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Tariffication of Tariff Rate Quotas under oligopolistic competition: the case of the EU import regimes for bananas [1]

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Abstract: The paper develops a two-stage capacity constrained duopoly model, in which the mode of competition is endogenous and the constraint is flexible, to investigate the impact of Tariff Rate Quotas (TRQs) and their liberalization. The model predicts that the greater the gap between the price of the licences plus the in-quota tariff and the out-of-quota tariff, the closer the outcome of the game to the pure Cournot outcome. The tariff equivalent changes according to the prevailing mode of competition under the TRQ. The model is used to address the issue of the tariffication of the non-ACP TRQ for EU banana imports. The results suggest that under the TRQ firms competed on quantity and that the tariff equivalent is higher than the tariff introduced by the EU in 2006.

Keywords: tariff rate quota, oligopoly, bananas

JEL code: Q18; F13; L13.

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Tariffication of Tariff Rate Quotas under oligopolistic competition: the case of the EU import regimes for bananas

1. Introduction

A high proportion of agricultural production and imports in developed countries is currently protected by Tariff Rate Quotas (TRQs). More than 15% of agricultural products imported by the EU are covered by a TRQ, while the figure in the US and Japan is slightly under 10%. TRQs are two level tariffs with a limited volume of import (the quota) subject to a lower in-quota tariff and subsequent import subject to a higher out-of-quota tariff. The Uruguay Round Agreement on Agriculture introduced TRQs with the aim to guarantee minimum market access in highly protected agricultural markets; TRQs are also among the most frequently used trade policy instruments by developed countries to grant preferential access to products from developing countries. Nevertheless, the extensive use of TRQs as a tool to liberalize agricultural trade has raised many questions and several countries within the current WTO negotiations have proposed modifications to the TRQs regimes to further liberalize trade. One controversial case is the European Union (EU) TRQs regime for bananas introduced in 1993. This regime has been at the heart of an endless international conflict - the so called "banana war". Within the WTO some major Latin American banana exporters and the United States - which does not produce bananas, but is the home country of the most important multinational banana traders – challenged the regime (Read, 2001; Josling and Taylor, 2003). Following the 2001 agreements reached within the WTO between the EU and the major exporters, in 2006 the EU replaced the TRQs system with a "tariff-only" regime. This new regime was challenged again within the WTO by major Latin American exporters and by the US. The key issue in the current controversy on bananas is that of establishing which tariff would leave unchanged previous imports under the TRQs. Papers assessing the tariff equivalent of previous TRQs for bananas assume perfect competition (e.g. Guyomard and Le Mouël, 2003; Guyomard *et al.*, 2006; Anania, 2006). While this assumption reflects reasonably well many manufactured products, where imports and exports are mostly carried out by small firms, it may be unrealistic for agricultural trade, which is often dominated by few large firms: three firms account for about 60% of world trade of bananas and two of them for about 50% of EU imports (UNCTAD, 2003).

This paper considers the implications of the existence of large traders operating in the international agricultural trade; a duopoly capacity constrained model in which the mode of

competition is endogenous is used, in order to examine the effect of TRQs and the implications for establishing the tariff which leaves imports unchanged.

The literature on the non-equivalence between quotas and tariffs in non competitive markets, which originated with the contribution by Bhagwati (1965), has considered different market structures and settings. Contributions assuming oligopoly have shown that when firms compete on price, strategic interactions under quotas and tariffs may be fundamentally different (e.g. Harris, 1985; Krishna, 1989). Many of these papers, however, implicitly assume that firms' behaviour and market structure are not influenced by the trade policy.[2]

Few papers have analysed import quotas under oligopoly by means of models in which the conduct of firms on the market arises endogenously and is determined by the trade policy. Syropoulos (1992) constructed a model where firm behaviour is endogenously determined in an infinitely repeated game and analysed the impact of quotas and tariffs on market conduct. Deneckere *et al.* (2000) developed a capacity constrained duopoly with homogeneous products in which the existence of price leadership and the identity of the leader are endogenous and depend upon firms' costs and capacities. They show how conclusions regarding the equivalence of quotas and tariffs may differ when endogenous conduct is taken into consideration.

Capacity constrained models are the natural framework for examining the impact of quantitative restrictions under oligopoly. Unlike other capacity constrained models (e.g. Kreps and Scheinman, 1983; Deneckere *et al.* 2000) the constraint in this paper is not rigid, as the firm can increase the imported volume, although if at a higher trading cost. The basic idea is that the existence of a TRQ introduces a capacity constraint for trading firms which is given by the number of licences they have been allocated. However, the firm can adjust its capacity over time by incurring adjustment costs: either by acquiring additional licences on the market in the first stage, or by importing out-of-quota in the second stage. Maggi (1996) has shown that, in this setting, the greater the gap between the cost of adjusting capacity between the two periods, the higher the effectiveness of the capacity constraint and the closer the outcome of the game to that of Cournot. The replacement of the TRQ with a tariff, by removing the capacity constraint, may imply a change in the mode of competition and generally leads to an increase in the degree of competition. As a consequence, the tariff which leaves imports unchanged varies according to the prevailing mode of competition under the TRQ; in general terms this is higher the less competitive the equilibrium under the TRQ, i.e. the more effective

[2] A recent contribution by Krishna and Tan (2007) analyses, in a competitive setting, the effect of quotas and tariffs considering the impact that trade policies may have on the size of the trading industry.

the capacity constraint under the TRQ. Therefore, the model suggests that, in order to find the tariff which would leave imports unchanged, it is essential to assess the prevailing mode of competition under the TRQ.

The model presented in this paper may contribute to both the literature on the tariff-quota equivalence and to that on the economics of TRQs. Very few papers (e.g. Deneckere *et al*, 2000) have examined tariff-quota equivalence within a capacity constraint model and those that have - unlike this paper- consider the product homogeneous and rigid constraints. On the other hand, this is the first paper which examines the economics of TRQs under oligopoly taking into account the fact that the mode of competition may be affected by the trade policy. A further contribution of the paper is that the theoretical model is used to empirically assess the tariff equivalent. To the best of our knowledge this is the first paper to use this kind of model in empirical trade policy analysis. Within this framework the mode of competition can be assessed by means of observable parameters, i.e. the values of adjusting costs in the two periods; a further advantage is that, while trade policy analysis based on the conjectural variation approach assume a constant conduct parameter, here the possibility that a trade policy change may change the mode of competition is taken into account.

The model is used to address the issue of the tariffication of the EU TRQ on bananas in place until 2006 for non-ACP countries. The prevailing mode of competition under the banana TRQ regime is first assessed. Then, the model is used to predict how the mode of competition would change under the tariff introduced in 2006; finally, the value of the tariff that would leave imports unchanged is assessed. The results show that, as in the case of multinationals' imports from non-ACP countries, the prevailing mode of competition under the TRQ is Cournot competition and this result holds for a wide range of parameter values; this is because the effectiveness of the capacity constraint is very high mainly due to the high value of the out-of-quota tariff. The results also suggest that the tariff which would leave imports unchanged is higher than the tariff introduced by the EU in 2006.

The paper is organised as follows. The next section presents the main hypotheses of the model and the various outcomes of the game. The third section addresses the issue of the tariff which leaves imports unchanged under the different outcomes. In the fourth section the model is empirically used to address some of the key issues in the debate about the tariffication of the EU TRQ for bananas. The final section offers some concluding remarks.

2. The model

The model considers two symmetric trading firms importing a differentiated product in one country. We assume quadratic utility functions and, thus, linear demands. The inverse demand function in the importing country for each product is:

$$p_1 = \alpha - \beta q_1 - \lambda q_2 \quad \text{and} \quad p_2 = \alpha - \beta q_2 - \lambda q_1 \qquad (1)$$

with q_i and p_i being the quantity and the price of the product traded by firm *i*; we assume that the own-price effect dominates the cross-price effect, i.e. that $\beta^2 > \lambda^2$.

The direct demand functions are:

$$q_1 = a - b_1 p_1 + b_2 p_2 \quad \text{and} \quad q_2 = a - b_1 p_2 + b_2 p_1 \qquad (2)$$

In the importing country a tariff rate quota is in force with *Q*, *t* and *T* being, respectively, the import quota, the in-quota tariff and the out-of-quota tariff.

As for the allocation of quota licences, we assume that the government has allocated the quota on an historical basis and that licences can be transferred between operators. Most studies to date have examined the case of auction quotas (e.g. Bergsten *et al*., 1987; Krishna, 1993) and more recently of licences-on-demand allocations (Hraianova *et al.*, 2006). Unlike these methods, the historical criteria allocate to importers the right to import a given quantity at the in-quota tariff for a number of years without paying for the licences. Licence transferability is generally allowed as it is expected to improve welfare - because licences are likely to be finally used by the lower marginal cost firms - although the common view that transferable licences are always welfare improving has been questioned in the literature (e.g., Lott, 1987; Krishna and Tan, 1999).

In this model the duopolist holds q_i^o licences. In addition, a large number of small operators hold other licences, for a total amount q^d, with $q_1^o + q_2^o + q^d = Q$. Marginal trading costs of small operators are assumed to be well above those of large firms and, thus, a market for licences arises. Small operators supply the licences to the large firms at price $P_L = e + f(q_1^d + q_2^d)$, with $f > 0$ and $q_1^d + q_2^d \leq q^d$. [3] We assume that the two large firms, which due to their low marginal trading costs are the sole purchasers of licences, exert market power in the licence market. This assumption reflects reasonably well the working of banana TRQs in the EU before 2006. Large multinational firms accounted for a major share of licences while a relatively large number of small operators held the remaining ones; most

[3] The supply of licences by small operators is likely to be driven by their opportunity cost, i.e. the gap between the expected import price and their marginal trading costs; if small operators face increasing marginal trading costs, then their supply of licences is upward sloping.

small operators stopped importing after the introduction of the TRQ and just exploited the quota rents by transferring licences to large operators.

The price of the licence plus the in-quota tariff is always not greater than the out-of-quota tariff, i.e. $P_L + t \leq T$. The two large firms face identical marginal trading costs, c , which are assumed to be constant. Profits of firm *i* are:

$$\Pi_i = \left\{ \begin{array}{ll} p_i q_i - c q_i - t q_i & \text{if} \quad q_i \leq q_i^0 \\ p_i q_i - c q_i - P_L q_i^d - t(q_i^d + q_i^0) & \text{if} \quad q_i^0 < q_i \leq q_i^0 + q_i^d \\ p_i q_i - c q_i - P_L q_i^d - t(q_i^d + q_i^0) - T(q_i - q_i^d - q_i^0) & \text{if} \quad q_i > q_i^0 + q_i^d \end{array} \right\} \qquad (3)$$

As already mentioned, in the first stage of the game firms choose capacity, i.e. they decide the quantity to trade; if this quantity exceeds their own quota, firms purchase licences on the market. By choosing capacity, firms commit themselves to import a certain volume in the second stage. In the second stage we assume that the only way to increase imports is to import out-of-quota. This assumption appears to be realistic in the context of several TRQ regimes with transferable licences, and specifically in the EU banana regime before 2006; licence transactions usually occur well before the entry of the product into the importing country, as firms plan the quantity to trade in advance in order to arrange contracts with suppliers, distributors and providers of logistical services. The amount of purchased licences could thus work as a firm's commitment to trade a certain quantity in the second period. The effectiveness of this commitment depends on the cost of increasing capacity in the second stage, that is, the cost of importing out-of-quota, which is tariff T . The higher T and the higher is the effectiveness of the capacity commitment; on the contrary, if the cost of increasing capacity in second stage is equal to that incurred by firms in the first stage ($P_L + t = T$), then the capacity chosen in the first stage does not work as a commitment device.

In the second stage, after observing capacity, firms compete on price. As Maggi (1996) has shown, the prevailing mode of competition and, consequently, the outcome of the game, depends upon the effectiveness of the capacity commitment; as the effectiveness of the commitment increases, the game moves from a pure Bertrand solution - when the capacity constraint is not important, firms compete on prices - to a pure Cournot outcome - when the capacity constraint is very important, firms commit themselves to import the quantity chosen in the first stage. The prevailing mode of competition, therefore, depends upon the values of

t, T, q_i^o, q_i^d and P_L, that is, it depends upon the value of the key instruments of the trade policy.

As usual, the game is solved backwards, by first considering the second stage decision, when firms compete on price, given the capacity chosen in the first stage. The subgame Bertrand reaction curve is a kinked curve with three branches (Figure 1). If $q_1 < q_1^o + q_1^d$ marginal costs are equal to $c+t$. The firm's imports are lower than the licences it holds (i.e. its own licences plus the licences acquired in the first stage). If $q_1 > q_1^d + q_1^o$ marginal costs of firms are equal to $c+T$. The firm's imports are greater than the amount of licences it holds; therefore there are also out-of-quota imports. If $q_1 = q_1^o + q_1^d$, the residual marginal revenue curve (MR) crosses the marginal cost curve at its vertical segment. The relevant price combination is derived from the demand functions by setting a fixed traded quantity $q_1 = q_1^o + q_1^d$. Unlike Bertrand games with homogeneous goods and rigid capacity constraints (e.g. Kreps, Scheinkman, 1983), this subgame admits a unique pure-strategy equilibrium (Maggi, 1996), given by the intersection of the two reaction curves.

The subgame perfect equilibrium implies that:

$$p = \begin{cases} p_i^B(c,t,P_L) & \text{if} \quad T = P_L + t < T^* \\ p_i^{BT}(c,T) & \text{if} \quad P_L + t < T < T^* \\ p_i^C(c,t,P_L) & \text{if} \quad T > T^* \end{cases} \qquad (4)$$

with T^* being a critical value of the out-of-quota tariff, and p_i^B e p_i^C being the Bertrand and Cournot equilibrium prices, respectively.

With no capacity constraints ($P_L + t = T$), the full game equilibrium is the outcome of a one-shot Bertrand game with long run costs equal to $c+t+P_L$. When the capacity constraint is effective (T is higher than the critical level T^*) then the full game equilibrium is given by the Cournot price. The Cournot solution is identified as the outcome of a one-shot game in which firms compete on quantity and have long run costs equal to $c+t+P_L$.

When the value of the out-of-quota tariff is lower than the critical level ($P_L + t < T < T^*$) the equilibrium price is between the Cournot and Bertrand prices and could be identified as the outcome of a one-shot Bertrand game in which firms compete on price and have long run costs equal to $c+T$. This is the equilibrium price even if firms do not import out-of-quota and incur marginal costs $c+t+P_L$ or $c+t$, which are both lower than $c+T$. The basic intuition is that when the cost of increasing capacity in the first stage is lower than in the second stage

($P_L + t < T$), investment in capacity in the first stage sustains a higher price ($p_i^{BT}(c,T)$) than the one that would prevail in a pure Bertrand one shot game ($p_i^B(c,t,P_L)$ or $p_i^B(c,t)$).

The critical level T^* above which the mode of competition switches from Bertrand to Cournot is defined implicitly by $p_i^{BT}(c,T) = p_i^C(c,t,P_L)$.

Figure 2 illustrates the "pure" Bertrand and Cournot equilibrium prices $p_i^B(c,t,P_L)$ and $p_i^C(c,t,P_L)$ as a result of the intersection of the reaction curves.

As for the Bertrand price $p_1^B(c,t,P_L)$, the reaction curves may be obtained by maximising (3) by holding fixed the rival's price, when costs are c,t,P_L:

$$\max_{p_1} \Pi_1 = p_1 q_1 - (c+t) q_1 - P_L q_1^d \qquad (5)$$

First order conditions are:

$$a - 2b_1 p_1 + b_2 p_2 + b_1(c+t+e) - 2f(a - b_1 p_1 + b_2 p_2) = 0 \qquad (6)$$

which yields:

$$p_1 = \frac{a(1-2f) + b_2 p_2 (1-2f) + b_1(c+t+e)}{2b_1(1-f)} \quad p_2 = \frac{a(1-2f) + b_2 p_1 (1-2f) + b_1(c+t+e)}{2b_1(1-f)} \qquad (7)$$

The Bertrand price $p_1^B(c,t,P_L)$ is therefore:

$$p_1^B = \frac{(aY + b_1(c+t+e))(2b_1 W + b_2 Y)}{4b_1^2 W^2 - b_2^2 Y^2} \qquad (8)$$

with $W = 1-2f$ and $Y = 1-f$. Because firms are symmetric, $p_1^B = p_2^B$.

The Cournot reaction curves are obtained by solving the maximisation problem:

$$\max_{q_1} \Pi_1 = q_1 p_1 - (c+t) q_1 - (e + f q_1^d) q_1^d \qquad (9)$$

First order conditions are:

$$\alpha - 2\beta q_1 - \lambda q_2 - (c+e+t) - 2f q_1 = 0 \qquad (10)$$

which yield:

$$q_1 = \frac{\alpha - \beta q_2 - (c+e+t)}{2(\beta + f)} \qquad (11)$$

Given that:

$$\alpha = \frac{a(b_1 - b_2)}{b_1^2 - b_2^2}, \ \beta = \frac{b_1}{b_1^2 - b_2^2} \text{ and } \lambda = \frac{b_2}{b_1^2 - b_2^2} \qquad (12)$$

reaction curves in the prices space can be obtained by substituting in equation (11) demand functions (2) and parameters (12):

$$p_1 = \frac{(b_1 + Z)a + (b_1{}^2 - b_2{}^2)(c + t + e) + b_2 p_2 (b_1 + Z)}{2b_1{}^2 - b_2{}^2 + b_1 Z} \qquad p_2 = \frac{(b_1 + Z)a + (b_1{}^2 - b_2{}^2)(c + t + e) + b_2 p_1 (b_1 + Z)}{2b_1{}^2 - b_2{}^2 + b_1 Z} \quad (13)$$

with $Z = 2f(b_1^2 - b_2^2)$.

The Cournot equilibrium price $p_i^C(c, t, P_L)$ is thus:

$$p_1{}^C = p_2{}^C = \frac{(b_1 + Z)a + (b_1{}^2 - b_2{}^2)(c + t + e)}{2b_1^2 - b_2{}^2 + b_1 Z - b_2(b_1 + Z)} \quad (14)$$

Finally, when $P_L + t < T < T^*$ the solution is identified by the one-shot Bertrand equilibrium with marginal costs $c + T$:

$$\max_{p_1} \Pi_1 = p_1 q_1 - (c + T) q_1 \quad (15)$$

The reaction curves are:

$$p_1 = \frac{a + b_2 p_2 + b_1 (c + T)}{2b_1} \text{ and } p_2 = \frac{a + b_2 p_1 + b_1 (c + T)}{2b_1} \quad (16)$$

The Bertrand price equilibrium $p_i^{BT}(c + T)$ is:

$$p_1^{BT} = p_2^{BT} = \frac{a + b_1 (c + T)}{2b_1 - b_2} \quad (17)$$

When parameters satisfy all constraints and $T < T^*$, $p_1^B < p_1^{BT} < p_1^C$ which implies $q_1^B > q_1^{BT} > q_1^C$.

The value of T^* determines the equilibrium under the TRQ. As already mentioned, T^* is identified as the tariff satisfying the identity $p_i^{BT}(c, T) = p_i^C(c, t, P_L)$. From (14) and (17) we obtain:

$$T^* = \frac{a(b_2^2 + b_1 Z) + c(b_1 - b_2)(b_2^2 + b_1 Z) + (e + t)(b_1 - b_2)(2b_1^2 + b_1 b_2 - b_2{}^2)}{b_1 (b_1 - b_2)(2b_1 + b_2 + Z)} \quad (18).$$

3. The tariffication of TRQs with endogenous mode of competition

A change in the trade policy instrument may affect the mode of competition. In this model a tariff means that there is no capacity constraint; firms in the first stage can increase their capacity by sustaining the same cost as in the second stage, i.e. by paying the tariff. In other words, a tariff represents the case in which $P_L = 0$, $T = t$ and thus $P_L + t = T$. Under these circumstances, the outcome of the game is the one-shot Bertrand solution. If t_0 is the tariff in force in the tariff-only regime, then the new equilibrium price is:

$$p_1^{Bt_0} = p_2^{Bt_0} = \frac{a + b_1(c + t_0)}{2b_1 - b_2} \qquad (19)$$

The impact of the tariffication may differ according to the equilibrium prevailing under the TRQ regime which depends upon the values of the in-quota tariff, the out-of-quota tariff and the price of the licence, the latter depending on the distribution of licences among small and large operators and on the licences supply parameters.

Let us assume that demand and cost conditions are such that firms do not import out of the quota Q, even though they import more than the quota they hold and, thus, they purchase licences from small operators at price P_L. We can distinguish three different cases.

Case a):

If under the TRQ regime $P_L + t = T < T^*$, i.e. there is no capacity constraint even before tariffication, then the outcome of the game under the TRQ regime is the Bertrand outcome $p_i^B(c, t, P_L)$. In this case tariffication does not induce any change in the mode of competition. After the policy change, the quantities imported by the firms will be the same if t_0 satisfies $q_i^B = q_i^{Bt_0}$. From equations (7) and (17) the tariff t_0^e is:

$$t_0^e = \frac{ab_2 f - (2b_1^2 - b_1 b_2)(t + e + cf) + b_1 b_2 cf}{(f - 1)(2b_1^2 - b_1 b_2) - b_1 b_2 f} \qquad (20)$$

This is the tariff that would leave unchanged the price as well. With import quotas, when firms compete on price, tariffs and quotas are not equivalent, as the rigid quantitative restriction sustains a higher price than the one that would prevail with a tariff implying the same level of imports (Harris, 1985; Krishna 1989). However, the quantitative restriction due to the TRQ is flexible. For each level of imports it is possible to find a tariff equivalent which is the sum of the price of the licence, the value of the in-quota tariff and the oligopsonistic rent of firms. This is shown in Figure 3 which represents the "pure" Bertrand equilibrium of Firm 1 under the TRQ regime when the firm purchases licences on the market ($q_1 > q_1^o$); small operators benefit from the quota rent which is equal to the price of the licences paid by the large firm; the large firm benefits from oligopsonistic and oligopolistic rents and from the quota rents generated by its own licences. If after tariffication firms continue to compete *à la* Bertrand, then the tariff t_0^e includes not only the in-quota tariff, but also the quota rent of small operators and the oligopsonistic rent.

Case b):

If under the TRQ regime $T > T^*$, i.e. there is a strong capacity constraint, before tariffication the outcome of the game is the Cournot price $p_i^C(c,t,P_L)$. In this case tariffication induces a change in the mode of competition; by shifting the outcome from Cournot to Bertrand it increases the degree of competition on the market. The tariff t_0^e which leaves quantities the same as before tariffication is the one which satisfies $q_i^C = q_i^{Bt_0}$ which implies $p_i^C(c,t,P_L) = p_i^{Bt_0}(c,t_0^e)$, that is, the tariff which has been defined as the critical tariff T^*. Therefore, when the out-of-quota tariff is sufficiently high, the tariff t_0^e is the critical tariff (equation 18) above which firms compete on quantities. This tariff captures the in-quota tariff, the price of the licence, the oligopsonistic rent and part of the oligopolistic rent under the TRQ regime. This is because tariffication, by shifting from Cournot to Bertrand, implies a decrease in the oligopolistic rent of firms.

Case c):

If under the TRQ regime $P_L + t < T < T^*$, i.e. there is a weak capacity constraint, before tariffication the outcome of the game is identified by the one-shot Bertrand game with costs equal to $c+T$, $p_i^{BT}(c,T)$, which is a less competitive outcome than in case *a)*. The tariff t_0^e which leaves quantities unchanged is the out-of-quota tariff T; this tariff again captures the price of the licence, the in-quota tariff, oligopsonistic rents and part of oligopolistic rents and it is greater than the one in case *a)*.

These results have a number of interesting implications. The tariff t_0^e changes with the prevailing mode of competition under the TRQ. This is higher if firms compete *à la* Cournot (case *b*) and lower if firms compete *à la* Bertrand (case *a*) with an intermediate value for in-between modes of competition (case *c*). Therefore, when addressing the issue of the tariffication of TRQs one must beforehand analyse the prevailing mode of competition between firms under the TRQ which ultimately depends upon the value of the out-of-quota tariff with respect to T^* and $P_L + t$. Even when the out-of-quota tariff is prohibitive and there are no out-of-quota imports, the value of this tariff influences the equilibrium under the TRQ; if the out-of-quota tariff is sufficiently high (i.e. higher than the critical value T^*), the capacity commitment is effective and firms compete on quantity, while a Bertrand competition prevails in the opposite case. This result differs from the prediction of perfect competitive static models; in the latter, when there are no out-of-quota imports, the value of the out-of-quota tariff never influences the equilibrium under the TRQ and, therefore, the

impact of tariffication and the value of the tariff equivalent (Boughner *et.al*, 2000; De Gorter and Kliuaga, 2006).

The prevailing mode of competition depends also on the price of licences. Everything else held constant, the higher the price of licences, P_L , the higher the probability of case *a)* and the higher the critical out-of-quota tariff above which firms compete on quantity (i.e. the lower the probability of the Cournot outcome, case *c*). The price of licences depends upon the distribution of licences among small and large operators; a high share of licences allocated to small operators increases the price of licences and, therefore, reduces the probability that the outcome is Cournot competition. In other words, the model suggests that, if the share of licences allocated to large traders is sufficiently high, then the degree of market power on the product market will be higher. This result adds further support to the conclusions - already developed in the literature on import quotas (e.g., Krishna *et al.* 1994) - that the degree of market power in an industry increases with the concentration of licences; in this model this occurs when licences are concentrated in the hands of the traders, because high concentration increases the effectiveness of the capacity constraint.

4. The case of the EU import regimes for bananas

More than 50% of EU banana imports are concentrated in the hands of two firms, Dole Food and Chiquita, which differentiate their product by the means of brands; these large firms are vertically integrated throughout the trading channel from the exporting countries to the EU market; they perform shipping, transportation and also ripening in the EU and generally sell the product directly to EU wholesalers (Taylor, 2003; UNCTAD, 2003; COGEA, 2005).

The tariffication of EU banana TRQ has been a much debated issue both at the scientific and the international political levels. Before 2006 two TRQs were in force, one for ACP countries and the other one for non-ACP countries; while the ACP in-quota tariff was zero, a positive in-quota tariff was applied to non-ACP countries. The non-ACP countries quota was always filled, whereas the ACP countries' quota was mostly underused. The out-of-quota tariffs were very high and in the whole period during which the TRQ regime was in force, there were virtually zero out-of-quota imports. Licenses, which were allocated through the historical allocation criteria, were transferable, albeit with certain restrictions, among operators. This regime was at the heart of a long standing trade dispute within the WTO (Read, 2001; Josling and Taylor, 2003). In 2006 the EU replaced the non-ACP TRQ with a tariff. Non-ACP exporters had been asking for a tariff close to 75 €/t (the in-quota tariff under the non-ACP TRQ) and an end to the ACP preferential duty-free quotas. After two unsuccessful WTO

arbitrations, the EU decided to set the tariff at 176 €/t and to maintain a duty-free import quota for ACP bananas. The new regime was challenged again within the WTO by major Latin American exporters and the US. A formal complaint by Ecuador in November 2006 was followed by one from Colombia, Panama and the US in 2007 [4] (WTO, 2006, 2007a, 2007b and 2007c); complainants claim that the new EU regime discriminates against bananas from Latin American countries.

The issue of what the tariff equivalent actually was in the EU import regime for bananas has been addressed by several quantitative studies. One of the open issues in this literature is related to the degree of competition in the banana trading industry. Many papers assume perfect competition (e.g. Guyomard *et al.* 1999 and 2006; Guyomard and Le Mouël, 2003; Anania, 2006), although various authors acknowledge the fact that the concentration ratio in this industry is very high; the few empirical studies on the degree of market power are based on rather old data, and provide contrasting results (Deodhar and Sheldon, 1995; Herrmann and Sexton, 2001). Perfect competitive models do not provide a justification for the high gap observed between the exporting countries FOB prices and the EU CIF import prices (Guyomard *et al.* 2006) and implicitly assume that this is due to quota rents which are captured somewhere along the chain. Finally, most studies perform comparative static under the assumption that everything remains constant after 2006; however, there occur many factors which cannot be captured by any variable observed before 2006; among the factors ignored to date by the literature, Anania (2006) mentions possible changes in firms' behaviour. Deodhar and Sheldon (1995) have found evidence that the introduction of the TRQs caused the industry to behave in a Cournot manner, thereby stressing the fact that trade policy changes may affect the mode of competition; other papers addressing the issue of the impact of the introduction by the EU of TRQs for bananas under oligopoly assume Cournot competition (e.g. Mc Corriston and Sheldon, 1996; Mc Corriston, 2000).

The model presented above is first used to assess the mode of competition in the EU banana import industry under the non-ACP TRQ and then to quantify the tariff equivalent. Unlike the conjectural variation approach, the mode of competition is here assessed on the basis of observable parameters, i.e. the cost of adjusting capacity in the first and second period; comparative static is performed by allowing the mode of competition to change with the trade policy, while in studies using the conjectural variation approach the mode of competition is assumed to be constant; a further advantage is that this framework is game-theory founded

[4] In December 2007 and May 2008 two WTO panels ruled against the EU tariff regime.

(Maggi, 1996), while the conjectural variation model lacks grounding in maximising behaviour.[5]

One of the main empirical difficulties is that this model requires data which are not always available. No official data on banana trading firms are available and those provided by the specialised press and/or directly by operators may be unreliable. The cross-price effect between different brands of bananas is needed and this is not found in the literature. Finally, no official data are available on the quantity and price of transferred licences and there is no public access to information about their allocation.

A further limit is the assumption of the existence of only two symmetric firms. This implies that the behaviour of one firm is influenced by the behaviour of only one rival firm, facing the same costs and the same demand. Although this may seem rather restrictive in many cases, however, the assumption of a symmetric duopoly does not appear to be too unrealistic for the EU market for non-ACP bananas. As mentioned, two firms, Dole Food and Chiquita, have dominated EU imports from non-ACP countries and account for similar market shares in the EU and world-wide; both firms differentiate their product on the market with a well known brand; their trading costs are roughly similar as both of them export mainly from neighbouring Latin American countries (Costa Rica, Panama and Colombia) and export to the EU through a full integrated marketing chain (UNCTAD, 2003; Taylor, 2003). The focus of the empirical exercise in this paper, thus, is the behaviour of these two large traders; pricing and imports of other smaller operators are assumed not to affect the behaviour of the two large traders and are not taken into consideration.

The problem of the lack of data has been dealt with in different ways. As for firms', imports into the EU from non-ACP countries have been assessed on the basis of the Chiquita's quarterly company reports for the year 2005 and all other available information (Table 1). [6] Unlike other papers (e.g. Guyomard *et al*. 1999; Guyomard and Le Mouël, 2003; Anania, 2006), the EU wholesale price, instead of the CIF price, has been considered. This is because the CIF price is likely to reflect intra-firm transactions and, therefore, to be a transfer price, often manipulated by firms for fiscal purposes. The wholesale price of Chiquita bananas in the EU market is from FAO (2006). Firms' costs have been obtained by adding up the various

[5] Criticisms of the use of the conjectural variation model in trade policy analysis can be found, among others, in Helpman and Krugman (1989).

[6] Chiquita reports the amount of imports in Europe; this includes imports coming from all sources (both ACP and non-ACP imports) and sold in all European countries (both EU and non EU). This figure has been corrected by subtracting imports of Chiquita from the Ivory Coast and imports of Chiquita into non EU countries. Both figures were estimated on the basis of market shares of Chiquita available in UNCTAD (2003) and data on countries' imports/exports provided by FAOSTAT.

costs the firm incurs when trading the product from the Latin American suppliers to the EU market. These include the FOB price of the countries Chiquita exports from (i.e. Panama, Costa Rica, Colombia), the insurance, freight and other relevant costs from these suppliers to the EU borders and the cost of ripening and transportation in the EU markets. The weighted average FOB prices have been calculated on the basis of the FAOSTAT database, while the estimate of the other costs is from Guyomard *et al.* (2006) and COGEA (2005).

The model is calibrated using two different values of the degree of brand differentiation.[7] We have assumed that in the case of Chiquita and Dole Food the degree of brand differentiation is not marginal as the two multinational firms have been investing over time in product differentiation strategies (Read, 1986; Taylor, 2003).

Finally, as for the licence market, two hypotheses on the distribution of licences have been considered: a highly concentrated allocation and a lower level of concentration. Data made available from the European Commission indicates that in 2004 the number of purchased licences corresponded to about the 25% of the quantity imported by Chiquita. We have also considered the hypothesis that concentration may well be higher, by assuming that firms purchase on the market only 15% of the licences they need. The price of the non-ACP import licence is the one reported in recent years in the specialised press.

Table 2 reports the value of the critical tariff under the different hypothesis. The results show that the critical tariff under all hypotheses is well below the value of the out-of-quota tariff (680 €/t, which is equal to about 845 US$/t at the 2005 average exchange rate); thus, the model predicts that the prevailing mode of competition under the TRQ regime is the Cournot outcome. This result holds when assuming different values for licence supply elasticity and the degree of brand differentiation.[8] Figure 4 shows the relationship between the assumed degree of brand differentiation and the critical tariff; for values of the degree of brand differentiation below 0.45 (0.5 in the low concentration scenario) the critical tariff is below the out-of-quota tariff and the outcome of the game is the Cournot one. This result is consistent with the conclusions reached by Deodhar and Sheldon (1995) who found empirical evidence of quantity competition under the TRQs regime in the mid nineties. Above this

[7] The degree of brand differentiation is defined as $\rho = \frac{\lambda^2}{\beta^2}$. Brands are highly differentiated (almost homogenous) when $\rho \to 0$ ($\rho \to 1$).

[8] Even if licence supply elasticity is set equal to 3, instead of 6 as assumed in the tables, the value of the critical tariff is always significantly lower than the out-of-quota tariff. These results also hold when using previous year data to calibrate the model. Details of the performed sensitivity analysis and the calibration process are available on request.

value for the degree of brand differentiation, the mode of competition is in between Bertrand and Cournot (in Figure 4 denoted by "BT competition") and the tariff equivalent is the out-of quota tariff T.

Table 2 shows also that the degree of market power is greater under the scenario of a high concentration of licences. As aforementioned, this is because concentration in the hands of importers exerting oligopsony power in the licence market decreases the price of the licences and, in this way, strengthens the capacity commitment.

Oligopolistic and oligopsonistic rents account for more than 60% of the EU price under all scenarios, while firms' costs, including the price of the licence, for less than 40%. Thus, a major part of the observed gap between FOB and EU domestic price is due to these rents.

The tariff that would leave unchanged the price and the imports of the two duopolists is always higher than the value finally set by the EU of 176 €/t (equal to 221 US$/t at the 2006 average exchange rate) and even higher than 230 €/t (corresponding to 288 US $/t), the tariff initially proposed by the EU during the 2005 WTO arbitrations. This result differs from previous studies which suggest lower tariff equivalents (e.g. Guyomard and Le Mouël, 2003; Anania, 2006). Such differences are explained mainly by three factors: a) unlike other studies, this paper concentrates on the behaviour of the two largest importers; the tariff equivalent here is the tariff which leaves unchanged the price and the quantity imported by the two traders; b) this paper takes into account the change in the mode of competition among firms and this makes the tariff equivalent higher than the one predicted by models assuming perfect competition c) the critical tariff and the tariff equivalent in this model are influenced by the choice of the value of the degree of differentiation; as Figure 4 shows, a higher brand differentiation results in lower critical tariffs and thus in lower tariff equivalents.

Table 3 compares the predicted impact of tariffication under the assumption that the tariff is the one introduced in 2006, with the effect of the tariff equivalents predicted by the model under the various hypotheses. With a tariff equal to 176 €/t, the Bertrand equilibrium price (quantity), $p^B(176)$, ($q^B(176)$) is always lower (higher) than the price (quantity) under the TRQ; the introduction of the tariff only regime causes a reduction in the firm's price of between 2.7% and 4.9% and an increase in imports between 4.4% and 7.8%. Despite the price reduction and the increase in competition, firms' profits do not decline and even increase under some of the hypotheses. This is because the decline in profits due to the more competitive environment is offset by a reduction in costs, as the new tariff is lower than the price of the licence plus the in-quota tariff. Consumers benefit from the price decrease and

taxpayers gain the tariff revenues; the only losers are the small operators who see their quota rent disappear. Overall welfare improves because the gains of the consumers, firms and taxpayers more than offset the small operators' losses.[9]

The final rows of Table 3 show the impact of tariffication if the new tariff were the critical tariff, that is, the tariff equivalent predicted by the model under the four hypotheses. The equilibrium price and quantity, $p^B(T^*)$ and $q^B(T^*)$, are by definition the same as under the TRQ; as a consequence, consumers' welfare does not change. Taxpayers would gain much more than under the current tariffication (almost twice) while firms' profits would decrease by 6.5% - 14%. This not insubstantial decline in profits is the consequence of the more competitive environment. The losses incurred by firms are higher the higher the concentration of licences under the TRQ and the lower the degree of differentiation. Small operators, as in the previous case, lose their quota rents. Overall welfare does not change with respect to the TRQ regime.

Thus, according to this model the recent tariffication leaves firms' profits almost unchanged, while the introduction of the tariff equivalent would have reduced them. Prices are expected to fall and quantity to increase with the tariff introduced in 2006 and this is consistent with the findings of Anania (2006) and also with the observed decline in price in certain EU markets in 2006 and the general increase in imports from non-ACP countries which, according to some observers, is a consequence of the new import regime.

5. Conclusions

This paper has used a two stage capacity constrained duopoly model, in which the mode of competition is endogenously determined and the constraint is flexible, in order to investigate the working of TRQs and their removal. The results emphasize the role played by two variables – the out-of-quota tariff and the price of licences – in determining the value of the tariff equivalent. Unlike previous studies on TRQs, the out-of-quota tariff in this model, by influencing the strategic interaction between firms, is crucial in determining the tariff equivalent even when the out-of-quota tariff is prohibitive and there are no out-of-quota imports. As for the licence price, this paper has considered the case of the historical allocation methods with a market for licences, under the assumption that large traders exert oligopsony power and that the supply of the licences is upward sloping. Under these circumstances, the price of the licences is lower the higher their concentration in the hands of large traders. Thus,

[9] It is worth remembering that the changes in welfare reported in Table 3 are based on changes in price and quantity by two firms, and do not refer to the overall welfare impact of the introduction of the tariff.

the model suggests that a low concentration of licences in the hands of large traders prevents Cournot competition, and lowers the degree of market power and the tariff equivalent. The model also shows that the tariff equivalent changes with the mode of competition under the TRQ: this will become higher the lower the degree of competition under the TRQ. Finally the theoretical framework proposes an approach to assess the mode of competition which is based on observable variables, i.e. the costs of adjusting capacity in the first and in the second stage: in the specific case of TRQs, the mode of competition can be assessed on the basis of the price of licences and of the in-quota and out-of-quota tariffs.

The case of the non-ACP TRQ regime for banana imports to the EU is an example of a prohibitive out-of-quota tariff which, by increasing the effectiveness of the capacity commitments, has influenced firms' behaviour; the empirical exercise, although constrained by lack of data and limited to the case of two banana traders, suggests that under the TRQ firms competed *à la* Cournot and this result holds for a wide range of parameter values. The predicted tariff equivalent is higher than the one suggested by other studies, possibly because it takes into account oligopolistic rents. The assumption of perfect competition, in markets dominated by large traders, may thus result in an underestimation of the TRQ tariff equivalent. The tariff equivalent is also much higher than the tariff introduced by the EU in 2006; the model, thus, predicts that imports from non-ACP countries should be well above (and the price well below) the 2005 levels. This could help to explain the significant observed increase in imports from non-ACP suppliers since 2006.

The empirical use of the model, although preliminary, has shown its potential when addressing issues which traditional perfect competition static frameworks tend to be unable to explain satisfactorily. The gap between the import and export price is here explained by the considerable oligopolistic and oligsponistic rents which account for about 60% of the market price. In conclusion, the efforts to take into consideration the role of large traders in the empirical analysis of trade policy may, in many circumstances, contribute to a better overall understanding of the phenomena in question.

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Figure 1: The price subgame reaction curve

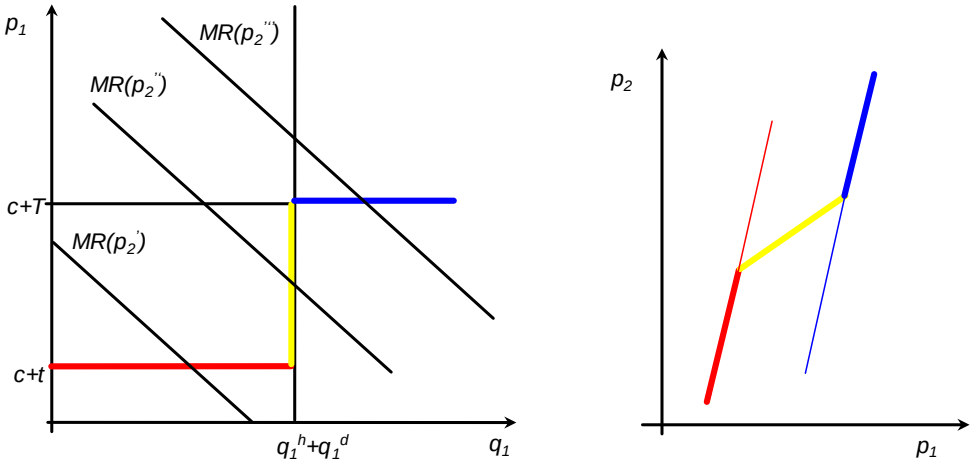

Figure 2: The full game

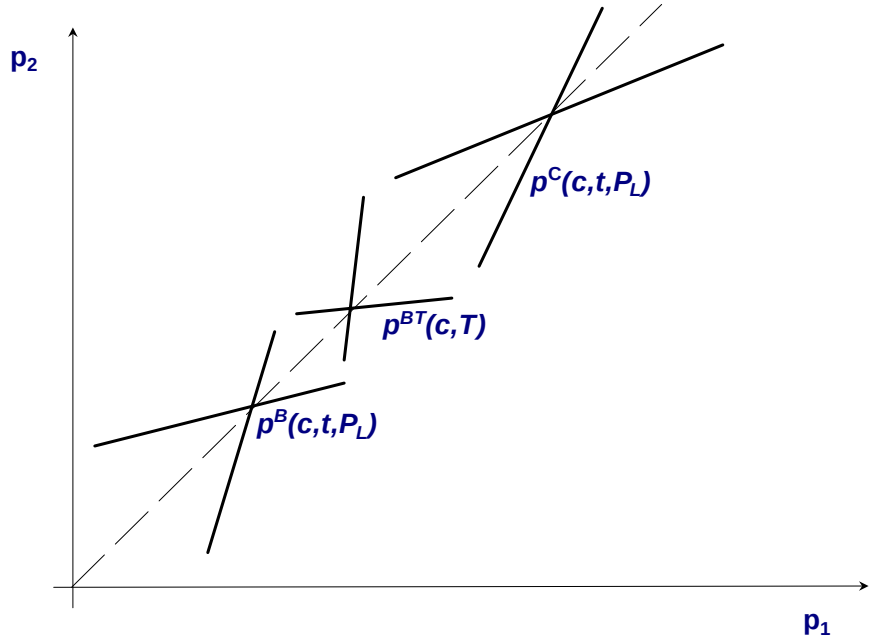

Figure 3: The tariff equivalent under Bertrand competition

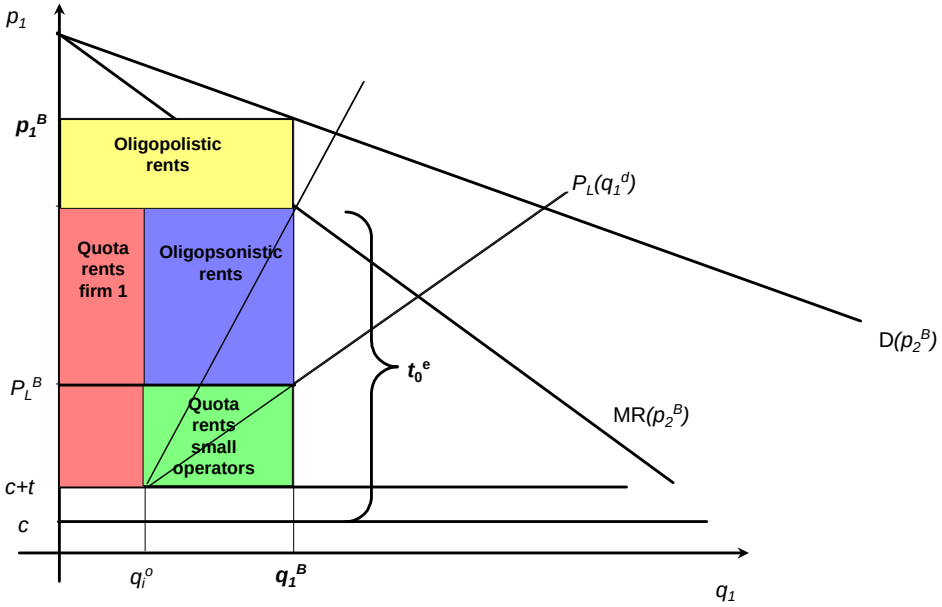

Figure 4: The critical tariff as a function of the degree of brand differentiation

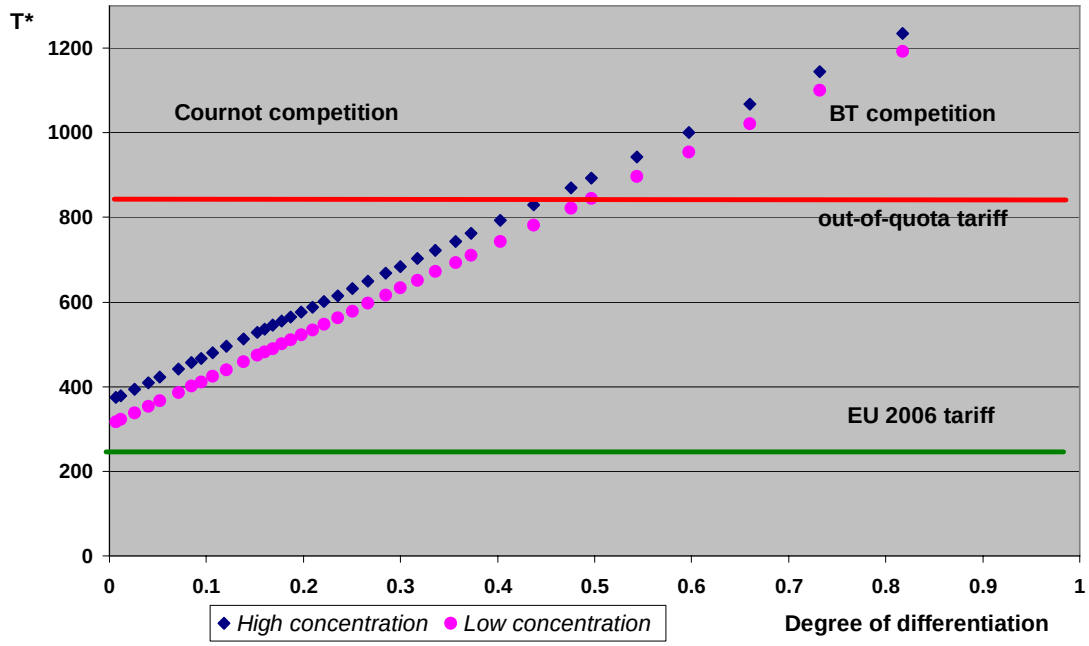

Table 1. Input data *(US $ /t, tons)*

Wholesale price	1800
Quantity imported by the firm	875,773
Degree of brand differentiation	
high differentiation	0.01
low differentiation	0.03
Price of the licence	150
Licences allocation	
high concentration	270,000
low concentration	450,000
Licences supply elasticity	6
Out-of-quota tariff	846
In-quota tariff	93
Trading costs	500

Table 2: Price, quantity and rents under the TRQ *(US $ /t, tons)*

	Low concentration of licences		High concentration of licences	
	High brand differentiation	**Low brand differentiation**	**High brand differentiation**	**Low brand differentiation**
Critical tariff (T*)	***317***	***337***	***374***	***394***
Cournot price (p^c)	1,870	1,873	1,900	1,903
Cournot quantity (q^c)	825,247	827,047	803,852	806,349
Quota rent trader	217	217	274	274
Oligopolistic rent	1060	1062	1033	1036
Oligopsonistic rent	67	67	124	124
% difference between observed and predicted values				
price	*3.9*	*4.0*	*5.5*	*5.7*
quantity	*-5.8*	*-5.6*	*-8.2*	*-7.9*

Table 3: The impact of tariffication *(US $ /t, tons)*

	Low concentration of licences		High concentration of licences	
	High brand differentiation	**Low brand differentiation**	**High brand differentiation**	**Low brand differentiation**
$p^B(176)$	1,820	1,809	1,820	1,809
$q^B(176)$	861,207	869,500	861,207	869,500
% changes with respect to the TRQ				
price	-2.7	-3.4	-4.2	-4.9
quantity	4.4	5.1	7.1	7.8
consumers welfare	4.4	5.1	7.1	7.8
taxpayers welfare	123	147	151	153
firm profits	1.8	0.6	1.1	0.4
total welfare	4.4	5.1	7.1	7.8
$p^B(T^*)$	1,870	1,873	1,900	1,903
$q^B(T^*)$	825,247	827,047	803,852	806,349
% changes with respect to the TRQ				
price	-	-	-	-
quantity	-	-	-	-
consumers welfare	-	-	-	-
taxpayers welfare	240	298	341	365
firm profits	-6.5	-9.0	-11.9	-13.6
total welfare	0.006	0.007	0.009	0.010