INTER-TEMPORAL PRICE DISCRIMINATION WHEN IMPORTS ARE RESTRICTED BY QUOTAS

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ABSTRACT:
A dominant firm holding import quota engages in inter-temporal price discrimination when facing a competitive fringe engaged in seasonal production. This causes a welfare loss that comes in addition to the loss attributable to limitation of imports below the free trade level.

JEL CLASSIFICATION: F12, F13.

KEYWORDS: quota, monopoly, inter-temporal discrimination.

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INTRODUCTION

An Ecuadorean official once remarked that in his country people who hold the lion’s share of the import quota to some agricultural products have a propensity to saturate the market with “excessive amounts” of foreign products precisely at the time when home-based growers harvest the domestically grown substitute. Whereas the foreign import can be purchased at any time of the year, the domestic substitute — a seasonal product — is offered only at harvest time. This is because the product is perishable, and adequate storage is either lacking or too costly. The official also noted that the Ecuadorean government often grants the entire import quota to a single individual, or to a very small group of persons.

The present paper rationalizes the behavior described by the official. It explains in what sense imports can be said to be excessive at some times, and insufficient at others. It shows that a sole importer chooses a time path of quota utilization that generates seasonal oscillations in the price. These oscillations occur when home-based suppliers offer the domestic substitute during a portion of the time during which the quota can be used. This suggests that the model developed in the paper is relevant primarily to markets of unprocessed agricultural products. However, seasonality of home production is not sufficient to generate fluctuations of the product price. It is also important for the importer to hold market power.

The paper shows that the importer’s lopsided time pattern of quota utilization lowers the price of the domestic substitute, bringing about a decline in production by home firms. Although the quota is fully used, the total quantity of product available for consumption, and overall welfare are lower than they would be if prices did not fluctuate.

The effects of quantitative import restrictions under conditions of imperfect competition have already received a good deal of attention in the literature. A well-known result is that an import quota causes a larger welfare loss than a tariff which admits an equal volume of imports when domestic production is carried out by a single firm, or by a small number of firms. One reason is that a quota, unlike a tariff, does not set a ceiling on the domestic price. A second reason is that a quota may facilitate collusion among oligopolists. A further cause is that firms endowed with monopoly power are less likely than firms in competitive environments to fully utilize the quota.

1 The remark was made during a working session with one of the authors that addressed problems caused by lack of competition in the local economy.
2 In fact there are many instances where governments grant import licenses of a product to a single firm. For example, until recently the right to import wheat, wheat flour, rice, sugar, garlic and soybeans was held by a single firm in Indonesia. (See Statement by A. Schumacher at http://www.fas.usda.gov/info/speeches/CT021298.html).
3 See Bhagwati (1965, 1968) for the case of domestic monopoly and Shibata (1968) for a foreign monopoly.
4 Harris (1985) and Krishna (1992). Some models of quota-restricted trade under imperfect competition are reviewed in Bowen et al. (1998).
5 In fact, a monopoly may purchase more quota that it actually uses. See Hillman et al. (1980).
While the older literature draws on one-period models, the more recent writings favor multi-period settings. They do this because they focus on the time pattern of quota utilization, in particular on the response of quota holders to foreseeable and random shocks in the demand for imports. These shocks affect quota prices and determine the rate of utilization of quota stocks. The bulk of recent writings assumes that quota holders operate in competitive environments. This means that they react to changes in quota and product prices but cannot influence them. In this paper, by contrast, manipulation of the price by the quota holder is key.

One paper which assumes an imperfectly competitive setting is Miyagawa and Ohno (2001). It looks at a market served by a single domestic producer and a single quota-constrained importer. Miyagawa and Ohno show that when future profits are not discounted too heavily, imports grow over time in spite of the fact that consumer demand is stationary. Because quota is used fully in the year it is issued, importing a given amount in the first part of the year, commits the importer to import the quota residual in the second part of the year. This means that the importer is a Stackelberg leader during the second part of the year and it explains why he imports more in that period than in the period before. The effect is somewhat akin to a market sharing arrangement between the importer and the local firm.

The focus in this paper is entirely different because the possibility of collusion between local producers and the importer is ruled out. The importer is assumed to be a leader regardless of the time pattern of imports.

Although this paper looks at the dynamics of quota utilization, it does so within the context of a parsimoniously specified static model. The goal is to capture in the simplest framework the basic tradeoffs faced by an importer who behaves in a manner described by the Ecuadorian official. The static model developed in this paper is sufficient to clarify why prices are cyclical, and to explain how the price oscillations affect welfare.

Section 1 explains the notation and sets out basic assumptions. It characterizes the pattern of quota utilization when the import sector has no market power. This pattern serves as a benchmark for comparison with the pattern chosen by a monopolistic importer. The second section gives formal meaning to the expression “excessive imports”. It explains why the pattern of quota use chosen by a monopolistic importer generates less welfare than a pattern that would emerge if the same amount of total quota were shared by a great many importers. A graphical illustration in the third section provides additional intuition. A final section summarizes the main findings, examines the robustness of results to changes in the basic set-up, and addresses some policy issues. It briefly

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7 To keep the model simple the paper does not consider the possibility of incomplete quota utilization. It simply assumes that the quota is sufficiently restrictive to rule out such outcome.
addresses the question whether the existence of fluctuations in price hinges on the hypothesis that quota holders do not pay for import licenses.

1. The Model

Notation and basic assumptions

There is a production-consumption cycle that has two periods or seasons, labeled 1 and 2. Consumer demand for the product - assumed to be homogeneous - is met through imports and domestic supply. There is a single importer and a competitive fringe of local producers. While imports can enter the country in seasons 1 and 2, the local product is harvested only in season 1. Consumer demand is the same in both seasons.

Neither producers nor consumers can store the good from one season to the other. For that reason the quantity consumed in season 1 equals domestic supply - denoted $S$ - plus imports during that season. The quantity consumed in season 2 equals the volume of imports during that season. Imports in seasons 1 and 2 are denoted $q_1$ and $q_2$ respectively. For simplicity, and without loss of generality, it is assumed that the international price of the imported product is zero.

Because storage is impossible, domestic supply responds only to the price prevailing in season 1. Therefore the inverse demands in seasons 1 and 2 can be written

\[
\begin{align*}
p_1 &= D[S(p_1) + q_1] \quad (1) \\
p_2 &= D[q_2] \quad (2)
\end{align*}
\]

where $p_i$ denotes the price prevailing in season $i$, $[i=\{1, 2\}]$. It is assumed that $D'(p_i) < 0$, and $S'(p_1) > 0$ for all $p_i \geq 0$.

The sum of imports in seasons 1 and 2 - called cumulative imports - is limited by the quota $Q$. That quota is sufficiently restrictive to ensure that

\[
q_1 + q_2 = Q \quad (3)
\]

in equilibrium, and that prices in each season are positive. Finally, it is assumed that the importer acts as a dominant firm in the sense of being a first mover.

The welfare maximizing time path of imports

Conditions (1)-(3) imply that the optimal allocation of imports across seasons - denoted $(q_1^*, q_2^*)$ - satisfies
\[ p^* = D[S(p^*) + q_1^*] = D[q_2^*] \]  

subject to condition (3). This allocation of quota is optimal because it insures that the marginal unit of imports yields the same utility in each season.

Because consumer demand is the same in both seasons, (4) entails

\[ S(p^*) + q_1^* = q_2^* \]  

As the quota is effective, and \( S'(p_i) > 0 \) for all \( p_i \geq 0 \), (5) implies \( q_1^* < q_2^* \).

The allocation \((q_1^*, q_2^*)\) is obtained when importers are price takers. Any other allocation creates a gap in product price across seasons. Such a gap cannot exist in equilibrium when importers are price takers. The reason is that an importer who procures foreign product in the season when price is lower could increase his profits by shifting purchases from that season to the season when price is higher.

**The time path of imports chosen by a sole importer**

Denote by \( q_i^d \) and \( p_i^d \) the import volume and product price in season \( i, \{i\in\{1,2\}\} \) that maximize the profits of the sole importer. In season 2 the importer faces a demand equal to consumer demand. In season 1 he faces a residual demand obtained by subtracting the supply of local firms from consumer demand.

Because the importer has market power, he allocates total imports across seasons so as to equalize marginal revenue from imports in season 2—denoted \( MR_2 \) to marginal revenue in season 1—denoted \( MR_1 \). Specifically, the importer chooses the quantities \( q_1^d \) and \( q_2^d \) that satisfy condition (6) below

\[ MR_1(q_1^d) = D[S(p_1^d) + q_1^d] + \frac{q_2^d}{1-D[S(p_1^d) + q_1^d]} \frac{D[S(p_1^d) + q_1^d]}{S(p_1^d)} = D[q_2^d] + q_2^d D[q_2^d] = MR_2(q_2^d) \]  

where \( q_1^d + q_2^d = Q \) and, \( p_1^d = D[S(p_1^d) + q_1^d] \).  

\[ ^1 \text{Condition (6) is obtained from maximization of } p_i q_i + p_i q_2. \text{ Recall that for the importer profit equals revenue as the price of imported product is zero. To see that the left hand side of (6) equals } MR_1 \text{ note that the importer's total revenue in season 1 is } p_1 q_1^d, \text{ and therefore } MR_1(q_1^d) = p_1 q_1^d + q_1^d (dp_1^d/dq_1^d). \text{ But, (1) entails } dp_1^d = D[S(p_1^d) + q_1^d] [S(p_1^d) dp_1^d + dq_1^d] \text{ yielding } (dp_1^d/dq_1^d) = D[S(p_1^d) + q_1^d] / (1-D[S(p_1^d) + q_1^d] S(p_1^d)). \]
In order to establish that the monopolistic importer sells more in season 1 than is optimal, it is sufficient to show that $MR_i(q_1^*) > MR_2(q_2^*)$ for the welfare maximizing allocation $(q_1^*, q_2^*)$. As long as marginal revenue is downward sloping, such showing proves $q_1^* > q_1^*$, and consequently, $q_2^* < q_2^*$.9

To prove that condition (7) below holds

$$MR(q_1^*) = D \left[ S(p^*) + q_1^* \right] + \frac{q_1^* D}{1-D} \left[ S(p^*) + q_1^* S'(p^*) \right] > D \left[ q_2^* \right] + q_2^* D \left[ q_2^* \right] = MR_2(2^*)$$

(7)

it is sufficient by virtue of (4), to establish that the second term on the left-hand-side is smaller in absolute value than the second term of the right-hand side. The latter clearly follows from $q_1^* < q_2^*$, (5), and $(1-D'S') > 1$.

2. PRICES AND WELFARE

Because a dominant importer sells a larger quantity in season 1 than a competitive import sector, and because storage is ruled out, the price that prevails in that season is lower than the price that would have prevailed under the efficient quota utilization given by (4). Accordingly, the price in season 2 is higher. Specifically, $p_1^* < p_2^* = p_2^* < p_2^*$.10

Because the supply by home firms is upward sloping, domestic output is lower when there is a single importer than when there are many importers. Because the total volume of imports is fixed by the quota, cumulative consumption is lower than under uniform pricing.

One notes that the importer acts in a way akin to a firm engaging in third degree price discrimination. Under conventional third degree price discrimination by a monopolist, welfare may be lower or higher than under uniform pricing. The latter occurs when discrimination brings about an increase in total output that is sufficient to make up for the welfare loss attributable to the price gap across markets.11 This possibility does not exist here. In fact, the reduction in production by home-based producers adds to the welfare losses that result from the price gap across seasons.

3. A GRAPHICAL ILLUSTRATION

Figure 1 displays the consumer demands for each season. Panel 1 also displays the supply of the fringe of home firms, the residual demand faced by the importer in season 1, and the marginal revenue associated with that residual demand.

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9 Profit maximization requires that the importer increase imports in season 1 and reduce imports in season 2 when marginal revenue in season 1 exceeds marginal revenue in season 2. The assumption that marginal revenue is downward sloping is standard in applied work. However, some functional forms can generate a locally upward-sloping marginal revenue function. See Seade (1980).

10 However, this does not imply that imports are larger in season 1 than in season 2.

Figure 1. Quota Allocation across Seasons

The import quota is represented by the distance between points E and Z which is equal to the distance between points F and G.

The efficient allocation of quota requires prices be the same in the two periods. This is attained by importing in season 1 an amount represented by ZH and importing in season 2 a quantity represented by HE. The common price in both periods is then p. This is the price that would emerge if the quota were held by a competitive importing industry.

When the quota is held by a single firm, imports are allocated in a way that equalizes derived marginal revenue in season 1 and marginal revenue in season 2. Import volumes are given by GT and TF in seasons 1 and 2 respectively. Corresponding prices are p1 and p2.

Compared to uniform pricing, there is a loss in consumer surplus in period 2 represented by the area RSHE, and a gain in period 1 shown by the area H MINK. Home-based producers suffer a loss in surplus represented by the area HBVK.

Inter-temporal price discrimination increases the value of the quota by the area SRHU minus the area HJI K. By construction, the latter area is as large as the area VYXN. Therefore, the total welfare loss due to discrimination is represented by the sum of the areas YBV+(MXN+SEU). The first term of this sum represents the loss in welfare due to lower production; the second term represents the loss attributable to the misallocation of consumption.

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12 By construction, ZH=BM.
4. Final Remarks

The paper has shown that when local production is seasonal, and storage unavailable, ownership of the entire stock of import licenses by a single firm gives rise to a time path of quota utilization that generates price cycles. Home production and welfare are lower than they would have been if the product price had remained constant across seasons. This would have occurred if the quota were held by a great number of importers.

The lower welfare is due to the fact that total consumption is lower and is not allocated optimally across seasons when there is a single importer.

The analysis has built on a number of simplifying assumptions. These were made in order to rationalize the type of behavior described by an Ecuadorian official within a very simple framework. However, the basic results do not hinge on these assumptions.

For example, the model assumed that the importer maximizes the sum of profits earned in seasons 1 and 2. It assigned the same weight to profits earned in both seasons. Discounting of profits in the "future" season would dampen or amplify the oscillation of prices depending on whether quota is issued at the beginning of season 1 or at the beginning of season 2. If quota were issued at the beginning of season 1, the importer would sell a somewhat larger quantity during that season than in the absence of discounting. The importer would equalize marginal revenue from imports in season 1 to discounted marginal revenue from imports in season 2. This would increase the amplitude of oscillations in the product price. Conversely, discounting would dampen the oscillations if the importer acquired the quota at beginning of season 2.

Another assumption has been that demands in the two seasons are independent. While this appears to be a rather weak assumption, it is interesting nevertheless to ponder if allowing interdependence while maintaining symmetry of demands across seasons affects the basic result. To see that it does not, consider the following thought experiment. Start with a competitive fringe of importers, and then bring all imports under the umbrella of a single firm. As long as importers remain competitive, quota is utilized to equalize product prices across seasons. Because of symmetry of demands the quantities consumed are the same in the two seasons. As soon as a single firm becomes the sole importer it seeks to equalize marginal revenue from imports across seasons. This condition cannot hold if imported quantities in each season remain as before. The reason is that part of the quantity consumed in season 1 is accounted for by domestic producers. This means that whenever the quantities consumed are the same in the two seasons, marginal revenue must be closer to price in season 1 than in season 2. Therefore, the transition from a competitive import sector to a monopolistic import sector increases imports in season 1 at the expense of imports in season 2. The latter gives rise to oscillations in price across seasons.

\[\text{Footnotes:~}
\]
\[13\text{To see why, simply think of discounting as a downward shift of the consumer demand in the next season.~}
\[14\text{As indicated in the paper, a different utilization entails less than full exploitation of profit opportunities.~}
\]
One should also note that the oscillation of prices does not hinge on the assumption that there is a single importer. Prices would fluctuate if quota were held by a small group of importers. What is called for, is a gap between product price and “perceived” marginal revenue of the individual importer. The size of that gap depends on the share of sales accounted for by the individual importer.\textsuperscript{15}

A lesson relevant for public policy is that a government that restricts imports to protect local production does better in terms of that objective when it allocates quota to several firms rather than to a single firm. A possible alternative is to issue import licenses valid for a specific season, and issue them in quantities that guarantee price stability. A priori though, this option appears less attractive as informational requirements are quite stringent.

A government that sells quota could possibly earn more by selling the entire quota as single package than by carving it up in smaller lots and auctioning the lots one by one. The reason is that quota is at least as valuable to a sole owner as to multiple owners.

When quota is carved up into smaller lots it will likely be purchased by different persons. To see why, consider the bidding for the last lot offered for sale, and assume that all previous lots have been acquired by a single firm. The maximum amount that this firm would be willing to pay for the last lot equals the contribution that this lot makes to its revenue, i.e. marginal revenue. By contrast, the maximum amount an outsider would be willing to pay equals the price of the product that prevails during the period where no production takes place. Because price in that period exceeds marginal revenue, an outsider will outbid the firm that has acquired the intra-marginal units of quota. The same reasoning applies to the second-to-the-last lot, the third-to-the-last lot, etc. The implication is that the welfare losses shown in the paper hinge crucially on quota being given freely to a small number of importers or, being auctioned in large lot sizes.

Whether the amount earned from selling a single package brings in a larger sum than the sale of smaller lots also depends on the intensity of competition among bidders for the entire quota, compared to the competition for smaller lots. There may be less competition for the entire quota if outside financing of quota acquisition is unavailable, or if it is provided at non-competitive rates.

However, the existence of price oscillations does not hinge on whether the quota is sold or given for free. At the time imports take place, any payment to acquire quota is already sunk. It is therefore irrelevant to the choice of an import-path.

\textsuperscript{15}As the number of importers increases, that gap becomes smaller and smaller. It vanishes when the number of quota holders becomes very large. This is why the price remains stable across seasons when there are a great number of importers.
REFERENCES


