Proportional Import Restraints in Oligopoly

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Abstract

We study the differences in the impact of trade restrictions on the level of imports (e.g. 200,000 automobiles per year) and restrictions defined in terms of market shares (e.g. 10% of the market). We argue that if domestic firms enjoy some market power proportional trade restrictions have a stronger anticompetitive effect than volume restrictions, and therefore lead to higher equilibrium prices and lower social welfare. In the case of Cournot competition and constant marginal costs, with proportional import restraints the equilibrium price sticks to the autarchic level, independently of the market share reserved for foreign firms. As a consequence, enlarging the share of imports does not increase consumers surplus and negatively affects the profits of domestic firms, thus lowering social welfare.

Keywords: International Trade, Oligopoly, Import Quotas, VER.

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1 Introduction

As successive rounds of GATT negotiations led to a considerable reduction in the world average tariff level, countries have increasingly resorted to non-tariff barriers to protect domestic industries, setting quotas or negotiating voluntary export restraints (VERs). This has caused some concern since import restraints have poorer performances than tariffs on welfare grounds.

This paper argues that reasons for concern may be even stronger than previously thought if one takes into account a relatively neglected aspect of trade policy in oligopolistic industries, namely that import restrictions are often defined in terms of market shares (e.g. 10% of the market) instead of being defined on the level of imports (e.g. 200,000 automobiles per year) as is usually assumed in the theoretical literature. We show that market-share restraints have a strong anticompetitive effect and lead to higher welfare losses than restraints defined on the level of imports.

In a sample of 289 VERs, Kosteki (1991) found that 25% of the restraints were explicitly set in terms of market share[1]. Prominent examples are the Japanese VER in the European car market until 1992 and the 1986 US-Japan agreement on semiconductors. In 1976, the British Carmakers Association and its Japanese counterpart agreed to limit the market share of Japanese cars in the British market to 11%. One year later, the President of France Giscard D'Estaign publicly announced that France would not tolerate a Japanese share exceeding 3% of the French market. Subsequently, similar restrictions were set in Spain (1%) and Portugal (14%). In 1981, Japan agreed with Germany not to raise its share of the German market by more than 1% per year[2]. As for semiconductors, in 1986 US and Japan agreed that

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[1] About 50% of the VERs surveyed by Kosteki were defined in terms of volume. Other VERs were defined in terms of increase of market shares or of volume.

[2] More precisely, the market share of Japanese firms was allowed to increase by a factor of 1.1 per year, starting from a level around 10% in 1981. De Melo and Messerlin (1988) assert that the French quota was not binding before 1984 and the German quota was never strictly binding. This claim, however, is questionable. According to their figures, the Japanese share in the French market was 2.9% already in 1980 and again in 1982. The Japanese share in the German market has actually been increasing by about 1% per year since 1982.

a 20% share of the Japanese chips market should be reserved for American exports.

Even when a quota or a VER is formally defined in terms of volume of imports, this may be due essentially to administrative reasons. In fact, it is often the case that restrictions on the volume of imports are set with an explicit market-share target in mind. As a consequence, import quotas are calibrated so as to achieve that target. If it is agreed that imports should be 10% of the total domestic demand then the quota can be periodically revised to obtain that objective.

For instance, in the Fall of 1983 the Reagan administration committed to negotiate Voluntary Restraint Agreements with major suppliers of imported steel so as to limit their sales to approximately 18,5% of the US market (this was roughly the average share of steel imports over the period 1979-1983). The negotiations were successfully completed by the end of 1984 and the new VRAs took effect, retroactively, on October 1st, 1984[3]. The 1991 EEC-Japan agreement on car imports after 1992 explicitly states that changes in market conditions would require revisions of import limits (see Section 5 for more details). As we shall show below, when restraints are formally defined in terms of volume but are periodically revised to achieve a target market share, they are essentially equivalent to restraints directly defined in terms of market shares.

We shall call "share restraint", or "proportional restraint", a trade restriction which fixes a given market share instead of a given volume of imports. The latter will be called "volume", or "level" restraint.

In a perfectly competitive market, it is easily seen that proportional restraints are equivalent to level restraints (which in turns are equivalent to a tariff). This equivalence breaks down, however, when domestic firms enjoy some market power. Generally speaking, a proportional import restraint (either voluntary or set by the government) induces domestic firms to behave less aggressively. This has several consequences. First, relaxing a proportional import restraint (namely, increasing the market share reserved for imports) may have paradoxical implications on domestic price and welfare. Second, fixing a proportional restraint at the level corresponding to the free trade equilibrium is not immaterial; in fact, it has restrictive effects. Third,

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[3]See McKinney and Rowley (1989) for further details. The quotas were changed by the Bush administration but they have not been strictly binding since 1987.

comparing a proportional import restraint to an equivalent (i.e., leading to the same volume of imports) level restraint, one sees that the industry equilibrium becomes more collusive. This benefits foreign firms and may also benefit domestic firms, while harming domestic consumers; social welfare is also reduced.

We prove these results within a model of a homogeneous market with Cournot competition. Our results are most clear in the case where domestic firms have constant marginal costs (not necessarily the same for all firms). In such a setting, we show that under a proportional import restraint, total domestic consumption and price are the same as under autarchy and are independent of the market share reserved for imports. This conclusion hinges on the particular way in which domestic firms react to a share quota, which implies that imports crowd out domestic output on a one-to-one basis.

The anticompetitive effect of proportional import restraints was first noticed by Sweeney et al. (1977)[4]. They considered a domestic monopoly and showed that, independently of the shape of the cost curve, a quantity quota entails a higher output level, and hence a lower welfare loss, than a share quota.

It is interesting how Sweeney et al.(1977) justify the assumption of a share quota. They assume a target ratio of imports to domestic production in a one-period model: the distinction between share and level quota is drawn according to whether the quota is perceived by the domestic monopoly as fixed or dependent on its production. Thus a share quota is described as a sort of Stackelberg leadership by the domestic monopoly that perceives the objective of the government and takes it into account when making its choice[5].

Taken literally, this argument requires that the government fixes the quota after observing the domestic output level. This is an extreme assumption.

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[4]This effect was later noted by Smith and Venables (1991) in a model of the European car market with Cournot competition and product differentiation. That proportional restraints facilitate collusive behavior is indeed quite intuitive. Kosteki (1991), having noticed that most market sharing VERs are adopted by Japanese companies (and to a lower extent by companies from South-Korea and Taiwan), suggests that this could be connected to the Japanese cultural trait of avoiding confrontation by means of self-initiated compromise.

[5]A corollary of this observation is the equivalence of tariffs and quotas when the domestic monopoly acts as a "Stackelberg leader" and knows the government's objective.

We relax it showing that if each time period the government revises myopically a level restraint to achieve a target share of imports out of domestic consumption, in the ensuing stationary equilibrium domestic firms behave as if they faced a proportional restraint provided the discount rate is sufficiently low. A low discount rate essentially means that the level restraint is revised frequently. The assumption of Stackelberg leadership by the domestic firms corresponds to the limit case of infinitely frequent adjustments.

The rest of the paper is organized as follows. In Section 2 we study the effects of proportional import restraints . We show that the effect on total domestic consumption and price depends on the shape of the marginal cost curves. Specifically, total domestic consumption increases, decreases, or remains constant, according to whether marginal costs are increasing, decreasing or constant. In Section 3 we specialize our analysis assuming that all firms (domestic and foreign) are symmetric and we study the consequences of imposing a proportional restraint that reflects the market share of foreign firms at the free trade equilibrium. Surprisingly, it turns out that this manoeuvre is not neutral but has a restrictive effect which harms consumers but benefits domestic and foreign firms. In Section 4 we compare the effects of proportional and volume restraints that lead to the same level of imports [6]. We show that proportional import restraints have a stronger anticompetitive effect, independently of the shape of marginal costs. In Section 5 we show that level restraints actually may be assimilated to proportional restraints if they are periodically adjusted so as to achieve a given objective in terms of market shares, provided the frequency of adjustments is sufficiently high. Section 6 concludes the paper.

2 Output and Welfare Effects of Proportional Import Restraints

In this Section we study the effects of proportional import restraints on domestic price, consumption, and social welfare performing a comparative statics analysis with respect to the market share reserved for foreign firms,

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[6]This kind of comparison is slightly different from the one performed by Sweeney et al. (1977) for the case of monopoly: they mantained constant the ratio of imports to domestic output.

denoted by s.

We consider a market for a homogeneous product with demand function $P(Y)$, where P is price and Y domestic consumption (namely domestic output Q plus imports)[7]. We assume that the demand function is continuous and twice piecewise differentiable. There are n domestic firms which engage in quantity competition. We do not model explicitly the behavior of foreign firms but we simply assume that the import restraint is binding. The cost function of firm i is denoted $C_i(y_i)$ and is assumed to be twice differentiable with $C_i'(y_i)$ denoting marginal costs. Throughout the paper the Hahn-Novsheck stability condition

$$nP'(Y) + P''(Y)Y - \sum_{i=1}^{n} C_i''(y_i) < 0. \tag{1}$$

is assumed to hold. We also assume that the S.O.C.s are satisfied.

We first analyze the effects of a proportional import restraint on domestic consumption and price. To fix ideas, assume that the market share reserved for imports, s, increases. One is then tempted to conclude that total domestic consumption must increase. Indeed, under a volume restraint total domestic consumption would increase and price would decrease if the restraint were relaxed. This follows directly from the Hahn-Novsheck stability condition that says that an increase in the output of any firm cannot reduce the aggregate output of all the other firms by a greater amount[8].

Things are different however under a proportional restraint. Here an increase in imports may crowd out domestic production on a one-to-one basis—as turns out to be the case with constant marginal costs—or even more. As Proposition 1 below shows, what happens depends ultimately on the shape of the marginal cost curves. For simplicity we make a weak symmetry hypothesis assuming that $C_i''(y_i)$ has the same sign for all domestic firms i.

Proposition 1. *Under a proportional import restraint, when the market share reserved for foreign firms increases, domestic consumption in-*

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[7]We assume for simplicity that domestic firms do not export. However this assumption is innocuous in the case of constant marginal costs.

[8]With Cournotian competition, imports limited by volume restraints may be assimilated to the output of an additional (i.e. $n+1$-th) firm.

creases, decreases, or remains constant according to whether marginal costs of domestic firms are increasing, decreasing, or constant respectively.

Proof. Notice first of all that under a proportional restraint,

$$Q = (1 - s)Y \tag{2}$$

where $Q = \sum_{i=1}^{n} y_i$ and therefore

$$\frac{\partial Y}{\partial y_i} = \frac{1}{1 - s}. \tag{3}$$

The F.O.C.s of the domestic firms are then:

$$P(Y) + \frac{1}{1 - s}P'(Y)y_i - C_i'(y_i) = 0. \tag{4}$$

Summing across the n domestic firms one gets

$$nP(Y) + \frac{1}{1 - s}P'(Y)Q - \sum_{i=1}^{n} C_i'(y_i) = 0. \tag{5}$$

Now, suppose that an increase in s causes a decrease in domestic output Q in such a way that domestic consumption Y remains constant. This implies that the first two terms on the L.H.S. of (2.5) do not change. If marginal costs are constant the third term also does not change and therefore at the Cournot equilibrium domestic consumption Y is unchanged. If marginal costs are increasing, the third term is decreased[9]; to restore the equilibrium then the y_is must increase (by the S.O.C.), implying that domestic consumption increases with s. By a symmetric argument it follows that if marginal costs are decreasing then domestic consumption decreases as the market share s reserved for imports increases. ∎

Proposition 1 shows a paradoxical implication of proportional import restraints: relaxing the restraint may actually harm consumers *via* a reduction in domestic consumption and a corresponding increase in price. Though this is what happens with decreasing marginal costs, to understand the source

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[9]Recall that the Hahn-Novsheck stability condition for a Cournot equilibrium implies that an industry shock, here a change in s, affects the output of all firms in the same direction. Thus the output of all the n domestic firms must decrease.

of this paradox it is useful to consider the case where domestic firms have constant marginal costs, not necessarily the same for all firms. In this case domestic consumption and price do not depend on s; the reason being that neither the sum of the marginal revenue curves perceived by domestic firms, nor the sum of marginal costs depend on s. With variable marginal costs the direction of the change in output is completely driven by the shape of the marginal cost curves as the sum of the marginal revenue curves is again unaffected.

In the case of constant marginal costs Proposition 1 says that total domestic consumption Y sticks to the autarchy level and is independent of s. To get an intuition of this striking result notice that a change in s may be assimilated to a change in the tax rate on profits and has therefore the same effects (namely, transferring profits from taxed firms to the government – here to foreign firms). Consider for instance the case of a domestic monopoly with constant marginal cost c. Its profit function under a proportional import restraint is

$$\pi = QP(\frac{Q}{1-s}) - cQ = (1-s)[YP(Y) - cY]$$

where the term inside square brackets is just the profit function of a domestic monopoly under autarchy. The case of a domestic oligopoly is only slightly more complex. Summing across firms and exploiting (2.2) it can be easily shown that aggregate industry profits are again given by $(1-s)[YP(Y)-cY]$, where c now denotes the industry average unit cost. The equivalence with a proportional tax on profits follows by noting that a change in s causes an equiproportional change in the output of all the domestic firms so that the share of each individual firm out of aggregate industry profits is constant and is independent of s[10].

The following corollaries of Proposition 1 are immediate.

Corollary 1. *When s increases, consumers' surplus decreases with decreasing marginal costs, increases with increasing marginal costs, and remains constant under constant marginal costs.*

Corollary 2. *The profits of all domestic firms decrease as s increases.*

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[10]Since the distribution of output across firms is independent of s, it follows that also the industry average unit cost is independent of s.

Proof. This follows noticing that an increase in s is equivalent to a negative proportional shock on demand. ■

From the above corollaries, the welfare effect of an increase in the level of s is immediate for the cases of constant or decreasing marginal costs if we define domestic social welfare as the sum of domestic profits and consumers' surplus. This is appropriate in the case of a VER or in the case of an import quota if the domestic government grants the import licenses to foreign agents for free. If instead the domestic government sells the import licenses, the corresponding revenue must be included in the welfare calculation. This may change the results.

For instance, in the case of constant marginal costs total welfare is unchanged with s if the government sells efficiently import licenses extracting all the quota rents provided that the average unit cost of domestic firms is equal to that of foreign firms[11]. Social welfare may increase when foreign firms have on average a lower marginal cost as a shift of production from domestic to foreign firms in this case improves production efficiency.

The case of increasing marginal costs is less immediate. Domestic welfare, i.e. the sum of domestic profits and of consumers surplus, is affected in two opposite directions by an increase in s as the first term decreases and the second increases, so that little can be said in general. A more definite result can be obtained if we assume that foreign firms have lower marginal costs on average and the domestic government captures all the quota rents through optimal auctions of import licences. Under these assumptions total social welfare (which would include the revenues from the auctions) unambiguously increases with s.

Summarizing, our results show that the usual policy prescriptions of trade liberalization may have perverse effects when restrictions are proportional and the concerned industry is an oligopoly. This conclusion may seem surprising since it is well known that free trade dominates autarchy and one may expect that increasing s from zero (autarchy) to the level corresponding to the free trade Cournot equilibrium must sooner or later lead to an increase in social welfare. This argument however is unwarranted: if one fixes a proportional restraint s at the level corresponding to the Cournot free trade equilibrium, this would alter the nature of competition and lead to a reduction in total domestic consumption. Indeed it may be impossible

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[11] Recall that the industry average unit cost is independent of s.

to reproduce the free trade equilibrium for any s, as it is immediate for instance in the case of constant marginal costs. In the next Section we study in more details what happens when a proportional restraint is fixed at the level corresponding to the free trade equilibrium.

3 A comparison of Proportional Restraints and Free-Trade Equilibrium

Smith and Venables (1991) show that a proportional VER that reflects the market shares of the free trade equilibrium may lead to a welfare reduction and to an increase in the profits of both domestic and foreign firms. They show this by numerical computations within a calibrated model of the European car industry with product differentiation and quantity competition. In this Section we provide a formal proof of the Smith and Venables result for the case of a homogeneous product.

Quite obviously, if the restriction reflecting the free trade equilibrium were defined on the level of imports, then it would leave the equilibrium unaffected[12]. With a proportional VER however the equilibrium changes because domestic firms perceive that foreign firms will accommodate any output reduction instead of reacting more aggressively.

In the present Section we assume that there are n domestic and m foreign firms; all firms are symmetric and have the same cost function $C(y)$. Let Y^* denote the free trade domestic consumption and Y^+ that prevailing with a proportional restraint set at the free trade share of imports; a similar notation applies to individual output.

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[12]This contrasts with Harris (1985) and Krishna (1989). Harris considered a duopoly with differentiated products and price competition, showing that if the foreign firm sets a VER corresponding to its equilibrium output level, then the profits of both firms increase. The reason is that the domestic firm's reaction curve shifts upward because it now perceives that the foreign firm will match any decision to increase price given its constraint not to sell more than a fixed amount. Harris' argument clearly relies on there being price competition. If competition were in quantities, then one can immediately see that fixing a level VER at the free trade equilibrium output level of the foreign firms does not alter the behavior of the domestic firms and hence the industry equilibrium. See also Krishna (1989). Generally speaking, a trade restriction which reflects the free trade equilibrium may alter the firms' behavior if it is defined in terms of a variable different from the firms' strategic variable (quantity with Bertrand competition, market share with Cournot competition, etc.).

Proposition 2. *Under the hypothesis of symmetry, when foreign firms commit to a share of the domestic market equal to their free trade market share, namely $s = m/(n + m)$, total domestic consumption decreases, price increases and the profits of both domestic and foreign firms increase with respect to the free trade equilibrium.*

Proof. Consider first the effect on domestic consumption. In the free trade equilibrium by symmetry we have:

$$(n + m)P(Y^*) + Y^* P'(Y^*) - (n + m)C'(y^*) = 0$$

whereas under a proportional restraint summing the F.O.C.s across the domestic firms we get:

$$nP(Y) + \frac{Q}{1 - s}P'(Y) - nC'(y) = 0.$$

Evaluating the R.H.S. of () at Y^* and y^* we obtain

$$nP(Y^*) + Y^* P'(Y^*) - nC'(y^*) = m[C'(y^*) - P(Y^*)] < 0.$$

Thus if we evaluate marginal costs and marginal revenues of the domestic firms at the free trade level of output we find that marginal cost exceed marginal revenue. By the S.O.C., this implies that $y^+ < y^*$ and therefore $Y^+ < Y^*$. As a consequence, the equilibrium price will be grater under a proportional restraint.

We now turn to the comparison of profits. Let Y_M denote the monopoly output corresponding to the given demand and cost functions[13]. Clearly $Y^* > Y_M$, and the aggregate profits at the free trade are lower than monopoly's profits. Recall also that the stability condition implies that the profit function of a monopoly is quasi-concave in output[14].

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[13]To wit, we consider a monopoly with cost function $(m + n)C(\frac{Y}{m+n})$, that is, it has $(m + n)$ equal plants with individual cost functions $C(y)$.

[14]If $Y^* > Y^+ > Y_M$, we could conclude immediately that aggregate profits are higher under a proportional restraint than under free trade. However, we cannot rule out the case $Y^+ < Y_M$ and therefore we must resort to a more roundabout proof.

Consider first the case of a domestic monopoly, i.e. $n = 1$. Under a proportional restraint set at the level corresponding to the free trade equilibrium, the domestic monopoly could replicate the free trade equilibrium. If it does not, than it must obtain higher profits than at the free trade equilibrium.

If $n > 1$, by the stability condition the equilibrium output under a proportional restraint will be higher than in the case of a domestic monopoly (but, as we have just shown, it will be lower than under free trade). By the quasi-concavity of the profit function, this implies that aggregate industry profits are larger under a proportional VER than at the free-trade equilibrium. When $s = m/(m + n)$, the individual output of foreign and domestic firms is equal. It follows that also individual profits (of both domestic and foreign firms) are larger under a proportional VER[15]. ■

It is also immediate to see that the imposition of a proportional VER reduces social welfare.

Corollary 3. *Under the hypothesis of symmetry, when foreign firms commit to a share of the domestic market equal to their free trade market share, social welfare decreases with respect to the free trade equilibrium.*

Proof. Since at the autarchy equilibrium the price is greater than the marginal cost, any output increase must increase social welfare as long as the price remains larger than marginal cost. Since this is the case at Y^*, lowering output to Y^+ must reduce social welfare. This argument is strengthened if one focuses on domestic social welfare neglecting the profits of foreign firms. We already know that the latter increase with a share VER, and therefore domestic welfare decreases by a still larger amount than total social welfare. ■

4   A Comparison of Proportional and Volume Restraints

In this Section we compare the effects of proportional and volume restraints that lead to the same level of protection. By this we mean that the volume of

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[15]By continuity, foreign firms would still benefit form a VER that fixes a market share slightly lower than $\frac{m}{m+n}$.

output imported must be the same under the two regimes. Thus we compare a volume restriction and a proportional restriction that leads to the same level of imports.

We come back to the hypotheses of Section 2. First we compare domestic consumption and price. As is well known, under a level restraint an increase in the level of allowed imports leads to an increase in total domestic consumption (under the Hahn-Novsheck stability condition). Thus with a level restraint that allows a positive amount of imports domestic consumption will be higher than under autarchy. Proposition 1 instead shows that with constant or decreasing marginal costs domestic output does not increase as s is increased. This means that with non-increasing marginal costs price is lower and domestic consumption is higher under a level restraint than under an equivalent proportional restraint. We now show that this result holds also in the case of increasing marginal costs.

Proposition 3. *For any given level of protection the equilibrium price is higher and the domestic consumption is lower under a proportional restraint than under a level restraint.*

Proof. Note first that $Y = \sum y_i + y_0$, where y_0 is the level of imports; and also that $\sum y_i = (1 - s)Y$, where s is the market share reserved for imports. Under a level restraint the F.O.C.'s are:

$$P(Y) + P'(Y)y_i = C_i'(y_i) \tag{6}$$

whereas under a proportional restraint they are

$$P(Y) + \frac{1}{1-s}P'(Y)y_i = C_i'(y_i) \tag{7}$$

Let y_i^- be the solution to (4.1), and let y_i^+ be the solution to (4.2). We suppose that the level of imports y_0 is to be equal in the two cases. Evaluating (4.2) at y_i^- and Y^- and assuming that the share s is adjusted to lead to the same level of imports y_0, so that total domestic consumption Y will be the same in the two cases (i.e. $Y^- = Y^+$), one sees immediately that the L.H.S. becomes lower than the R.H.S. To restore the equilibrium the output level must decrease (assuming the S.O.C.s hold). This implies that $y_i^+ < y_i^-$. ∎

Proposition 3 implies that consumers' surplus is higher under a level restraint than under an equivalent proportional restraint.

We next compare the two instruments with respect to their effects on the aggregate profits of domestic firms. Generally speaking it is impossible to say whether domestic profits increase or not. The reason is that domestic price is higher under proportional restraint but, as is clear from the proof of Proposition 3, domestic output is lower. In fact, in the simple case of linear demand function and symmetric constant marginal costs domestic profits may be higher or lower under proportional restraints according to the level of protection which is being achieved.

More precisely, if the demand function is $P = a - Y$ and all firms have constant marginal costs c, by standard calculations it turns out that the aggregate profit of domestic firms are higher under a proportional restraint if

$$y_0 < \frac{(n-1)}{n}(a - c). \tag{8}$$

Notice that under domestic monopoly this inequality can never be satisfied. With two domestic firms condition (4.3) says that the level of imports must be less than 50% of the competitive output. Condition (4.3) becomes weaker and weaker as the number of domestic firms increases. This indicates that, at least in the linear demand and constant marginal costs example, a domestic oligopoly is likely to benefit from a proportional restraint more than from an equivalent level restraint[16].

Consider next the foreign firms' profits. The aggregate profit of foreign firms under a level restraint will be lower than under a proportional restraint that leads to the same level of imports[17].

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[16] In the course of the negotiations leading to the EEC-Japan 1991 agreement on car imports, the Association of European Automobile Manufactures criticized a former proposal based on level restraints and called for a division of market growth between European and Japanese producers, a decrease in Japanese volume if the market contracted, and a cap on the Japanese market share (inclusive of transplant production). See Mason (1994).

[17] We are here assuming that the distribution of output across foreign firms does not depend on the type of restraint considered. Thus, since the comparison is performed at a given level of imports, the foreign firms' total costs will be the same under the two instruments.

Corollary 4. *For a given level of imports the aggregate profits of foreign firms are higher under a proportional restraint than under a level restraint.*

Proof. Since by assumption the production level of foreign firms is the same in the two cases they will have the same total costs. But by Proposition 3 price is higher under a proportional restraint. Profits must therefore be higher. ∎

Finally, domestic social welfare is lower under a proportional restraint than under an equivalent level restraint. This result holds both in the case of a VER and in the case of a quota whether the Government sells the import licenses in an efficient way extracting all the quota rents or not.

Corollary 5. *For a given level of protection, domestic social welfare is lower under proportional restraints than under level restraints.*

Proof. Like in the proof of Corollary 3, the result follows from the observation that the ordering of situations according to social welfare is the same as their ordering according to production levels. By Corollary 4, this argument is strengthened if one focuses on domestic social welfare neglecting the profits of foreign firms. ∎

5   Implementing Proportional Import Restraints

The arguments of the previous Sections directly apply to those import restrictions that are explicitly defined in terms of market shares. However, as we argued in the Introduction, it is often the case that quotas or VERs are set in terms of level of imports only for administrative reasons, but are negotiated or established with a market share target in mind.

The Japanese VER in the European car market after 1992 is a case in point. The approval of the EC's Single European Act in 1986 required a renegotiation of the old proportional VERs which had been agreed on national basis, as it obliged Member States of the EEC to remove restrictions on movements of goods within the Community by the end of 1992. Since

various EEC members did not impose quotas, this obligation would have enabled Japanese firms to circumvent national quotas.

The agreement signed on 31 July 1991 provisionally set specific export levels until 1999. These levels, however, were based on market forecasts, and both sides agreed that changes in actual market conditions would require revisions in Japanese export limits so as to keep the share of Japanese car in the European market around 8%[18]. In fact, beginning in the autumn of 1992 and lasting for more than six months, the two sides disagreed over prospects for total EEC car demand, and therefore over allowable limits on Japanese car imports during the first year of the accord's operation[19]. This further clarifies that setting level quotas in this case is just a way to implement a proportional import restraint[20].

On the other hand, the implementation of proportional import restraints always raises similar problems. Recognizing these problems, to justify the share quota hypothesis Sweeney et al. (1977) assume that the Government fixes a level quota after observing the output of domestic firms (acting as a Stackelberg follower)[21]. But this assumption seems rather extreme. A more realistic hypothesis is that a level restraint be periodically revised so as to achieve a target share of imports out of total domestic consumption.

In this Section we analyze a multi-period model which incorporates this assumption and show that, if the interaction between the government and firms is repeated over time, the long run equilibrium tends to the situation arising under a proportional restraint if the discount factor tends to one.

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[18]The agreement also set lower market share for Japanese cars in some countries, namely Spain (5.3%), France (5.3%), Italy (5.3%), Portugal (8.4%) and U.K. (7%). Quite obviously, problems arise to implement these country-specific target shares without violating the spirit -- if not the letter-- of the Single European Act.

[19]For more details on the 1991 EEC-Japan agreement on auto exports see Mason (1994).

[20]Though the Japanese VER for car exports in the U.S. market was less explicit, still the export ceiling fixed at 1.68 million cars for the first year (April 1981 to March 1982) was meant to be raised according to the growth in the U.S. market. Since the market actually did not grow untill 1984, the quota was increased by 10% only for the fourth year. See Feenstra (1985).

[21]A similar assumption is implicit in Harris' analysis. Harris (1985) assumes that the domestic firm perceives that the foreign firm would adjust its price so as to keep with the quota. This implies a form of Stackelberg leadership by the domestic firm. As we argue below for the case of a proportional restraint, this assumption is justified if the "follower" adjusts its choices frequently enough. For a critique of Harris' assumption see Krishna (1989).

The economic interpretation of this result is that if the level restraint is adjusted very frequently, then domestic firms actually perceive the restraint to be proportional. The Sweeney *et al.*'s assumption that the government acts as a Stackelberg follower corresponds to the limit case where the speed of adjustment is infinite.

Consider a multi-stage Cournot game between the n domestic firms, assuming that the government in each stage fixes a level restraint $y_0(t)$ as a constant fraction of the domestic output of the previous period, i.e.

$$y_0(t) = \frac{s}{1-s} \sum_{i=1}^{n} y_i(t-1) \tag{9}$$

Domestic firms maximize the discounted sum of their period profits. With an infinite horizon, the objective function of firm i is

$$\pi_i = \sum_{t=0}^{\infty} \{ P[Y(t)]y_i(t) - C_i[y_i(t)] \} \delta^t \tag{10}$$

where δ is the discount factor. To avoid the proliferation of solutions usually associated with supergames, we assume that firms use history-independent strategies. However, they perceive that the import quota in period t depends on their output in period $t-1$ and keep this into account when maximizing discounted profits.

The F.O.C. of firm i relative to period t is

$$P[Y(t)] + P'[Y(t)]y_i(t) - C_i'[y_i(t)] + \delta \frac{s}{1-s} P'[Y(t+1)]y_i(t+1) = 0 \tag{11}$$

In the stationary equilibrium all variables are constant through time and therefore the previous condition reduces to

$$P(Y) + P'(Y)\frac{1-(1-\delta)s}{1-s}y_i - C_i'(y_i) = 0 \tag{12}$$

Comparing (5.4) with (2.4) one sees immediately that they coincide if $\delta = 1$. This suffices to prove the claims made at the beginning of this Section.

The case of level restraints corresponds to the stationary solution with $\delta = 0$, which means that the quota is actually never revised. The case where $0 < \delta < 1$ is intermediate between the two polar cases of pure level and pure proportional restraints. It can be easily checked that all the results of Sections 3 and 4 hold as far as $\delta > 0$.

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6 Conclusions

Proportional import restraints are widespread. Our analysis helps to explain why this is so: both foreign and domestic firms generally benefit from a proportional import restraint more than from a level restraint. By way of contrast, proportional restraints are more harmful to consumers than level restraints, and social welfare is also lower under proportional restraints. In fact, if marginal costs are constant there is no benefit to consumers by increasing the share reserved for imports. In this special case, paradoxically, domestic social welfare decreases as imports are increased.

Though these results are obtained within the confines of a model of a homogeneous oligopoly with Cournot competition, that proportional import restraints lead to a more collusive outcome is a general phenomenon. It was noted, for instance, by Smith and Venables (1991) in a model with Cournot competition and product differentiation[22]. They argue that the anticompetitive effect of proportional trade restrictions arises because domestic (or, more generally, non restricted) firms behave as if their market shares were larger than they effectively are and therefore perceive a less elastic demand function.

A similar argument holds also with price competition. Consider for instance Harris' (1985) explanation of why VERs are really voluntary[23]. Harris assumes that foreign firms set a quantity VER at a level corresponding to the free trade equilibrium, and shows that this leads to an increase in the profits of both domestic and foreign firms. The reason is that the VER alters the nature of competition in the product market: domestic firms now perceive that any price increase they decide must be matched by a corresponding increase in the prices set by foreign firms, for otherwise their exports would violate the VER. But suppose that the VER is proportional, so that foreign firms limit the share they can have in the domestic market. Then, when raising prices, domestic firms will perceive that foreign firms would react by raising their prices by a still larger amount than under a quantity VER. The reason is that raising prices reduces domestic output, and this reduces also the volume of imports that foreign firms are allowed to under a share VER.

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[22]With product differentiation, the problem arises as to whether market shares are defined in terms of volumes or in terms of value. Certain features of the equilibrium may depend on the way market shares are specified but this does not alter the main argument.

[23]See also Krishna (1989).

Summarizing, proportional import restraints induce domestic firms to internalize the reaction of foreign firms to a change in their output levels and therefore are conducive to collusive outcomes. They should be viewed with suspicion by Governments and be kept under closer scrutiny by Antitrust authorities. But, to improve social welfare, they should be abolished altogether, since a mere relaxation of a proportional import restraint may have perverse effects.

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