table results. The estimation is done through the estimator proposed by Correia et al. (2020).

The simultaneity bias get special attention due to the fact that this problem can produce problems of endogeneity, affecting the properties of the estimator. In the construction of the weighted NTM variables are used the exports at the 5-digit HS in order to minimize the rise of the issue. As noted by Haveman et al. (1999); Haveman and Thursby (2000), one can argue that the protectionism is endogenous in the equation, since it is through the tariffs and NTM's that the governments seek to control the trade flow. However, it is noted that the imposition of a trade measure is prior of the observed trade flow, so the present trade flow cannot be influenced by the imposition of this measure.

The regression is performed at 4-digit MTN, which means that each of the 25 agricultural groups have a separate regression for the products that belong to them. This approach checks the impact of trade measures within each product group. Using MTN instead the HS group, there are more products for each category which improves the sample power and avoid endogeneity problems that may arise from the fact that there are a sector classification within the product classification. Additionally, it is performed a general regression across the products without sectoral distinction.

The equation 1.14 to be empirically estimated, with the changes in the tariffs and NTM's, as well as adding the model controls and the trade costs factors, is given by

$$\begin{aligned} M_{ijt}^{k} = exp(\alpha + \kappa_k H + \lambda_i I + \beta_1 ln(gdp) + \beta_2 deal_{ij} \\ +\delta_1 ln(TARRed_{it}^{k}) + \delta_2 ln(TARDiv_{ijt}^{k}) + \delta_3 ln(TARCom_{ijt}^{k}) \\ + \sum_{l} \left[\phi_{l1} NTMRed_{ilt}^{k} + \phi_2 NTMDiv_{ijlt}^{k} + \phi_3 NTMCom_{ilt}^{k}\right] \\ + \sum_{l} \left[\eta_{l1} TARRed_{it}^{k} \cdot NTMRed_{ilt}^{k}\right]), \end{aligned} \tag{1.15}$$

where in the first line there are the dummies for importer country, products, and the GDP of trade partner. In the second line there are the tariffs variables, and its reduction, diversion, and compression effects. The third line represents the NTB's variables and its respective effects, on the l four types of categories. Fourth line is the mitigation effect from the interaction between the tariffs and NTM's.

1.7 RESULTS AND DISCUSSION

Table 1.3 shows the results at 6-digit without sectoral distinction. Colums (I) e (II) are the annual panel data and columns (III) and (IV) are the 3-year interval panel data. In all estimations are applied the controls for sector and importer, although equations in (II) and (IV) the standard fixed-effect is replaced by an importer-product fixed effect. Only two variables keep their significance through the four estimations: $TARred$ and $TARcom$. The GDP of trade partners appears to be significant at 5% in annual panel data, and significant only at estimation through 3-year panel, at 10%. Other variables appear to be significant only in one of the estimations, such as $NTMred\_quant$, $NTMred\_qualy$, MIT_qualy, and MIT_quant. The remaining coefficients do not present either, statistical or economic significance.

Looking at controls, few comments are needed. The GDP of trade partner is significant on annual specifications, losing significance in the 3-year panel. The negative sign of coefficient for the importer GDP was not expected, and opposite to the findings in

Table 1.3: Annual and 3-year panel estimations through PPML - Joint regression

Dependent variable	**Imports of Brazilian agricultural products**			
	Annual PPML		3-year PPML	
	(I)	(II)	III	IV
ln_gdp	-0.4870**	-0.6451**	-0.3654	-0.6227*
	(0.2191)	(0.2981)	(0.2291)	(0.3204)
Deal	0.1740	0.1493	0.0936	0.0717
	(0.1102)	(0.2060)	(0.2415)	(0.2257)
TAR_red	-0.7880***	-0.6636**	-0.9445***	-0.9934***
	(0.2290)	(0.2918)	(0.2572)	(0.3083)
TAR_div	0.1771	0.1159	0.1949	0.0807
	(0.1285)	(0.1385)	(0.3396)	(0.3454)
TAR_com	0.9480***	1.0261***	0.9526***	1.0836***
	(0.0663)	(0.0850)	(0.0630)	(0.0909)
NTMred_price	-0.1716	0.0210	0.0351	0.0782
	(0.1499)	(0.4467)	(0.2479)	(0.2616)
NTMred_qualy	-0.0166	-0.0140	-0.0441**	-0.0750**
	(0.0215)	(0.0213)	(0.0194)	(0.0328)
NTMred_quant	12.6948**	12.3787**	11.1068	7.9827
	(4.9461)	(5.5121)	(15.8335)	(14.9145)
NTMred_licen	-0.2191	-0.1839	-0.1934	-0.1053
	(0.1383)	(0.1274)	(0.2128)	(0.2024)
NTMdiv_price	-0.1153	-0.0664	-0.0189	-0.0245
	(0.1235)	(0.1001)	(0.0750)	(0.0672)
NTMdiv_qualy	-0.0102	-0.0155	-0.0094	-0.0062
	(0.0089)	(0.0098)	(0.0104)	(0.0106)
NTMdiv_quant	-0.0518	-0.0211	-3.7382***	-2.3208
	(0.0625)	(0.0301)	1.3785	(1.4348)
NTMdiv_licen	-0.0157	-0.0538	-0.0902	-0.1128
	(0.0440)	(0.0339)	(0.0888)	(0.0769)
NTMcom_price	0.0000***	0.0000***	0.0000*	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
NTMcom_qualy	0.0000*	0.0000*	0.0000**	0.0000**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
NTMcom_quant	0.0000	0.0000	0.0000**	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
NTMcom_licen	-0.0000	0.0000	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
MIT_price	0.0226	0.1256	-0.0494	-0.0881
	(0.0225)	(0.3610)	(0.2187)	(0.2431)
MIT_qualy	0.0051	0.0046	0.0290***	0.0574**
	(0.0069)	(0.0066)	(0.0059)	(0.0238)
MIT_quant	-11.0206**	-10.7186**	-10.0425	-7.1202
	(4.6898)	(5.1482)	(14.6319)	(13.6181)
MIT_licen	0.2195*	0.1945	0.2276	0.1546
	(0.0882)	(0.1245)	(0.2157)	(0.2051)
Controls				
H	Yes	No	Yes	No
I	Yes	No	Yes	No
$I * H$	No	Yes	No	Yes
$PseudoR^2$	0.6719	0.7055	0.6604	0.6974
Observations	32,353	32,325	10,598	10,554

PPML clustered standard errors at 6-digits HS in parenthesis. * p<0.10, ** p<0.05, *** p<0.01.

the literature that suggests that increases in the importer income affects positively the bilateral imports. Deal is not significant at all. It is not a surprise that have a trade agreement has no effect on agricultural bilateral imports. As discussed early, the Mercosur is very restrictive. The PTA and FTA done by the bloc is very heterogeneous, not limited to agricultural products, which suggests that they did not have a positive effect to improve the regional agricultural trade.

On tariffs, the results appear to be stable through the specifications. The reduction and compression effects present the expected results, while the diversion effect shows no significance. Looking for columns (I) and (III), in either annual or 3-year interval the elasticity of the reduction-bilateral imports is between -0.7% and -1% and the compression-bilateral imports is around 1%. Both results are according to the expected from the theoretical model, as well from the literature. Increases in the average import-tariff faced by Brazil reduces the imports of Brazilian agricultural products.

The compression effect for tariffs suggests that the tariffs faced by Brazilian products tend to compress the imports into the largest importers. As fixed costs are increasing in trade value, the benefit to trade with large importers overcome the cost of the tariff. In some way, since the compression effect in the joint regression reflects how trade shifts among importers, it is possible to conjecture that protectionist policies from main trade partners tend to be more effective at the lower bound of importers. Yet, countries that are specialized in importing a specific product has no stimulus to import other products from Brazil if the cost to import is high due to the import-tariff, and they do not reduce the tariff rates to keep protecting their domestic market.

The tariff diversion effect has no significance, such that the understanding of the whole effect of tariffs on bilateral imports becomes limited to reduction and compression effects. This absence of significance can be understood in two ways. (i) There is no diversion effect. In fact, in the single-exporter setup, the exporter takes the role of the main supplier and despite compute the average tariff for the main Brazilian competitors, importers do not shift trade based on the tariffs differential; (ii) information loss when aggregated. As explained in section 1.4, in order to better calculate the compression effect, it was necessary to aggregate the variable into 2-digit HS. Using the tariff at 2 digits, micro-information on product is lost, and, therefore, the explanatory power of the variable is affected.

As discussed before, the direction of the NTM's effects is still unknown in the literature, and the results of table 1.3 helps to understand the behavior of the likely factors. Across the regressions, the coefficient for the NTM reduction effect is significant and negative. The quality NTM reduction effect shows significance at 3-year panel being a negative factor on bilateral imports, while the coefficient for quantitative reduction effect is positive only at annual data, but has a positive effect on bilateral imports. The remaining variables show no significance at all or significance in just one specification. For instance, the coefficient for diversion effect for quantity NTM's is significant only in 3-year PPML, with individual controls.

Additionally, the mitigation effect shows some interesting results. The coefficient for quality effect is significant only at the 3-years panel, while the coefficient for quantity effect is significant only at the panel data. They have opposite signs though. The introduction of a tariff over a product that already suffers from some quantity NTM has a negative effect on bilateral trade. By the other hand, the introduction of a tariff over a product that already suffers from some quality NTM, affects positively the bilateral trade.

It is intriguing to note that all NTM's compression effects, despite showing statistical significance for most of the coefficients, show no "economic significance". The coefficients are so small that, even looking for a sufficient large number of decimal places, the coefficient remains zeroed. Since the compression effect for NTM's is modeled the same way as the tariffs, the fact that is not log-linearized, and it is multiplied by a variable in scale much larger, it may have affected the variable, and losing its initial proposition.

Table 1.4: Annual PPML regressions summary

	Observations		**Convergence**		**Pseudo-R^2**		**Nº Fixed Effects**	
Sector	*H&T*	*H * T*	*H&T*	*H * T*	*H&T*	*H * T*	*H&T*	*H * T*
12 -								
1201	2,594	2,593	Yes	Yes	0.5561	0.5710	20	35
1202	310	310	No	No	-	-	-	-
1203	2,202	2,194	Yes	Yes	0.4348	0.4505	21	43
13 -								
1301	1,375	1,375	No	No	-	-	-	-
1302	-	-	No	No	-	-	-	-
1303	1,155	1,155	Yes	Yes	0.7134	0.7599	21	39
14 -								
1402	894	894	Yes	Yes	0.6416	0.6416	20	20
1403	382	382	No	No	-	-	-	- -
15 -								
1501	1,281	1,279	Yes	Yes	0.4714	0.4936	20	33
1502	421	421	Yes	Yes	0.7202	0.7202	11	11
1503	3,335	3,329	Yes	Yes	0.3279	0.3532	24	66
16 -								
1601	705	705	Yes	Yes	0.6846	0.6846	20	20
17 -								
1701	334	334	Yes	Yes	0.8771	0.8771	14	14
1703	2,309	2,309	Yes	Yes	0.3510	0.4105	20	37
18 -								
1801	585	585	Yes	Yes	0.8471	0.8471	20	20
1803	3,004	3,004	Yes	Yes	0.7180	0.7811	21	40
19 -								
1901	1,660	1,652	Yes	Yes	0.4199	0.5172	22	58
20 -								
2003	2,729	2,728	Yes	Yes	0.4636	0.5056	21	37
21 -								
2101	68	68	Yes	Yes	0.9438	0.9438	6	6
2103	705	705	Yes	Yes	0.7272	0.7272	18	18
22 -								
2201	582	582	Yes	Yes	0.6032	0.6032	19	19
2203	366	366	Yes	Yes	0.7580	0.7580	18	18
23 -								
2301	2,160	2,145	Yes	Yes	0.7555	0.8689	28	109
2302	1,668	1,663	Yes	Yes	0.6659	0.6968	23	65
2303	1,3561	-	Yes	No	0.4561	-	21	-

[1]Number of coefficients significant at 0.1, 0.05, and 0.01.

When looking at the general effects of tariffs and NTM's on bilateral imports, table 1.4 shows a summary of the regressions performed at 4-digit MTN. Based on results on table 1.3, only the specifications (I) and (II) were estimated for each MTN sector. The 3-year panel was not estimated due to the high loss of observations with exclusions for some years. General comments about the sectors are made and the regression outputs for each of the 25 sectors are in the Appendix B. The estimation for some sectors was not possible, due to the non-convergence of the log-likelihood in PPML.

In general, the results obtained from the regressions reported on Appendix B are very heterogeneous across sectors. The tariff reduction effect is significant in 7 out of the 17 sectors that were estimated, such that 3 are positive. The reduction effect varies from

-10.14% to 19.46%. The diversion effect was significant in five estimations, where 4 were negative . The diversion effect varies from -4.20% to 0.41%. The tariff diversion effect, in the way that was modeled, appears to capture the tariff rate differential between Brazil and its main competitors, in contrast to the joint regression coefficients. As in the joint regression, the compression effect is significant in almost all sectors estimations, varying from 0.62% to 1.22%.

The results for tariffs suggest that there may have a strong compression effect on the imports of Brazilian agricultural products, with fixed effects playing an important role on bilateral imports and how its import flows are arranged among the importers. For instance, looking at the data, China is likely one of the countries that the costs to import Brazilian agricultural products appears to be lower than the benefit to keep importing despite the tariff. The reduction effect, despite heterogeneous, is not far away from the literature results, especially for Brazil. Ferraz et al. (2017) shows opposite effect of tariffs on imports.

For NTM's the heterogeneity remains, with majority of the coefficients being no significant, but it is possible to observe some patterns across sectors. Indeed, some coefficients for the NTM compression are still zero, while others show some economic effect on bilateral imports. The NTM diversion effect for license and the NTM reduction effect for quality are significant in 7 out of 17 estimations, where the coefficients are positive in 4 and 6 of the regressions, respectively. Interestingly,, if we look at the mitigation effect, it is possible to note the effect is highly heterogeneous. Yet, the quantity mitigation effects show some coefficients that are extremely large and significant.

As argued by Haveman et al. (2003), the impact of NTM's on trade is ambiguous. For some sectors NTMs can improve bilateral imports, but for others they can impose a severe restriction for imports of the Brazilian agricultural products. This sectoral heterogeneity is not a surprise, despite the fact that some effects have a great amplified magnitude, sometimes positive and sometimes negative. Studies such as Ferraz et al. (2017) and Nonnenberg et al. (2020) were able to find some effect of NTM's on bilateral imports, where the former in a multi-industry setup, and the latter looking only for agricultural products. Nonnenberg et al. (2020), in fact, did not find the effect of NTM's across sectors, suggesting another way to model these measures. Therefore, my approach split the NTM's and find some results that are interesting to study, mainly cross-sector comparisons, however, I also find an enormous heterogeneity across sectors, as well as some variables not significant statistically and "economically".

1.8 CONCLUSION

This work aimed at answering the question: **Are the imports of Brazilian agricultural products affected by the tariff and non-tariff measures applied by the main importers?** Based on the results obtained in section 1.7, I can ensure a positive answer. The empirical outputs obtained advances in some of previous results from the literature.

The model was based in the theoretical construction made by Haveman et al. (1999), but there were some changes to adapt the model to single-exporter setup. That theoretical framework allows that tariffs and NTM's can be estimated according to their likely effect: (i) reduction, (ii) diversion, and (iii) compression. (i) is related to the general - and "traditional" - effect of tariffs on trade; (ii) to the shifts in trade patterns between the exporters; (iii) to the fixed costs embedded in international trade.

Additionally, the NTM's are classified according to their likely effect on trade. There are four categories: price, quantity, quality, and license. All this theoretical construction implies in a more consistent and robust empirical specification. This is the first work that uses this approach for tariffs and NTM's applied to Brazilian trade. Previous works, such as Ferraz et al. (2017) and Nonnenberg et al. (2020) follows the standard measure qualifying the NTM's into dummies and dividing into technical or phytosanitary barrier.

This research built a database at 6-digit HS, improving the disaggregation and allowing us to capture micro-information that often are lost when working at sectoral or industry level. The bilateral imports and tariffs information were obtained through WITS Query System, being the COMTRADE and TRAINS the main data sources. The NTM's information came from TRAINS in a raw form and a deep treatment and compatibility process was done to adequate all information of different HS levels.

A joint regression was estimated under different specifications, in which all the products were in the same regression without sectoral distinction, and a group regression where the products were estimated separately according to the group which they belong. Following Silva and Tenreyro (2006) and Silva and Tenreyro (2022), all specifications were estimated through PPML. The joint regression has two panel approaches: the annual panel and 3-year panel. These comparisons were made to verify that the robustness of gravity models goes beyond cross-sections or interval panels, and can be applied to annual panel data.

Summing-up the main results:

1 The tariff reduction effect is significant for all specifications in the joint regressions. However, at sectoral estimations, the results are heterogeneous across sectors and tariff reduction can have a positive effect on trade.

2 The tariff diversion effect is not significant in joint regressions, as well as in the major part of sectoral regressions.

3 The compression effect is significant at all specifications. Which suggests that the fixed costs play an important role on imports of Brazilian agricultural products. This effect indicates that the imports tends to concentrate into the largest importers.

4 The NTM's effects are very heterogeneous and vary across sectors, being positive for some sectors and negative for others.

5 The mitigation effect - the behavior when a tariff is applied to a sector that already suffers from NTM's - switch between positive and negative coefficients, with most of them being insignificant.

6 The importer income coefficient presents a contra-intuitive result. In the joint regression it is negative, suggesting that increasing the importer income (GDP) reduces the imports of the Brazilian agricultural products. In the sectoral regression, most of the coefficients are insignificant and not reported.

7 Deal is insignificant in all specifications. The result, as discussed, is not a surprise, since the agreements made through Mercosur did not have the agricultural products as their target goods. When looking at the sample, countries as Argentina or

Mexico imports mainly manufactured, instead of agricultural products. Since the coefficients are no significant in almost all specifications, they are not reported.

Despite the advance made in this work, there is still a huge gap in the literature when talking about NTM's and their effects on imports. Working in a single-exporter setup seems to be the best way to look at this issue, as well as, focusing in a specific industry in order to try to isolate the effects on different sectors and types of measures.

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APPENDIX A – COMPLEMENTARY INFORMATION

Figure A.1: Major categories of NTB's

Deardorff and Stern	USTR	OECD
Quantitative restrictions and similar specific limitations	Import policies	Technical measures
Import quotas	(including quantitative restrictions, import	Food safety and health requirements
Export limitations	licensing, customs barriers)	Sanitary and phytosanitary requirements
Licensing		Labeling regulations
Voluntary export constraints		Quarantines
Exchange and other financial controls	Standards, testing, labeling, and certification	Certification and testing requirements
Prohibitions		Customs rules and procedures
Domestic content and mixing requirements		Excessive documentation required
Discriminatory bilateral agreements	Government procurement	Unpredictability
Countertrade		Slow customs clearance
Non-tariff charges and related policies affecting imports		Complex regulations
Variable levies	Export subsidies	Arbitrary enforcement of rules
Advance deposit requirement		Lack of harmonization
Antidumping duties		Internal taxes or charges
Countervailing duties	Lack of intellectual property protection	Competition-related restrictions on market access
Border tax adjustments		Quantitative import restrictions
Government participation in trade, restrictive practices, and more general government policies	Service barriers	Procedures and administration (general)
		Public procurement practices
Subsidies and other aids		Subsidies and related government supports
Government procurement policies		Investment restrictions or requirements
State trading, government monopolies, and exclusive franchises	Investment barriers	Transport regulations or costs
Government industrial policy and regional development		Restrictions of services (general)
Government financed research and development and other technology policies	Anti-competitive practices with trade effects tolerated by foreign governments	Restrictions on mobility of business people or labor
		Trade defense instruments
National systems of taxation and social insurance		Antidumping duties
Macroeconomic policies		Countervailing duties
Competition policies	Trade restrictions affecting electronic commerce	Safeguards
Foreign investment policies		Local marketing regulations
Foreign corruption policies		
Immigration policies		
Customs procedures and administrative practices	Others	
Customs valuation procedures		
Customs classification procedures		
Customs clearance procedures		
Technical barriers to trade		
Health and sanitary regulations and quality standards		
Safety and industrial standards and regulations		
Packaging and labeling regulations, including trademarks		
Advertising and media regulations		

Source: Mattson et al. (2004).

Table A.1: Agricultural products under study at section level

HS-2 code	Description	HS-2 code	Description
01	Live Animals	19	Cereal flour, starch, etc.; cakes
02	Meat and edible meat offal	20	Products of vegetable, fruits
04	Milk; eggs; honey	21	Miscellaneous food
05	Other animal products	22	Beverages, wine, and vinegar
06	Living plants	23	food industry residues and waste
07	Edible vegetables, roots and tubers	24	Tobacco, and tobacco substitute products
08	Edible fruits and nuts	29	Organic chemicals
09	Coffee, tea, mate and spices	33	Essential oils and resinoids; Perfumery
10	Grains	35	Albuminoidal substances
11	Milling products; malt; gluten	38	Miscellaneous chemicals products
12	Oilseeds; Kernels; Industrial medicinal plants	41	Raw hides and skins and leather
13	Shellac; gum, fat and other plant liquids	43	Furskins and artificial fur
14	Planting materials for planting	50	Silk
15	Animal and vegetable oils and fats	51	Wool and other animal hair
16	Meat, fish and other aquatic invertebrate products	52	Cotton
17	Sugar and confectionery	53	Other plant fibers
18	Cocoa and Cocoa products		

Source: Prepared by the author.

Table A.2: Agricultural products at 2-digits MTN

MTN-02 code	Description	MTN-02 code	Description
12	Fruit & vegetables	18	Oilseeds, fats and oils
13	Coffe, tea, mate, & cocoa	19	Flowers,plants,vegetable materials, etc.
14	Sugars	20	Beverages & spirits
15	Spices,cereal and other food preparations	21	Dairy products
16	Grains	22	Tobacco
17	Animals and products thereof	23	Other agricultural products

Source: Prepared by the author.

Table A.3: Classification of the UNCTAD NTM's into 4 categories of NTM's

Code	Class	Code	Class	Code	Class	Code	Class	Code	Class	Code	Class
A000	QUALY	A100	QUALY	A110	QUALY	A120	QUALY	A130	QUALY	A140	QUALY
A150	LICEN	A190	QUALY	A200	QUALY	A210	QUALY	A220	QUALY	A300	QUALY
A310	QUALY	A320	QUALY	A330	QUALY	A400	QUALY	A410	QUALY	A420	QUALY
A490	QUALY	A500	QUALY	A510	QUALY	A520	QUALY	A530	QUALY	A590	QUALY
A600	QUALY	A610	QUALY	A620	QUALY	A630	QUALY	A640	QUALY	A690	QUALY
A800	LICEN	A810	LICEN	A820	QUALY	A830	LICEN	A840	QUALY	A850	QUALY
A851	QUALY	A852	QUALY	A853	QUALY	A859	QUALY	A860	QUALY	A890	QUALY
A900	QUALY	B000	QUALY	B100	QUALY	B110	QUALY	B140	LICEN	B150	LICEN
B190	QUANT	B200	QUALY	B210	QUALY	B220	QUALY	B300	QUALY	B310	QUALY
B320	QUALY	B330	QUALY	B400	QUALY	B410	QUALY	B420	QUALY	B490	QUALY
B600	QUALY	B700	QUALY	B800	LICEN	B810	LICEN	B820	QUALY	B830	LICEN
B840	QUALY	B850	QUALY	B851	QUALY	B852	QUALY	B853	QUALY	B859	QUALY
B890	QUALY	B900	QUALY	C000	QUALY	C100	QUALY	C200	QUALY	C300	LICEN
C400	LICEN	C900	LICEN	D000	PRICE	D100	PRICE	D110	QUALY	D120	PRICE
D130	PRICE	D200	PRICE	D210	QUALY	D220	PRICE	D230	PRICE	D300	QUALY
D310	QUALY	D311	QUALY	D312	QUANT	D313	QUANT	D314	QUANT	D320	QUALY
D321	QUANT	D322	PRICE	D390	QUALY	E000	LICEN	E100	LICEN	E110	LICEN
E111	LICEN	E112	LICEN	E113	LICEN	E119	LICEN	E120	LICEN	E121	LICEN
E122	LICEN	E123	LICEN	E124	LICEN	E129	LICEN	E200	QUANT	E210	QUANT
E211	QUANT	E212	QUANT	E220	QUANT	E221	QUANT	E222	QUANT	E230	QUANT
E231	QUANT	E232	QUANT	E300	QUANT	E310	QUANT	E311	QUANT	E312	QUANT
E313	LICEN	E314	QUANT	E315	QUALY	E316	QUALY	E319	QUALY	E320	QUALY
E321	QUALY	E322	QUALY	E323	QUALY	E324	QUALY	E325	QUALY	E329	QUALY
E500	QUANT	E510	QUANT	E511	QUANT	E512	QUALY	E513	QUALY	E590	QUALY
E600	PRICE	E610	PRICE	E611	PRICE	E612	PRICE	E620	PRICE	E621	PRICE
E622	PRICE	E690	PRICE	E900	QUANT	F000	PRICE	F100	PRICE	F110	PRICE
F120	PRICE	F190	PRICE	F200	PRICE	F300	PRICE	F310	PRICE	F320	PRICE
F390	PRICE	F400	PRICE	F500	PRICE	F600	PRICE	F610	PRICE	F620	PRICE
F630	PRICE	F640	PRICE	F650	PRICE	F660	PRICE	F670	PRICE	F680	PRICE
F690	PRICE	F700	PRICE	F710	PRICE	F720	PRICE	F730	PRICE	F790	PRICE
F800	PRICE	F900	PRICE	G000	LICEN	G100	LICEN	G110	LICEN	G120	LICEN
G130	LICEN	G140	LICEN	G190	LICEN	G200	PRICE	G300	LICEN	G310	LICEN
G320	LICEN	G330	LICEN	G331	LICEN	G332	LICEN	G339	LICEN	G390	LICEN
G400	LICEN	G900	LICEN	H000	PRICE	H100	LICEN	H110	LICEN	H190	LICEN
H200	LICEN	H210	LICEN	H220	LICEN	H290	LICEN	H900	LICEN	I000	LICEN
I100	LICEN	I200	LICEN	I900	LICEN	J000	LICEN	J100	LICEN	J200	LICEN
J210	LICEN	J220	LICEN	J900	LICEN	K000	LICEN	K100	LICEN	K200	LICEN
K900	LICEN	L000	PRICE	L100	PRICE	L110	PRICE	L111	PRICE	L112	PRICE
L113	PRICE	L114	PRICE	L115	PRICE	L116	PRICE	L117	PRICE	L118	PRICE
L119	PRICE	L120	PRICE	L130	PRICE	L140	PRICE	L141	PRICE	L142	PRICE
L150	PRICE	L510	PRICE	L520	PRICE	L530	PRICE	L600	PRICE	L610	PRICE
L620	PRICE	L700	PRICE	L710	PRICE	L800	PRICE	L810	PRICE	L810	PRICE
L820	PRICE	L900	PRICE	M000	LICEN	M100	LICEN	M110	LICEN	M120	LICEN
M130	LICEN	M140	LICEN	M190	LICEN	M200	PRICE	M210	PRICE	M222	PRICE
M230	PRICE	M290	PRICE	M300	LICEN	M310	LICEN	M320	LICEN	M330	LICEN
M400	LICEN	M410	PRICE	M430	LICEN	M440	LICEN	M500	LICEN	M510	LICEN
M520	LICEN	M530	LICEN	M540	LICEN	M550	LICEN	M560	LICEN	M561	LICEN
M562	LICEN	M570	LICEN	M590	LICEN	M600	LICEN	M610	LICEN	M620	LICEN
M630	LICEN	M640	LICEN	M690	LICEN	M700	LICEN	M710	LICEN	M720	LICEN
M730	LICEN	M790	LICEN	M800	LICEN	M810	LICEN	M820	LICEN	M830	LICEN
M840	LICEN	M850	LICEN	M860	LICEN	M890	LICEN	M900	LICEN	M910	LICEN
M920	LICEN	M921	LICEN	M922	LICEN	M923	LICEN	M924	LICEN	M925	LICEN
M926	LICEN	M990	LICEN	N000	LICEN	N100	LICEN	N110	LICEN	N120	LICEN
N130	LICEN	N140	LICEN	N150	LICEN	N200	LICEN	N210	LICEN	N211	LICEN
N212	LICEN	N213	LICEN	N220	LICEN	N221	LICEN	N222	LICEN	N223	LICEN
N230	LICEN	N231	LICEN	N232	LICEN	N233	LICEN	N240	LICEN	N241	LICEN
N242	LICEN	N243	LICEN	N250	LICEN	N251	LICEN	N252	LICEN	N253	LICEN
N300	LICEN	N310	LICEN	N311	LICEN	N312	LICEN	N313	LICEN	N314	LICEN
N320	LICEN	N321	LICEN	N322	LICEN	N323	LICEN	N324	LICEN	N330	LICEN
N331	LICEN	N332	LICEN	N333	LICEN	N334	LICEN	N340	LICEN	N341	LICEN
N342	LICEN	N343	LICEN	M344	LICEN	N350	LICEN	N351	LICEN	N352	LICEN
N352	LICEN	N353	LICEN	N354	LICEN	N900	LICEN	O000	QUALY	O100	QUALY
O110	QUALY	O111	QUALY	O112	QUALY	O113	QUALY	O114	QUALY	O115	QUALY
O116	QUALY	O117	QUALY	O120	QUALY	O121	QUALY	O122	QUALY	O123	QUALY
O130	QUALY	O200	QUALY	O210	QUALY	O211	QUALY	O212	QUALY	O213	QUALY
O214	QUALY	O215	QUALY	O216	QUALY	O217	QUALY	O219	QUALY	O220	QUALY
O221	LICEN	O222	LICEN	O223	LICEN	O229	LICEN	O900	QUALY	P000	LICEN
P100	LICEN	P110	LICEN	P120	LICEN	P130	LICEN	P140	LICEN	P150	QUALY
P160	QUALY	P161	QUALY	P162	QUALY	P163	QUALY	P169	QUALY	P170	QUALY
P190	QUALY	P200	LICEN	P210	LICEN	P220	LICEN	P290	LICEN	P300	PRICE
P310	QUANT	P320	QUANT	P330	LICEN	P390	LICEN	P400	PRICE	P410	PRICE
P420	PRICE	P430	PRICE	P490	PRICE	P500	PRICE	P510	PRICE	P590	PRICE
P600	LICEN	P700	PRICE	P900	PRICE						

Source: Prepared by the author.

APPENDIX B – SECTORAL REGRESSION

Table B.1: Tariff effects

Sector	Tariff Reduction		Tariff Diversion		Tariff Compression	
	$H\&T$	$H*T$	$H\&T$	$H*T$	$H\&T$	$H*T$
1201	-2.41	-1.53	2.21	2.70	0.80***	0.72***
	(4.27)	(4.31)	(2.61)	(2.78)	(0.17)	(0.14)
1202	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)
1203	-8.14***	-6.25***	0.88	-0.06	0.67***	0.69***
	(2.84)	(2.96)	(1.77)	(1.69)	(0.20)	(0.19)
1301	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)
1302	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)
1303	-7.46***	-8.69***	-2.33	-0.86	0.80***	0.82***
	(2.17)	(1.2703)	(2.90)	(2.00)	(0.13)	(0.16)
1402	2.27***	2.27***	-0.25	-0.25	0.79***	0.79***
	(0.83)	(0.83)	(0.92)	(0.92)	(0.18)	(0.18)
1403	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)
1501	-4.77	-6.52	2.48	3.18**	0.80***	0.83***
	(3.81)	(4.66)	(1.68)	(1.43)	(0.15)	(0.16)
1502	0.11	0.11	-0.35	-0.35	0.58**	0.58**
	(0.54)	(0.54)	(1.60)	(1.60)	(0.24)	(0.24)
1503	-1.22	-1.11	-2.45*	-1.81**	0.95***	1.00***
	(1.35)	(1.12)	(1.49)	(0.90)	(0.16)	(0.13)
1601	-0.16	-0.16	-0.17	-0.17	1.22***	1.22***
	(0.29)	(0.29)	(0.50)	(0.50)	(0.12)	(0.12)
1701	3.74*	3.74*	5.17	5.17	1.03***	1.03***
	(1.96)	(1.96)	(3.70)	(3.70)	(0.09)	(0.09)
1703	-0.70	-0.69	0.93	1.22*	0.89***	0.89***
	(0.88)	(0.95)	(0.82)	(0.69)	(0.11)	(0.11)
1801	-0.29	-0.29	-2.19**	-2.19**	0.91***	0.91***
	(0.43)	(0.43)	(0.85)	(0.85)	(0.07)	(0.07)
1803	-1.41	-4.22	-8.10	-6.37	0.73***	0.89***
	(3.22)	(5.30)	(7.52)	(6.04)	(0.17)	(0.10)
1901	-2.37	-1.71	0.26	-0.71	0.77***	0.84***
	(2.39)	(2.15)	(1.31)	(1.09)	(0.18)	(0.18)
2003	6.46**	5.40*	-0.03	-0.09	0.18	0.21
	(3.01)	(2.83)	(0.22)	(0.17)	(0.27)	(0.21)
2101	19.46**	19.46**	-4.20**	-4.20**	1.14***	1.14***
	(8.50)	(8.50)	(1.70)	(1.70)	(0.02)	(0.02)
2103	-10.14***	-10.14***	-2.95***	-2.95***	0.99***	0.99***
	(2.8418)	(2.84)	(1.1314)	(1.13)	(0.13)	(0.13)
2201	-1.68	-1.68	-0.04	-0.04	0.86	0.86
	(2.53)	(2.53)	(0.07)	(0.07)	(0.07)	(0.07)
2203	-0.68	-0.68	0.41**	0.41**	0.84***	0.84***
	(0.62)	(0.62)	(0.20)	(0.20)	(0.14)	(0.14)
2301	-2.07	-0.82***	-0.15	-0.10	0.93***	0.93***
	(2.64)	(0.78)	(2.18)	(2.12)	(0.10)	(0.13)
2302	-2.74	2.23	2.26	1.97	0.62***	0.68***
	(2.12)	(2.64)	(2.32)	(2.24)	(0.17)	(0.18)
2303	-2.70	-	-1.99	-	0.97***	-*
	(2.13)	(-)	(1.81)	(-)	(0.11)	(-)

PPML clustered standard errors at 6-digits HS in parenthesis. * p<0.10, ** p<0.05, *** p<0.01. The sectors in which there is no convergence on PPML are indicated by "-".

Table B.2: NTM's effects - Individual $H\&T$ effects

	NTM Reduction				NTM Compression				NTM Diversion			
Sector	Price	Qualy	Quant	Licen	Price	Qualy	Quant	Licen	Price	Qualy	Quant	Licen
12 -												
1201	15.59	0.00	-40.23	-0.91***	-0.00	0.00***	-0.00***	0.00	0.63	-0.14**	-2.49	0.06***
	(10.87)	(0.38)	(251.71)	(0.30)	(0.00)	(0.00)	(0.00)	(0.00)	(0.54)	(0.06)	(1.74)	(0.02)
1202	-	-	-	-	-	-	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1203	-17.65***	-0.25*	-16.65	-0.79**	0.00***	0.00***	-0.00**	-0.00**	-0.28	-0.00	-6.30	-0.10*
	(6.42)	(0.13)	(29.42)	(0.37)	(0.00)	(0.00)	(0.00)	(0.00)	(1.14)	(0.02)	(4.11)	(0.06)
13 -												
1301	-	-	-	-	-		-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1302	-	-	-	-	-		-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1303	-0.53	-0.78**	2.88	-0.42	0.00	-0.00	0.00	0.00	-0.02	0.02	-0.04	-0.11**
	(0.68)	(0.38)	(27.37)	(1.16)	(0.00)	(0.00)	(0.00)	(0.00)	(0.23)	(0.02)	(1.01)	(0.05)
14 -												
1402	-0.90	0.21	179.83	-1.35	0.00	0.00	-0.00*	0.00	-0.09	-0.02	-7.00***	0.04
	(0.77)	(0.24)	(138.52)	(0.97)	(0.00)	(0.00)	(0.00)	(0.00)	(0.33)	(0.03)	(2.48)	(0.18)
1403	-	-	-	-	-		-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
15 -												
1501	-7.04	-0.15	-1739.41	-1.11	0.00	0.00	0.56**	-0.00	-0.30	-0.06*	-0.28	-0.08*
	(25.44)	(0.41)	(3095.70)	(1.10)	(0.00)	(0.00)	(0.22)	(0.00)	(0.54)	(0.04)	(1.08)	(0.05)
1502	0.09	-0.06	14.77	-0.95	-0.00***	0.00**	0.00	0.00	-3.75**	-0.25**	0.99**	-0.47*
	(1.32)	(0.10)	(73.98)	(1.10)	(0.00)	(0.00)	(0.00)	(0.00)	(1.47)	(0.10)	(0.46)	(0.28)
1503	0.19	0.36***	2.64	-0.13	0.00	-0.00	0.00	0.00	0.09	-0.02	-1.67***	-0.03
	(1.63)	(0.10)	(2.53)	(0.15)	(0.00)	(0.00)	(0.00)	(0.00)	(0.11)	(0.01)	(0.63)	(0.06)
16 -												
1601	0.04	0.14	729.49***	-1.84*	0.00	-0.00***	-0.00	-0.00	-0.11	-0.01	0.02	0.05
	(0.05)	(0.10)	(51.59)	(0.92)	(0.00)	(0.00)	(0.00)	(0.00)	(0.22)	(0.01)	(0.02)	(0.07)
17 -												
1701	-8.57	3.55***	-13.69	0.82	-0.00**	0.00	0.00	-0.00	0.18	-0.23*	0.84	0.03
	(31.94)	(0.93)	(31.17)	(4.84)	(0.00)	(0.00)	(0.00)	(0.00)	(0.49)	(0.13)	(8.29)	(0.13)
1703	-3.08	-0.16*	48.73*	-0.64	0.00	0.00	0.00***	0.00	0.26	-0.02	-7.34***	-0.19
	(3.36)	(0.08)	(27.95)	(0.62)	(0.00)	(0.00)	(0.00)	(0.00)	(0.22)	(0.02)	(1.63)	(0.17)
18 -												
1801	-20.23	-0.59***	849.99	0.28	0.00	-0.00	-0.00***	0.00**	-6.32	0.09***	-32.70*	-0.23
	(22.78)	(0.23)	(1760.49)	(0.25)	(0.00)	(0.00)	(0.00)	(0.00)	(4.47)	(0.03)	(19.90)	(0.16)
1803	2.46	2.25	472.49**	-2.51	0.00	0.00**	0.00*	-0.00	-1.27	0.04***	10.29	0.08
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
19 -												
1901	-4.15	-0.46	-7.49***	-0.15	-0.00	0.00**	0.00***	-0.00***	-0.21	-0.04	-0.56	0.04
	(3.46)	(0.88)	(2.74)	(0.71)	(0.00)	(0.00)	(0.00)	(0.00)	(0.13)	(0.06)	(1.29)	(0.07)
20 -												
2003	2.01	-0.69	103628.62**	0.90***	0.00***	0.00***	-1.15*	0.00	0.23	-0.05	-31.91	-0.05
	(4.09)	(0.13)	(322.33)	(0.79)	(0.00)	(0.00)	(0.05)	(0.00)	(0.05)	(0.01)	(1.28)	(0.27)
21 -												
2101	27.32***	0.36	-13.67 **	-4.14**	-0.00***	-0.00***	0.01***	0.01***	-1.44	0.50***	-2.24*	-3.73***
	(3.65)	(0.39)	(6.49)	(2.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.92)	(0.13)	(1.17)	(0.33)
2103	3.44***	0.07	3.84	-1.16***	-0.00	0.00***	-0.00**	-0.00*	-0.16**	0.00	-1.69	-0.05***
	(0.80)	(0.06)	(2.38)	(0.30)	(0.00)	(0.00)	(0.00)	(0.00)	(0.08)	(0.02)	(1.04)	(0.02)
22 -												
2201	-3.79	-0.12	-15.72	1.33**	-0.00	-0.00*	0.00	0.00	-0.03	0.02**	-0.39	-0.09
	(2.66)	(0.27)	(24.03)	(0.62)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.01)	(0.88)	(0.08)
2203	-3.87***	0.05*	67.95***	-0.22	0.00**	0.00	-0.00**	0.00	-0.47***	-0.07	-16.75***	-0.06
	(0.89)	(0.03)	(21.78)	(0.17)	(0.00)	(0.00)	(0.00)	(0.00)	(0.18)	(0.04)	(4.69)	(0.09)
23 -												
2301	-0.29	0.88***	-6.01	-0.93	0.00**	-0.00***	-0.00	-0.00	-0.02	-0.04	-6.22	0.06
	(0.18)	(0.31)	(73.93)	(0.68)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.04)	(4.26)	(0.05)
2302	-19.32***	-1.53***	-9893.29***	-6.83***	0.00	0.00**	-0.00	-0.00	0.49***	-0.04	-3.06	0.01
	(7.43)	(0.36)	(3550.48)	(1.54)	(0.00)	(0.00)	(0.00)	(0.00)	(0.12)	(0.03)	(2.38)	(0.06)
2303	-27.08*	-0.33**	-2.76***	0.26	0.00	0.00*	0.00	-0.00***	0.10	0.05***	1.28	-0.03
	(16.27)	(0.16)	(0.82)	(1.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.12)	(0.02)	(2.02)	(0.11)

PPML clustered standard errors at 6-digits HS in parenthesis. * p<0.10, ** p<0.05, *** p<0.01. The sectors in which there is no convergence on PPML ar
indicated by "-". OMT means that the variable was omitted due to collinearity or too few clusters.

Table B.3: NTM's effects - Pairwise combination $H * T$ effects

	NTM Reduction				NTM Diversion				NTM Compression			
Sector	Price	Qualy	Quant	Licen	Price	Qualy	Quant	Licen	Price	Qualy	Quant	Licen
12 -												
1201	17.36	0.05	-29.13	-0.81***	-0.00	0.00***	-0.00*	0.00	0.13	-0.15***	-2.01	0.01
	(12.09)	(0.39)	(207.67)	(0.30)	(0.00)	(0.00)	(0.00)	(0.00)	(0.58)	(0.06)	(1.85)	(0.02)
1202	-	-	-	-	-	-	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1203	-15.30***	-0.21*	-29.29	-0.59	0.00***	0.00***	-0.00***	-0.00**	-1.14	-0.02	-8.83	-0.12**
	(5.93)	(0.13)	(31.95)	(0.37)	(0.00)	(0.00)	(0.00)	(0.00)	(1.10)	(0.03)	(6.34)	(0.06)
13 -												
1301	-	-	-	-	-		-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1302	-	-	-	-	-	-	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1303	-0.13	-0.97*	-4.50	-0.39	0.00	-0.00	0.00	0.00	-0.38*	0.00	-0.12	-0.11*
	(0.99)	(0.54)	(23.00)	(1.15)	(0.00)	(0.00)	(0.00)	(0.00)	(0.22)	(0.01)	(0.84)	(0.06)
14 -												
1402	-0.90	0.21	179.83	-1.35	0.00	0.00	-0.00*	0.00	-0.09	-0.02	-7.00***	0.04
	(0.77)	(0.24)	(138.52)	(0.97)	(0.00)	(0.00)	(0.00)	(0.00)	(0.33)	(0.03)	(2.48)	(0.18)
1403	-	-	-	-	-		-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
15 -												
1501	-17.45	-0.11	749.61	-0.57	0.00	0.00	0.51*	-0.00	-0.11	-0.10**	-3.61**	-0.01
	(20.71)	(0.30)	(4313.93)	(1.15)	(0.00)	(0.00)	(0.27)	(0.00)	(0.67)	(0.05)	(1.41)	(0.04)
1502	0.09	-0.06	14.77	-0.95	-0.00***	0.00**	0.00	0.00	-3.75**	-0.25**	0.99**	-0.47*
	(1.32)	(0.10)	(73.98)	(1.10)	(0.00)	(0.00)	(0.00)	(0.00)	(1.47)	(0.10)	(0.46)	(0.28)
1503	0.18	0.36***	2.85	-0.06	0.00	-0.00	0.00	0.00	0.02	-0.03**	-1.17**	-0.05
	(0.48)	(0.14)	(8.79)	(0.87)	(0.00)	(0.00)	(0.00)	(0.00)	(0.05)	(0.02)	(0.34)	(0.05)
16 -												
1601	0.04	0.14	729.49***	-1.84*	0.00	-0.00***	-0.00	-0.00	-0.11	-0.01	0.02	0.05
	(0.05)	(0.10)	(51.59)	(0.92)	(0.00)	(0.00)	(0.00)	(0.00)	(0.22)	(0.01)	(0.02)	(0.07)
17 -												
1701	-8.57	3.55***	-13.69	0.82	-0.00**	0.00	0.00	-0.00	0.18	-0.23*	0.84	0.03
	(31.94)	(0.93)	(31.17)	(4.84)	(0.00)	(0.00)	(0.00)	(0.00)	(0.49)	(0.13)	(8.29)	(0.13)
1703	-4.74	-0.16*	14.29	-1.03	0.00	-0.00	0.00***	0.00	0.35*	-0.05**	-6.02***	-0.41**
	(3.40)	(0.09)	(22.47)	(0.63)	(0.00)	(0.00)	(0.00)	(0.00)	(0.18)	(0.02)	(1.39)	(0.19)
18 -												
1801	-20.23	-0.59***	849.99	0.28	0.00	-0.00	-0.00***	0.00**	-6.32	0.09***	-32.70*	-0.23
	(22.78)	(0.23)	(1760.49)	(0.25)	(0.00)	(0.00)	(0.00)	(0.00)	(4.47)	(0.03)	(19.90)	(0.16)
1803	-31.09	2.18	4455.94	-2.59	0.00	0.00	-0.00	-0.00	-0.68	-0.07*	-1.06	-0.02
	(21.87)	(2.41)	(3616.48)	(1.83)	(0.00)	(0.00)	(0.00)	(0.00)	(0.90)	(0.04)	(7.15)	(0.07)
19 -												
1901	-2.80	0.36	-7.13**	0.07	-0.00	0.00**	0.00**	-0.00**	-0.21	-0.10***	-1.01	-0.06
	(3.10)	(1.66)	(2.95)	(1.18)	(0.00)	(0.00)	(0.00)	(0.00)	(0.17)	(0.04)	(1.15)	(0.06)
20 -												
2003	1.62	-0.46	67168.18***	0.54	0.00***	0.00	-0.99**	0.00	-1.26	-0.04	-15.12	-0.36
	(1.24)	(0.74)	(24092.79)	(0.34)	(0.00)	(0.00)	(0.39)	(0.00)	(0.80)	(0.03)	(23.43)	(0.30)
21 -												
2101	27.32***	0.36	-13.67 **	-4.14**	-0.00***	-0.00***	0.01***	0.01***	-1.44	0.50***	-2.24*	-3.73***
	(3.65)	(0.39)	(6.49)	(2.05)	(0.00)	(0.00)	(0.00)	(0.00)	(0.92)	(0.13)	(1.17)	(0.33)
2103	3.44***	0.07	3.84	-1.16***	-0.00	0.00***	-0.00**	-0.00*	-0.16**	0.00	-1.69	-0.05***
	(0.80)	(0.06)	(2.38)	(0.30)	(0.00)	(0.00)	(0.00)	(0.00)	(0.08)	(0.02)	(1.04)	(0.02)
22 -												
2201	-3.79	-0.12	-15.72	1.33**	-0.00	-0.00*	0.00	0.00	-0.03	0.02**	-0.39	-0.09
	(2.66)	(0.27)	(24.03)	(0.62)	(0.00)	(0.00)	(0.00)	(0.00)	(0.06)	(0.01)	(0.88)	(0.08)
2203	-3.87***	0.05*	67.95***	-0.22	0.00**	0.00	-0.00**	0.00	-0.47***	-0.07	-16.75***	-0.06
	(0.89)	(0.03)	(21.78)	(0.17)	(0.00)	(0.00)	(0.00)	(0.00)	(0.18)	(0.04)	(4.69)	(0.09)
23 -												
2301	0.52	0.86***	-31.29	-1.01	0.00**	-0.00	-0.00*	-0.00	0.00	-0.03	-1.49	0.06**
	(1.19)	(0.22)	(23.57)	(0.88)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.03)	(1.16)	(0.02)
2302	-13.79	-1.58***	-11219.71***	-6.23***	-0.00	0.00**	-0.00	-0.00	0.08	-0.06**	-0.84	0.02
	(11.46)	(0.46)	(3252.06)	(1.83)	(0.00)	(0.00)	(0.01)	(0.00)	(0.14)	(0.02)	(2.22)	(0.05)
2303	-	-	-	-	-		-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)

PPML clustered standard errors at 6-digits HS in parenthesis. * p<0.10, ** p<0.05, *** p<0.01. The sectors in which there is no convergence on PPML a
indicated by "-". OMT means that the variable was omitted due to collinearity or too few clusters.

Table B.4: Mitigation effect

Sector	MIT Price		MIT Qualy		MIT Quant		MIT Licen	
	$H\&T$	$H*T$	$H\&T$	$H*T$	$H\&T$	$H*T$	$H\&T$	$H*T$
12 -								
1201	-14.99	-16.98	-0.01	-0.05	58.61	32.49	0.89***	0.79***
	(10.85)	(12.00)	(0.37)	(0.38)	(237.75)	(197.93)	(0.28)	(0.28)
1202	-	-	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1203	16.55***	14.45*	0.19	0.15	38.08	57.57**	0.95***	0.76**
	(6.255)	(5.63)	(0.12)	(0.12)	(29.39)	(28.56)	(0.34)	(0.34)
13 -								
1301	-	-	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1302	-	-	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
1303	0.49	0.18	0.77***	0.96**	-7.42	-3.03	0.41	0.47
	(0.68)	(0.94)	(0.28)	(0.44)	(18.82)	(16.21)	(0.94)	(0.93)
14 -								
1402	0.68	0.68	-0.22	-0.22	-144.39	–144.39	0.90	0.90
	(0.66)	(0.66)	(0.21)	(0.21)	(118.51)	(118.5)	(0.65)	(0.65)
1403	-	-	-	-	-	-	-	-
	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)
15 -								
1501	7.24	17.33	0.15	0.12	871.28	-1003.35	1.20	0.68
	(24.74)	(20.06)	(0.41)	(0.29)	(2320.85)	(3164.50)	(1.08)	(1.11)
1502	1.14	1.14	0.05	0.05	-15.42	-15.42	1.15	1.15
	(1.30)	(1.30)	(0.06)	(0.06)	(74.39)	(74.39)	(1.00)	(1.00)
1503	-0.18	-0.16	-0.34***	-0.35**	-1.48	-1.82	0.12	0.05
	(1.45)	(1.56)	(0.10)	(0.11)	(1.49)	(1.95)	(0.16)	(0.14)
16 -								
1601	-0.01	-0.01	-0.12	-0.12	-595.51***	-595.51***	1.71	1.71
	(0.05)	(0.05)	(0.10)	(0.10)	(59.74)	(59.74)	(0.87)	(0.87)
17 -								
1701	9.70	9.70	-3.36	-3.36	OMT	OMT	-0.77	-0.77
	(32.16)	(32.16)	(0.93)	(0.93)	(OMT)	(OMT)	(4.83)	(4.83)
1703	2.49	3.81	0.18**	0.19**	-43.97*	-11.98	0.67	1.09*
	(2.70)	(2.74)	(0.08)	(0.09)	(26.06)	(0.63)	(0.62)	(3.97)
18 -								
1801	20.96	20.96	0.06**	0.06**	-737.21	-737.21	0.05	0.05
	(22.23)	(22.23)	(0.03)	(0.03)	(1723.67)	(1723.67)	(0.08)	(0.08)
1803	-2.30	31.08	-2.22	-2.14	-398.26**	-4035.28	2.38	2.43
	(2.03)	(21.45)	(2.46)	(2.41)	(198.64)	(3286.40)	(1.90)	(1.69)
19 -								
1901	4.19	2.86	0.46	-0.35	3.14*	2.91**	0.23	0.05
	(3.36)	(3.01)	(0.87)	(1.66)	(1.22)	(1.20)	(0.72)	(1.18)
20 -								
2003	-1.60	-1.18	0.48	0.32	-82362.68**	-51752.87***	-0.82***	-0.43
	(1.18)	(1.14)	(0.77)	(0.54)	(41467.11)	(18413.21)	(0.30)	(0.35)
21 -								
2101	-18.98***	-18.98***	-0.11	-0.11	9.80**	9.80**	-0.22	-0.22
	(2.59)	(2.59)	(0.11)	(0.11)	(4.87)	(4.87)	(2.95)	(2.95)
2103	-2.47***	-2.47***	-0.05	-0.05	-2.36	-2.36	1.26***	1.26***
	(0.59)	(0.59)	(0.05)	(0.05)	(1.90)	(1.90)	(0.31)	(0.31)
22 -								
2201	3.45	3.45	0.43**	0.43**	16.47	16.47	-1.43**	-1.43**
	(2.42	(2.42)	(0.19)	(0.19)	(22.59)	(22.59)	(0.63	(0.63)
2203	3.85***	3.85***	-0.02	-0.02	-36.14***	-36.14***	0.19	0.19
	(0.99)	(0.99)	(0.02)	(0.02)	(11.41)	(11.41)	(0.13)	(0.13)
23 -								
2301	0.02	-0.70	-0.83***	-0.82***	0.07	29.27	0.95	1.02
	(0.05)	(1.10)	(0.31)	(0.23)	(66.24)	(22.64)	(0.66)	(0.87)
2302	18.93**	13.87	1.47***	1.53***	8300.03***	9405.16***	6.84***	6.25***
	(7.43)	(11.44)	(0.32)	(0.43)	(2949.89)	(2704.47)	(1.51)	(1.81)
2303	26.83*	-	0.29**	-	OMT	-	-0.14	-
	(16.30)	(-)	(0.14)	(-)	(OMT)	(-)	(1.05)	(-)

PPML clustered standard errors at 6-digits HS in parenthesis. * p<0.10, ** p<0.05, *** p<0.01. The sectors in which there is no convergence on PPML are indicated by "-". OMT means that the variable was omitted due to collinearity or too few clusters.

APPENDIX C – DATABASE TREATMENT

C.0 NON-TARIFF MEASURES - NTM'S

The NTM data for Brazil and the eleven exporters are obtained from the TRAINS-Online in a *.xlsx* file. The original file has 18 columns and the variables starts from line 9, as shown in figure C.1. The major part of the data was treated at Python, and the remaining through Stata. The hardest work was made in Python. The first step is to break the lines concerning to the HS codes. In the column 6 of figure C.1, the head *HS code*, it is possible to note that one NTM can be associated with more than one product, but as I work at 6-digit HS, I split the codes of each excel cell. The second step is to correct some information regarding to the implementation and repeal date, and the NTM code, adding a right zero on the variable.

Figure C.1: An example of the *.xlsx* file with the NTM data from TRAINS Online

1	UNCTAD, TRAINS NTMs database, Extract made on: Friday, 29 July 2022 13:10:57									
2	Your query covers 37251 measures									
3	Type of Measures:	All								
4	Country(ies) imposing:	Afghanistan, Algeria, Antigua and Barbuda, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belgium, Benin, Bolivia, Botswana, Brunei Darussalam, Bulgaria, Burkina Faso, Cabo Verde, Cambodia, Cameroon, Canada, Chad, Chile, China, Colombia, Costa Rica, Côte d'Ivo								
5	Partner(s) affected:	Brazil, World								
6	Product(s):	All								
7										
8										
9	Country imposing NTM(s)	Partner affected by NTM(s)	NTM code	Measure description	Product description	HS code	Issuing agency	Regulation title	Regulation symbol	Implementation date	Official regulation document
10	Nepal	World	A86	Importer of live animals must fulfill following conditions: if any animal died after its dispatchment, he/she must inform with details to quarantine officer; must submit the details like identification mark, number, weight and type. Vehicle use for transportation of exporting animals must be	Live animals	010641, 010649, 010690	Nepal Central Animal Quarantine Office	Animal Health and Service Regulation 2056		14-01-2008	
11	Nepal	World	A19	For fishery purpose, only following species are allowed to import: Cyprinus carpio, Hypothalmichthys molitrix, Ariestichthys nobilis, Ctenopharyngodon idella, Labeo rohita, Cirrhinus mrigala, Catla catla and	Fish (Live animals)	010641, 010649, 010690	Nepal Central Animal Quarantine Office	Animal Health and Service Regulation 2056		14-01-2008	
12	Nepal	World	A14	Importer must obtain permit from quarantine check-post prior to the importation of animals	Live animals	010641, 010649, 010690	Nepal Central Animal Quarantine Office	Animal Quarantine Directives 2064		17-07-2008	
13	Nepal	World	A14	Importer of dogs and cats must submit certificate of health and rabies vaccine obtained from concerned authorities. In case of rabbit and rats, importer must submit health certificate	Live animals	010641, 010649, 010690	Nepal Central Animal Quarantine Office	Animal Quarantine Directives 2064		17-07-2008	
14	Nepal	World	A83	While importing chicks, must keep international animal health certificate and the recommendation letter of Department of Livestock Services stand by.	Chicks	010599	Nepal Central Animal Quarantine Office	Animal Quarantine Directives 2064		17-07-2008	
	Nepal	World	A86	Parent chicks must be imported via air route (only via animal quarantine	Chicks	010599	Nepal Central Animal Quarantine Office	Animal Quarantine Directives 2064		17-07-2008	

Notes: Prepared by the author.

As complement, I created, from the *HS code* column, the variables HS-6, HS-4, HS-2 - important further. Also, I did some corrections on the countries names to match with a countries ISO code/name database that I have already. The third step was to replicate the NTM over the years according to the implementation date and the repeal date, and some small details concerning to the treatment. This first three steps were made on the raw base, directly on the *.xlsx* in Python. The following steps were done in Stata.

At fourth step I matchd the *ntm database* with my country ISO/name data, to associate each country with the ISO code. Fifth step, I created the NTM's categories: price, license, quantity, and quality according to the NTM code. Step sixth,, I broke down the database into three bases, based on the digits of HS code: a base only for HS-6, another for HS-4, and another for HS-2. This was necessary because NTM's are applied at different digits. I did not have any information about the version of the product code (H0-H5) which the NTM at 6-digit is applied, thus, I tried to compatibilize, first, with the more recent version, H5 and the remaining codes with the H4. For the HS-4 and HS-2 digits, I matched using directly the H5 version. This step was important because I convert all my products code from H5 and H4 to H0, the version where my imports-flow database was built.

Due the conversion from H5/H4 to H0, some NTM's were duplicated in the process. This occurred because sometimes two products at H5, and consequently two different product codes, when converted to H0 becomes a unique code. So, if I had an A110 applied

against two products at H5, but converting to H0, I would have now two A110 on the same product. I dropped this duplicated observations. Within this conversion, I did some interaction within the products code. As I worked at HS-6, the NTM's applied at HS-4 and HS-2 would not be very useful to my work. Then, I related the HS-4 and HS-2 with its respective HS-6. To illustrate, a NTM applied at HS-2, following my approach, would be related with all HS-6 in that chapter, while a NTM applied at HS-4 would be related with all HS-6 in that sub chapter.

Step 7, I merged the *ntm database* with the WTO agricultural product codes, keeping only the products code that were in both data. Step 8, I restricted my sample to the main exporters exhibited in the panel A of table 1.1.

For instance, using the figure C.2, let me take the first line, which the information are: A NTM imposed by Nepal, to World (and obviously Brazil), at NTM code A86 on products 010641, 010649, and 010690, applied in 2008 with repeal date in 9999. Applying the steps 1 and 2, we get the output displayed at figure C.3. Step 3 get me the result on figure C.4. Note that, in figure C.4 the *year* is fixed, as it refers to the year that the NTM was applied, while the *year_int* is at least equal *year* and maximum at 2017. This occurs because I replicated the NTM's until the *repeal* be equal or less than the *year_int*, since in this example the repeal date is 9999, I replicated the NTM's for all periods from its implementation. At step 3, I have 6,373,439. observations.

Figure C.2: The database before steps 1 and 2

	Country imposing NTM(s)	Partner affected by NTM(s)	NTM code	Implementation date	Repeal Date	HS code
0	Nepal	World	A86	2008-01-14	9999-12-31 00:00:00	010641, 010649, 010690
1	Nepal	World	A19	2008-01-14	9999-12-31 00:00:00	010641, 010649, 010690
2	Nepal	World	A14	2008-07-17	9999-12-31 00:00:00	010641, 010649, 010690
3	Nepal	World	A14	2008-07-17	9999-12-31 00:00:00	010641, 010649, 010690
4	Nepal	World	A83	2008-07-17	9999-12-31 00:00:00	010599
...	...	...	...	...	...	...
37246	Chad	World	E125	2000-11-24	9999-12-31 00:00:00	051000(Only for manufacture of pharmaceutical ...
37247	Chad	World	B33	2015-03-16	9999-12-31 00:00:00	3808(Only Pesticides for agricultural use)
37248	Chad	World	B33	2009-08-06	9999-12-31 00:00:00	2524, 270791, 280540, 282911, 282919, 283329, ...
37249	Chad	World	B42	2009-08-06	9999-12-31 00:00:00	2524, 270791, 280540, 282911, 282919, 283329, ...
37250	Chad	World	B15	2009-08-06	9999-12-31 00:00:00	2524, 270791, 280540, 282911, 282919, 283329, ...

Notes: Prepared by the author.

Figure C.3: The database after steps 1 and 2

	hs_list	country_from	country_to	ntm_code	repeal	year	hs_2	hs_4	hs_6
0	010641	Nepal	World	A860	9999	2008	01	0106	010641
1	010649	Nepal	World	A860	9999	2008	01	0106	010649
2	010690	Nepal	World	A860	9999	2008	01	0106	010690
3	010641	Nepal	World	A190	9999	2008	01	0106	010641
4	010649	Nepal	World	A190	9999	2008	01	0106	010649
5	010690	Nepal	World	A190	9999	2008	01	0106	010690
6	010641	Nepal	World	A140	9999	2008	01	0106	010641
7	010649	Nepal	World	A140	9999	2008	01	0106	010649
8	010690	Nepal	World	A140	9999	2008	01	0106	010690
9	010641	Nepal	World	A140	9999	2008	01	0106	010641
10	010649	Nepal	World	A140	9999	2008	01	0106	010649
11	010690	Nepal	World	A140	9999	2008	01	0106	010690

Notes: Prepared by the author.

The subsequent steps (4º onward) are detailed in figures C.5 to C.9. Step 4 is detailed at figure C.5. 165 countries did not match between the *NTM database* (master) and the *countries ISO base* (using). Those who did not match, one is Brazil (Since Brazil did not imports from itself), and 27 are EU members countries - given that the NTM are applied by the EU as a whole. The numbers of countries that did not match must

Figure C.4: The database after step 3

	hs_6	hs_4	hs_2	country_from	country_to	ntm_code	year	year_int	repeal
0	010641	0106	01	Nepal	World	A860	2008	2008	9999
0	010641	0106	01	Nepal	World	A860	2008	2009	9999
0	010641	0106	01	Nepal	World	A860	2008	2010	9999
0	010641	0106	01	Nepal	World	A860	2008	2011	9999
0	010641	0106	01	Nepal	World	A860	2008	2012	9999
0	010641	0106	01	Nepal	World	A860	2008	2013	9999
0	010641	0106	01	Nepal	World	A860	2008	2014	9999
0	010641	0106	01	Nepal	World	A860	2008	2015	9999
0	010641	0106	01	Nepal	World	A860	2008	2016	9999
0	010641	0106	01	Nepal	World	A860	2008	2017	9999
1	010649	0106	01	Nepal	World	A860	2008	2008	9999
1	010649	0106	01	Nepal	World	A860	2008	2009	9999
1	010649	0106	01	Nepal	World	A860	2008	2010	9999
1	010649	0106	01	Nepal	World	A860	2008	2011	9999
1	010649	0106	01	Nepal	World	A860	2008	2012	9999
1	010649	0106	01	Nepal	World	A860	2008	2013	9999
1	010649	0106	01	Nepal	World	A860	2008	2014	9999
1	010649	0106	01	Nepal	World	A860	2008	2015	9999
1	010649	0106	01	Nepal	World	A860	2008	2016	9999
1	010649	0106	01	Nepal	World	A860	2008	2017	9999
2	010690	0106	01	Nepal	World	A860	2008	2008	9999
2	010690	0106	01	Nepal	World	A860	2008	2009	9999
2	010690	0106	01	Nepal	World	A860	2008	2010	9999
2	010690	0106	01	Nepal	World	A860	2008	2011	9999
2	010690	0106	01	Nepal	World	A860	2008	2012	9999
2	010690	0106	01	Nepal	World	A860	2008	2013	9999
2	010690	0106	01	Nepal	World	A860	2008	2014	9999
2	010690	0106	01	Nepal	World	A860	2008	2015	9999
2	010690	0106	01	Nepal	World	A860	2008	2016	9999
2	010690	0106	01	Nepal	World	A860	2008	2017	9999

Notes: Prepared by the author.

be interpreted with caution, because my using database includes subdivisions of national states and countries that no longer exist for the period as of 2000, such as Soviet Union or Yugoslavia.

Figure C.5: Step 4

Result	# of obs.
not matched	165
from master	0
from using	165
matched	6,373,274

Notes: Prepared by the author.

In step 5, I keep in the base the observations that matched in step 4, thus, dropping 165 observations. I created the four categories of NTM'S: price, license, quantity, and quality. Figure 6 shows how many observations was assigned to each category out of a total of 6,373,274.

Figure C.6: Step 5

Variable	Obs
price	341,547
licen	1,635,942
quant	55,891
qualy	4,274,550

Notes: Prepared by the author.

Step 6 requires a bit more attention. The NTM's can be applied at 3 different levels: 6-digit, 4-digit, or 2-digit. If applied at 6-digits, my work is to designate which version of the HS code the NTM's were applied. As the file made available by TRAINS does not indicate which version of the product code the NTM was applied, I first used the H5 to H0 version to match as many codes as possible, and the remaining I match using H4 to H0 version. Figure C.7 shows the merge of the NTM database with the bases regarding the product code.

Figure C.7: Step 6 - 6-digits HS codes treatment

Result	# of obs.
not matched	55,811
from master	55,803
from using	8
matched	4,852,030
HS-5	

Result	# of obs.
not matched	5,155
from master	29
from using	5,126
matched	55,774
HS-4	

Notes: Prepared by the author.

As I treated the NTM's files separately, problems in the data were treated individually. In the file that I am using to illustrate the database mechanics, for instance, 29 products code did not match with the benchmark bases. Looking into the database, this code corresponds to the product "001909", which does not exist. Two reasons: 1) It is a misstatement; 2) Nationwide code. One solution: I keep those that matched, and I ignored those 29 observations that did not match from the master database. At last, I append the HS-5 and the HS-4 databases.

I repeat this process for the databases that the NTM's were applied at 4 and 2 digits. The difference is that for 4 and 2-digit, instead of merging the master data (ntm) and the using data (HS code conversion), I did a join within groups. This means that for all 4-digit NTM's I iterated over all 6-digit code that belong to that sub-chapter, and that for all 2-digit I iterated over all 6-digit code that belong to that chapter. For instance, a NTM applied at code 0901 is replicated over the six digits: 090111, 090112, 090121, 090122, and 090190. If applied at 2-digit, 09, the NTM are replicated for all 39 products of the chapter. After step 6 I have 20,220,115 observations.

Of 20,220,115, 52% has repeal date equal "nan", which means that in the original file this date are in blank. The approach adopted is described at the Data Section. I replaced this blank repeal date by 9999, and dropped duplicated NTM's, Figure C.8 shows the output of step 6 in terms of observations and repeal date.

Figure C.8: Step 6 - repeal frequency and observations

repeal	Freq.	Percent
2000	6	0.00
2001	86	0.00
2002	447	0.00
2003	1,415	0.01
2004	331	0.00
2005	965	0.01
2006	753	0.01
2007	2,057	0.01
2008	286	0.00
2009	755	0.01
2010	419	0.00
2011	6,179	0.04
2012	15,603	0.10
2013	4,843	0.03
2014	2,906	0.02
2015	67,670	0.45
2016	91,165	0.61
2017	122,642	0.82
9999	14,605,852	97.87
Total	14,924,380	100.00

Notes: Prepared by the author.

Step 7 is displayed in figure C.9. Now, the master base is the data concerning to the H0 agricultural products code and the using is the NTM's database. The not matched observations from master means that Brazil, for some reason, did not receive a NTM in that product. The not matched observations from using means that those are not agricultural products. Applying the step 8, restricting the sample to the top importing countries, I have 1,825,967 observations, and the treatment of NTM database is concluded.

Figure C.9: Step 7

Result	# of obs.
not matched	8,990,364
from master	95
from using	8,990,269
matched	5,934,111

Notes: Prepared by the author.