Estimation of Tariff Equivalent for NTM on Brazilian beef exports to the European Union

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Selected paper prepared for visual presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August, 2012.

Abstract

In this paper, we estimate the tariff equivalent of NTMs considering the beef trade between Brazil and the EU. The literature review points out a considerable number of requirements that affect beef trade. The tariff equivalents are estimated for the period of 2000 to 2009, for frozen and fresh beef, bone and boneless. Two models are estimated, assuming homogeneity and heterogeneity of goods, and following, respectively, the methodology proposed by Deardorff and Stern (1997) and Yue, Beghin and Jensen (2005). In general, we observe high values for the tariff equivalents, i.e., the European domestic prices and the world prices actually differ, which could indicate that the European beef market has been protected by NTMs.

Key-words: non-tariff measures, heterogeneity, beef, trade.

1 Introduction

The non-tariff measures (NTMs) topic was first discussed in trade multilateral negotiations during Tokyo Round (1973-1979). According to Beghin (2006), NTM means a wide and diverse range of policy interventions other than border tariffs, which affect and distort trade in goods, services and production factors.

The Standards Code was created then to regulate the implementation of these measures in order to ensure that regulations, standards, test procedures and certification do not create unnecessary obstacles to trade. However, Lima and Barral (2007) argue that this Code was found to be limited to requirements for agricultural products. So it was necessary to establish a specific agreement to address sanitary and phytosanitary issues. That was achieved with the creation of the World Trade Organization (WTO) in 1995, when the Agreement on Technical Barriers to Trade (TBT) and Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) were signed, replacing the Standards Code.

These agreements have made great prominence in the current context of international trade, once there has been an increase of NTMs (in special sanitary and technical measures) incidence, since the Uruguay Round agreed limiting the use of tariff and quotas. In fact, according to UNCTAD (2005), the use of tariff measures decreased from 5.8% of total tariff lines in 1994 to 0.3% in 2004. Likewise, the use of quantity controls (quotas) also reduced from 49.2% of the total tariff lines in 1994 to 34.8%, in 2004. On the other hand, the occurrence of technical measures increased from 31.9% in 1994 to 58.5% of tariff lines in 2004.

Requirements on technical and sanitary measures lead to impacts on trade, regardless of whether the goal is to protect the market or to correct market inefficiencies. Further, potential restriction on trade due to these regulations constitutes a challenge especially to developing countries seeking to increase production for export markets (Maskus, Wilson, 2001). Brazil is directly affected by those requirements, particularly on agribusiness products exported to the United States of America (USA) and to member-countries of the European Union (EU), as highlighted by Viegas (2003).

In fact, Miranda and Barros (2009) assert that sanitary aspects, traceability and other issues, as the environmental requisites affect the Brazilian trade flows. In this context, Foot and Mouth Disease (FMD) is an important barrier to Brazilian trade, once that countries already FMD-free are cautious about buying fresh beef from countries that still have this disease, and in some cases they even forbid the imports (Miranda; Barros, 2009).

Therefore, this paper analyzes the effects of measures imposed by the EU on beef imports, which is a sector challenged by a number of disputes involving health and quality requirements, as can be seen in the literature. Kassum and Morgan (2002) state that meat and animal products account for an important share of SPS notifications submitted to the WTO, representing an average of 31% of total sanitary measures issued by country-members between 1995 and 2001. In addition, the authors note that in this period almost half of the reports were originated in the USA, New Zealand, Mexico, European Community, Chile and Canada.

Although it is well accepted that these non-tariff measures are becoming increasingly important and frequent in affecting international trade of agricultural products, the application and effects of those measures are not perfectly clear. Thereby, we can use the price-wedge method to represent these measures, transforming them into tariff equivalents.

This methodology is based on the idea that any NTM can be measured in terms of its impact on the domestic price relative to a reference price, normally the world price (Beghin, 2006). We can then get a tariff equivalent, i.e., a rate that would restrict trade at the same level as the existing NTM. We propose to use an adapted version of the price-wedge methodology, applied by Yue, Beghin and Jensen (2005), to estimate the impact of sanitary and technical measures on beef exports from Brazil to the EU.

2 The beef trade between Brazil and EU

The world production of beef amounted in 2009 was about 57 million tons equivalent-carcass (approximately 23.75 million tons in net weight). It stands out in relation to world production that the

producers of beef cattle are classified into categories because of their health status and the major classification is related to the existence or not of FMD in the countries. Among the FMD free countries, we highlight the United States (larger producer, accounting for 20.70% of total beef production, in 2009), Canada, Japan, South Korea, New Zealand and Australia.

Brazil is considered a country with FMD and since 2005 is the second largest producer of beef, surpassing the EU. Among the Brazilian partners in the meat trade the EU can be underlined, as between the years 2004 to 2006 accounted for about 25% of the total destination of Brazilian beef exports. However, in subsequent years (2007 to 2009) the EU lost importance and in 2009 was responsible for less than 5% of Brazil's beef exports (Figure 1).

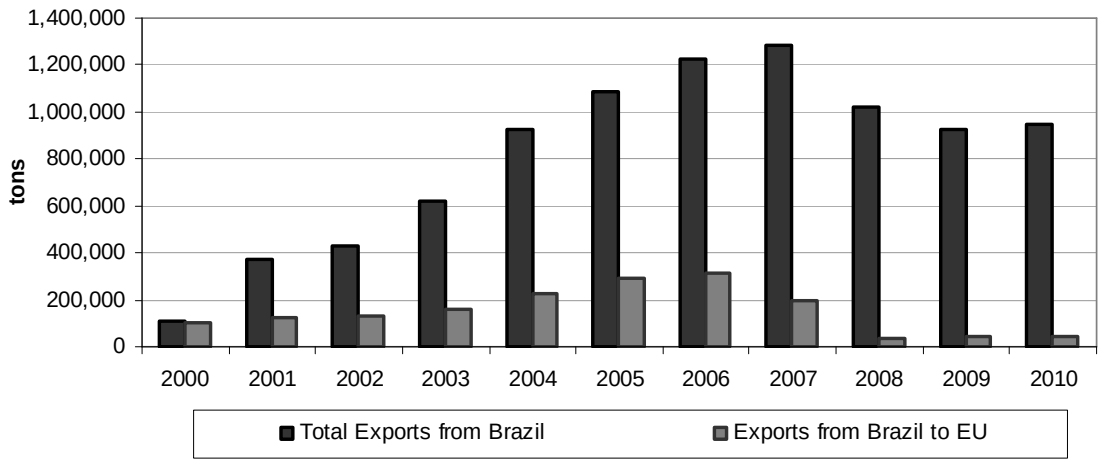

Figure 1 – Beef exports from Brazil (HS 0201.10 to 0202.30). 2000-2010

Source: Ministry of Development, Industry and Foreign Trade – Brazil (MDIC).

Also with regard to imports, it is emphasized that the EU imposes a series of measures to control imports with a technical focus (especially for animal identification and traceability) and health concerns, aimed at ensuring food safety and prevent the spread of diseases such as FMD or Bovine Spongiform Encephalopathy (BSE) in the domestic market. The EU prohibited the import of beef with bone from Brazil, claiming that the bones could spread the FMD. Indeed in 2010, Brazil exported to the EU only boneless beef, fresh or chilled (0201.30) and frozen (0202.30): the frozen beef represented 43.43% of the total exported to the EU and the fresh beef represented around 56.57%.

In this context, we can affirm that FMD constitutes an important barrier to beef exports (LIMA; MIRANDA; GALLI, 2005). The presence of this disease in areas of Brazil restricts exports of beef, once

that some importing countries are very cautious regarding the importation of fresh (MIRANDA; BARROS, 2009). Likewise, the fact that important areas of the country are free of FMD, as observed in 2001 in Mato Grosso, leads to an expansion of exports (Figure 2) to countries that follow the principle of regionalism, introduced in the SPS Agreement/WTO. In fact, the major exporting regions of beef in Brazil are free of FMD, with vaccination and Santa Catarina state is free of FMD without vaccination.

In 2005, however, there was an outbreak of FMD in Mato Grosso do Sul state, which reduced the reliability of the Brazilian product to the importers, so in next period there was a reduction of exports from Brazil to the EU (Figure 2). Despite that sanitary event, Brazil followed the World Animal Health Organization (OIE)´s guidelines to react to the outbreak and later on the trade has been recovered to other countries. However, in following periods the beef trade flows to the European Union started being limited mainly by traceability requirements.

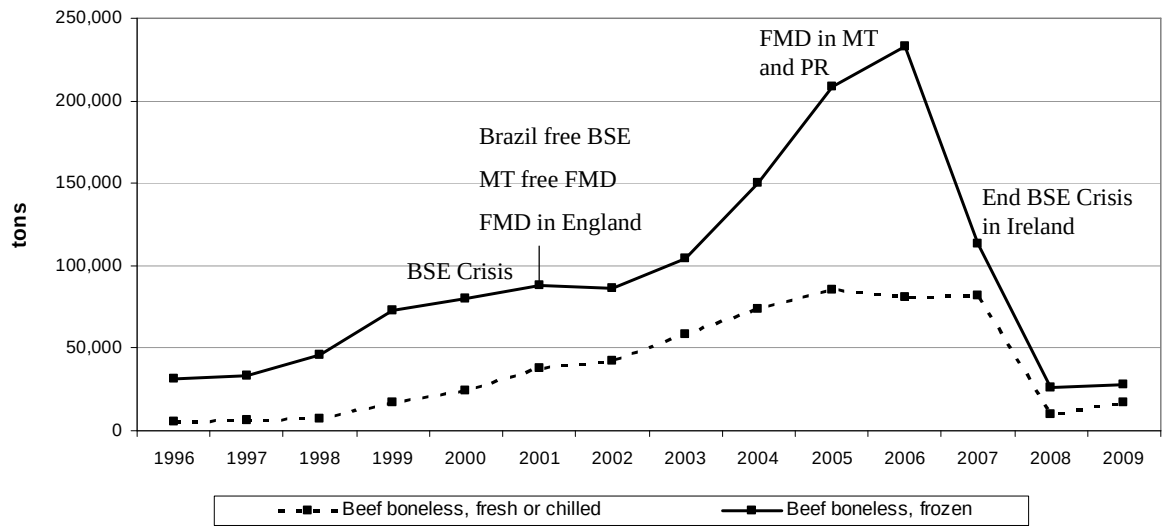

Figure 2 – Beef exports from Brazil (HS 0201.30 and 0202.30) to EU. 1996-2009.

Source: Ministry of Development, Industry and Foreign Trade – Brazil (MDIC).

Freitas and Costa (2005) assert that the largest inflows of Brazilian agricultural products in the EU depend on reducing the restrictions on access to the EU market, and an important constraint is the existing import tariffs. Indeed, according to the WTO (2007), import tariffs (*ad valorem* equivalent - AVE) in the EU range from 0% to 427.9%, and the agricultural products face the highest rates.

In addition, about trade with the EU, Machado (2007) asserts that 46.7% of SPS notifications submitted to the WTO by the European Community, between 1995 and 2005, refer only to beef. The highlight of the beef in notifications is due to the fact that this product is exposed to diseases, pandemics, and problems related to food, which underlie the implementation of regulatory instruments, such as sanitation (SCHLUETER; WIECK, 2009).

According to Schlueter and Wieck (2009), the EU was the most active to enforce sanitary requirements for beef among the 10 largest importers examined (Canada, China, EU15, Hong Kong, Japan, South Korea, Mexico, Russia, Saudi Arabia and the United States) between 1996 and 2007, followed by the United States and China. The sanitary measures imposed by the EU, which are appealing to all countries that trade with the block, refer mainly to issues regarding the tolerable concentration of veterinary products in meat products. Measures on prevention of diseases and pests and conformity assessment procedures for inspection are also important among the EU regulations. Kassum and Morgan (2002) identify that, between 1995 and 2001, 60% of all notified measures aimed to ensure animal health.

Additionally, there are requirements to control the use of veterinary products and so producers must keep records of these inputs. For instance, the European Council Regulations 2.377/90 establishes maximum residue levels (MRL) for registered veterinary products in animal feed, products interdicted in the food chain at any level and the banishment on the hormones use in animal production (ASHMEAD, 2008).

In addition, the Community regulation n^{o} 92/46 requires that virtually all animal products imported into the EU come from establishments licensed by the European Commission. However, the licensing process is slow, creating barriers for new exporting meat establishments (MDIC, 2001?). Further, the EU Directive 92/116 ECC requires inspection of animals before, during and after slaughter, considering the required standards of hygiene, health, process, among others, for all types of meat and meat products (CUNHA FILHO, 2006). Additionally, the European Community Regulation EC n^{o} 1760/2000 states that animals must be individually identified by ear markers in both ears, and determines the development of a national computerized database and deploys the labeling system for meat, with information on the meat, place of origin and slaughter of the animal (PITELLI, 2004).

Maskus and Wilson (2001) argue that technical regulations imposed on products sold affect existing trade patterns, the ability for producers to enter new markets and costs to the consumer.

However, Maskus and Wilson (2001) emphasize that there is little empirical evidence on the impact of technical regulations and trade.

Tariffs and quotas raise the costs to consumers, allocate resources inefficiently and guard the power of the domestic market, which is proven by several studies claiming that their elimination or reduction generates a mutual benefit to those countries involved (MASKUS; WILSON, 2001). However, the authors assert that the elimination of technical requirements (including sanitary - author's note) whose objectives are important to the community in general, and safeguard public health or environmental protection, could produce social losses greater than the potential gains of economic efficiency.

In addition, safety regulations and product quality can solve problems of imperfect information. In this context, these regulations could increase the effective demand, to alleviate consumer concerns about the quality of the product (THILMANY, BARRETT, 1997).

However, regardless of purpose found in the application of sanitary and technical measures, they will produce effects on trade, reflected mainly in models, as noted by Roberts, Josling and Orden (1999), on prices, which rise due to the increase in costs caused by the incorporation of a compliance cost of the measures imposed. Then prices are responsible by changing the quantity produced, consumed and marketed.

3 Analytical Framework

According to Beghin and Bureau (2001), the price-wedge method is based upon the idea that a NTM can be measured in terms of its impact on the domestic price of goods in importing markets (P_i) relative to a reference price, which is usually the world price (P_i^*) of a comparable good. Deardorff and Stern (1997) assert that as the impact on price is a general property of the NTMs, a comparison can show the net effects without necessarily identifying them.

This comparison would then be presented by relative prices, representing the difference between the domestic price in the importer country and the world price, and can be given as a percentage, similarly to a tariff.

$$T = 100 \times \frac{\left[P_i - P_i^*\right]}{P_i^*} \qquad (1)$$

From the equation (1), we estimate a tariff equivalent to the NTM, i.e., we obtain a rate that is supposed to restrict trade at the same level as the existing NTM. This NTM can be a quota, a sanitary requirement, a technical measure or a mix of these and other measures, for example. However, in order to reflect only trade restrictions arising from the NTM, it is necessary that no other factor is affecting these prices and the tariff equivalent estimative. Besides, comparisons between domestic and international prices of an asset may be influenced by differences in the supply and demand elasticities between countries. In this context, the observation of the difference between the prices is relatively straightforward when the imported and domestic goods are perfect substitutes (BORA; KUWAHARA; LAIRD, 2002).

As a result of this above-mentioned discussion, we should also consider the exporting costs of goods to estimate the tariff equivalent. Only in this case, one might conclude that the domestic market is protected if a difference between prices in two different countries could be found (BRADFORD, 2003). If tariffs are included in these importing costs, they should also be subtracted from the equivalent rate calculated in order to obtain an equivalent rate that only reflects the NTM´s effect.

However, we do not expect to see these assumptions in practical situations, since prices of imported and domestic goods will differ due to differences in quality and to imperfect substitution. Thus, Yue, Beghin e Jensen (2005) derive a model to estimate the tariff equivalent for technical measures relaxing the assumption of homogeneity of goods, through the use of a simple model of constant elasticity of substitution (CES). This model incorporates trade costs and was applied to the case of apples' commerce between the USA and Japan.

Yue, Beghin and Jensen (2005) assume the case of a small country that faces an exogenous world price for its imports and claim that the import price (p_I) is expressed as follows.

$$p_I = p^* + TBT_1 + TBT_2 + IT_R + Tariff + T_R = p^* + TBT_T + IT_R + Tariff + T_R \qquad (2)$$

In this equation, p^* represents the price/cost of U.S. apples being sold elsewhere than Japan (in our case, replaced by the beef world price), IT_R is the shipping cost, insurance and other costs of international trade of exporting apples to Japan, $Tariff$ is the specific import tariff, T_R is the transportation and transaction cost per unit, from the destination port to the wholesale market and TBT_T is the tariff equivalent to the effect of technical measures, which comprises two components: TBT_1 represents the technical requirements imposed on the production of apple and TBT_2 represents

the technical measures required since the arrival of the product in the destination country until it reaches the consumer (YUE; BEGHIN; JENSEN, 2005).

Then isolating the TBT_T in the left side of the equation and considering the first element of the right side as a new expression of the import price (p_I), we can obtain the tariff equivalent (TBT_T). That new expression is estimated through the maximization of consumer's utility, considering the constant elasticity of substitution (CES).

$$TBT_T = p_D \frac{1-\alpha}{\alpha}\left(\frac{D}{I}\right)^{\frac{1}{\sigma}} - p^* - IT_R - Tariff - T_R \quad (3)$$

Where p_D is the price of domestic good, $\sigma = 1/(1-\rho)$ is the elasticity of substitution, α and ρ are parameters that reflect the preferences, D and I represent the quantities of domestic and imported goods respectively (Yue; Beghin; Jensen, 2005). Working the expression in (3), the authors present the equation for obtaining the equivalent *ad valorem* rate, transcribed below:

$$TBT_T^{\%} = \frac{p_D}{p^*}\frac{1-\alpha}{\alpha}\left(\frac{D}{I}\right)^{\overline{\sigma}} - \frac{p^*}{p^*} - it_R - t - t_R \quad (4)$$

In equation (4), t is the *ad valorem* import tariff, it_R is the tariff equivalent *ad valorem* of the cost of international transport, insurance and transaction, and t_R is the cost of internal transportation and transaction. This equation allows for assuming different levels of preference and substitution between goods, as well as perfect substitution and that consumers are indifferent between domestic and imported goods ($\alpha = 1/2$ and $\sigma \to \infty$).

Although in the case that the product analyzed is not homogeneous we cannot reasonably assume these values for α and σ. Then, we must use the elasticity of substitution between goods produced domestically and imported, commonly referred as Armington elasticity (Armington, 1969).

According to Gallaway, McDaniel and Rivera (2003), an important assumption in Armington approach is that consumers distinguish products according to their origin. Thus, according to Tourinho, Kume and Pedroso (2002), domestic demand is met by a good result of a CES aggregation of domestic and imported goods, as shown in eq. 5.

$$Q_i = \overline{Q}_i\left[\alpha_i q_{Ii}^{-\rho_i} + (1-\alpha_i) q_{Di}^{-\rho_i}\right]^{-1/\rho_i} \quad (5)$$

Where Q_i, q_{Ii} and q_{Di} represent, respectively, the rates of aggregate amount of the good, the imported product and the domestically produced good of sector i, $\overline{Q_i}$ represents the scale factor and α_i and ρ_i are parameters. The first parameter indicates the distribution factor, i.e., the share of domestic and foreign markets in supplying the aggregate of good. The second parameter represents the shape of the indifference curve, indicating the degree of substitution between imported and domestic products (TOURINHO; KUME; PEDROSO, 2002).

The optimal composition between goods from different sources is given by the solution of the problem of minimizing the total cost demand, given the expense and the prices of imported and domestic products (TOURINHO, KUME, PEDROSO, 2002). The result, showing the distribution of the total demand between domestic and imported goods is given below.

$$\frac{q_{Ii}}{q_{Di}} = \left(\frac{\alpha_i}{1-\alpha_i} \frac{p_{Di}}{p_{Ii}} \right)^{\sigma_i} \tag{6}$$

Thus, the ratio of the amount of domestic and imported goods depends on the ratio of their prices, p_{Di} and p_{Ii}, and on the elasticity of substitution $\sigma_i = 1/(1+\rho_i)$. From the equation (6), using the logarithm to obtain a relationship between relative price and relative amount in which the elasticity of substitution is the slope, afterwards we have the equation shown below.

$$\log\left(\frac{q_{Iit}}{q_{Dit}}\right) = \sigma \log\left(\frac{\alpha_i}{1-\alpha_i}\right) + \sigma \log\left(\frac{p_{Dit}}{p_{Iit}}\right) + \varepsilon_{it} \tag{7}$$

Where $\sigma \log\left(\frac{\alpha_i}{1-\alpha_i}\right)$ is a constant and σ is the Armington elasticity of substitution between imported goods and domestic goods.

The elasticity of substitution is used to explain the degree of substitution between two different products.

4 Quantifying the NTM's effects

The data used for estimating the tariff equivalent are aggregated to 6-digit Harmonized System (HS). The choice for this aggregation can distort the analysis because there are requirements that focus

only on some tariff lines to 8 digits, so it is considered that the barrier covers all products to six digits, overestimating their occurrence (VIEGAS, 2003). The products to be analyzed are the follow: 0201.10 beef (carcasses and half carcasses), fresh or chilled; 0201.20 beef (Other cuts with bone-in), fresh or chilled; 0201.30 beef boneless, fresh or chilled; 0202.10 beef (carcasses and half carcasses), frozen; 0202.20 beef (Other cuts with bone-in), frozen; and 0202.30 beef boneless, frozen.

The elasticities of Armington are estimated between the European beef imports from Brazil and from other European-members (domestic beef). For estimation, we use the monthly quantity of beef imported by the EU-27 originating in the countries of EU-27 and originating in Brazil, separate to the fourth digit HS (0201 and 0202, representing, respectively, fresh beef and frozen beef).

In addition, we use the average unit value of these imports, obtained by dividing the revenue of imports (in euro) for the imported quantity (in kilograms) as a proxy for the price, since there is no price data available at that level of aggregation. To convert to dollar values, we use the monthly average exchange rate provided by EUROSTAT. Data are extracted from the Eurostat database, provided by the European Commission, for the period January 1999 to December 2010.

To perform the estimation of elasticities, we use time series analysis. So, before estimating the elasticities, the individual series are checked for unit root presence. The series used to estimate the elasticity of substitution between EU and Brazil are LQUANT, which refers to the logarithm of the ratio between the quantity imported by the EU-27 from the EU-27 and the quantity imported by EU-27 originated in Brazil; and LPRECO which is the logarithm of the ratio between the average price of meat imports from Brazil and from the EU-27. The subscript F is used to indicate fresh meat and C to indicate frozen meat. The unit root tests indicate the presence of a unit root in the series for price ratios and the absence of unit roots in the series for quantity ratios. So, after doing some trials, we run the model with variables $LQUANT_F$ and $LPRECO_F$ in level to facilitate interpretation of results. The elasticity of Armington obtained for that period, for fresh meat, is 0.54. This elasticity indicates that the Brazilian and European beef are not good substitutes.

We do the same process for frozen meat, and we verify that $LQUANT_C$ and $LPRECO_C$ have both one unit root. In this case, variables are tested for cointegration using Engle-Granger methodology (Enders, 2010). Results show that the ratio of quantity and of prices is not cointegrated.

So, in this case, we should estimate the elasticity in the first difference to eliminate the unit root, and we obtain the value of 0.29, which is not statistically significant. So, the tariff equivalent for frozen beef is estimated assuming the same elasticity found for fresh beef.

The data on quantity and value of imports necessary to calculate the tariff equivalents are extracted from COMTRADE (Commodity Trade Statistics Database), for the years 2000 to 2009. At the chosen level of disaggregation is not possible to identify domestic prices and world prices for the estimation of tariff equivalent, so we opt to use proxies. To represent the domestic price in the EU (p_D), we use the average unit value obtained from dividing the total value of EU imports (in US$) by their correspondent volume imported (kg). We use the average unit value of imports as a proxy for the average household price in EU, assuming that firms are unable to discriminate prices, so that the goods are sold on domestic or international markets at the same prices. As a proxy for world price ($p*$), it is adopted the average unit value of imports of the 50 largest world importing countries for beef, which accounted, in 2009, more than 95% of beef imports for all analyzed.

Estimating tariff equivalents under assumption of goods' heterogeneity also requires data on volume of product sales, for both domestic and imported products (D and I , respectively). Once there are no series for sales of domestically produced beef in the European Union, an approximation has been obtained by subtracting exports from total production.

Cost of transport, insurance and transaction (IT_R - called transport cost) is calculated as the difference between the FOB and CIF unit averages for trade between Brazil and the EU of boneless beef, fresh or chilled (0201.30) and boneless beef, frozen (0202.30). The same cost obtained for 0201.30 is assumed to other fresh meat categories and the same procedure was taken for transport costs calculated to 0202.30 and to other frozen meat[1].

In this paper we don't incorporate the cost of internal transportation and transaction (t_R) in the estimation, because we are not using wholesale values. And there is no need to extract the *ad valorem* tariff (t) of the tariff equivalent calculation, once we use CIF values as proxy for the world and domestic prices, and those prices do not include tariffs.

Finally, $\hat{\alpha}_i$ represents the preference of the consumer and σ is the elasticity of substitution. As a first approach, $\hat{\alpha}_i$ is equal to 0.5, which indicates that consumers are indifferent to either European beef or Brazilian imported beef.

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[1] Although there is a generalization of the transportation costs, we opt to use costs closer to the actually observed in the items analyzed, instead of using the difference between the FOB and CIF average units of total trade. According to Anderson and Van Wincoop (2004), considering the alternative of the same cost for all products is criticized by Hummels (2001); however, it is used by other authors, because of its availability to countries and years, and because of the difficulty of obtaining other specific data more detailed.

5 Estimation of tariff equivalents

Table 1 displays results for the tariff equivalents for NTMs faced by Brazilian beef imported to the European Union, considering that the beef is a homogeneous good and that European consumers are indifferent to either domestic or imported beef. Results are shown for different categories of beef, classified according to 6 digit-level of the HS.

Table 1 - Tariff equivalents of NTMs imposed by the EU to Brazilian beef. 2000 to 2009. $\hat{\alpha}_i = 0.5$ and $\sigma \to \infty$.

	Carcass or half carcass, fresh or chilled (%)	Other cuts with bone in, fresh or chilled (%)	Boneless meat, fresh or chilled (%)	Carcass or half carcass, frozen (%)	Other cuts with bone in, frozen (%)	Boneless meat, frozen (%)
2000	132.32	58.92	48.20	75.63	-14.98	39.09
2001	25.07	57.56	18.36	86.37	94.78	10.41
2002	18.49	51.34	8.31	116.53	243.37	7.62
2003	-16.58	33.50	17.13	169.80	273.80	3.06
2004	25.44	26.89	20.09	121.89	180.18	13.24
2005	8.02	24.70	16.44	NA	121.53	2.37
2006	-8.55	24.78	31.75	441.50	146.47	12.60
2007	3.35	30.60	44.65	168.27	191.58	49.75
2008	8.85	40.17	71.70	324.00	165.21	82.95
2009	5.43	47.48	29.86	238.63	167.58	47.07

Source: results.

We note that for most products and years the tariff equivalents are positive, indicating that the price observed in the European domestic market is higher than the world price, both given by proxies. This price difference is justified by the presence of policies that impede the free access of products imported from countries outside the block to the European market. Additionally, one can note that the tariff equivalent tend to increase after 2005, particularly for those products that have a more representative share in Brazilian exports to the European Union, such as the boneless beef frozen.

It is noteworthy that in reality, beef is not characterized by homogeneity, since there are differences in quality and consumer preference (MIRANDA; BARROS, 2009), as to its origin, related to the perception of health, animal welfare, environmental requirements. As part of the issue of sanity there are differences between the meat produced in the Pacific Basin countries (Australia, New Zealand, Canada, USA, Japan and South Korea) and other exporters of meat, as these countries are considered free of FMD, and face higher international prices due to the perceived superior quality of their products (MIRANDA; BARROS, 2009).

Table 2 – Tariffs equivalents for NTMs in the EU to Brazilian beefs imports. 2000-2009. ($\hat{\alpha}_i = 0.5$ and $\sigma = 0.54$)

	Carcass or half carcass, fresh or chilled (%)	Other cuts with bone in, fresh or chilled (%)	Boneless meat, fresh or chilled (%)	Carcass or half carcass, frozen (%)	Other cuts with bone in, frozen (%)	Boneless meat, frozen (%)
2000	1,356.84	909.23	828.39	1,014.50	470.43	798.92
2001	871.95	1,090.82	792.72	1,360.12	1,403.63	803.40
2002	546.69	703.92	475.99	1,007.86	1,642.54	468.03
2003	426.76	722.95	619.99	1,549.25	2,175.99	552.35
2004	519.63	518.41	480.33	948.44	1,221.01	452.74
2005	437.79	502.63	460.16	NA	922.11	381.86
2006	222.41	316.59	330.80	1,581.88	668.91	255.90
2007	253.40	336.77	378.20	797.96	871.20	416.94
2008	344.22	458.18	571.05	1,538.69	933.94	618.71
2009	313.01	467.72	397.20	1,182.74	920.07	467.89

Source: results.

To estimate the tariff equivalents considering the heterogeneity of goods and consumer's preferences, we need to take the estimated elasticity of substitution for fresh beef, which is $\sigma = 0.54$. At a first analysis, the assumption is that consumer doesn't have preference between the domestic and the imported beef, i.e., $\hat{\alpha}_i = 0.5$. Results are presented in Table 2.

We observe significant high tariff equivalents for frozen meat, reaching more than 1,000%, reflecting the barriers to import meat with bone in the EU. In the case of fresh meat with bone, we can note smaller tariff equivalents, which could be explained also by frequent presence of bans on their imports. Consequently, the average price (average unit value calculated and used to estimations) can be really not representative of the market conditions.

Boneless meats are more important to Brazilian trade flows, and they also face high tariff equivalents, although lower than the previous categories discussed. The tariff equivalents have reduced from 2001 through 2006, and then again have started increasing. At this time we also observed an increase of the producer prices for some beef producers, as showed by Figure 3.

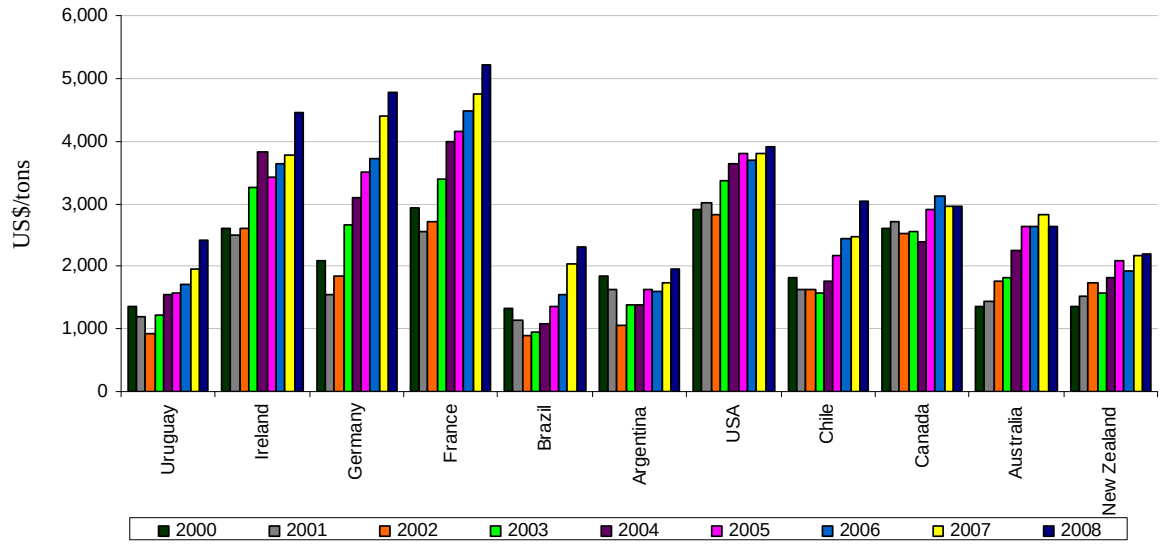

Figure 3 – Producer's prices of beef for selected countries. 2000-2008

Source: FAO.

Finally, we estimate the tariff equivalent assuming that consumers have preference for domestic product, therefore we assume $\hat{\alpha}_i = 0.7$ (results are shown in Table 3).

Then we can observe that once $\hat{\alpha}_i$ increases the estimated tariff equivalent decreases. Thus, we can say that the value used to $\hat{\alpha}_i$ affect the results, so using a good estimation for this parameter is very important. In that case, as we assume that goods are heterogeneous, we need information from studies that estimate this degree of preference, in such a way that trade patterns can, in fact, reflect what the effects from NTMs are and differentiate them from those effects of consumer preference.

With regard to the final results obtained from the use of $\hat{\alpha}_i = 0.7$ we can observe that the values presented are still in some cases high, although they are much lower than those observed when we consider that consumers are indifferent between consuming domestic and imported goods. In addition, we notice negative tariff equivalents in some cases, which mean that as the preference for the European product is larger than for Brazilian beef, the effect of non-tariff measures would cease to exist, indicating otherwise that there is a lack of protection for domestic meat.

Table 3 – Tariffs equivalents for the NTMs impose for EU to beefs imposts, when $\sigma = 0.54$ and $\hat{\alpha}_i = 0.7$

	Carcass or half carcass (%)		**Other cuts with bone in (%)**		**Boneless meat (%)**	
	Fresh or chilled	**Frozen**	**Fresh or chilled**	**Frozen**	**Fresh or chilled**	**Frozen**
2000	517.70	371.11	326.53	137.79	293.74	278.22
2001	310.10	515.08	405.32	535.30	278.99	277.31
2002	169.13	370.74	237.46	642.41	141.69	138.93
2003	122.73	603.26	250.15	871.52	206.56	175.66
2004	159.12	345.47	159.85	461.72	144.59	132.12
2005	123.07	NA	152.64	335.85	135.22	103.96
2006	27.32	618.60	70.10	227.61	78.19	50.39
2007	45.98	275.62	82.80	307.44	101.51	112.34
2008	84.36	597.49	134.28	338.29	184.13	203.58
2009	72.90	445.74	139.67	332.66	110.44	139.38

Source: results.

5 Conclusions

In this paper, we estimate the tariff equivalents of NTMs imposed on beef exported from Brazil to the European Union. First of all, the literature points that there is a considerable number of

requirements affecting Brazilian beef trade. And then we observed that the estimated tariff equivalent could approach the effects of NTMs.

In general, we estimate high values for the tariff equivalents, either for fresh and frozen beef. This shows that the European domestic prices and the world prices actually differ, which could indicate that the European market has been protected not only by tariffs but also for non-tariff measures, like technical and sanitary ones.

Also we observe that when it is considered heterogeneity of products in the estimation, the tariff equivalents values are bigger than those obtained when we consider homogeneity. Furthermore, the estimation depends on the value of the parameter of consumer preference ($\hat{\alpha}_i$), which was not estimated in this paper. We estimate the tariff equivalents considering only $\hat{\alpha}_i = 0.5$ and $\hat{\alpha}_i = 0.7$ and observe that when $\hat{\alpha}_i$ increases there is a decrease of the estimated tariff equivalents. Thus a good estimation of this parameter is important to ensure that the estimated tariff equivalents are representative of the NMTs on the market.

Besides beef, other Brazilian agribusiness products that are internationally traded face sanitary and technical requirements and there is an increasing concern that these kinds of NTMs become more frequent and more restrictive to commerce. Therefore, the tariff equivalent estimation is a tool that may improve the trade modeling in terms of incorporating the NTMs effects in order to analyze trade patterns and simulate negotiations. However, finding accurate databases on prices is very important to provide also accurate results for tariff equivalents.

Further studies will address the incorporation of the estimated tariff equivalents into beef trade models and the analysis of NTMs for other tradable products.

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