

## Environmental regulation of countries within the WTO: an illustration for Brazilian ethanol<sup>1</sup>

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During the 80s, environmental movements began to increase in the world and governments had to incorporate new policies to pursue economic growth combined with sustainability principles. The society began to demand eco-friendly products and some sectors of the economy suffered pressure to change their traditional methods and production processes to adapt to this new demand. These requirements of society resulted in changes in environmental legislation and other related laws focusing on regulating the production and marketing of goods and services. It is argued in the literature that often the requirements can generate trade barriers, even though their main purpose has nothing to do with trade. Literature review is not conclusive about such effects of environmental regulation on trade flows. This paper aims at investigating how environmental regulation evolves in international trade and applying an inventory approach to analyze the case of Brazilian ethanol trade. Coverage and frequency coefficients have been calculated for Brazilian ethanol exports considering the regulation in the Agreement on Technical Barriers to Trade (TBT) notified under the legitimacy goal of environmental protection. The period analyzed covered notifications from 1995 to 2010. Data were collected from WTO website (docsonline) and Sistema Alice (for Brazilian trade data). Altogether, we analyzed 1,649 notifications to the TBT Agreement, whose main objective was alleged protection of the environment. Afterwards these notifications have been separated for target-products as fuels or biofuels, totaling 94 notifications. From this subtotal, only those affecting the ethanol have been examined, which added up to 29 regulations notified by 13 countries. The most frequent countries notifying technical environmental regulations were the United States (USA), European Union and countries of Central America and the Caribbean. Among the countries reporting environmental technical regulations for ethanol, those who stood out as importers from Brazil are the USA, EU, Colombia, Costa Rica, El Salvador and among the main topics regulated, ones could highlight those related to requirements for reducing emissions of greenhouse gases (GHG). The coefficients of frequency did not exceed 32.7% in the analyzed period, while the coverage ratio reached a peak in 2006, when the U.S. had great representation. Although at first, the high coverage coefficient could lead to the inference of the presence of environmental trade barriers, this high coefficient may also indicate that the marketing of ethanol was not negatively affected by the measure. Another important element for discussion is that, when the contents of notifications are analyzed in detail, it is clear that there is a concern with the reduction of GHG emissions. Results of this study do not allow inferring that the environmental technical regulations affect Brazilian exports of ethanol during those years.

**Keywords:** Environmental regulation; TBT; Non-tariff barriers; Ethanol; Coverage ratio; Coefficient of frequency

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## **I - Introduction**

During the 80's the environmental initiatives have become more numerous and the governments have started to incorporate policy tools in order to achieve goals of economic growth respecting the sustainability principles. Therefore, the economic sectors were pushed to change their traditional methods and processes to adapt to a new demand focused on environmentally friendly goods (Feix, 2008).

Currently, the environmental problems have become critical, cumulatives and reflecting significantly on the production system. Simultaneously, the society is gradually moving to be more demanding to have efficiency in solving such environmental problems, particularly people living in richer countries. Due to that demanding pressure, some changes are being implemented in legislation and in regulation of production and distribution of goods and services, and some of these changes may represent barriers to trade. Part of these new requirements and adjustments may even expelled some goods from international markets or reduce their competitiveness. Among these regulatory measures that can turn into trade barriers, one might highlight technical regulations and standards, especially those justified by environmental protection goals.

In Brazil, soybean, meat and ethanol, which contribute in a large share for surplus in agricultural trade balance, are frequently challenged by environmental requirements imposed to their production systems, by importing countries. However, a few studies have been conducted so far to measure the magnitude of effects caused by these requisites on Brazilian trade flows.

The major objective of this paper is to examine how the environmental issues are being negotiated under the World Trade Organization (WTO) and are being handled by international trade business, by illustrating with the environmental regulation conducted through the Technical Barriers to Trade Agreement (TBT), and its potential impacts over the Brazilian ethanol exports.

## **2 – Environmental issues regulated by GATT/WTO**

Since the General Agreement to Tariffs and Trade (GATT) was established, eight rounds of multilateral negotiations were concluded, and currently the ninth is the Doha Round, which has begun end of 2001, and had been previously forecast to close in 2006. Tokyo Round deserves a specific mention because although it promoted a significant tariff cut for industrial goods, the world economic scenario (oil crisis, unemployment and inflation outbreaks) made countries to increase the use of non-tariff barriers to trade – NTB (Azevedo, 2008).

Uruguay Round was, however, the longest and more complex trade negotiation conducted through GATT. Among its major outcomes, it is highlighted the creation of WTO that inherited GATT's principles and agreements, and the emergence of new agreements: The Agreement on Agriculture, the Sanitary and Phytosanitary Agreement – SPS, which split from the Standards Code that also derivate to the TBT Agreement, This round also saw an advance in introducing the environmental topic to trade negotiations through the creation of the Committee on Trade and Environment<sup>4</sup> - CTE.

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<sup>4</sup>Previously, in 1948, GATT implemented the EMIT Group (Group on Environment and International Trade) that remained almost inactive. Except by the famous controversy tunna/dolphins, a dispute involving Mexico and the United States (Castro et al, 2003).

At the beginning of Uruguay Round there was a fear that including environmental questions could even become more complicated the conflictuous negotiations among developed and developing countries. Nevertheless, after the United Nations Conference of on Environment in 1992, in Rio de Janeiro, the debate on environment issues became more intense and enhanced also in related topics addressed by Uruguay Round negotiations (Almeida, 1997).

Thus, the CTE was composed by Marrakesh Ministerial Decision, in 1994, in order to introduce environmental concerns in the scope of multilateral trade negotiations, establishing a program of 10 main topics, basically the same proposed to EMIT Group several decades earlier. The way to promote the Multilateral Environmental Agreements rules merge with WTO rules, determination of taxes and other environmental policy tools, like technical regulations, and the creation of an environmental database (EDB) were some comprised in the list.

Besides the CTE, the environmental topics are still addressed by other agreements, in specific contexts, like the TBT Agreement, in which the environment protection has been included as one of the legitimate goals to countries imposes technical requirements for goods.

Despite this previous history, the greatest advance in incorporating environmental issues in trade negotiations was actually in its promotion as one of priorities given by the Doha's mandate. Official documentation states that the trade liberalization argument must be consistent to goals of sustainable development in country-membes. An example of specific topic on negotiation by this Round is the trade liberalization of environmental good, which intends to provide them a special treatment aiming to promote commerce and use of these products because they contribute to a more sustainable development (Meirelles Neto, Rios & Velloso, 2006).

Other themes from Doha's Ministerial Declaration relate to environmental issues, such as: agriculture (paragraphs 13 and 14) and subsidies to fishing activities (paragraph 28). Paragraph 13 refers to liberalization of agriculture commodities and particularly for Brazil, it comprises also biofuels because ethanol has been classified as an agriculture commodity and consequently its negotiation is under the Committee of Agriculture mandate. Despite ethanol is classified as agriculture, biodiesel is included in chapter 38 of the Harmonized System, which gives it the status of an industrial good, and its liberalization might be expected to be faster than in agriculture. This apparently favored treatment to biodiesel in relation to ethanol and the debate on including biofuels as environmental goods at CTE-Special Session negotiations has been addressed by Oliva and Miranda (2008). This topic about renewable energy having a preferential liberalization and the inclusion of not of biofuels will be probably back to scene during Rio +20 discussions, particularly under the Green Economy discussion.

In this study, the environmental regulation at WTO is looked up in the scope of technical regulations and standards. The Technical Barriers to Trade were only formally added as a negotiation issue after the Standards Code was established, in 1980, during the Tokyo Round. The purpose was to avoid discrimination in preparing, adopting and applying technical measures among countries and to guarantee their transparency to country-members. However this Code was not compulsorily taken by GATT's members and it has been subscribed only by 39 countries, including Brazil (Ferracioli, 2002).

In Uruguay Round, the Standards Code was divided into two different Agreements, aiming to discriminate questions related to animal, plant and human health, handled in SPS Agreement; and the use of technical requirements that could affect trade, regulated by TBT Agreement. The TBT objective is to guarantee that technical regulations, conformity assessment procedures and

standards will be not used by countries to create unjustifiable obstacles to international trade. Among the legitimate objectives which justify the technical regulations, we can highlight the protection of the environment. Consequently, countries assigning the TBT must notify technical regulation implemented in their territories to this Agreement and the TBT Committee distribute these notifications to all other country-members to give them opportunity to argue or to be informed, according to transparency principles.

### **3 – Environmental regulation and trade impacts**

According to Huang (2002), some factors pushed the evolution of literature on environmental regulation and competitiveness. For example, changes in the understanding of the meaning of the term competitiveness and the development of policies and standards for environment protection.

DEFRA (2007) states that the relevance of environmental regulation has emerged in mid of 60's, in the United States, when the Environmental Protection Agency (EPA) was created and the Clean Air Act has been signed. These events have generated a increasing debate about economic effects of such a policy and resulted in several theoretical studies on economic impacts of environmental regulation.

Baumol and Oates (1975), Pethig (1976) and Siebert (1977), neoclassical economists, conducted the first studies and concluded that environmental regulation affected significantly the production costs and the competitiveness of the United States, therefore underlining the existence of a trade-off between regulation strictness and competitiveness (Feix, 2008). This view is compatible with one of the three theoretical approaches identified by Iraldo et al. (2009) to address this important relation.

Iraldo et al. (2009) mention that the first approach to relate environment and competitiveness is called "traditionalist", characterized by a neoclassical view of environment economics and states that the goal of an environmental regulation is to correct negative externalities, internalizing their costs, and correcting market failures, at the same time that impose additional costs to companies. Therefore, supporters of this approach consider an inevitable trade-off between environment and economic gains.

The second approach is the "revisionist" and proposes that a better environmental performance is a potential source of competitiveness advantage, since it can lead to more efficient processes, improved productivity, lower costs and new market opportunities. Porter (1990) and Porter and van der Linde (1995) suggested that environmental regulations are potentially useful to companies, as they promote incentives to shift production routines (technological or process innovations) saving resources, inputs, using waste and residues, differentiating final goods and consequently, improving competitiveness (this is known as Porter's Hypothesis).

The third and more recent approach reviewed by Iraldo et al (2009) is known as "approach based upon resources" and relates firms competitiveness to quality and quantity of resources available and to capacity of companies to improve their utilization.

The two first approaches have been examined in literature for longer, determining two radical and oppose working fields. Jaffe et al (1995) assumed an intermediate position on this debate, stating that there is a list of reasons to believe that the link between environmental regulation and competitiveness is significant, but may be small and hard to identify.

Some papers tested those hypotheses, namely Baumol and Oates (1988); Tobey (1990) apud Feix (2008), Ederington and Minier (2003) and Feix, Miranda and Barros (2010). Ederington and Minier (2003) supported that the endogeneity of environmental regulation might have influenced descendently the estimates of its effects on trade flows. For instance, if countries tend to flexibilize their environmental policy over industries that face a heavy competition from imports, then net imports and the level of environmental regulation might seem only weakly correlated. So, even though the regulation is strict, this could be an important cause of comparative disadvantage. Feix, Miranda and Barros (2010) related the environment status of several countries to their trade net flows, considering environmental indexes and resources endowments, analyzing for agriculture commodities, but the results were not conclusive, except by rice.

#### **4 – The case of Biofuels**

Currently, one of the sectors that are constantly focused on debates involving environment and trade issues is the biofuels. For Brazil, it is a sensitive sector to negotiate. Ethanol has been used as a fuel for decades in a commercial scale. It is produced from sugarcane and there are two different products, besides the sugar: one is the hydrous ethanol, used as a replacement for gasoline (a substitute good) and the other one is the anhydrous ethanol, used as an additive to gasoline, as a complementary good. Besides their economic importance as an alternative fuel in energy domestic consumption and exports, they both contribute to reduce CO<sub>2</sub> emissions.

Recently, the EPA reconsidered a previous evaluation about sugar cane ethanol and its potential to reduce Green House Gas (GHG) emissions compared to gasoline. The previous calculations showed that this reduction was 26 percent in relation to gasoline, however the more recent calculations made by the ICONE and FAPRI showed a reduction rate of 61 percent in relation to gasoline. This finding was responsible to EPA classify the Brazilian ethanol as an advance biofuel (ICONE, 2010), which might cause future important gains in trade for Brazilian producers.

According to Szwarc (2007), the Brazilian ethanol has the highest potential to reduce GHG emissions and the lowest cost of production by GHG ton avoided (less than US\$20/ton of CO<sub>2e</sub>). These features provide better conditions to compete and attractiveness in international markets, although countries in general are searching to develop their own domestic solutions in terms of biofuels alternatives to fossil fuels, in order to reduce external dependency in energy.

The increase in ethanol commercialization allowed identifying an increase also in its regulation and standards. The European Union issued a Directive of the European Parliament and of the Council 2009/28/EC<sup>5</sup>, which establishes requirements to biofuels. The processes of certification to achieve this Directive's demands point that there will be important challenges to adjust sectors in the following years, to keep trading in the European market.

The evolution of volumes exported of Brazilian ethanol is shown in Figure 1, where a noticeable drop is seen after 2008, possibly associated to an unbalance between sugar and ethanol international prices, favoring sugar production and exports instead of ethanol (Jank, 2011). This reduction can also be explained by an uneven parity between export and domestic sales, caused by a persistent appreciation of Brazilian currency in relation to dollar. It is worth-mentioning that

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<sup>5</sup> Available at : <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF> (Access in October 2011).

the United States, which has been one of the most important destiny of Brazilian ethanol has increased domestic production in that same period, reducing imports. The ethanol volumes include both products commercialized for fuel and chemical purposes.

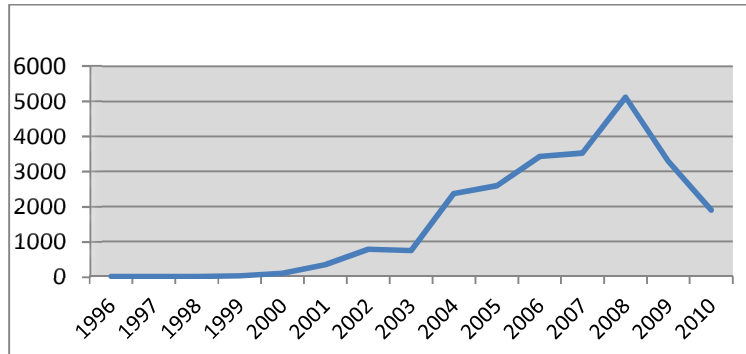


Figura2 – Brazilian exports of ethanol (1000 m<sup>3</sup>) in 1996-2010  
Source: based on data from MDIC (2011).

In 2008, the most important importer of ethanol for Brazil was the USA (35.4%), followed by the Netherlands (26.2%), summing up more than 61% of total Brazilian exports. Brazil has sold for 57 countries in 2008. In 2010, the USA imported only 20.3% from Brazilian ethanol, followed by South Korea (18.5%), Japan (12.9%), and the Netherlands (12%), totalizing 42 different importing countries.

Ethanol is classified in chapter HS 22, and therefore is negotiated under the Agreement on Agriculture. As mentioned before, Miranda (2011) discusses that this classification is polemic because there is a proposal that all biofuels should have a specific category in the Harmonized System classification at WTO. For Brazil, it would be even more interesting to have biofuels included in the Environmental Goods and Services negotiation, which could guarantee a faster liberalization. However, most of developed countries that take part of CTE-SS negotiations do not agree in keeping biofuels in the category of renewable energies.

This debate is capable to affect Brazilian ethanol exports, but this product is also target of several tariff and non-tariff measures in some of major markets, like the United States (specific and ad valorem tariffs) and the European Union (tariffs and sustainability requirements). According to Cavalcante (2010), a significant share of ethanol imports by the European Union occurs under preferential regimes, which distort international trade and competitiveness.

Gadret (2009) explains the European policy evolvments for biofuels, particularly the Directives 2001/77/EC, 2003/30/EC and the most recent in 2008, which set up a target of 20% of renewable energy sources in total consumption of energy in European members and a minimum of 10% for biofuels. This Directive lists the sustainability criteria that should be reached by suppliers: minimum requisites on reducing GHG emissions and restrictions on land use change that could generate shifts in carbon stocks or in biodiversity.

## 5 – Methodology and database

### 5.1. Inventory approach: the frequency and coverage coefficients

To determine the share of Brazilian ethanol exports subject to environmental regulations in importing countries, and that could consist on environmental barriers to trade<sup>6</sup>, it is used the Frequency Coefficient (CF) and the Coverage Coefficient (CC). The CF represents the share of transactions that belong to a certain group of products, facing a non-tariff barrier (BNT) in a certain country (LAIRD, 1996), and it can be calculated by the following expression:

$$CF_{ij} = \left[ \left( \sum_{i=1}^m L_{jm} \times N_{jm} \right) \div \sum_{i=1}^m L_{jm} \right] \times 100 \quad (1)$$

Where  $CF_{ij}$  = Coefficient of Frequency of barriers on group  $i$  of products, composed by  $m$  tariff lines and imposed by country  $j$ .

$$L_{jm} = \begin{cases} 1, & \text{if good } m \text{ is exported by country Brazil} \\ 0, & \text{if good } m \text{ is not exported by Brazil} \end{cases}$$

$$N_{jm} = \begin{cases} 1, & \text{if good } m \text{ is subject to a barrier (environmental regulation)} \\ 0, & \text{if good } m \text{ is not subject to a barrier} \end{cases}$$

The  $\sum_{i=1}^m L_{jm}$  for all  $i = 1, \dots, m$  represents the number of goods that are comprised in group  $i$ .

The Coefficient of Coverage allows estimating the amount of commerce subject to the analyzed barriers (or regulations) and it can be expressed by:

$$CC_{ij} = \left[ \left( \sum_{i=1}^m M_{jm} \times N_{jm} \right) \div \sum_{i=1}^m M_{jm} \right] \times 100 \quad (2)$$

Where:  $CC_{ij}$  = Coeficiente of Coverage of barriers on group  $i$ , comprised by  $m$  tariff lines and imposed by country  $j$ ; and  $M_{jm}$  = value of imports from country  $j$  for each good  $m$  belonging to group  $i$ , which is represented by the ethanol in this paper.

$$N_{jm} = \begin{cases} 1, & \text{if good } m \text{ is subject to a barrier (regulation)} \\ 0, & \text{if good } m \text{ is not subject to a barrier} \end{cases}$$

The method of inventory deserves some additional comments. As the regulation (notified by countries) is very strict, the term  $M_{jm}$  tends to become lower and consequently it will have a lower contribution to the CC calculation. This term could be even zero if the regulation is so restrictive that impedes the trade flow and in this case the coefficient will be underestimated (Laidr, 1996).

On the other hand, the CF avoids underestimation because it attributes equal weighs for all regulations analyzed. In the case of a total ban of a certain good imports due to the regulation imposition, the value 1 can be given to  $L_{jm}$  once there is an effective potential of this good exports. So, if a country is importing ethanol from Brazil, it will count in the CF, and if this country notified some regulation, it will count as well, although this regulation could not be

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<sup>6</sup>Although it is now using the word “barrier”, the analyzed regulations are not working necessarily as impediments to trade, regarding illegitimacy point of view. This discussion is not targeted by this paper. Thus, the word barrier is used from now on to express environmental regulations notified by countries that potentially could affect trade.

causing any difficult to exports. So, the CF does not measure the relevance of barriers (or regulations), comparatively, among exporting tariff lines, as this coefficient does not reflect the relative amount of exporting income being affected by relevant regulations (Viegas, 2003).

Discussing the validity of inventory models, Beghin e Bureau (2001) affirm that is it not clear if there is any correlation between the number of measures and effects on trade flows. In relation to international trade data collection, reports might be different in contents according to each country methodology or committment to build statistics databases. However, this approach can be useful to analyze frequency of occurrences and potentiality of trade income affected, supplying information about the importance of specific topics and about how intense is regulation on certain sectors, more than for others, which can give us a direction where to find potential barriers to trade.

Several authors, from national and international literature, applied the CC and CF to evaluate the application of NTB on trade flows directly, or to include these coefficients as explanatory variables in econometric models. Among others, we mention: Pereira (1989) who measured NTB imposed by the USA, Japan and the European Community against Brazilian total exports, between 1981 and 1986; Viegas (2003) who analyzed agriculture products exported by Brazil to the USA and European Union; and Viegas (2006), analyzing incidence of NTBs on dairy products commercialized by Brazil; Bellonia and Silva (2007) that applied those coefficients to verify the incidence of NTBs on Brazilian meat exported between 1990 and 2003; and Ferreira, Lírio and Mendonça (2009), which used the coefficients to identify and quantify barriers to fruits (banana, lemon, mango, apple, melon and grapes), exported by Brazil between 1995 and 2008, to Mercosur, the EU and NAFTA.

## 5.2. Database

This paper uses notifications of WTO member-countries to the Committee on the Technical Barriers to Trade Agreement and statistics on international trade of Brazil, collected from Alice Website/MDIC, for the period between 1995, when the TBT was created, and 2010. Data collected from Comtrade database was also used to analyze the evolution of ethanol imports by some countries that notified to TBT, in order to evaluate if they also imported from Brazil or not and eventually if their notifications could have impacted on trade flows.

Notifications to TBT were counted and aggregated by country. From the total, those related to the environmental protection legitimate objective were selected to be analyzed detailed. In the case of the European Union, it is worth mentioning that the block notifies as a whole, but also individually.

As the ethanol is the relevant product for this study, notifications with environmental protection objective were also verified to fuels, biofuels and to ethanol. So, all notifications including chapters to HS that include biofuels were separated to be examined and those specifically affecting the ethanol were included in the calculations of CC and CF. In this sense, to calculate the coefficients, the group  $i$  was considered as ethanol, with HS 2207, containing  $m$  tariff lines, which should be equal to 2. However, as all notifications found comprised ethanol as a whole group and not by tariff lines,  $m$  could be considered equal to 1.



## 6 - Results and Discussion

From January 1995 to December 2010, 12,934 regulations were notified to the TBT Agreement Committee by WTO country-members. In the last years, it is remarkable the increasing number of notifications. In the total, 805 documents were notified by the USA, 772 by China, 618 by the Netherlands, 582 by Japan, 546 by the European Union, 539 by Israel and 539 by Brazil.

Note in Figure 2 that besides a boost in technical notifications as a whole, the number of those related to environmental protection goals also increased after 2003; therefore its potential effects on trade should rise.

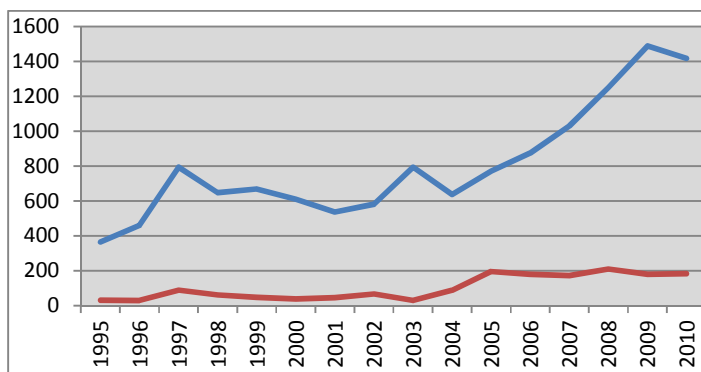


Figure 2 – Total notifications to TBT Agreement Notifications under the legitimate objective of environmental protection. World - 1995 – 2010. Source: elaborated using WTO (2011).

Figure 3 shows the countries that notify most frequently on TBT, using arguments on environment protection. Note that in this particular subject, the developed countries can be identified as more active in regulating environmental technical aspects of goods production and distribution than developing countries. The United States rank as the first in number of notifications, 205, which accounts for more than 12.3 percent of the total notifications related to environmental protection. The second position is China and the EU, each one has 166 notifications, accounting each by 10 percent of total. The Netherlands and Canada notified, respectively, 105 and 97 documents and Thailand comes in the sixth position, with 46. Brazil notified 32 technical regulations justified by environmental protection.

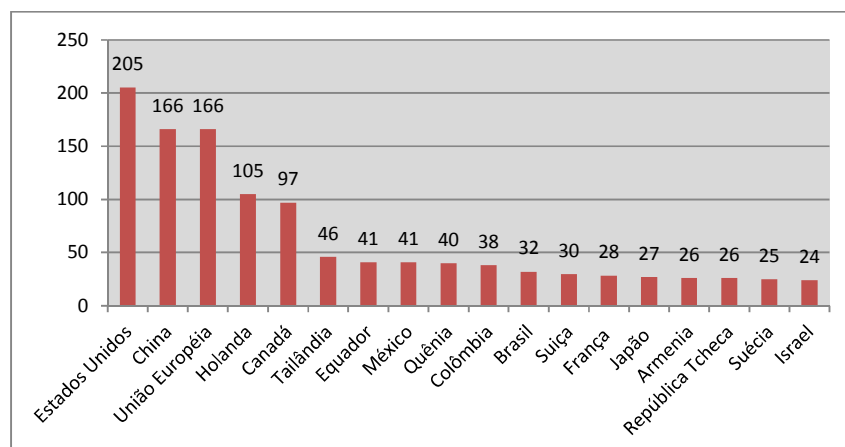


Figura 3– Participation of countries in the number of notifications to TBT related to environmental protection. 1995-2010. Source: based on database of WTO (2011).

Comparing these results with those presented by Machado (2003), for a previous period, the scenario seems to have fairly changed. Between 1995 and 2002, the major countries in notifying on environmental protection were Canada and the EU, followed by Japan and the USA. Brazil had notified only three regulations under this scope. The updated analysis shows that after 2002, there was a process of intensification and diversification of countries notifying to TBT on environmental purposes. China is not necessarily a surprise, because after its entrance in WTO, this country was expected to start communication regulations under the notification process. However, it is remarkable that this country assumed the second position in regulatory policy on environmental protection.

In the period studied by Machado (2003), the environmental protection notifications accounted for 7 percent of total TBT notifications. Currently, this share jumped to 13 percent. Machado emphasizes that this account reflects the notifications where the field for “objective” was filled in with “environmental protection”, explicitly. However, he argues that other regulations could be classified under other legitimate objectives although they might have also environmental implications. His reasoning is that the classification of notifications is a subjective process and he also notes that there are some regulations issued by national agencies of environment protection, but they are notified with other goals than environmental protection.

Regarding the groups of products found in the notifications, which are affected by those regulations, they were classified by HS chapters and interestingly the most frequent groups are those related to machines, equipments and vehicles. The United States notifications were most focused on chapters 84 and 85 (machinery and equipments; and mechanical machines, devices and tools, respectively) accounting for 35.1% of total environmental notifications; secondly, group 87 (terrestrial vehicles, parts and accessories), with 13.2%; group 38 (several products from chemical industry, and it includes the biodiesel), accounting for 9.8% of environmental notifications.

China has also focused TBT notifications on environmental protections in the same chapters most frequently notified by the United States, however among the 166 documents, 27.7% belonged to chapter 38, 20.5% and 20% approximately to chapters 85 and 87, in this order. In the case of the EU, 56.6% of environmental notifications to TBT were related to chapter 38, from chemical

industry, and about 22.8% to machines and vehicles. So, this country followed also the same pattern that the United States and China in terms of environmental regulation to TBT Agreement.

On the other hand, when the notifications based upon environmental protection purposes from a certain country are related to its total number notifications to WTO, some interesting inferences can be made, signaling that there are some countries, which are not very active in issuing technical measures and notifying to WTO, but that are relatively active in notifying specifically with environmental protection purposes. For instance, Mauritius and Nigeria presented, respectively, 2 and 1 notifications to TBT Agreement and all of them were dealing with environmental issues; 63% of notifications by Ecuador were environmental-related; 35% of the 469 notifications by the EU; 25.5% from 805, by the USA; and 21.5% from 772, by China. So, one can note that even countries without tradition to notify to TBT, have technical regulations notified to achieve environmental protection with the environmental, besides the relative importance that developed countries also give to this objective.

Brazil has 530 notifications to TBT registered and only 32 pointed the environmental protection as the legitimate goal to regulate the topic, only 6% of the total. However, the most common products in those regulations also belonged to chapters 84 and 85 of HS, which indicates the same trend observed for the USA and the EU. About 82 countries out of 154 notified under this legitimacy goal to TBT.

Once some basic description of notifications has been done, the estimates of frequency and coverage coefficients were calculated using only those notifications related to ethanol, explicitly or related to fuels or biofuels, which would comprise ethanol. The main objective of this part of the study is to verify if there is a pattern between the environmental technical regulations and ethanol trade flows or trends.

From the whole set of notifications with environmental protection goal, 29 were identified to hold for biofuels and those were analyzed through the CF and CC. These 29, out of 94 identified to affect fuels in general, account for roughly 31 percent affecting biofuels, which is a large share considering the importance of fuels in terms of environmental issues. Additionally, it is remarkable if one considers that biofuels are a new tradeable commodity in the international markets and they have already raised so many technical regulatory initiatives.

Table 1 shows the results of frequency and coverage coefficients for Brazilian exports of ethanol, considering the notifications to TBT supported by the legitimate goal of environmental protection, which could be eventually affecting the biofuel trade flows. Although there were notifications to fuels before 2003, they do not comprise biofuels, and for this reason, they have not been considered for calculating the coefficients.

Year	Coverage Coefficient	Frequency Coefficient
2003	0.3%	1.8%
2004	0.0%	1.6%
2005	0.0%	0.0%
2006	55.5%	5.6%
2007	37.8%	17.5%
2008	44.8%	11.3%
2009	45.8%	31.7%
2010	46.4%	32.7%

Table 1 – Frequency and Coverage Coefficients to technical regulation of TBT related to environmental protection and affecting Brazilian exports of ethanol. 2003-2010. Source: elaborated by authors.

In 2002, there were only two TBT notifications affecting ethanol, by Czech Republic ((G/TBT/N/CZE/41 and G/TBT/N/CZE/43) that could interfere with ethanol exports, as they referred to rules to reduce GHG emissions, one specifically for fuels and the other one to other products. However, despite the fact that this country imported US\$ 121.7 thousand of ethanol from the world, Czech Republic did not buy from Brazil and so these regulations were not computed to CC and CF calculations, and therefore, neither was the year 2002.

In 2003, only Colombia notified (G/TBT/N/COL/25) and the regulation was specific to ethanol. It described the quality and quantities of ethanol for carburant use and for its blends, transportation, production and commercialization in the country. As this country accounted for a small share of Brazilian exports (US\$ 457 thousand out of US\$ 7.5 million), the coefficients for that year were very little, 0.3% and 1.8%, respectively for CC and CF. Surprisingly, in 2002, Colombia had imported significant US\$1.9 million in ethanol from Brazil (and US\$ 10 million from the rest of the world) and this drop between 2002 and 2003 could raise questions if the new technical regulation could have impacted on this bilateral trade. However, this cannot be stated without more specific and detailed analysis of the ethanol commerce between Brazil and Colombia at those years, to verify what other factors could have affected this performance.

In 2006, the USA notified (G/TBT/N/USA/219) about the total volume of renewable fuels that should be used yearly in the country, in a progressive scale during a forecast timetable. This regulation has been imposed aiming at reduce the dependence of external suppliers of fossil fuels, offering a broader market for national farmers and reducing the GHG effects in the atmosphere. This notification reflected in the CC calculated to 2006 and so on. For Brazilian exports of ethanol, the CC reached 55.5 percent, pointing that more than a half of the exports income had been subject to those new rules. This high coefficient is due to the significant share of the USA in the total ethanol exported by Brazil that year. On the other hand, the CF was 5.6 percent, showing that a very small number of importers (Colombia and the USA out of 41 different countries) had imposed technical regulations related to environment protection over Brazilian ethanol exports.

In 2007, Canada issued a technical regulation to determine the quantity of renewable fuels necessary to mix with gasoline, and this notification (G/TBT/N/CAN/193) had potentially a direct

effect over the producers and traders of ethanol. At that same year, Colombia also notified (G/TBT/N/COL/96) establishing deadlines to convert engines to biofuels and regulating these products production; and also Costa Rica (G/TBT/N/CRI/66), El Salvador (G/TBT/N/SLV/107) and Honduras (G/TBT/N/HND/45), which issued notifications containing physical-chemical specifications for commercializing ethanol in Central America. Ecuador specified fuels requirements, and particularly on packing, labelling, inspection and other technical aspects through a notification to TBT (G/TBT/N/ECU/26). Besides all those above-mentioned, the USA also notified a technical regulation affecting imports of grains used to produce ethanol. In 2007, Brazil exported US\$1.4 billions for 44 countries and the CC and CF were 37.76% and 17.54%, in this order.

In 2008, other countries emerged notifying on biofuels, like New Zealand (specifications for ethanol as a component to gasoline blends) and Vietnam (regulating the blend of biodiesel– B100 and denatured ethanol). Colombia and Czech Republic also notified on themes related to biofuels and blends. Considering all the importing countries in that year and all the technical environmental regulations imposed since 1995, the CC and CF were, respectively, 44.8% and 11.3%.

In the next year, Germany presented three new regulations to TBT that could potentially interfere in ethanol markets. These legislation dealt with reductions of GHG emissions and established a minimum quota of biofuels required for the fuels commercialized in the country, according with the European Directive. The European Union, at this same year, also notified (G/TBT/N/EEC/250), introducing a mechanism to monitor GHG emissions, which goal was to achieve 6 percent of reduction between 2010 and 2020, by road transportation, and projecting to raise the blend of ethanol to a bound of 10 percent. The United States also determined a minimum amount of biofuels required in transportation and a schedule of progress along the following years.

So, 2009 saw an interesting pattern of technical regulations from major ethanol consumers and although the coefficients, particularly the CC, had not drastically changed, it is remarkable that these types of regulations would certainly have contemporaneous and future impacts in the exporting ethanol market.

In 2010, Germany notified again the same topics it had been done in 2009 by the European Union. Canada also notified additions to a previous regulation issued in 2007, related to a mandatory reduction of GHG emissions and establishing an average ratio of 5 percent of ethanol blended to gasoline. The USA issued two notifications to TBT regarding environmental protection focusing on the regulation of dangerous materials (like liquid fuels) and on reduction of GHG emissions. The CC and CF were even higher this year, reaching more than 46 percent and roughly 32.7 percent, respectively.

As mentioned in the methodology, when both CC and CF are big percentages, results could indicate that there is a high level of protection to this sector, however if CC is big, it might indicate that just a few measures are prohibitive. So, even if there are restrictions and more technical requirements related to environment aspects, the sector is still exporting the ethanol and the regulation is not necessarily working as a barrier. There are some literatures in international economics that point that technical regulation could even result in a better performance in trade (Roberts and Unnevehr, 2005).

## **8 - Conclusions**

The topic of environmental problems related to air quality, production and consumption sustainability among others is gaining space in multilateral forums, not only environmental-related but also trade-related, as many of the new regulations and standards on environmental protection imply potential impacts for trade flows and for the performance of some sectors, in particular, such as the biofuels.

Despite the preview of negative impacts, this paper that illustrates this discussion for the Brazilian ethanol, similarly to other previous work in the literature, concludes that the effects of environmental regulations over competitiveness might be small and difficult to be measured and sometimes, even to be identified. None significant and undoubtful result could be pointed to support the idea that governments environmental policies are negatively impacting the Brazilian ethanol trade flow, at least in the short-term. Probably some changes imposed by the analyzed regulations, which have a gradual schedule of adoption, can generate more visible impacts after some years, in the medium or long-term analyses. Besides, it is important to emphasize that this paper does not use an econometric tool or other statistic methods to correlate the notifications of environmental regulations to Brazilian trade flows. This study analyzed the coefficients of frequency and coverage that allow having a general idea about how this type of regulation is evolving and some evidences that they might impact trade. So, the results provide information to continue analyzing the subject, using more sophisticated analytical methods, or otherwise, applying study-cases.

Despite the environment theme gained status since the Doha's Round, its regulation was already being dealt by WTO through other agreements like the TBT or the EMIT Group. In fact, it was under the scope of the technical regulations to TBT Agreement that this study has focused to identify how Brazilian ethanol sector might be impacted by rules and standards that countries have been imposing under the arguments of environmental protection since 1995.

Results of notifications description show that recently, there has been an increase in regulations related to environmental protection to the TBT Agreement. Until 2002, the number of notifications were 528 while this number more than tripled, reaching 1,649 regulations in December 2010.

The USA, China and the EU are the countries most active in notifying to the TBT Agreement using the environmental protection objective to give support to technical regulations. And about sectors more frequently targeted, one can highlight chemicals, machinery and equipments, road vehicles, their parts and accessories, which consist on a group of high aggregated value and very relevant in terms of GDP share in developed countries.

However, it is not possible to affirm that these products are facing trade barriers only based upon these results. As commented above, the inventory results could be used to introduce non-tariff measures in econometric models that allow correlating them statistically with trade variables.

Moreover, in the industrial organization field of study, these results could be examined to discuss the production structures in different countries and sectors and their ability to make adjustments to new requirements from importing countries.

Another interesting element to bring to discussion is that, examining detailed the contents of technical regulations related to environment issues, it is remarkable the frequent concerns on GHG emissions, which is the most common topic found in the regulations to ethanol and biofuels in general, verified in this paper. Several notifications were related to the definition of programs to gradually adopt the biofuels or other renewable fuels, many of them determining minimum

ratios in the blends with gasoline. This kind of regulation can even generate better results for ethanol exported by Brazilian companies, probably creating new markets in those countries.

It is possible that the biofuels sector face an increase of standards and rules of sustainability, as well as requirements on certifications, and such requisites will certainly cause additional costs to private sectors involved in this business, at least in the first moment of adaptation to comply with the new rules. Without inferring that these requirements will be negative to biofuels setor, in fact it is possible to affirm that it will cause some impacts on competitiveness in the international market. However, considering the results obtained in this study, it is not possible to conclude that they are being negative so far. Nevertheless, it is possible to affirm that the relative share of environmental issues being regulated through trade agreements tend to keep increasing in the near future, and particularly for renewable energy and biofuels.

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