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EXPORT RESTRAINTS WITH IMPERFECT COMPETITION: A SELECTIVE SURVEY

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ABSTRACT

This paper is a selective survey of the work on the effects of export restraints with imperfect competition. Although there are a number of excellent surveys of strategic trade theory as a whole, not much attention is paid in these to the effects of export restraints per se. The large and growing literature in this area is explicitly game theoretic and contains a wide variety of models which often yield different results. For this reason, the literature in this area can be difficult to follow.

This survey provides a stylized overview of the area which serves as a guide to the work. Short run effects are contrasted to long run effects. The short run effects usually studied are on pricing behavior. Long run effects are multidimensional. These include effects on quality choice and investment which often work in the opposite direction to the short run effects.

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1. Introduction

The post World War II era is often hailed as a period of great trade liberalization which has led to gains for all parties through free trade. Through a series of negotiations conducted under the auspices of GATT, tariffs have been negotiated steadily downward until at present they are at an average level of about 4% on manufactured goods.[1] However, this does not necessarily indicate that protection has fallen over time. Since 1970, a new kind of protectionism involving non-tariff barriers (NTBs) has arisen.

The leading instrument of this "new protectionism" has been the so called "voluntary export restraint" or "VER", and its relation, the "orderly marketing arrangement" or "OMA". Although the articles of GATT explicitly forbid quotas, the proportion of total world trade that moves under some kind of quantitative restraint is thought to be between 30 and 50% and growing. This by itself means little.[2]

The popularity of VERs stems from a number of legal, political and economic advantages they have over more traditional means of protection. This is likely to make them even more widely advocated in the future. From the standpoint of policy makers, they are attractive because they serve to transfer income from consumers to domestic and foreign producers, and do so in

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1. See Cline (1983), p. 6.

2. Estimates of the tariff equivalent of NTBs are more to the point. Tarr (1989) uses a computable general equilibrium model to argue that if in 1984 the NTBs on autos, steel, textiles and apparel alone were removed and replaced by an average tariff of 25% on <u>all</u> imports, there would be no net effect on U.S. consumers. He also points out that the last time the average tariff rate in the U.S. was close to this was prior to World War II, so that the rise of NTBs seems to have negated the tariff reductions negotiated in the various GATT rounds conducted in the post-war period.

a relatively opaque manner. Because losses to an individual consumer are small, and the policy is opaque, consumers are unlikely to be greatly concerned by such policies. This minimizes the votes lost from consumers. On the other hand, since the effects of such policies fall primarily on producers, they are more likely to see through these policies. Since producers generally benefit from VERs, they are likely to be in favor of them. In addition, VERs tend to circumvent the public debate which is associated with policies that have to go through Congress. Since VERs are "negotiated" directly between the domestic executive branch and foreign governments who agree to enforce them, industries can in effect obtain them without a prolonged and public process.

In addition, GATT places several restrictions on the use of the more traditional forms of protection, namely tariffs and quotas.[3] Because of their supposedly voluntary nature, VERs are not at present considered to be illegal. Hence it is natural for substitution toward them to occur.

A vast literature exists on the effects of quotas in international economics. It is not my intention to do an exhaustive survey of this literature here. Rather, I plan to limit my survey to the effects of export restraints in imperfectly competitive markets. The approach is a positive one and I limit myself, by and large, to partial equilibrium models as this is where the bulk of the work, both theoretical and empirical, lies.

The natural question to ask at this point is what warrants a separate survey on export restraints with imperfect competition. Such a survey is

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3. Tariffs have been restricted through agreements on bindings (which are agreements to bind tariffs) and through negotiated reductions in tariffs. Quotas are expressly forbidden by article XI of GATT.

desirable for two reasons. First, the effects of such policies depend greatly on market structure. A number of issues either do not arise or take different forms depending on the market structure. For example, issues concerning the impact of such restraints on collusion among producers by definition do not arise in competitive markets. Questions related to the supply response that occurs due to the entry and exit of firms takes a different form depending on the market structure. Second, there has been a tremendous amount of work in this area in recent years. There is a profusion of models and results and it is hard to put the often seemingly contradictory results in perspective. There is little to guide the uninitiated through this embarrassment of riches. Although there are a number of excellent surveys of "strategic trade theory" as a whole, not much attention is paid in these to export restraints as such.

The work on export restraints in imperfectly competitive markets is quite recent and explicitly game theoretic in character. It is closely tied to other work in strategic trade theory as surveyed by Grossman and Richardson (1985), Dixit (1984), (1987a), Venables (1985), and Venables and Smith (1985) as well as by others not mentioned here.

In imperfectly competitive markets firms are "large" and so take account of the fact that their actions affect the market and the actions of other agents. Thus all the interesting aspects of strategic behavior arise in these models. These include, but are not limited to, the use of threats and their limitation by their credibility, and the choice of a variety of instruments to precommit for strategic reasons. These aspects have no place in perfectly competitive environments. Such behavior may have unexpected effects or expected effects for unexpected reasons. Intuition based on standard competitive models can therefore be seriously flawed.

The study of such restraints is also topical in the United States. VERs are in force in industries which have little in common. These include such basic industries and manufactures as steel and autos, as well as industries where comparative advantage is changing, such as footwear and textiles which are in decline in the U.S., and semiconductors where comparative advantage is being formed. Clearly the effects of export restraints will differ in these markets. This is because some industries, such as autos, are more concentrated than the others, such as textiles. Characteristics peculiar to each industry further influence the response of firms to export restraints. For example, firms are more likely to respond to export restraints by altering the location of production if the restraint is likely to persist than if it is perceived as temporary. They are more likely to invest if the domestic market is growing than if it is declining.

Given that the response to export restraints is likely to be multi-dimensional, with the relative importance of the different dimensions varying across industries, it is important to have a coherent way of thinking about such multidimensional effects. An attempt to provide such a structure is made in the stylized overview which follows.

2. A Stylized Overview

A useful way to organize an examination of the effects of export restraints is outlined in equations (1) - (4). Equation (1) states that in the absence of any restraint, the profit function, π^i, of the ith firm depends on the values taken by its k strategic variables, $(s^i_{-1},\ldots,s^i_k) = S^i$, as well as those of its competitors denoted by S^{-i}. Note that the superscript refers to the firm and the subscript to the strategic variable. There are n firms altogether, with profit functions given by:

$$\pi^i(S^1,\ldots S^n) \qquad i = 1,\ldots n \ . \qquad (1)$$

In the absence of any restraint, each firm chooses its set of strategic variables to maximize its profits, taking those of the others as given. The levels of these variables which are mutually consistent give the Nash equilibrium under free trade. These are denoted by $S^1(F),\ldots,S^n(F)$. Thus, given that the other firms choose as their strategic variables those given above, each of the n firms is similarly best off choosing its strategic variables as those given above. This gives equilibrium profits:

$$\pi^i(S^1(F),\ldots S^n(F)) \qquad i = 1,\ldots n \ . \qquad (2)$$

for each of the n firms. The equilibrium levels of other endogenous variables such as output and welfare can be derived from the equilibrium levels of the strategic variables and the specification of the model.

When an export restraint is imposed, each firm's profit function is affected. This in turn affects the choice of the strategic variables. Denote the profits of the ith firm with an export constraint of V in effect by:

$$\Pi^i(S^1,\ldots S^n;V) \qquad i = 1,\ldots n \ . \qquad (3)$$

With the export constraint, firms choose their strategic variables to maximize the relevant profit function, $\Pi^i(\cdot;V)$. Again, the levels of these strategic variables which are profit maximizing and mutually consistent are the Nash equilibrium ones. The equilibrium profits of the firms are then given by:

$$\Pi^i(S^1(V),\ldots S^n(V);V) \qquad i = 1,\ldots n \ . \qquad (4)$$

and the values of the other endogenous variables are functions of the equilibrium levels of the strategic variables as before.

To examine the effects of export restraints (ERs), consider a model with n_1 home firms and n_2 foreign firms where $n_1 + n_2 = n$, and where all the strategic variables can be varied. First note that export restraints need not be restrictive to have an effect. Their very presence changes the relevant profit function from $\pi^i(\cdot)$ to $\Pi^i(\cdot;V)$. If $V = V^F$, the free trade level, then $\Pi^i(\cdot;V^F) = \pi i(\cdot)$ at $S = S^F$. However, this equality is not necessary at other values of the strategic variables. Since firms under imperfect competition <u>choose</u> the level of the strategic variable, any change in the profit <u>function</u> can alter the equilibrium.

Second, notice that the choice of strategic variables allowed and the implementation procedure are crucial. They both affect the nature of the constrained profit functions $\Pi^i(S;V)$. For example, the choice of strategic variable affects whether or not a given ER has an effect--if the strategic variable is quantity, then an ER at the free trade level will have no effect, but if the strategic variable is price, it will. The implementation procedure is also critical. ERs implemented by fixing a limit on each firm's sales will differ in their effects from an ER on their total sales. We implicitly assume that variables not taken to be strategic do not change with the imposition of an export restraint.

It is necessary to realize that all strategic variables cannot be immediately adjusted. This makes it vital to impose some kind of a timing structure on the strategic variables. A minimal way of doing this is to divide time into the short run and the long run and to specify that some variables can only be adjusted in the long run. There are two ways to distinguish between short run effects and long run impacts. The first method is to say that the short run equilibrium with an ER corresponds to one where short run variables adjust but long run variables remain fixed at their free trade level. The profit functions are affected by the ER, and are thus given by $\Pi^i(\cdot;V)$ not $\pi^i(\cdot)$. The long run equilibrium is said to correspond to one where all the strategic variables are chosen.

This interpretation is not quite appropriate when strategic interactions matter. Purists would argue that the temporal aspect needs to be better specified and that it is proper to model such a situation as a two stage game. The long run variables would be chosen at the higher stage and the short run variables at the lower stage taking as given the variable chosen at the upper stage. The short run equilibrium with an ER would then correspond to the equilibrium in the subgame with the long run variables at their free trade levels. The long run variables would then be chosen strategically with a view to influencing the equilibrium in the subgames. The equilibrium in the long run would then be the sub-game perfect equilibrium of the two stage game. If the short run variables can be adjusted more quickly than the long run variables, as seems reasonable, then this approach is the correct one.

The literature contains models that use both approaches. Typically, the short run variable used is price, while the long run variables used include quality, foreign direct investment, and the entry and exit decisions of firms.

When studied at all, the long run variables are incorporated one at a time, which in part accounts for the profusion of models. Interactions between these variables are generally not considered. This is partly because of the complexity of doing so and partly because this work has only begun recently. The consideration of interactions between variables is definitely an area where future research will be useful.

I shall use this short run/long run dichotomy to organize the theoretical part of this survey. Section 3 deals with short run effects of VERs and Section 4 with their long run effects. There is also a small but growing literature on the empirical implementation of such models. This is integrated into sections 3 and 4. Both recent econometric work as well as work using computable partial equilibrium models, a fairly new development in trade, is briefly surveyed. Section 5 outlines some lessons from the research surveyed and suggests directions for future research.

3. Short Run Effects

Under this heading I will discuss the main ideas that emerge in the analysis of export restraints when dimensions of choice aside from price are suppressed. These are called short run effects as it is being assumed that prices can be adjusted in the short run, but other dimensions of choice cannot. I begin by considering work done in the simplest model of imperfect competition, namely monopoly.

I then move on to slightly more complicated models of static oligopoly. Here the timing structure in the oligopoly game is important as the results are sensitive to the assumptions made. To highlight this I discuss the work that uses Stackelberg leadership models, where one firm moves first and the other follows, as well as models where both players move simultaneously. Another aspect that proves important in oligopolies is the choice of the strategic variable. Whether price or quantity is chosen is irrelevant in models of monopoly but is vital in models of oligopoly.

Finally I move on to dynamic models where the game is repeated many times or where there is an explicitly dynamic aspect of behavior that is affected by an export restraint.

3.1 Monopoly.

The starting point for much of the work on export restraints in imperfectly competitive markets comes from Bhagwati's (1965) much cited paper on the non-equivalence of tariffs and quotas.[4] The basic point made by

4. The non-equivalence of tariffs and quotas under monopoly is closely linked to the effects of ER.

Bhagwati is that with domestic monopoly and foreign competitive supply, a quota at the free trade level causes prices to rise and domestic consumption to fall. Thus, a quota need not be set at restrictive levels for it to have profound effects. This contrasts with the competitive case where a quota must be set below the free trade level for it to have any effect. Call this the "M" (for monopoly) effect.

The logic behind the result is that the residual demand curve facing the monopolist becomes steeper for price increases in the presence of a quota. This occurs because in the face of a quota, foreign supply cannot expand as price rises. This kink in the demand curve makes it profitable for the monopolist to raise his price above the free trade level. Note that profits at the free trade level are unaffected, yet a quota has an effect. An ER set below the free trade level provides a further effect. With approximately linear demands, a more restrictive quota increases the sales of the domestic firm but reduces total supply, thereby raising price in the domestic market. This effect of a more restrictive ER is common to models of both monopoly and competition. Call this the "C" effect as it exists even under competition.

One might ask what the model of domestic monopoly implies for the effect of an ER on domestic production. Oddly enough, under domestic monopoly there need not be any effect for a wide range of the ER. To see why, consider the model of domestic monopoly where the world price is given and the monopolist's marginal costs are increasing. This model also illustrates the "M" effect of a quota in the special case where world supply is infinitely elastic. These conditions are depicted in Figure 1. CD is the domestic demand curve. DMC is the domestic marginal cost curve. Under free trade, the residual

demand curve facing the monopolist is given by ABD at home and AP^W abroad. The monopolist thus produces AE, while imports equal EB.

Now consider an ER at the level of imports EB. The residual demand now is given by FEBD at home and AP^W abroad. The ER lets the price at home exceed the price abroad, allowing the monopolist to price discriminate in this direction. Equating the horizontal sum of marginal revenues, FGP^W, with marginal costs, DMC, gives that AE remains the production level. However, only AG is sold at home at price OH, which exceeds the free trade price OA, while GE is sold abroad at price OA. The ER creates market power where none existed when foreign supply is infinitely elastic. With an upward sloping foreign supply curve, the ER just enhances the market power. Varying the ER from being prohibitive to being irrelevant does not affect domestic production in Figure 1 as DMC intersects P^W to the right of CI, the marginal revenue with a zero quota. Had this intersection been to the left, domestic output would have started rising as the quota became very restrictive but would not change until then.

In essence, this result emerges because the effective marginal revenue curve remains flat at the world price despite changes in the quota. This fixes domestic output at the point at which DMC equals the world price. Since this point does not change, only the allocation of the output across markets changes. This should be contrasted with the case of competitive supply where reducing the quota raises domestic prices which in turn elicits a greater domestic supply.

3.2 Oligopoly.

With oligopolistic markets, it is important to carefully model the effects of a VER on the game played by the firms. Duopoly models are traditionally used here. Stackelberg leadership models show that even quotas imposed at the free trade level have effects. The idea is very simple. An ER alters the best response functions. Even if these are not affected at the free trade level, changes anywhere can affect the equilibrium in a Stackelberg leadership model as the leader maximizes along the followers' best response function.

As an illustration, consider the duopoly case when the home firm is the leader. $B(\cdot)$ and $B^*(\cdot)$ are the best response functions in Figures 2(a) and (b). Under free trade, the equilibrium is given by the point S in Figures 2(a) and (b) which correspond to price and quantity respectively being the strategic variables. For illustrative purposes, I depict the case with linear demand and constant marginal cost. A quota at the free trade level alters the foreign best response function. In Figure 2(a), the line P'P traces out the set of prices where the free trade level of imports is demanded. The best response function of the foreign firm with an ER at the free trade level is given by the dark line. It is the free trade best response when this calls for a higher price than along P'P and is P'P otherwise. In the former case the foreign firm is not constrained by the quota, while in the latter case it is. The Stackelberg equilibrium with a quota is at S'. Here the domestic firm has higher profits of $\tilde{\pi}^a$ than at S. The foreign firm also has higher profits as it sells the same amount at a higher price than under free trade. Both firms thus gain from a quota. By the use of continuity

arguments the result goes through for ERs close to this level. Similar results obtain with the quantity competition depicted in Figure 2(b). Again the dark line gives the new best response function of the foreign firm, and the equilibrium moves from S to S' in Figure 2(b). The leader's profits rise from π^s to $\bar{\pi}^s$ as he chooses a new point when the old was available, while the follower's profits rise as total output falls, so that price rises and he again sells at the free trade level.

This is pointed out in Itoh and Ono (1982) and (1984). They also claim that if the foreign firm is the leader, this kind of effect does not occur. This point is not quite correct as they assume that the home firm's best response is not affected by a quota on the foreign firm. However, this is not so unless it is assumed that shortages in the market for one good do not affect demand in the market for the other. This is inconsistent with the assumption that goods are substitutes for one another. This is pointed out in Krishna (1989c) and noted in Itoh and Ono (1984). This assumption is called one of "no spillovers".

If a constraint on the foreign firm exists, the home firm's best response function changes, as it now has the option of making the constraint bind on the foreign firm by choosing to charge a high price for its own good. The domestic firm uses this option strategically. If the foreign price is low, it chooses to charge a fixed high price and create excess demand in the market for the foreign good. If the foreign price is high enough, it is best off ignoring the existence of the ER, so that its best response is unaffected.

Itoh and Ono (1982) also consider the endogenous determination of leadership and argue that this works in favor of the home firm being the leader. However, they do not specify the extensive form of the game.

Moreover, they make the same assumption here about no relationship between shortages in one market and demand in the other, which limits the generality of their results.

More recently, Dean and Gangophadhyay (1988), (1989) focus on two aspects of ERs. In their earlier paper they consider the effect of the threat of an ER on equilibrium. Their model is one of two exporters with market power who compete in price and a competitive fringe which is domestic. One of the exporters already has an ER on it while the other is faced with an exogenous probability of such an ER. They assume prices are set first and then the ER is either imposed or not. They find that the threat of an ER affects the equilibrium whether or not it is imposed. This is to be expected given the timing structure assumed, namely that prices are set before the ER is either imposed or not. They also show that a high probability of the ER is associated with a pure strategy equilibrium while a low probability is associated with a mixed strategy equilibrium. Again, this results from the timing structure. Because of the timing structure assumed, firms profits are a convex combination of the profits with two sided capacity constraints (when the ER is imposed) and one sided capacity constraints (when the ER is not imposed). The results when the probability of an ER is large are thus close to those of the former case and the results when the probability is low are close to the latter case.

In their later paper, Dean and Gangophadhyay discuss the endogenous determination of the leader-follower issue addressed by Itoh and Ono, but in terms of their model described above. They argue that if both firms want to be the leader or follower, then neither is and the firms move simultaneously. However if their desires are consistent, they are implemented. Again, they do

not specify the extensive form that corresponds to this outcome. They argue that if the probability of an ER is low, the unrestrained firm will be the leader, while if it is high, the restrained firm will be the leader. It remains unclear whether such "endogenous determination of the leader" results hold when the models are more carefully specified. It is not clear how one firm becomes a leader. What allows one firm to precommit to its actions?

Itoh and Ono (1984) and Harris (1985) analyze the effects of an ER in a duopoly model with one foreign and one domestic firm where neither is a leader. Firms are assumed to compete in price and to produce differentiated but substitutable products. Itoh and Ono argue that an ER at the free trade level has no effect. However, since they make the "no spillovers" assumption their result is not general. Harris argues that ERs have an effect by their very existence. However, he argues that the ER makes the home firm into a Stackelberg leader. This assumption drives his result.

Krishna (1989c) argues that the ER gives the domestic firm the profits of a Stackelberg leader in equilibrium when neither firm moves first. The essence of the argument is that there is a third effect of an ER in oligopolistic markets beyond the "M" and "C" effects mentioned above. Call this the "I" (for interaction) effect. It arises because each agent is affected by the ER and the equilibrium is affected by the interaction of these agents. While the "M" effect can only raise the agents profits, the "I" effect can raise or lower them. With an ER, it tends to raise them. However with other restraints, it can lower them, as shown in Krishna and Itoh (1988).

Consider what happens when an ER is imposed at the free trade level. Why is the free trade price not an equilibrium? The existence of the ER makes the demand curve facing the home firm less elastic for price increases above

the free trade level as a higher price makes the ER bind on the foreign firm. This is the analogue of the "M" effect. This price increase by the home firm makes it profitable for the foreign firm to raise its price as it is effectively supply constrained by the ER at the free trade price. This is the essence of the "I" effect. The equilibrium is shown to be a mixed strategy one which gives the domestic firm the profits of a Stackelberg leader when a natural rationing rule is used. It also raises foreign profits. The result depends on whether goods are complements or substitutes. Krishna (1989a) shows that when the products are complements, an ER has no effect on equilibrium if imposed at the free trade level.

Both price and quantity competition models and their variants are used in studying the effects of ERs. However, it is a bit unsatisfactory to use Cournot models in analyzing quantity constraints since these restrict the strategic variable itself, leaving no room for firms to use the existence of the ER strategically. When quantity is the strategic variable, non-restrictive ERs have no effect as no "M" effect occurs and hence no "I" effect can occur.

Ethier (1989) presents a Cournot model in which he studies the effects of ERs. He outlines a novel diagrammatic way to illustrate a variety of effects of ERs in such models. He also outlines a model that endogenously determines the probability of an ER. As he puts it on page twelve of his paper: "A proper analysis cannot confine itself to the ex-post consequences of establishing a VER but must instead look at the equilibrium performance of an industry in which a VER is an endogenous probability." The model does not yield clear cut results but rather points to the various factors that work in opposing directions.

The effects of ERs have also been studied in the context of repeated games. The effects here are much richer and consequently more difficult to predict. Usually, trigger strategies are considered: collusive equilibria are maintained by the threat of going to the non-cooperative one shot equilibrium. Rotemberg and Saloner (1986) study such a model and conclude that there are two effects at play. An ER reduces the profitability of deviation from a collusive equilibrium as foreign firms cannot sell more than the ER by deviating. However, it also reduces the ability to punish deviators as this is also restricted by the ER. Thus, whether more collusive outcomes become possible with an ER, or whether the most collusive outcome possible becomes less collusive depends on details of demand and market structure.

In one case, studied by Krugman and Helpman (1989), the answer is unambiguous. They consider the case where there are a number of domestic Cournot oligopolists and foreign supply is competitive. They show that an ER at the free trade level actually lessens the most collusive outcome that can be sustained. Assuming that this outcome is chosen from among the continuum of sustainable outcomes and that this outcome is less collusive than that of a perfect cartel, this implies that an ER will raise output and lower price! This result is extremely counterintuitive and occurs because in this case only the penalty for cheating is reduced in the relevant region.

Bull (1986) studies another aspect of ERs. ERs are often specified as a fixed quantity per year, which are allocated on a first-come first-served basis. This creates incentives for "quota induced sales games" where firms rush to import in order to obtain the quota. With costs of storage it is not best to import everything at the beginning of the year and fill the quota. This makes the problem a non-trivial one. Given the fact that quotas are

often filled in the first few months of the year even when they are not very small, the problem is quite relevant.

3.3 Drawing policy conclusions.

What are the main points that emerge from the above discussion of the impact effects of an ER? How do they relate to evidence on the effects of such ERs? The main point of the literature seems to be that ERs need not be set at restrictive levels to have significant effects. This result is robust to a variety of specifications of market structure. The expected effect of such ERs, aside from the Krugman-Helpman result, which they themselves regard as a curiosity anyway, is that ERs tend to raise price, and encourage collusive behavior. The question then arises as to how one can separate the restrictive effect of the ER from the induced effect on behavior. Moreover, since the effects of ERs are sensitive to the strategic variable chosen and to market behavior, how can the appropriate model be chosen?

Recent work on computable partial equilibrium models that tries to empirically implement the corresponding theoretical work holds out some hope in this area. This work is in its infancy and the results reported should be taken as suggestive at best. Dixit (1987) develops a static oligopoly model and calibrates it to data from the auto industry, including some years when a VER was in effect. He uses a conjectural variations approach to model firm interactions and derives estimates for the conjectures in the calibration process. In doing so he bypasses the question of what is the appropriate strategic variable to use. However, conjectural variations models have a number of problems, the main one being that they have no extensive form

associated with them so that it is unclear what the timing structure is.[5] His results suggest that the ER did make behavior more collusive, particularly in the early years of its implementation as reflected in changes over time in the calibrated levels of the conjectural variations parameters.

Dixit assumes that domestic goods are perfect substitutes for one another as are foreign goods, though domestic and foreign goods are imperfect substitutes for one another. This means that the behavioral estimates derived are biased towards collusion, as behavior must be more collusive than Bertrand for positive profits to be exist. Krishna et al (1989), show that although the level of the calibrated behavioral parameters become less collusive when a richer specification allowing for intra-country product heterogeneity is used, they still become more collusive with an ER.

Lambson and Richardson (1986) attempt to calibrate a repeated game model to the auto industry as well. Their main result is that it is not inconsistent with the data. They specify a repeated game model which is more sophisticated than that of Rotemberg and Saloner (1986) or Krugman and Helpman (1989) in that they do not restrict themselves to trigger strategies. Punishments more severe than the non-cooperative one-shot equilibrium can sometimes be credible threats as shown by Abreu (1984, 1985). The greater punishments, in turn, allow greater collusion.

The more traditional approach to analyzing the effect of ERs is to use a similar calibration approach. Demand and supply functions for the good are specified--usually these are linear--and the loss of consumer surplus and

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5. Recent work by Driskill and McCafferty (1988) provides some basis for such a model using a dynamic Markov game specification. However, this work is very preliminary and has yet to be empirically implemented.

profits with the ER is shown to be the sum of the relevant areas under these curves. These areas are then approximated using any one of a number of alternative approaches, econometric or otherwise, to fit the curves. This is the basis for estimating welfare effects. Examples of such work include that of Greenaway (1986), Dardis and Jia-Yeong (1985), and Dardis and Decker (1984) who use this kind of approach to study the welfare effects of VERs on footwear in the U.K. and automobiles in the U.S., respectively. Greenaway's paper is notable for the attention paid to the present cost of such restraints as a function of the length of time they are imposed, and the effect on unemployment. Dardis and Decker (1984) make a number of interesting points about what should and should not be included in the welfare calculations. Also of interest is the exchange between Dardis (1987) and Russo (1987) on this issue. Tarr and Mokre (1984) is another example of this approach.

A point worth making is that the supply responses in such models are often perverse. With domestic monopoly, the example in this paper suggested that although production for the home market falls, home production is to a large extent unaffected by an ER. With oligopoly, a concern about the use of VERs is that since they are not usually imposed on all suppliers, the ER would raise the supply from unconstrained suppliers and affect total imports from other sources. A simple duopoly model with two foreign suppliers and no home supply or an upward sloping domestic supply curve, with one of the producers subject to an ER, is analytically equivalent to the model of Krishna (1989c). Applying this yields the result that the unconstrained suppliers output may rise or fall with an ER on the other firm. This suggests that there may be less of this supply diversion than suggested by competitive models. This is

an aspect of the effects of ERs that has received little attention in oligopolistic markets. More work here seems warranted.

4. Long Run Effects

It is likely that in the longer run, ERs will have other effects when firms have a chance to adjust along non-price dimensions. As the number of such dimensions is potentially infinite, I will restrict myself to the dimensions upon which most work has focused. This is not, of course, to say that these are the only interesting dimensions to study. The dimensions I focus upon include quality, the location of production, and the entry and exit of firms. It would be interesting to develop a less specific model of response to ERs. A question that has not been studied so far is whether there is any broad result concerning the effect on non-price competition of an ER. The work of Spence (1977) on price versus non-price competition might serve as a starting point here.

4.1 ERs and Quality

Perhaps the greatest amount of attention has been paid in the literature to the quality aspect. The basic idea is that firms choose both price and quality in maximizing profits and that the way that quality responds to price depends on the details of the cost and market structure. For this reason one must consider a variety of models to consider this aspect of behavior in the face of an ER.

The simplest and perhaps most appealing idea comes from Falvey (1979). His arguments are most persuasive in a competitive framework. The basic point can be made as follows. Assume that relative demand for high and low quality goods is inversely related to their relative price. Further, assume that costs are closely related to price and that higher quality goods have a higher

price. Quotas implemented by licenses raise the implicit price of all qualities by the same amount: the implicit or explicit price of the license. Thus, the relative price of low quality goods rises and their relative demand drops. Hence an ER alters the quality composition of imports towards higher quality goods. Falvey argues that the same logic applies when market power exists. This is less plausible as in this case, the prices of different qualities are set strategically and need not follow costs closely. The result does go through with monopoly when further restrictions such as constant demand elasticity are added.

Rodriguez (1978) and Santoni and Van Cott (1980) use the demand characterization associated with Swan (1970) and focus on perfect competition. The assumption in the Swan model is that demand is essentially for the services produced by the goods and that higher quality goods provide more services, but are more costly to produce. The profit-maximizing quality choice is shown to be that which minimizes the cost of producing a service and is independent of the level of services provided. The choice of quality is thus a pure cost side decision. A quota, it is argued, raises the quality chosen. The effect of raising quality on cost per service is, to the first order, equal to zero as cost per unit of a service is already being minimized. However, an increase in quality allows partial circumvention of the quota on physical units and this makes the ER less binding. Thus, on the margin, raising quality in response to an ER is profitable.

In contrast to the above results, Krishna (1987) argues that a foreign monopolist may raise or lower quality in response to an ER. The premise here is that it is costly to produce a variety of products and so quality is chosen to best suit the entire group of consumers being served. However, different

consumers value increments in quality differently. An ER removes the marginal consumer from the market as the ER raises price. If the marginal consumer values increments in quality less than all consumers on average, removing him raises the quality chosen as this is targeted to the preferences of all consumers on average. If the reverse is true, quality falls in response to an ER. Thus, evidence showing that quality rises with an ER could be interpreted as support for the assumption that marginal consumers value increments in quality less than do all consumers on average. This seems like a reasonable assumption in many cases.

Aw and Hwang (1988) consider the effect of an ER with joint production. They assume that two products are produced, a high quality one and a low quality one. Further they assume that the demands for the two goods are independent and that costs depend on both outputs. An ER constrains the total sales of the goods. With economies of scope, an ER raises marginal costs of producing both goods. Diseconomies of scope reduce the marginal cost of production with the imposition of an ER. This then affects the composition of production. However, no clear results obtain even with their assumption of independent demand.

However, firms must decide on both the number of products as well as their qualities. Models using the Swan specification of quality circumvent this issue as it is optimal to choose only one quality--that which minimizes the cost of services--since only the services produced by the product matter in demand. Models using the Spence specification are based on the assumption that only one quality can be produced, implicitly assuming that variety is very costly. When a firm is faced with consumers with diverse preferences it is likely to produce a variety of products to better target products to

consumers. The cost of variety in relation to the preferences of consumers would then determine the range of products offered in equilibrium. An ER would in such a model affect the pricing decision as well as the range of products offered. The equilibrium behavior of these variables would determine the effect of an ER on the aggregate quality of products sold.

There are two modelling approaches taken here. One approach is to focus on the effects of an ER on the strategic setting of quality in oligopoly but to assume each firm makes one product. The other is to focus on monopoly but to study the product line decision. The first approach, followed by Das and Donnenfeld (1986) uses a duopoly model and has the two firms choose their quality as well as their output strategically to serve consumers who are differentiated by their willingness to pay for quality. Price is set at a later stage to clear the market, given output and quality decisions. Their results indicate that an ER raises the quality of imports. The effect of an ER on quality in the home firm depends on whether the foreign producer makes the high or low quality product. In the former case, quality rises, in the latter it falls.

Unfortunately, it is not clear how general these results are. The assumption that price is set non-strategically to clear the market makes the model equivalent to a single stage game where output and quality are chosen simultaneously by each firm. This removes the ability of the domestic firm to set price strategically in the presence of an ER. It also assumes away any temporal aspects that would occur were quality set prior to output or price as in a standard two-stage game. It is unlikely, however, that clear results will come from more general models. In any event, since fairly strong

assumptions must be made to solve such models, further work on these lines seems unprofitable.

The other approach is taken in Krishna (1989b). A foreign monopolist is assumed to produce a product line. However, as he cannot identify consumers by their preferences for quality his ability to extract surplus is constrained. Using a model slightly more general than the standard one of Mussa and Rosen (1978), it is shown that the average quality of imports rises. The quality purchased by consumers remaining in the market is unchanged, but marginal consumers leave. As they purchase the lowest quality, average quality rises. Recent work by Srinagesh and Bradburd (1989) develops an alternative specification of preferences to that of Mussa and Rosen (1978) which reverses many of their results. This is also likely to alter the effects of an ER though this has not yet been studied.

How then does existing work correspond to the analysis one would like to have? Ideally, one would like to be able to augment the work on the short run effects of an ER to incorporate the effects of changes in the other relevant variables such as quality. However this is far from the state of affairs that exists. In studying the effects of ERs on other aspects of choice, the approach has been to take models which suppress the interesting short run effects. The result is that no unified model exists which examines both kinds of effects and sheds light on the adjustment between the short and the long run. In part this is because these models become complex quite fast and in part because of the problem common in industrial organization that there are many possible models so that there is no single correct model. Empirical work on the other hand tends to yield fairly clear cut results on the quality effects of ERs.

Empirical studies of the effects of ERs on quality show that ERs are accompanied by increases in quality. This result seems to appear for a variety of products with markets ranging from competitive to oligopolistic. The increase in quality then partially accounts for the increase in price due to an ER. This in turn suggests that the anti-competitive effects of ERs occur in the short run and are undone by adjustments in non-price dimensions in the longer run. Feenstra (1988), for example, argues that nearly all of the increase in Japanese auto prices between 1981 and 1984 can be explained by the upgrading of individual models.

Two kinds of approaches are taken to estimating quality change. The first uses the analogue of productivity indices to derive quality indices for imports. Examples of this can be found in Aw and Roberts (1986) who study footwear imports and Feenstra (1984, 1986, 1987, 1988) who studies autos. The other approach uses hedonic regressions to estimate quality change. An example of this approach can be found in Feenstra (1988) as well.[6]

Of course, neither of these measures is perfect. For example, because it estimates changes in the composition of cars demanded, the quality index approach does not capture quality upgrading that takes the form of adding options to automobiles. The hedonic regression approach assumes that characteristics such as increases to the wheel base are per se good or bad. It does not allow that this might be good in some models but bad in others. In addition, characteristics like the reliability of a product are usually not used as variables in the hedonic regression.

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6. More informal support for quality upgrading in autos also comes from data on average consumer reports quality ratings for U.S. and Japanese cars reported in Crandall (1988).

4.2 Direct Investment and ERs

In the longer run, a foreign firm can circumvent an ER by relocating production to the country imposing the ER. This is not an unimportant issue as such investment by Japanese producers has been occurring in the auto industry in the U.S. It is not clear the degree to which this is in response to the VERs of the past, the threat of future ERs, the changes in exchange rates and the concomitant changes in the relative costs of production in Japan and the U.S., or all of the above.

If investment responds to an ER, one might argue that if the ER is not too restrictive then the advantages of investing are small and direct investment will not occur. If the ER is restrictive, then the advantages to circumventing the ER become large enough to warrant investment. To formalize this, refer to Figure 3 which considers the decision of a foreign monopolist facing an ER. Let markets be segmented so that multi-market effects do not enter. Assume, as is usually done, that the foreigners have the licenses as this is a "voluntary restraint" so licenses are given away to the producer. If the monopolist produces at home (that is, not in the U.S.), then his costs are given by MC^f, while if he invests they are given by MC^{fdi} which exceeds the former.

In the absence of an ER he produces Q^f and charges P^f. If he invests he would produce Q^i and charge P^i. If a quota is imposed, he can produce up to that level at MC^f but can exceed that level by producing in the host country at a higher marginal cost. Hence, a quota creates a "jump" in the marginal cost curve at the level of the quota. It is apparent that if the ER is set at Q^f, then no investment occurs. If the ER is set between Q^i and

Q^f, then the firm produces the level of the ER but does not invest. Only when the ER falls below Q^i does the firm invest. It invests so as to keep its total sales at Q^i. Notice that even in the absence of fixed costs investment occurs only when the ER is quite restrictive.[7]

One might argue that the same sort of effect would arise with more firms. The simplest extension to the above would add a domestic firm with market power. Assuming Cournot behavior would then lead one to argue that the best response function of the foreign firm is that depicted in Figure 4. It is given by $B^*(Q)$--the best response corresponding to marginal costs of MC^f below the level of the ER, and $\bar{B}^*(Q)$--the best response corresponding to marginal costs of MC^{fdi} above this level, and is the vertical line joining the two at the level of the ER. Given this, it is apparent that investment only occurs when the ER falls below Q^{i*}. When the ER falls below this, sales are constant at Q^{i*} but domestic production rises one for one with the fall in the ER.

However, one would get a completely different story using a model of price competition. In this case, it is not clear that the foreign firm would wish to evade the ER since it is better off being able to credibly commit to restricting sales. But this model is likely to be more complex than the one outlined above. Moreover, there remains the possibility of entry or expansion by other firms who remain unrestricted.

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7. Levinsohn (1988) assumes that the government sets a price of a quota license that implements the quota and sells them to the producer. He discusses the equivalence of optimal tariffs and quotas with foreign direct investment, rather than focusing on the effects of ERs. The model used here is closely related to his but he emphasizes different issues.

While most of the attention in the long run effects of ERs has focused on how the existence of an ER affects firms' decisions such as investment, an interesting paper by Brander and Spencer (1987) asks the opposite question. It asks how the investment decision of the firm depends strategically on the government's inability to precommit to an ER policy. In this event, firms know of the government's inability to commit and take it into account in their investment behavior. They argue that in the presence of unemployment, the optimal tariff by the government exceeds the optimal tax for any given level of capital investment, leading to foreign direct investment.

4.3 Entry, Exit and Supply Responses

Supply diversion effects of ERs in imperfectly competitive markets are not well addressed in the literature. It is likely to be worth addressing these because, as pointed out in Section 3, supply responses by unrestrained producers are likely to be different with imperfect competition. Moreover the behavior of unrestrained producers, both actual and potential is likely to be important. For example, Dinopoulos and Kreinin (1988) argue that a large part of the welfare loss of the VERs on Japanese autos arose because European producers raised their prices instead of expanding output. On the other hand, it is likely that the entry of Korea and Yugoslavia into the U.S. auto market was not slowed down by the higher prices due to the VER.

The issue of firms' entry and exit in response to an ER is addressed in Buffie and Spiller (1986). Using a conjectural variations model, they point out that the time horizon is critical in evaluating the likely effects of an ER. They assume that the number of firms is fixed in the short run but varies to ensure zero profits in the long run. In the short run, an increase in the

quota reduces the domestic price. However, in the long run, as firms leave the industry, this may well raise price. Their use of a conjectural variations model limits the kind of short run effects that can occur. However, this is one of the few careful treatments of short versus long run effects to be found in the literature.

5. Conclusion

There has been a considerable literature on the effects of ERs, both in the short and long run. A selective subset of this is surveyed above. Having done this, the question to ask is where the major gaps in this literature exist so that future work can be directed to these areas. There seem to be two main deficiencies in this literature. The first is that some of the interesting issues are not addressed by the literature. The second is that the link between the theoretical work and the empirical work needs to be improved. Only in the area of quality upgrading is there much of a link. There are deficiencies on the side of the theorists as well as on the part of those more empirically oriented.

In general the theoretical work tends to focus on special models which yield results that may not be general. In addition, and maybe for this reason, the empirical implications of the results are not spelled out. For example, much theoretical attention is paid to the quality of imports with an ER, but there is little attempt to spell out the actual implications on domestic quality. Greater attention to empirically testable issues by theorists would be welcome.

Theorists also tend to neglect a number of interesting policy questions in the search for clear and surprising results. For example, there is little attention paid to the question of supply diversion to third markets when markets are oligopolistic. Attention is restricted to competitive markets[8]

8. See Kreinin and Dinopoulos (1989) for a discussion of such issues in competitive markets.

although there is good reason to believe that the results are likely to be quite different in oligopolistic markets.

In addition, not enough emphasis is put on the importance of the implementation schemes used. ERs are implemented in a number of ways. Sometimes the level of the restriction is based on historical market share. Sometimes the ERs are global. A question that needs to be asked is how differences in implementation schemes affect the outcome both at a point in time and as demand and cost conditions change. There has been some work on this in competitive markets--see for example Kreinin and Dinopoulos (1989)--but none when markets are oligopolistic.

This question is important both because it can help us understand the effects of various schemes and because it will most likely provide empirical implications. The role of implementation schemes is even more important in oligopolistic markets than in competitive ones because firms will respond strategically to any scheme. This may have unexpected policy consequences. Krishna (1988), (1989), for example, argues that auctioning import quota licenses is likely to raise little or no revenue when the license market is competitive and the product market is not.

On the other hand, empirical work has focused on a small number of issues. While quality upgrading in the wake of an ER is relatively well documented, there is little attention paid to investment or supply diversion effects of ERs. In addition, there is little detailed discussion of exactly how the ERs are implemented. Such details would be of great value in interpreting any empirical regularities. It would be useful to have more empirical work even in areas where the theoretical results are ambiguous since this could help focus the theoretical work. A closer relationship between the

theoretical and empirical work would greatly improve the quality of both in this area.

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FIGURE 1

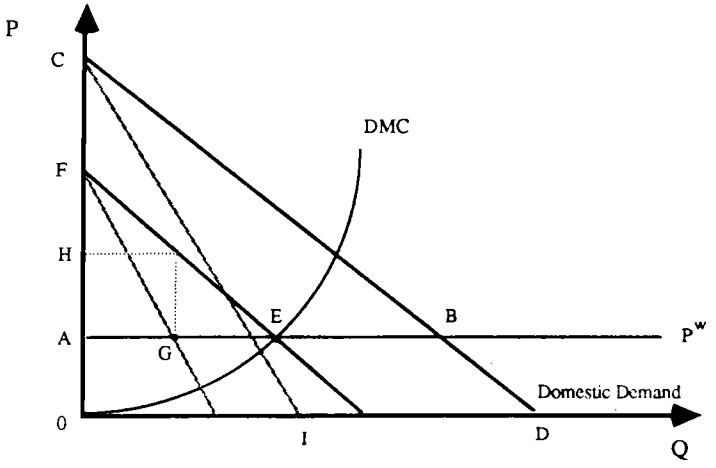
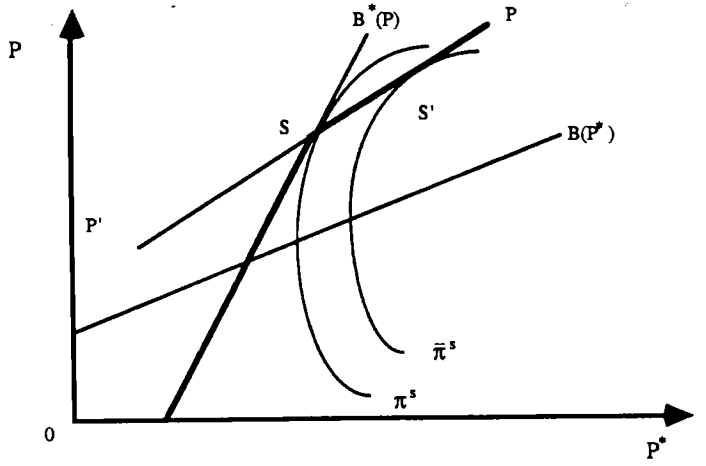


FIGURE 2

(a)



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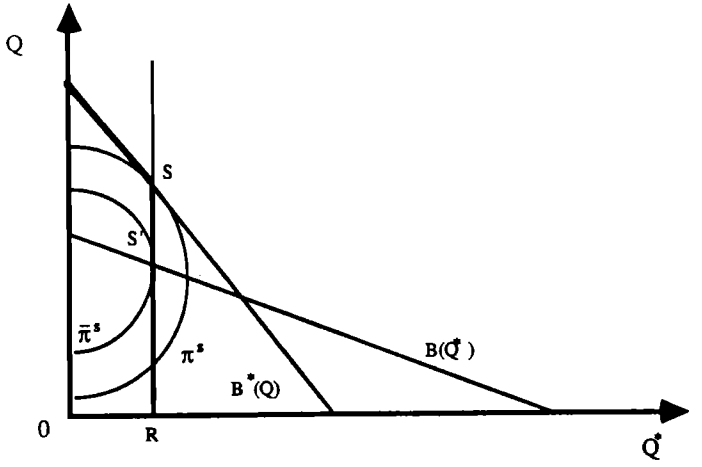

FIGURE 3

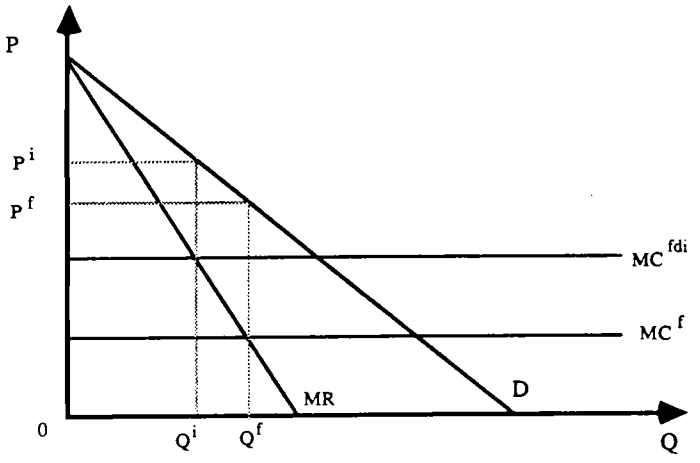

FIGURE 4

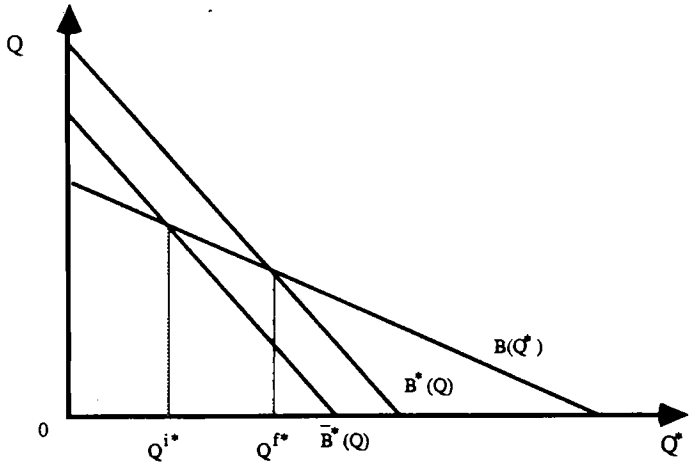

Figure 7

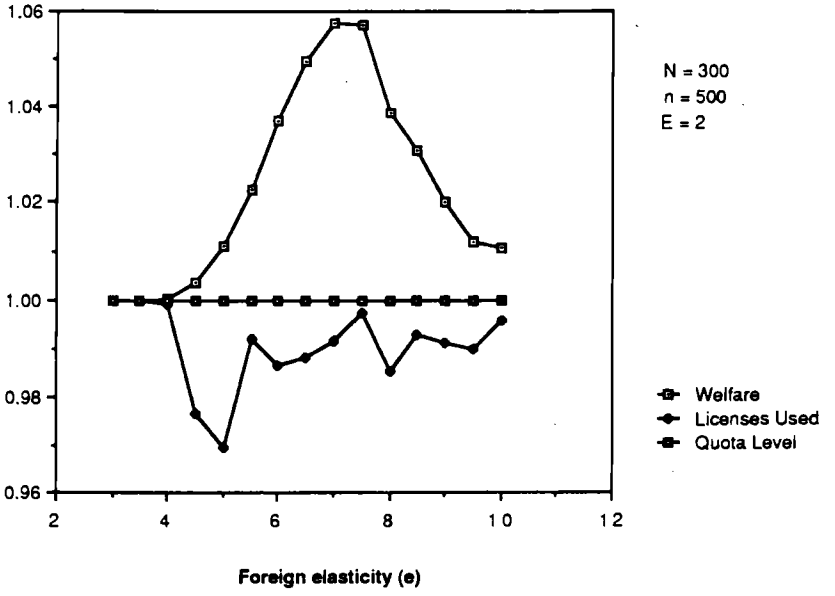
1.06
1.04
1.02
1.00
0.98
0.96
2
4
6
8
10
12
Foreign elasticity (e)
N = 300
n = 500
E = 2
Welfare
Licenses Used
Quota Level

Figure 8