Tariff quotas and the effects on the Brazilian agricultural exports to the European Union

Honorio Kume[1] IPEA and UERJ,
Guida Piani[2] IPEA,
Pedro Miranda[3] IPEA,

Résumé : Les accords bilatéraux de libre-échange ont souvent recours pour les produits agricoles à des baisses de tarif limitées à un volume prédéterminé, donc à des quotas tarifaires. L'Europe utilise cette approche dans ses négociations commerciales avec les pays en développement. Cette contribution vise, d'une part, à examiner les questions théoriques que soulève l'utilisation des quotas tarifaires et, d'autre part, à éclairer l'impact des quotas européens sur les exportations agricoles brésiliennes, dans le cadre de la négociation commerciale entre le Mercosur et l'Union Européenne.

Mots clefs : quotas tarifaires, exportations agricoles, Brésil, Mercosur

***Abstract**: Bilateral free trade agreements often include a lowering of prices of agricultural products limited to a predetermined volume, and thus to tariff quotas. Europe uses this approach in trade negotiations with developing countries. This article is aimed on the one hand at examining the theoretical questions raised by the use of tariff quotas and, on the other, at shedding light on the impact of European quotas on Brazilian agricultural exports within the framework of trade negotiations between Mercosur and the European Union.*

***Keywords**: tariff quota, agricultural exports, Brazil, Mercosur*

I – Introduction

During the last decades, protectionism and discriminatory practices have been the most remarkable characteristics of international trade in agricultural products. The developed countries, in particular, have intensely used measures such as domestic subsidies, export subsidies, and import restrictions, mostly in the form of non-tariff barriers and extremely high tariffs.

Some attempts to change these policies at a multilateral level had already been made in negotiation rounds of the General Agreement on Tariffs and Trade (GATT) prior to the Uruguay Round, but their results were negligible, especially from the standpoint of developing countries.

In 1995, the Uruguay Round Agreement on Agriculture (URAA) managed to establish rules for improving the access to the international trade in agricultural products. Most of the non-tariff restrictions upon these goods were replaced by tariffs. In addition, tariff-rate quotas (TRQs) were introduced, allowing for a specific amount of imports at lower tariffs – the in-quota rate – and additional imports, at higher tariffs (the extra-quota).

Since then, the use of tariff quotas has been widely disseminated, as part of the Agreement implemented by the World Trade Organization, as well as in several bilateral or regional agreements, once it provided the guarantee of access to a group of agricultural exports and the appropriation of the rents generated by the tariff-quota system.

However, the role of tariff quotas as a protectionist device, mainly in trade negotiations, has not yet been quite well understood, as quite often one disregards that only one of the three components of the tariff-quota mechanism will be determinant.

The aim of the present study is to assess the possible effects of the implementation of tariff quotas offered by the European Union on Brazilian agricultural exports to its market, based on the last official European proposal, of May 2004, in the course of the negotiations for a Mercosur-EU free trade agreement.

This paper is organized into three additional sections. After a brief history on the development and dissemination of tariff quotas in the mid-1990s, section 2 presents a theoretical analysis of the operation of this trade policy instrument and an assessment of the economic effects that might be expected from a large tariff-quota concession. Section 3 estimates the potential gains for Brazilian exports, in the case of an agreement between the two parties, based on the European proposal of May 2004. Section 4 concludes.

II – Tariff quotas

1. An overview

Too little was achieved in the first attempts of GATT member countries regarding the agricultural trade liberalization on a worldwide scale. In the Kennedy Round (1962-1967), the negotiations conducted between the United States and the European Union led to the signing of the International Grains Agreement. The Tokyo Round (1973-1979) produced several agreements on trade of temperate zone commodities. The Swiss Formula, used for a deeper reduction of high tariffs of industrial goods, was not used for agricultural products.

From the Uruguay Round (1986-1994) emerged the first agricultural agreement, which revolved around two key features: the adoption of tariffs in substitution of non-tariff barriers and the implementation of tariff quotas.

In order to make the rules for agricultural trade more compatible with those applied to industrialized goods, negotiators agreed to convert all non-tariff restrictions – except for health safety measures – to specific or ad valorem tariff rates or a combination of both. In this process, known as “tariffication”, the difference between domestic and international prices was calculated, based on current prices for the 1986-1988 period. Given the high level of prevailing protection, the resulting tariff equivalents turned out to be quite high, some of them amounting to over 150%, as in the case of grains in the European Union. Despite the commitment made by the industrialized countries with the implementation of a schedule for an average tariff reduction of 36% during the following six years, the adoption of an average-cut criterion, instead of a cut in average tariffs, allowed the maintenance of especially high tariffs for the more “sensitive” products.[4]

The second important change introduced by the URAA concerns the implementation of tariff quotas, with the purpose of guaranteeing a minimum access level to agricultural markets in the industrialized countries. Two categories of tariff quotas were created. In the first one, known as **minimum access quotas**, tariffs should be sufficiently low as to prevent “tariffication” from hindering trade opportunities for certain products. In this case, import market-share should correspond to 3% of domestic consumption, based on the 1986-1988 period levels.[5] The second category, the **current access quotas**, should keep the market access levels for some products equivalent to those historically established by previously imported amounts.

Given the possibilities of appropriation of the rents from tariff quotas, determined by their volume or by the difference between in-quota and extra-quota rates, the type of administration plays a crucial role.

Import licenses are frequently used, assigned to importing firms or to exporting ones, or to both, by several methods, which include: applied tariffs – in which, given the in-quota, the demand for imports is lower than the volume stipulated by the quota –, the first-come, first-served (FCFS) method – in which imports can benefit from the in-quota until the quota is fulfilled –, licenses on demand – granted according to quota fulfillment, in a given period–, auctioning, and historical performance (Skully, 2001 and Gorter and Hranaiova, 2004).

As of 1995 until 2002, 1,425 tariff quotas came into effect, as a result of the URAA[6] Taking into account product categories, most tariff quotas are applied to fruit and vegetables (370 tariff quotas), meats (258) and cereal grains (226). As to the countries, the European Union (15 countries) and the United States are relatively important users – applying respectively 87 and 54 tariff quotas –; the leaders, however, are Norway (232) and Poland (109) (Gorter and Hranaiova, 2004).

The most widely used administration method is the "tariff-applied" one, on more than 50% of the total applied, followed by licenses on demand, FCFS, and historical performance. The auctioning system, which would probably result in a more efficient allocation and would also allow the government to keep the quota rents, represents less than 4% of the total.

2. Economic analysis of tariff quotas

Tariff quotas impose a usually low tariff on in-quota imports, up to a previously set amount (quota) and a usually high extra-quota tariff, when such amount is exceeded. Thus, tariff quotas are based on three instruments: quota, in-quota and extra-quota tariff rates; nevertheless, depending on the demand for imports, only one of them will effectively control imports (Skully, 2001). Therefore, in trade negotiations for expansion of access to the market of goods subjected to tariff quotas, it is important to verify which of these instruments is playing a "binding" role; otherwise, demands might have a null impact on exports.

Figure 1 shows three cases of possible restrictions resulting from the use of tariff quotas for a given small importing country. P1 represents the free-trade import price, QT is the quota, M is the imported amount, TI stands for the in-quota, TE is the extra-quota and D represents the demand curve for imports. Up to amount QT, imports pay the TI tariff rate; beyond this amount, TE is applied.

In Figure 1A, the demand is D1 and the imported amount M1, at price P2, is less than the amount established by the quota. Then, import restriction is given by the in-quota tariff rate, whereas the quota and the extra-quota are redundant. The government's tax revenue is obtained through the in-quota tariff rate charged on imports M1. Thus, imports expand only with the reduction of the in-quota tariff rate.

In Figure 1B, demand is D2 and the imported amount M2 is exactly the same as the amount established by the quota. This therefore restricts external purchases and the protection level varies across the in-quota and the extra-quota, and should be measured by comparing domestic price P3 and external price P1. The quota rent is represented by the rectangle area formed by P3 – P2 (difference between the domestic price of the importing country and the price paid for imports, including the in-quota), multiplied by the quota volume.

Finally, in Figure 1C, demand D3 is sufficiently high to allow for extra-quota imports, producing an import amount M3 that is larger than that established by the quota. In this case, imports are controlled by the extra-quota tariff rate. Domestic price P4 is determined by price P1 plus the extra-quota tariff rate. The rents are given by the difference between

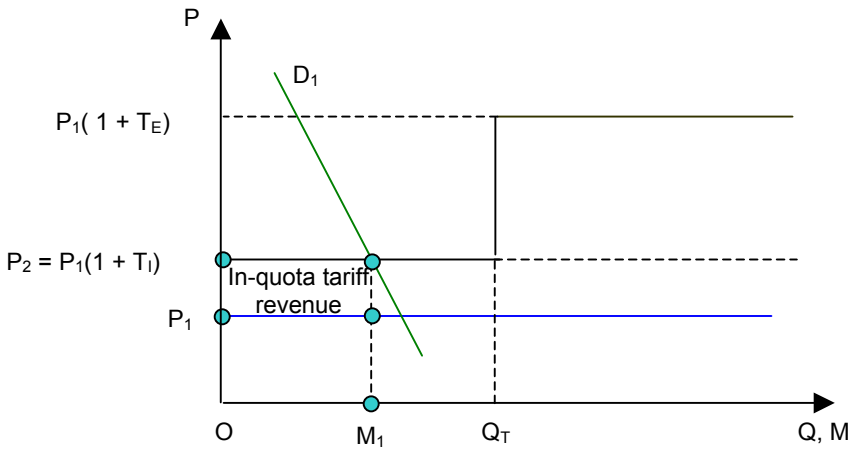
domestic price P4 and import price, including the in-quota, P2. The government's tax revenue is generated by the difference between P2 and P1, applied to the in-quota imports and between P4 and P1, applied to extra-quota imports (M3 – QT).

The criterion used for the allocation of import rights up to the amount established by the quota defines the appropriation of rents among the exporting and importing countries and the private economic agents and the government in each country. If the quota is administered by the importing (exporting) country, the rents are retained by the importers (exporters). In any of the countries, if the quota is auctioned off in a competitive way, the quota rent is transferred to the government by the payment of a premium charged on the import license, whereas, if other methods are applied, private agents retain the rents.

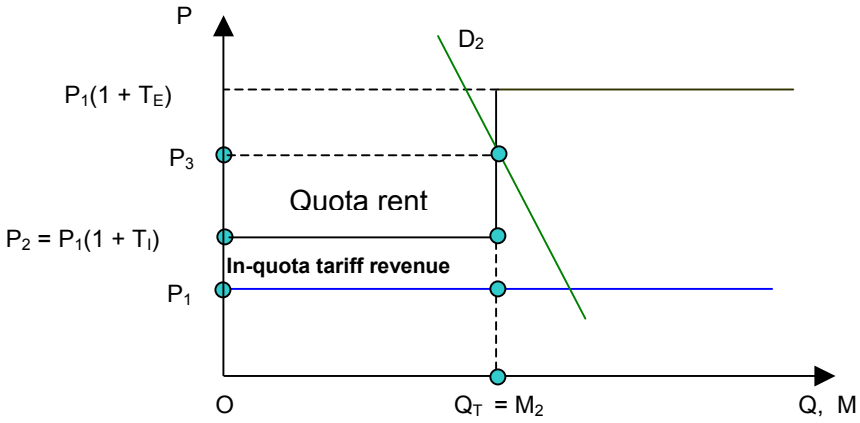
Figure 1

Import restriction with tariff quotas

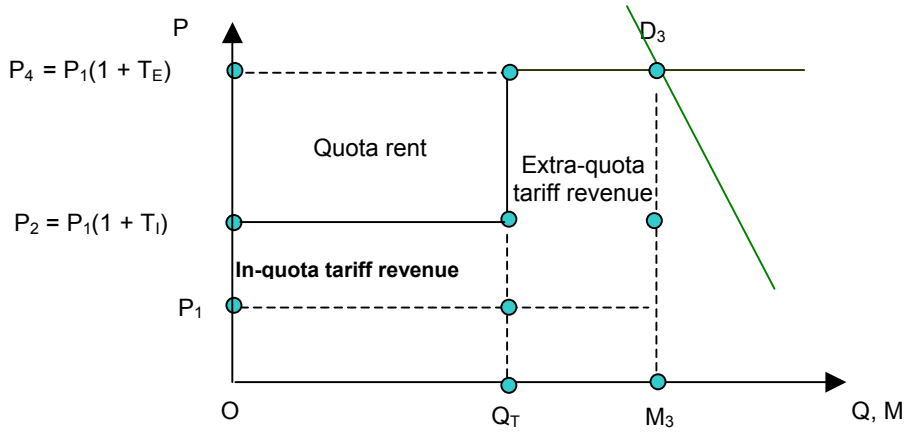
1A. Imports controlled by the in-quota tariff rate



1B. Imports controlled by the quota



1C. Imports controlled by the extra-quota tariff rate



Source : Skully (2001)

Therefore, when the trade negotiations include, among other goals, the increase in the foreign currency revenue, the exporting country should administer the quota and request a greater market access based on the instrument that effectively restricts its exports: the reduction of the in-quota tariff-rate, if current imports do not reach all the current quota amount; an increase in the quota volume, if imports match the quota; and the reduction of the extra-quota tariff rate, if imports exceed the current quota amount.

3. Effects of an additional quota

In order to deal with the exporting interests of developing countries in market access negotiations, the developed countries have often used the strategy of offering additional quotas for the more "sensitive" agricultural products in their markets. Usually, these concessions include a temporary and increasing schedule up to the elimination of the quotas, as provided by the U.S.-Chile free trade agreement (USTR, 2003) or a once for all increase in the amounts of the quotas, as in the negotiations between the European Union and Mercosur (Kume et al., 2004).

The following subsection analyzes – from the exporting country's point of view – the effects of an expansion in the import country's quotas, on the exports and the quota rents, in the three cases mentioned. For simplicity, we assume that the quota is administered by the exporting country.

a) Initial imports not exceeding the quota

In this case, as previously shown (Figure 1A), imports are controlled by the in-quota tariff rate, and the quota and the extra-quota rate are redundant. Therefore, an offer of an additional quota has no impact on exports.

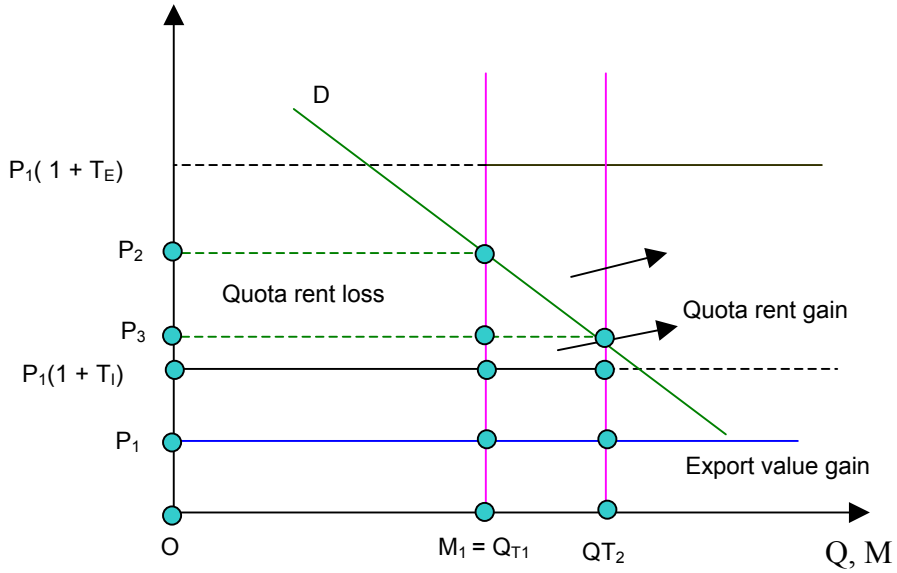
b) Initial imports matching the quota volume

In this context, an additional quota produces an equivalent growth in the exports from QT1 to QT2 and decreases domestic price from P2 to P3 (Figure 2). The increase in the export value equals the additional quota multiplied by price P1. The decrease from P2 to P3 reduces the rent previously established by the quota. However, the additional quota generates an extra rent, which corresponds to the additional quota multiplied by the difference between price P3 and the in-quota price, P1(1 + TI). Therefore, the net result for the exporting country depends on the magnitudes of the gains of the export value and on the net gains of rents.[7]

It should be noted that there is no distinction for the exporting country between the export value obtained in dollars and the one arising from the quota rent.

Figure 2

Effects of an additional quota – initial imports matching the quota volume



Source: Authors.

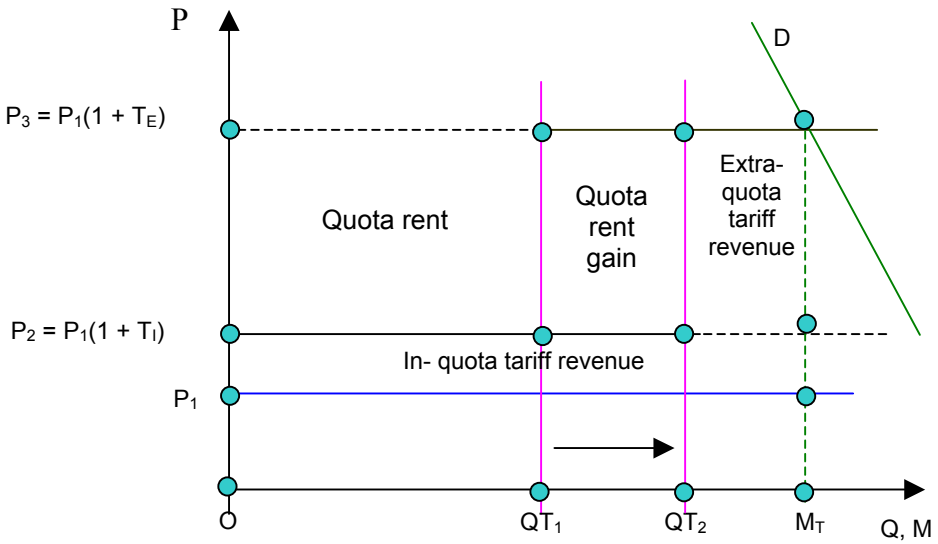
c) Initial imports exceeding the quota volume

This situation includes two cases: if the additional quota does not exceed the extra-quotas imports that already own, and if it does.

An increase in the amount of quota not exceeding the extra-quota imports does not affect the total demanded amount; so there is only a partial replacement of extra-quota imports with the additional quota. The exporting country's gain will only result from the appropriation of the rents, provided by the additional quota (Figure 3).

Figure 3

Effects of an additional quota not exceeding the extra-quota imports

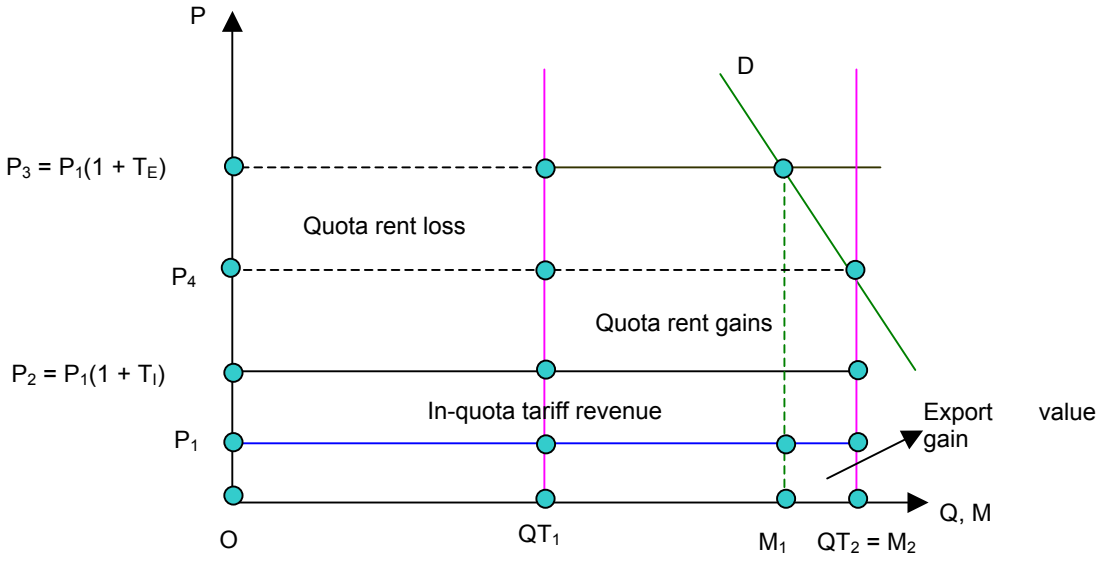


Source: Authors.

An additional quota ($QT_2 – QT_1$) larger than the extra-quota imports ($M_1 – QT_1$) causes a decrease from P_3 to P_4 (Figure 4). The partial loss of the previous quota rent (QT_1) can be gauged by the difference between P_3 and P_4 multiplied by QT_1. The new quota produces a rent equivalent to the difference between P_4 and P_2 multiplied by the additional quota. The increase in export value will correspond to the additional exported amount ($M_2 – M_1$) multiplied by price P_1. Again, the net result can be either positive or negative, depending on the value defined by these areas.

Figure 4

Effects of an additional quota exceeding the extra-quota imports



Source: Authors.

III – Effects of an additional quota: an application

The European Union (EU), one of the major markets for the export of agricultural products from Mercosur, adopts tariff quotas for many of these commodities. Thus, the occasional concessions by Europeans in this area should be assessed according to the previously described parameters, which may indicate prospects of effective gains in foreign currency earnings for Mercosur countries. The offer of additional quotas for certain agricultural products made by the EU in May 2004, in the context of a future free trade agreement between the EU and Mercosur, will be used as a way to illustrate the estimation of possible effects on some Brazilian agricultural exports.

1. The European Union's offer

The negotiations aimed establishing at a free trade agreement between Mercosur and the European Union began in the first half of the 1990s. As long as the European point of view is concerned, the aim of the agreement was to "gradually establish a free trade area in the industrial and service sectors, as well as reciprocal and progressive agricultural trade liberalization, considering the sensitivity of certain products" (European Committee, 2004). The position of the EU has become more clear since then: extra care should be taken regarding possible concessions in the agricultural trade.

After having cooled down, negotiations restarted and, in May 2004, there was a formal exchange of proposals among prospective members, and the agreement was expected to be concluded by October of that year, when the tenure of office of European commissioners would expire. However, both blocs were not capable of overcoming certain specific disputes and no deal was achieved.

As the offer made in May 2004 by the EU can be regarded as the best proposal ever, it exemplifies the effects expected from the concession of additional quotas for agricultural products subjected to tariff quotas for some Brazilian exports.

According to this offer, the number of traded products amounted to 10,427 (EU's 8-digit Combined Nomenclature – NC8). A liberalization scheduled was proposed to occur in different periods within a time span of up to 10 years, for 92% of the total amount of products. Nearly 122 of these products, corresponding to 1.2% of the total, had a fixed preference of 20% or 50%, with no perspective of total liberalization. Finally, there was no liberalization plan for approximately 21 products.

Additional quotas were offered for a set of agricultural products, most of them with a tariff preference of 50%, divided into two shares: the first one, immediately after the signature of the agreement, and the second one, after the conclusion of the Doha Round. The amount of the second share would be therefore conditional on the results of the negotiations in the WTO, and might increase or decrease, depending on the agricultural concessions by the European Union in the multilateral forum.

In Table 1, the 249 products (NC-8) for which the European Union offered new quotas were grouped into 13 categories of goods. For the European Union, these additional quotas represented a certain participation in its total imports, ranging from approximately 0.9% to 686.3%, in 2002. The smallest offers – some of them quite insignificant – were those for bananas (share of the offered quota on imports of 0.9%), wheat (1.5%), butter and milk fat (3.5%) and rice (4.4%). The quotas with highest impact on external purchases were those for ethanol (686.3%), beef (42.0%), poultry (29.5%), pork (27.5%), corn (25.4%) and garlic (21.3%). The high quota for ethanol is due to the expected high future demand for this product when the European Union will have approved the new environmental control rules.

For Mercosur countries, the products with the largest potential growth of exports (indicated by the participation of total additional quota on the EU imports from Mercosur) are, in decreasing order: ethanol (2.785.5%, due to the modest current Mercosur exports), rice (816.3%), wheat (389.9%), garlic (87.7%), bananas (83.1%), poultry (70.9%), beef (48.5%) and corn (38.4%). Among these products, special attention should be paid to ethanol, poultry and bananas, of which Brazil is basically the only Mercosur exporting member. Brazil is also an important exporter of beef, accounting for more than half of Mercosur exports, and even though the regional exports of pork meat to EU are still null, it is worth remembering that Brazil is a very competitive producer of this product worldwide.

The extra-quotas tariff rates of these products that would benefit from additional quotas are very high, ranging from 18.2% to 107.5%, whereas the in-quota rates vary from 0% to 48.8%.

2. Additional quotas and the potential gains for Brazil

The estimates of gains for Brazil were calculated for five products[8]: beef[9], poultry, bananas, corn and ethanol. The import values for 2002 are from UNCTAD (TRAINS-WITS). The tariffs and tariff quotas were obtained from the European offer of May 2004 (European Commission, 2004), considered the best UE proposal, as previously described. The methodology applied to estimate the gains was the one presented in section 2.2.

For each product, we supposed that Brazilian share in the additional quota offered by the European Union would be equivalent to its participation in Mercosur's total exports to that market and that the in-quota tariff-rate would be reduced to a half of its current level[10]. Moreover, since the quota administration method had not been decided yet, we took in account the two extreme situations: in the first one the Mercosur would be in charge of the quota administration, and in the other one the quota rent would be entirely appropriated by EU agents.

The effects on the quota rents and the increase in exports, both divided into two shares, according to the European proposal, are shown in Table 2.

Table 1

Offered quotas, extra-quota and in-quota tariff rates, EU's total imports, imports from Mercosur and from Brazil and participation of the quota in imports

Type of product	Offered Quota (1,000 tons)		No. of items (NC-8)	Extra-quota tariff rate (%)	In-quota tariff rate (%)	EU imports – 2002 (1,000 tons)			Participation of quota in EU imports (%)	
	1st share	2nd share				Total	Mercosur	Brazil	Total	Mercosur
	(A)	(B)				(C)	(D)	(E)	(A+B)/C	(A+B)/D
Beef	50.0	50.0	11	87.5	20.0	238	206	118	42.0	48.5
Pork	6.0	5.0	21	28.5	14.2	40	0	0	27.5	
Poultry	37.5	37.5	83	32.0	6.6	255	106	103	29.5	70.9
Milk	6.5	6.5	28	78.6	33.4	92	0	0	14.1	
Butter and milk fat	2.0	2.0	8	98.4	48.8	116	0	0	3.5	
Cheese and cottage cheese	10.0	10.0	42	37.1	15.5	156	0	0	12.9	
Garlic	5.0	5.0	1	107.5	9.6	47	11	0	21.3	87.7
Bananas	30.0	0.0	1	103.7	11.4	3,288	36	36	0.9	83.1
Wheat	100.0	100.0	1	69.6	0.0	12,922	51	3	1.5	389.9
Corn	400.0	300.0	7	64.0	34.0	2,761	1,824	387	25.4	38.4
Rice	20.0	20.0	32	66.6	17.6	901	5	0	4.4	816.3
Ethanol	500.0	500.0	2	39.1	20.7	146	36	36	686.3	2,785.5
Animal food preparations	6.5	6.5	12	18.2	-	0	0	0		

Source: Quotas and tariffs: European Committee; Import: WITS and SECEX/MDIC. Author's elaboration.

Brazil does not have a tariff quota for poultry, corn and bananas, so all of its exports are subjected to the extra-quota.[11] As long as the share offered to Brazil is lower than the amount of Brazilian current exports to the European market, the new additional quota will partially replace previous sales and there will be no increase in the exported amount. However, the elimination of the extra-quota tariff rate for these products would generate rents of the order of US$ 59 million for poultry, US$ 19.5 million for bananas and US$ 11 million for corn (Table 2), to be retained by Brazilian exporters.

Table 2

Estimation of gains for Brazil (US$ million)

Product	Quota value	Quota rent – Mercosur´s administration			Export gain			Total
		1st share	2nd share	Total	1st share	2nd share	Total	
Poultry	116.9	29.5	29.5	59.0	0.0	0.0	0.0	59.0
Banana	13.4	19.5	0.0	19.5	0.0	0.0	0.0	19.5
Corn	17.2	6.3	4.7	11.0	0.0	0.0	0.0	11.0
Beef	175.5	83.7	42.2	125.9	0.0	50.0	50.0	175.9
Ethanol	426.4	19.0	19.0	38.0	213.2	213.2	426.4	464.4
Total	**749.4**	**158.0**	**95.4**	**253.4**	**213.2**	**263.2**	**476.4**	**729.8**
Total, excluding ethanol	**323.0**	**139.0**	**76.4**	**215.4**	**0.0**	**50.0**	**50.0**	**265.4**

Source: Author's estimations.

Note: The tariff quota values shown in the first column correspond to the additional quotas offered, at export prices from Brazil to the EU, in 2002.

The first share of the additional quota offered for the Brazilian beef is lower than the European extra-quota imports of this product from Brazil, upon which is applied the extra-quota tariff rate. Thus, the current extra-quota imports will be partially replaced by the new quota, and no increase in exports will occur, but extra rents of US$ 83.7 million will be generated. However, when the second share is included, the additional total quota will be larger than the current extra-quota imports. In this case, the price of Brazilian meat would be reduced[12], negatively affecting the quota rent, which would reach US$ 42.2 million. The exported amount, however, would be increased by the difference between the new quota and the previous extra-quota imports (US$ 50.0 million – Figure 4). Altogether, Brazil would have a net gain of US$ 175.9 million.

The new European environmental law is expected to produce a positive impact on the demand for ethanol, in such a way as to absorb the offered quota without influencing prices. Thus, there would be an increase of US$ 426.4 million in exports and a gain of US$ 38 million in the quota rent.

Assuming that Mercosur would be in charge of the quota administration, the estimates of the total gains for Brazil reach US$ 729.8 million, of which US$ 253.4 million would result from the appropriation of the quota rents and US$ 476.4 million from the growth in exports. That value corresponds to 63.7% of the value of the additional quotas offered for these products.

These results suggest that, depending on the conditions under which Brazilian exports suit the current EU's tariff quotas, the offer of additional quotas may cause an increase in gains for Brazilian exports that may be less than those estimated at current prices (column 1, Table 2). The total gains would reach a level close to the additional quota value only in the case that the exporters appropriated quota rents. This emphasizes the relevance in choosing the quota administrator during the negotiation of a trade agreement.

In addition, since the estimates of total gains are strongly influenced by ethanol, the potential gains can be better assessed by excluding this product. This procedure would imply a huge decrease, from US$ 729.8 million to US$ 265.4 million in the potential gains and from US$ 476.4 million to US$ 50 million in the export gain.

In conclusion, excluding the ethanol from the calculations, the theoretical models application of tariff quotas on EU's offer of May 2004 indicates that Brazilian gains would be significantly influenced by the definition of the quota administrator. If this role is played by Mercosur, the Brazilian gains would be US$ 265.4 million. In the opposite case, if the UE gets the attribution, it would be reduced to US$ 50 million.

IV – Final remarks

For most agricultural products, protection is provided by the tariff quota mechanism, composed of three instruments: the in-quota tariff rate, which is often low, applied to imports up to a certain amount, the quota and the extra-quota tariff rate, which is often high, applied to the import share that exceeds the quota. Nevertheless, given the demand curve for the product, only one of them effectively restricts imports. Furthermore, the quota administration method plays a crucial role in defining if the quota rents are appropriated by the exporting or by the importing country.

A common practice in trade negotiations is the offering of additional quotas in order to allow increasing imports at a low tariff rate (in-quota). This is often interpreted as an effective increase in the exported amount equivalent to the additional quota offered. Nevertheless, this evaluation disregards the effects on the rents provided by the tariff quota system.

The present study aimed to estimate the gains for Brazil derived from the additional quotas offered by the European Union for five products: beef, poultry, bananas, corn and ethanol. In the case Mercosur gets the quota administration by, the results indicate a total gain of US$ 728.5 million, of which US$ 252.1 million generates from the quota rent and US$ 476.4 million from the expansion of exports. That value is not far below from the one of the additional quotas for these products at current prices. However, if the quota control goes to the EU, the Brazilian gains would be concentrated in the exports increase, reaching only 63.7% of the mentioned additional quota value. Excluding ethanol, the increase in total gains would correspond to US$ 264.1 million (US$ 214.1 million from the quota rent and US$ 50 million from export gains).

These results point out that we can overestimate the potential gains generated by the additional quotas for agricultural products when both the tariff quota systems operation and the demand curve for different products are not appropriately taken in consideration.

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Notes

[1] kume@ipea.gov.br

[2] guidapiani@ipea.gov.br

[3] pmiranda@ipea.gov.br

[4] In addition to tariff peaks, th “tariffication” preserved the so-called “tariff escalation”, by which the tariffs of processed goods were kept at higher levels than those of the inputs.

[5] This proportion should increase to 5% by the year 2000.

[6] A small amount of tariff quotas has been allocated to new WTO members, which implemented them in order to be accepted as members.

[7] The variation in rents also depends on the elasticity of demand.

[8] In the previous versions, the gains for pork, whose Brazilian exports to the European market were practically null in 2002, had also been included. For those, we assumed perfect substitution with the product from other sources due to the lower price of the Brazilian swine meat. For methodological reasons, we decided here to exclude that product.

[9] Cicowiez and Galperín (2005) estimate the Argentinean gains with the EU’s additional quota for beef.

[10] For products with no in-quota tariff rate, the value used was half of the current tariff level.

[11] This case has the characteristics of the theoretical framework, in which the initial quota is null and the offer of the additional quota is lower than the extra-quota imports. (Figure 4)

[12] For the estimation of the new price, it has been used an import price-elasticity of 1.12, which corresponds to a simple mean of those applied by Cline *et al.* (1979) and Hoekman, Ng and Olarreaga (2202).