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TRADE RESTRICTIONS AS FACILITATING PRACTICES

Kala Krishna

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ABSTRACT

This paper deals with the effect of trade restrictions on competition in oligopolistic markets. Quantitative restrictions, such as VER's (Voluntary Export Restrictions) are shown to affect the extent to which foreign firms can compete in the domestic market, and hence to raise the equilibrium prices and profits of both domestic and foreign firms - when such restrictions are not too severe. This increase in prices and profits is shown to make it unlikely for VER's to raise National Welfare. In addition, I show that domestic output may fall due to the VER's. For these reasons, VER's do not seem to be desirable ways of restricting imports.

Tariffs and Quotas are also shown to be non-equivalent in such oligopoly models. A comparison of the effects of tariffs and quotas shows that it would be in the interest of domestic manufacturers to lobby for VER's instead of import equivalent tariffs. In addition, it is shown that the foreign firm would prefer VER's to import equivalent tariffs, even if tariff revenues were refunded to them. Thus, the recent VER's on Japanese automobiles may well have been in the interests of both Japanese and American firms, and at the expense of the nation as a whole.

Kala Krishna
Department of Economics
Harvard University
Littauer 320
Cambridge, MA 02138

I. Introduction

The analysis of trade restrictions has focused on their effects in the polar cases of monopoly and competition, and hence, has neglected their possible effects on the <u>nature</u> of strategic interaction between firms. Interactions between firms are crucial in oligopolistic situations and when the nature of interaction between firms is affected, the consequences of "slight" restrictions are profound.

Voluntary export restraints (VER's) have been increasingly used to restrict imports recently. I show that when firms compete in prices, such restraints alter the nature of interaction between firms in a collusive direction and thereby raise (the equilibrium) prices and profits of all firms[1]. Hence, trade restrictions <u>can</u> impose on firms the collusion they themselves were unable to achieve - that is, they can act as facilitating practices. VER's affect the market, not because they are set at restrictive levels, but because they impede the ability of firms to compete effectively.

The increase in foreign profits due to a VER is shown to make it unlikely for a VER to raise domestic welfare. In addition, tariffs are shown to be fundamentally non-equivalent to quotas as quotas affect the nature of strategic interaction between firms, while tariffs do not. This is the analogue in oligopolistic markets of Bhagwati's[2] famous result for the case of domestic monopoly.

2. The Model

The simplest model which permits me to show how a trade restriction can affect oligopolistic interaction is used. There are assumed to be two firms, one home and one foreign, who produce differentiated products which are substitutes for each other, and compete in prices in the domestic product market[3]. The equilibrium concept is that of Nash Equilibrium.

Let P be the price of the home product, and P^* that of the foreign one. Similarly let $Q(P^*, P)$, $Q^*(P^*, P)$ and $C(Q)$, $C^*(Q^*)$ be the demand functions and cost functions facing the home and foreign firms respectively. Thus,

$$\pi(P^*, P) = P\,Q\,(P^*, P) - C\,(Q\,(P^*, P))$$

$$\pi^*(P^*, P) = P^*Q^*(P^*, P) - C^*(Q^*(P^*, P))$$

are their profit functions.

For any given P (P^*) denote the profit maximizing price P^* (P) that the foreign (home) firm can charge by $B^*(P)$ ($B(P^*)$). These constitute the best response on the part of a firm to any price set by its competitor. By definition, the Nash equilibrium is given by the pair (P,P^*) which satisfies both $B^*(P) = P^*$ and $B\,(P^*) = P$.

I will assume that a unique stable Nash equilibrium exists[4]. In particular, I assume that profit functions are strictly concave in their own price alone[5], and that best response functions are upward sloping.

Diagram 1 illustrates the equilibrium. $B^*(P)$ is the level of P^* such that the highest iso-profit contour for the foreign firm is reached, given the domestic firm charges P. Hence, iso-profit contours of the foreign firm are horizontal along $B^*(P)$. Similarly, the domestic firm's iso-profit contours are vertical along $B(P^*)$. Profits are assumed to increase in the competitors' price, which defines the direction in which higher profit contours are reached. $B^*(P)$ is steeper that $B(P^*)$ to ensure stability. The equilibrium is at the intersection of $B(P^*)$ and $B^*(P)$ denoted by the point (P^{*N}, P^N) in Diagram 1.

In order to specify how a VER affects the equilibrium, it is necessary to examine how it affects the best responses of both firms. As these depend on how their profit functions are affected, we must first carefully examine how the latter are affected by a VER.

First consider the foreign firm's profit function when it is constrained to sell no more that "R". At prices (P^*, P), such that $R = Q^*(P^*, P)$, the constraint is just binding. For a given P and R, let $P^*(P, R)$ be such that this constraint is just binding. The set of such prices is depicted in Diagram 2 by the line P^*P when R is set at the free trade level of imports. At all points above PP^* the constraint is strictly binding. At points below P^*P, the constraint is not binding.

The foreign firms iso-profit contours in the presence of a VER are thus vertical lines above P^*P because its profits are independent of the domestic firm's price in this region as the VER is binding. Below P^*P, they are unaffected by the existence of a VER. They have a kink along P^*P as shown in Diagram 2.

In the region where P^*P lies below $B^*(P)$, this <u>kink</u> makes $P^*(P,R)$ the best response function for the foreign firm in the presence of a VER. In the region where P^*P lies above $B^*(P)$, its best response function is unaltered. This is illustrated in Diagram 2, where the dark line, $B^{*R}(P, R)$ is the best response function of the foreign firm <u>with</u> the VER. Hence, formally:

$$
\begin{aligned}
B^{*R}(P, R) &= P^*(P, R) \quad \text{if } P^*(P, R) \geq B^*(P) \\
&= B^*(P) \quad \text{if } P^*(P, R) \leq B^*(P).
\end{aligned}
$$

Now we turn to how the domestic firm's profits are affected by a VER on the foreign firm. If prices lie above the line P^*P then the demand for the foreign firm's product exceeds the level of the VER. Hence, at these prices, some consumers of the foreign product would be rationed. This would affect the demand for the <u>domestic</u> firms product. A natural way of specifying the relationship between rationing in one market and its spillover effects in another is to introduce arbitrage. If the firms charge prices such that the demand for the foreign good exceeds R, there is room for arbitrage profits to be made. Assume that if demand exceeds R, it is as if the entire stock of the foreign good is thrown on the market for what it will bring. Consumers lucky enough to get the foreign good at the price charged, make profits by selling the good at a price that clears the market. As the income effects of such transactions are assumed away, the effect on the domestic firms demand is <u>exactly</u> what it would have been, if the foreign firm was <u>actually</u> charging the price that cleared the market. For any price, P^* charged by the foreign firm, and VER at level R, define $P(P^*, R)$ as the price of the domestic product that makes demand for the foreign good equal R.

This is illustrated in Diagram 2. If the domestic firm charges the price $\tilde{P}$ and the foreign one charges the price $\tilde{P}^*$, demand for the foreign product exceeds R. Consumers fortunate enough to get the foreign good sell it for what the market will bear, $P^*(\tilde{P}, R)$. Thus, if prices charged are $\tilde{P}$ and $\tilde{P}^*$ and $Q^*(\tilde{P}^* \tilde{P}) > R$, the price that enters the domestic firm's demand function is $P^*(\tilde{P}, R)$ and <u>not</u> $\tilde{P}^*$. Also, if the foreign firm charges <u>any</u> price, P^* the domestic one can make the constraint bind on it by raising the price of the domestic good above $P(P^*,R)$. Hence, the profit function for the domestic firm, $\pi^R(p^*, p, R)$, is now:

$$\pi^R(p^*, p, R) = \pi(p^*, p) \qquad \text{if } p \leq P(P^*, R),$$
$$= \pi(P^*(P, R), P) \qquad \text{if } p \geq P(P^*, R)$$

The next question is how the best response of the domestic firm to any price set by the foreign firm is affected by this change in its profit function. Let (P^{*H}, P^H) be the point where the iso-profit curve of the domestic firm is tangent to P^*P[6]. Let $(\hat{P}^*, P^L)$ be the point where this iso profit contour intersects $B(P^*)$ – as illustrated in Diagram 3. Let P^{*L} be $B^{*R}(P^L, R)$.

I claim that if the foreign firm changes a price, P^*, below $\hat{P}^*$, then the domestic one finds it optimal to charge P^H. If P^* exceeds $\hat{P}^*$, it is optimal for it to charge $B(\hat{P}^*)$. If $P^* = \hat{P}^*$, it is indifferent between charging either price.

Given any price, P^*, charged by the foreign firm, the domestic firm has the choice of charging a price above $P(P^*,R)$ or less than or equal to it. _If_ it charged a price above $P(P^*, R)$, what constitutes the highest profit level it can attain? In this case the price _actually_ charged by the foreign firm would no longer enter the domestic firm's demand function, as all demand for the foreign product cannot be met due to the VER. The scarcity price, $P^*(P,R)$, which exceeds P^*, enters instead. Thus, in Diagram 3, if the foreign firm charged $\tilde{P}^*$, the domestic one could attain all profit levels along the line P^*P to the right of $(\tilde{P}^*, P(\tilde{P}^*, R))$ by charging the appropriate price. The _highest_ profit level would thus be attained by charging P^H – to attain V in profits, as long as $(\tilde{P}^*, P(\tilde{P}^*, R))$ lay to the left of (P^{*H}, P^H) along P^*P. If it lay to the right of (P^{*H}, P^H), the maximum profit attainable by charging a price weakly above $P(\tilde{P}^*, R)$ would be lower than V and would correspond to the profits associated with the point $(\tilde{P}^*, P(\tilde{P}^*, R))$ itself. Thus, if the domestic firm had to charge a price weakly above $P(\tilde{P}^*, R)$ when the foreign one charged $\tilde{P}^*$, it would want to charge the price P^{*H} if $\tilde{P}^* \leq P^{*H}$, and $P(\tilde{P}^*, R)$ if $\tilde{P}^* \geq P^{*H}$.

Of course, it could choose to change a price below $P(P^*, R)$ and ignore the effect the VER has on its profit possibilities. In this case, as long as $P^* < \hat{P}^*$, it must necessarily get lower profits than V by doing so. To verify this in Diagram 3, note that such points must lie on lower iso-profit contours than the one tangent to P^*P - which yields 'V'.

If $P^* > \hat{P}^*$, then although the domestic firm could charge a price above $P(P^*, R)$, it can attain a higher Iso-profit contour than "V" by charging $B(P^*)$ - which is again apparent from Diagram 3.

If $P^* = \hat{P}^*$, it gets the same level of profits whether it charges P^H or $B(\hat{P}^*)$ - by definition of $\hat{P}^*$. In other words, although the domestic firm can make the VER bind on the foreign firm, it chooses to do so only if the foreign firm's price is low. If the foreign products price is high enough, it will not be in the <u>interest</u> of the domestic firm to <u>make</u> the restriction bind. Hence, the best response of the domestic firm to any price charged by its competitor is given by:

$$\begin{aligned} B^R(P^*,R) &= P^H && \text{if } P^* \leq \hat{P}^* \\ &= B(P^*) && \text{if } P^* \geq P^* \end{aligned}$$

Note that $B^R(P^*, R)$ is discontinuous and takes on two values at $P^* = \hat{P}^*$.[7] Also note that $B^R(P^*, R)$ does <u>not</u> intersect $B^*(P,R)$. Thus, there is no equilibrium in pure strategies.

<u>Theorem I</u> Assume that the line P^*P is steeper than $B(P^*)$[8], and that a unique maximum exists to $\pi(P^*(P, R), P)$ which is attained at $P=P^H$. If R is set at or close to the free trade level, there is no equilibrium in pure strategies.

Proof: Follows from Diagram 3. A more formal proof is relegated to the appendix.

The non-existence of pure strategy equilibria can be understood by noting that a quantitative restriction acts like a capacity constraint on the foreign firm. The non-existence of a Bertrand-Nash equilibrium in pure strategies in the presence of capacity constraints has been known since Edgeworth's classic criticism of Bertrand.[9] Of course, mixed strategy equilibria can be shown to exist under very general conditions.[10] However, the mere existence of mixed strategy equilibrium does not yield any information about the effects of a VER. The form of the mixed strategy equilibrium needs to be characterized in order to get such information. We turn to this next.

Before we begin, notice that although the domestic firm's profit function is non-concave in its own price, so that while it may be in its interest to randomize its prices, the foreign firm's profit function remains concave in the price - even if the domestic firm chooses to use a mixed strategy - as a convex combination of concave functions remains concave. Thus, it is never in the interest of the foreign firm to use a mixed strategy, and the foreign firm will always choose to charge only one price. If the foreign firm charges only one price, the domestic firm will only randomize if $P^* = \hat{P}^*$. In this case, it would randomize over P^H, P^L - which give it equal profit. These strategies are a natural candidate for the equilibrium.

Theorem 2:

The unique mixed strategy equilibrium consists of the foreign firm charging $\hat{P}^*$, and the domestic one randomizing over P^H, P^L - charging P^H with probability α, and P^L with probability $1 - \alpha$.

Proof: If the foreign firm charges $\hat{P}^*$ the domestic firm is indifferent between charging P^H or P^L, or randomizing over them, that is, charging P^H with probability α and P^L with probability $1-\alpha$. If we could show that there exists an α between 0 and 1 such that the foreign firm's best response to this strategy on the part of the domestic firm is to charge $\hat{P}^*$, the proof would be complete. That such an α exists can be seen by referring to Diagram 4. In Diagram 4, P^{*H} and P^{*L} are (as in Diagram 3) defined as being equal to $B^{*R}(P^H, R)$ and $B^{*R}(P^L, R)$ respectively.

The profit function that the foreign firm maximizes when the domestic firm randomizes across P^H and P^L in the above manner is $\pi^{*R}(p^*, \alpha, R)$ and is given by:

$$\begin{aligned}\pi^{*R}(P^*, \alpha, R) &= P^*R - C(R)) && \text{if } P^* \leq P^{*L}\\ &= \alpha(P^*R - C(R)) + (1-\alpha)\pi^*(P^*,P^L) && \text{if } P^{*L} \leq P^* \leq P^{*H}\\ &= \alpha\pi^*(P^*,P^H) + (1-\alpha)\pi^*(P^*,P^L) && \text{if } P^* \geq P^{*H}.\end{aligned}$$

The profit function of the foreign firm, given that the domestic firm is randomizing over P^H and P^L, is a convex combination of $\pi^{*R}(P^*,P^L, R)$ and $\pi^{*R}(p^*,p^H, R)$ which are depicted in Diagram 4. Note that if P^* is less than P^{*L}, the restriction binds on firm 1 irrespective of whether firm 2 charges P^H or P^L. Thus, both profit functions take on the value of $P^*R - C^*(R)$, and so does a convex combination of them. If P^* lies between P^{*L} and P^{*H} the restriction binds only if the domestic firm charges P^H, so that the profit function for the foreign firm takes on a value given by a convex combination of $P^*R - C^*(R)$ and $\pi^*(P^*,P^L)$. If $P^* > P^{*H}$, then the restriction does not bind when <u>either</u> P^H or P^L are charged so that profits are just a convex combination of the unrestricted profit functions.

We know from Theorem 1 that $P^{*L} < \hat{P}^* < P^{*H}$. In this region, the foreign firm's profits are a convex combination of $P^*R - C^*(R)$, which is increasing in P^* and $\pi^{*R}(P^*, P^L, R)$ which is negatively sloped in this region. Thus, for all P^*'s between P^{*L} and P^{*H} there exists an α such that the slope of the foreign firm's profit function at P^* is zero. As this is true for all P^*'s between P^{*L} and P^{*H}, it is true for $\hat{P}^*$. (Although Diagrams 3 and 4 are drawn so that P^*P is flatter than $B^*(P)$, arguments similar to those above work even when P^*P is steeper than $B^*(P)$.)

If firm 2 is randomizing according to this α, and firm 1 is charging $\hat{P}^*$, both are doing the best they can given what the other is doing, and this is a Nash equilibrium. (Note that as $P^{*L} < \hat{P}^* < P^{*H}$, the equilibrium can be calculated by evaluating the P^* that maximizes the expression for the profits of firm 1 correct for this range of P^*, as a function of α, and setting this chosen value of P^* equal to $\hat{P}^*$.) Uniqueness of the equilibrium follows from the fact that it is not in the foreign firm's interest to randomize, and that the domestic firm wants to randomize only then the foreign firm is charging $\hat{P}^*$. This completes the proof.

With Theorem 2 in hand, it is possible to analyze the <u>effects</u> of a VER.

<u>Theorem 3</u>: The imposition of a VER at or close to the free trade levels raises both firms prices and profits in equilibrium. In fact, the domestic firm attains the level of profits of a Stackelberg leader. As both prices rise, domestic output may rise or fall.

<u>Proof</u>: Notice that a VER at the free trade level raises the expected profits of the domestic firm, from π^N to V. (Note that V is the level of profits that would have accrued to the domestic firm if the foreign firm's reaction function was given by $P^*(P, R)$ and the domestic firm was the Stackelberg leader.)

The expected profits of the foreign firm also rise. Whether the domestic firm charges P^H, or P^L, the foreign firm could charge P^{*N} and sell R. This would yield a profit at the free trade level. As it prefers to charge $\hat{P}^*$ over P^{*N}, its profits must have risen due to the VER. Notice that both P^H, P^L, and $\hat{P}^*$ are above their free trade levels. Notice that although the VER is set at the free trade level of imports, it has a considerable impact on the equilibrium because it impedes the ability of the foreign firm to compete effectively in the domestic product market.

A simple example is calculated next. The example shows that the strategic advantage derived by the domestic firm due to the imposition of a VER depends crucially on the degree of substitutability between the two goods. The calculations for a special case of the example also show the possibility of VER's adversely affecting domestic employment.

An Example With Spillover Effects

Let the demand functions be given by,

$$Q^* = a - bp^* + p$$

$$Q = a + p^* - bp \qquad \text{with } b > 1.$$

Assume that costs are zero. $b > 1$ ensures that $\pi(P^*(P,R), P)$ has a unique finite maximum.[11] Simple but tedious calculations yield the values of P^{*H}, P^{*L}, P^H, P^L, p^*, the expected value of profits of the two firms and $\alpha/(1-\alpha)$ when the restriction is set at the free trade equilibrium level. Table 1 summarizes these calculations. The only parameter that effects equilibrium is "b". "a" is only a scale parameter. Table 2 gives the numerical values on the assumption that "a" is equal to 10 and "b" is equal to 1.5. Expected profits of both firms rise after the imposition of a VER. The domestic firm's output is also lower on average. An index of power acquired by the domestic firm due to the quantitative restriction might be defined by I, where

$$I = \left(\frac{V - \pi^N}{\pi^N}\right)$$

where π^N is the level of the domestic firm's profits in the absence of restrictions, and V is, as before, the level of expected profits of the domestic firm when a VER at the free trade level of imports is set on the foreign firm. Using the information in Table 1, it is easy to see that I = $1/(4b^2(b^2 - 1)$. Thus, I is decreasing in b. As the domestic firm becomes less able to affect the foreign firm's demand, it gains less by using the advantage given to it by the VER imposed on the foreign firm.

3. A Special Case

A natural question that arises at this point is what the effects of a VER might have been had there been <u>no</u> effect of a ration in the market for the foreign product on the demand for the domestic one. This assumption is termed that of "no spillovers" in demand. It is useful to consider this case as a benchmark as it isolates the restrictive effect of a VER from its effect on the interaction between firms. The assumption of "no spillovers" might seem to contradict the assumption that the two goods are substitutes. However, although unlikely, it seems possible for them to be consistent with each other <u>locally</u>. A possible argument is as follows.

Market demand consists of aggregated individual demands. Some individuals may choose to purchase the substitute good when rationed, while others may not. If there is no resale, the effect of a ration in one market, on the demand in the other, depends on which consumers get the rationed good. If consumers who substitute between products are assigned the rationed good, while consumers whose demand falls on a numeraire good in the event of being rationed, are rationed, the ration need not affect demand for the substitute good. The no spillovers assumption is made, <u>not</u> because of any belief in its realism, but because it allows me to isolate one effect of a VER from the other. Even with this assumption, a VER close to the free trade level can be shown to raise both firms profits.

<u>Theorem 4</u> If there are no spillovers in demand, and the equilibrium is stable in the presence of a VER, a VER set slightly below the free trade level must raise both firms profits and prices.

<u>Proof</u> The reason is very simple and is illustrated using Diagrams 1 and 2. A formal proof is relegated to the Appendix.

Note that the assumption of "no Spillovers" means that the domestic firm's profit function, and hence its best response function is unaffected by the presence of a VER on the foreign firm. Thus, the VER only makes the foreign firm's best response function into $B^{*R}(P,R)$, as discussed earlier. Hence, a VER _at_ the free trade levels will have no effect on the equilibrium. In order for the equilibrium to be _stable_ it is necessary for the line P^*P to be steeper than $B(P^*)$ - and this assumption is made in this section as well.

Now consider the effect of lowering the VER slightly. This moves the line P^*P to the right in Diagram 2. As P^*P is steeper than $B(P^*)$, the equilibrium given by the intersection of $B(P^*)$ and $B^{*R}(P, R)$ moves up along $B(P^*)$ in the direction of the arrows in Diagram 2. This must lie in the shaded area in Diagram 1, which is precisely the region of greater profits for both firms. Both firms are on higher iso-profit contours in the shaded region than under free trade. Also, as $B(P^*)$ is upward sloping, prices must rise as well.

4. The Effects of Tariffs and Quotas

The analysis of the previous section allows us to compare the effects of a VER or quota with those of an import equivalent tariff. It is shown that: (1) Prices under a tariff are lower than those under the VER set at the post tariff import levels. (2) The profits of the domestic firm are also higher under the VER; (3) If the VER is set close to the free trade level of output, it will be preferred by the foreign firm to no restrictions. In addition, the foreign firm would prefer the _VER_ to the _tariff_, _even_ if the tariff revenues were returned to it as a lump sum.

A tariff (when costs are positive)[12] moves the foreign firm's reaction function to the right[13] as in Diagram 5. The analysis comparing a VER to an equivalent tariff is similar to that comparing a VER at the Nash equilibrium level, to the equilibrium in the absence of any restriction. To substantiate the first point, compare the level of domestic prices under a quantitative restriction set at the level of imports induced by a tariff, and the tariff. The former are greater than the latter. This is shown in Diagram 5. $B^*(p,t)$ is the best response function of the foreign firm with the tariff, and R_T is the level of imports with the tariff. $B^{*R}(P, R_T)$ and $B^R(P^*, R_T)$ are the best responses of the foreign and domestic firms respectively in the presence of a VER at the level of imports prevailing under the tariff at rate t. The notation used in Diagram 5 corresponds to that previously introduced for examining the effect of a VER. Both p^L and p^H are above p^T, the price of the home good with the tariff. Also, $\hat{p}^*$ is greater that p^{*t}, the price of the foreign good with the tariff. Thus, prices are greater under the VER than under the import equivalent tariff.

It is also easy to see that the domestic firm's profits are higher under the VER as compared to their level under the tariff, as V^t is greater than π^t.

The foreign firm's profits must rise due to a VER as long as the VER is not too severe. As shown, the profits of the foreign firm must rise if the restriction is set at the free trade level. As its profits are strictly greater with a VER at the free trade level, continuity arguments show that they should remain so when R_t is close to the free trade output level.

In addition, even if revenues of the tariff were returned to the firm as a lump sum transfer, the foreign firm would prefer a VER to a tariff. This is due to the equilibrium profits of the foreign firm with the VER being greater that its profits if the domestic firm randomized between p^H and p^L as given, and it charged p^{*t}. This is because it could have charged p^{*t}, but chose not to. If it had charged p^{*t}, it would have earned $p^{*t}R_t$ which is exactly the total price paid by consumers in the tariff regime, or what the foreign firm would get if tariff revenues were returned to it in a lump sum.

It is obvious that had we assumed that there were no "spillovers in demand" - that a tariff and a quota at the level of imports generated by the tariff would lead to the same level of domestic prices. Tariffs and quotas would be equivalent. However, this is not true in general.

My results show that tariffs and quotas are fundamentally nonequivalent in the case of oligopolistic markets, because of their different impacts on the way firms compete in the market.

The equivalence/non-equivalence of tariffs and quotas is an old issue in trade theory. Bhagwati (1969) pointed out that tariffs and quotas are not equivalent in the presence of monopoly elements. This section extended his results to oligopolistic markets.

Itoh and Ono (1982) consider the effect of a quota on the desirability of being the Stackelberg leader in a duopoly. Itoh and Ono (1984) claim that tariffs and quotas are equivalent, but considers only the case of no spillovers in demand. This is an extreme assumption and best viewed only as a hypothetical case that allows us to abstract from the effect of a quantitative restriction on interaction between firms. As such it is only of interest when compared to the no spillovers case.

5. Policy Implications

Voluntary export restraints have been shown to raise the prices and the profits of both the domestic and foreign firm. The question naturally arises of what implications we might draw for policy from these results.

An argument which might be made for VER's is that while a VER lowers consumer welfare by raising prices, it also raises the profits of domestic producers. If the gain in national welfare because of the latter outweighed the loss due to the former, national welfare would rise. In this event, VER's would be in the national interest despite being far from the first best policy. (See Brander and Spencer (1982) and Dixit (1983) for a discussion of such profit shifting effects.)

Notice, however, that as a VER causes both firms' profits to rise, there is no profit shifting from foreign to domestic firms. Thus, the increase in the domestic firm's profits occurs solely at the expense of domestic consumers, who also pay for the increase in the foreign firm's profits. Hence, one would expect national welfare to fall due to the absence of any profit shifting effects of a VER, so VER's would not be in the national interest. A possible exception arises if the market for the domestic product is more distorted that that for the foreign product and domestic output rises due to the VER. In this event the loss in welfare due to the decrease in imports and increase in foreign profits could be more than compensated for by the increase in domestic output. Of course, if domestic output fell due to a VER, welfare would have to fall as well. A fall in domestic output is sufficient, but not necessary for the national welfare to fall due to a VER. Another sufficient condition for national welfare to fall due to a VER is that world welfare fall when both prices rise.

Although the intuition for VER's to be welfare decreasing is clear, a formal argument is useful. This is provided next.

<u>Theorem 5</u>: If both firms' profits rise due to a VER, and world welfare decreases when both prices increase, national welfare must fall. Domestic output must rise due to the VER for it to be possible that national welfare also rises.

<u>Proof</u>: The demand side is represented by an aggregate consumer with utility $u(Q^*,Q) + n$, where n is the consumption of a numeraire good. Profits of the domestic firm are returned to the consumer as a lump sum.

Utility maximization subject to the budget constraint yields the demand functions $Q^*(p^*, p)$ and $Q(p^*, p)$. Substituting for n in the utility function via the budget constraint gives the national welfare function:

$$N(p^*,p) = W(p^*, p) - \pi^*(p^*,p)$$

where $W(p^*, p)$ is the welfare function corresponding to <u>both</u> firms being domestic firms or world welfare. When $p = p^H$, and $p^* = \hat{p}^*$, the price paid by consumers is p^{*H}, and arbitrage profits of $(p^{*H} - p^*) R$ accrue to domestic arbitragers. Thus, substituting for n in the utility function, using the budget constraint, yields:

$$\begin{aligned} N(\hat{p}^*, p^H) &= W(p^{*H}, p^H) - (\hat{p}^* Q^*(p^{*H}, p^H) - C^*(Q^*(p^{*H}, p^H))) \\ &= W(p^{*H}, p^H) - \tilde{\pi}^*(\hat{p}^*, p^H) \end{aligned}$$

where the ~ on top of the π^* denotes the fact that demand is not met at these prices. When $p^* = \hat{p}^*$ and $p = p^L$, national welfare is given by:

$$N(\hat{p}^*, p^L) = W(\hat{p}^*, p^L) - \pi^*(\hat{p}^*, p^L)$$

Thus, expected national welfare with a VER is given by:

$$\begin{aligned} E(N) &= \alpha N(\hat{p}^*, p^H) + (1-\alpha) N(\hat{P}^*,P^L) \\ &= \{\alpha W(\hat{P}^*, P^H) + (1-\alpha) W(\hat{P}^*, P^L)\} \end{aligned}$$

$$-\{\alpha\tilde{\pi}^* (\hat{p}^*, p^H) + (1-\alpha)\pi^* (\hat{p}^*, p^L)\} .$$

Note that $\hat{p}^*$ is above P^{*N} and both p^H and p^L are above p^N. In addition, the foreign firm's expected profits rise due to a VER. Hence, if W is necessarily smaller when both p^* and p rise, national welfare must fall due to a VER.

Also as

$$\Delta W \simeq \frac{\partial W}{\partial p^*} \Delta p^* + \frac{\partial W}{\partial p} \Delta p$$
$$= (p^* - C^{*\prime}) \Delta Q^* + (P-C')\Delta Q ,$$

the possibility of W rising when p^* and p rise exists only if $\nabla Q > 0$. Therefore, N <u>could</u> rise due to a VER if domestic output rose, the domestic market was sufficiently distorted ((p − C′) was large enough) and foreign profits only rose slightly.

Another argument made in favor of VER's is that they create employment (or prevent unemployment which is desirable in itself. However, my analysis shows that employment may <u>fall</u> due to a VER.

A third argument made in favor of VER's is a more sophisticated one. It adapts the old infant industry arguments to a mature economy. The argument is that a mature economy subjected to unexpected shocks (like the oil-crisis) needs time to adapt its products (cars) and increase the competitiveness of its products relative to (Japanese) imports. VER's are a temporary measure to buy that time. However, VER's raise domestic profits, which is likely to make unions more aggressive in their demands, which would make it harder for domestic products to compete effectively in the future.[14]

An import equivalent export tax imposed by the exporting nation would not have the severe anti-competitive effects associated with a VER. In addition, prices and foreign profits would be lower. However, it is clear from an examination of history that trade restrictions tend to be self-perpetuating. For this reason, it is essential to link any restriction to increases in the efficiency of domestic producers so that the restrictions would ultimately be removed. It is in the interest of domestic producers to lobby for quantitative restraints over tax policies which are import equivalent, because of the anti-competitive nature of the former. For this reason, such proposals should be viewed with a good deal of suspicion by policy makers.

6. Conclusion

Voluntary export restrictions have been increasingly used lately as substitutes for more direct trade controls like tariffs or quotas. The presumption, however, has been that:

(1) Political or legal considerations dictate that tariffs cannot be used to restrict trade.

(2) VER's are both politically and legally feasible.

(3) Although far from being a first best solution they are in the national interest.

The analysis of this paper shows that the imposition of a VER in a duopolistic market, raises the profits of both the domestic and the foreign firm. They do so because of their adverse effect on competition in the market. This makes it quite unlikely for VER's to be in the national interest. The analysis shows that the <u>form</u> of the restriction is crucial in oligopolistic industries, as it affects the nature of strategic interaction between firms. As trade restrictions in oligopolistic industries may have unexpected effects, special care should be taken in formulating policy for such industries.

APPENDIX

Theorem I Assume that the line P^*P is steeper than $B(P^*)$[8], and that a unique maximum exists to $\Pi(P^*(P,R), P)$ which is attained at $P=P^H$. If R is set at or close to the free trade level, there is no equilibrium in pure strategies.

Proof: It is enough to show that P^H is greater than $P(\hat{P}^*, R)$ and that this is greater than $B(\hat{P}^*)$, which equals P^L. The iso-profit curve that sets profits of the domestic firm at the level V is convex in P. It reaches a minimum at $\hat{P}^*$. Therefore, $P^*(P^H, R)$ which equals P^{*H} is greater than $\hat{P}^*$. This means that $P(\hat{P}^*, R)$ is less than P^H. As $B(P^*)$ is flatter than $P(P^*, R)$, and as they are both positively sloped and intersect at a point to the left of $\hat{P}^*$, $B(\hat{P}^*)$ (which is P^L) is less than $P(\hat{P}^*, R)$. Note that Theorem 1 implies that as $P^H > P(\hat{P}^*, R) > P^L$, $P^{*H} > \hat{P}^* > P^{*L}$.

Theorem 4 If there are no spillovers in demand, and the equilibrium is stable in the presence of a VER, a VER set slightly below the free trade level must raise both firms profits and prices.

Proof: The formal proof is elementary, though tedious. As a decrease in R is being considered, foreign firm's profit function is given by $p^*R - C^*(R)$. Differentiating the profit functions with respect to R and evaluating them at the free trade prices (with R set at the level of output implied by the free trade prices) gives:

$$\frac{d\Pi^*}{dR} = \left(\frac{\partial\Pi^*}{\partial p^*}\right)\left(\frac{dp^*}{dR}\right) + \left(\frac{\partial\Pi^*}{\partial p}\right)\left(\frac{dp}{dR}\right) + \left(\frac{\partial\Pi^*}{\partial R}\right),$$

$$= R\left(\frac{dp^*}{dR}\right) + (p^* - C^{*\prime})$$

and

$$\frac{d\Pi}{dR} = \left(\frac{\partial \Pi}{\partial p^*}\right)\left(\frac{dp^*}{dR}\right) + \left(\frac{\partial \Pi}{\partial p}\right)\left(\frac{dp}{dR}\right)$$

$$= \left(\frac{\partial \Pi}{\partial p^*}\right)\left(\frac{dp^*}{dR}\right) .$$

There are two effects of the VER on the domestic firm's profits: the effect on profits due to the change in its own price, and that due to the change in its competitor's price as R is lowered from the free trade level. As the derivative is being evaluated at R equal to the free trade import level, we can use the first order conditions for a maximum. Thus, the first order effect due to its own price change is zero. As the effect on the second firm's profits when its competitor raises its price is positive, $\left\{\frac{\partial \Pi}{\Pi p^*} > 0\right\}$, the net effect on the second firm's profits depends on the sign of $\frac{dp^*}{dR}$. That this is negative is easy to show.

The slope of the best response function of the foreign firm in the absence of any restrictions is given by:

$$\frac{dB^*}{dp}(P) = \frac{\Pi^*_{12}}{-\Pi^*_{11}} = \frac{a_1}{b_1}$$

Both numerator and denominator are positive by our assumptions on the profit function. Similarly, let the slope of firm 2's best response function be given by:

$$\frac{dB(P^*)}{dp^*} = \frac{a_2}{b_2}$$

with both the numerator and the denominator positive for similar reasons. The slope $\frac{dp}{dp^*}$ of the line P^*P is given by $\left(\frac{-Q_1^*}{Q_2^*}\right)$. Stability in the absence and presence of a VER requires that $\left(\frac{a_1}{b_1}\right)^{-1} > \frac{a_2}{b_2}$ and that $\frac{a_2}{b_2} < \frac{-Q_1^*}{Q_2^*}$. The foreign firm can be thought of as maximizing its profits subject to Q^* being less than or equal to R , while the domestic firm maximizes its own profits. Differentiating the first order conditions and using Cramer's rule gives the expression for $\frac{dp^*}{dR}$ to be:

$$\frac{dp^*}{dR} = \frac{b_2}{(a_2Q_2^* + b_2Q_1^*)}$$

This is negative, as the denominator is negative if the system is stable, and the numerator is positive. Thus, the domestic firm's profits rise whenever R falls.

The total effect of a VER on the foreign firm's profits is made up of the direct effect on profits, as well as the indirect effects on profits which operate through p^* and p . The effect via p is zero by the definition of the foreign firm's profit function for decreases in R. As the derivatives are being evaluated at the free trade levels, the first order conditions for a maximum can be used. Thus, $(p^* - C^*) = \frac{-R}{Q_1^*}$. This implies that:

$$\frac{d\Pi^*}{dR} = \frac{R\,(-a_2Q_2^*)}{[Q_1^*\,(a_2Q_2^* + b_2Q_1^*)]} ,$$

so that the foreign firm's profits rise when R is lowered from the free trade level of its output.

Thus, as long as the stability condition is met, both firms' profits and prices rise as a slightly restrictive VER is imposed. Although the diagrams are drawn so the P^*P is flatter than $B^*(p)$, it is obvious that the result holds even if P^*P is steeper than $B^*(p)$ as the proof does not depend on the relative slopes of $B^*(p)$ and P^*P. It can also be seen in a diagram similar to Diagram 1 as the equilibrium would move up along $B(p^*)$ as R falls, in this case as well.

FOOTNOTES

[1] Whether or not the nature of interaction is affected by a trade restriction depends on how competitively firms behave and the form of the restriction. For example, a restriction on market shares when firms compete in quantities has a similar effect to a restriction on output (or market share) when firms compete on prices, as they all affect the nature of interaction between firms. The importance of the strategic variable for policy is also brought out in Eaton and Grossman (1983).

[2] See Bhagwati (1969).

[3] If goods are produced at constant marginal and average costs, and there is no possibility of profitable resale in between markets, firms may compete in other markets as well. I will also assume that a numeraire good exists and hence, that there are no income effects.

[4] For conditions sufficient to ensure this see Friedman (1981).

[5] This insures continuity of the functions B and B^*. Reasonable demand functions may lead to non-concave profit functions - as in Roberts and Sonnenschien (1977).

[6] It is assumed, in other words, that $\Pi(p^*(P,R), P)$ has a unique finite maximum attained at $P = P^H$.

[7] This is because the domestic firms profit function becomes non-concave due to the VER.

[8] If P^*P was flatter than $B(P^*)$ no maximum to $\Pi(p^*(P,R), P)$ would exist given our assumptions about profits increasing in the competitors' price, as demonstrated by the following argument. If P^* ($>P^{*N}$) were the price charged by the foreign firm, the domestic firm would be able to

ensure itself $\Pi(P^*(B(P^*), R), B(P^*))$ by charging $B(P^*)$. However, as $B(P^*)$ lies above P^*P, in this region it can certainly get more by raising its price, even if the scarcity price of the foreign good remained at $P^*(B(P^*), R)$. In addition, as the scarcity price of the foreign good rises as well - profits rise even more. As this argument can be repeated, no maximum to the above profit function can exist.

[9] See Fellner (1949), pp. 77-86 for an excellent discussion.

[10] If the strategy sets (the prices that can be charged) are assumed to be non-empty and compact, existence is ensured by Glicksburg's theorem as profit functions remain continuous despite the VER. See Dasgupta and Maskin (1982).

[11] An example of a linear model that satisfies these assumptions is that of Gabszewicz and Thisse (1979), also used by Shaked and Sutton (1982).

[12] If costs were zero, the presence of a tariff would not affect the reaction function of firm 1, as the profit function facing the foreign firm with a tariff would be a monotonic transformation of the profit function in the absence of one.

[13] If a tariff at rate t is imposed, the revenue of the foreign firm, when it sets a <u>market</u> price of p^*, is $(1-t)p^*Q^*(p^*,p)$. Note that the <u>market</u> price is p^*. Its profits are denoted by $\Pi^*(p^*, p, t)$ which is equal to $p^*(1-t)Q^*(p^*, p) - c^*(Q^*(p^*, p))$. Maximizing this with respect to p^* gives the first order condition

$$\Pi^*_1 (p^*, p, t) = 0$$

Totally differentiating the first order conditions gives:

$$\Pi^*_{11}dp^* + \Pi^*_{12}dp + \Pi^*_{13}dt = 0.$$

Therefore, the change in p^* (or p) as t changes when p (or p^*) is fixed is given by:

$$\frac{dp^*}{dt} = \frac{-\Pi^*_{13}}{\Pi^*_{11}} \qquad \left(\text{or } \frac{dp}{dt} = \frac{-\Pi^*_{13}}{\Pi^*_{12}}\right)$$

As $\Pi^*_{13} = -\dfrac{c^{*\prime} Q^*_1}{(1-t)} > 0$, $\Pi^*_{11} < 0$, $\Pi^*_{12} > 0$,

the reaction function of the foreign firm moves to the right as in Diagram 5.

[14]This seems to be exactly what is happening in the U.S. auto industry.

[15] An example of a linear model that satisfies these assumptions is that of Gabszewicz and Thisse (1979), also used by Shaked and Sutton (1982).

REFERENCES

1. Bhagwati, J.N. (1969); Trade, Tariffs and Growth. London: Tinling, 1969

2. Brander, J. and Spencer, B. (1982); "Tariff Protection and Imperfect Competition" in Monopolistic Competition in International Trade (ed. H. Kierzkowski). Oxford: Oxford University Press, forthcoming.

3. Dasgupta, P. and Maskin, E. (1982); "The Existence of Equilibrium in Discontinuous Games, I: Theory," ICERD Discussion Paper No. 82/54, London School of Economics.

4. Dixit, A. (1983); "International Trade Policy for Oligopolistic Industries," Woodrow Wilson School Discussion Paper No. 48. Princeton University.

5. Eaton, J. and Grossman, G. (1983); "Optimal Trade and Industrial Policy under Oligopoly," Woodrow Wilson School Discussion Paper No. 59, Princeton University.

6. Fellner, William (1949); Competition Among the Few. New York: Augustus M. Kelly, 1960.

7. Friedman, J. (1981); "Oligopoly Theory," in The Handbook of Mathematical Economics, Vol. 2, ed. by K. Arrow and M. Intriligator, North Holland Publishing Co., pp. 501-505.

8. Gabszewicz, J.J. and Thisse, J.F. (1979); "Price Competition, Quality and Income Disparities," Journal of Economic Theory, Vol. 20, pp. 340-359.

9. Itoh, M. and Ono, Y. (1982); "Tariffs, Quotas, and Market Structure," Quarterly Journal of Economics, May, 1982.

10. Itoh, M. and Ono, Y. (1984); "Tariffs vs. Quotas under Duopoly of Heterogeneous Goods," (Forthcoming) Journal of International Economics.

11. Roberts, J. and Sonnenschein, H. (1977); "On the Foundations of the Theory of Monopolistic Competition," Econometrica, Vol. 45, No. 1, pp. 101-113.

12. Shaked, A. and Sutton J. (1982); "Relaxing Price Competition Through Product Differentation," The Review of Economic Studies, Vol. 49, pp. 3-13.

Table 1

Variable	Equilibrium value
p^{*N} $(=p^N)$	$a/(2b-1)$
Q^{*N} $(=Q^N)$	$ab/(2b-1)$
p^{*H}	$\dfrac{\{2a(b-1)(b^2-1) + a(2b^2-1)\}}{2b(2b-1)(b^2-1)}$
p^H	$\dfrac{a(2b^2-1)}{2(2b-1)(b^2-1)}$
$E(\Pi)$ $(=V)$	$\dfrac{\{a(2b^2-1)\}^2}{\{2(2b-1)\}^2\, b(b^2-1)}$
$\hat{p}^*$	$\dfrac{ah(b)(2b^2-1) - a(2b-1)}{(2b-1)}$
$h(b)$	$\{1/(b^2-1)\}^{\frac{1}{2}}$
p^L	$\dfrac{ah(b)(2b^2-1)}{2b(2b-1)}$
p^{*L}	$\dfrac{2ab(b-1) + ah(b)(2b^2-1)}{2b^2(2b-1)}$
$\dfrac{\alpha}{1-\alpha}$	$\dfrac{\{h(b)(2b^2-1) - 2b\}(4b^2-1)}{2b^2}$
$E(Q)$	$a + \alpha p^{*H} + (1-\alpha)\hat{p}^* - b(\alpha p^H + (1-\alpha)p^L)$

Table 2

Π^{*N} $(=\Pi^N)$	37.5
p^{*N} $(= p^N)$	5.00
Q^{*N} $(=Q^N)$	7.5
p^{*H}	6.333
p^H	7.0
$E(\Pi)$	40.8
$E(\Pi^*)$	45.99
$\hat{p}^*$	5.645
p^L	5.215
$E(p)$	5.548
α	.1865
$E(Q)$	7.451
$E(Q^*)$	6.888

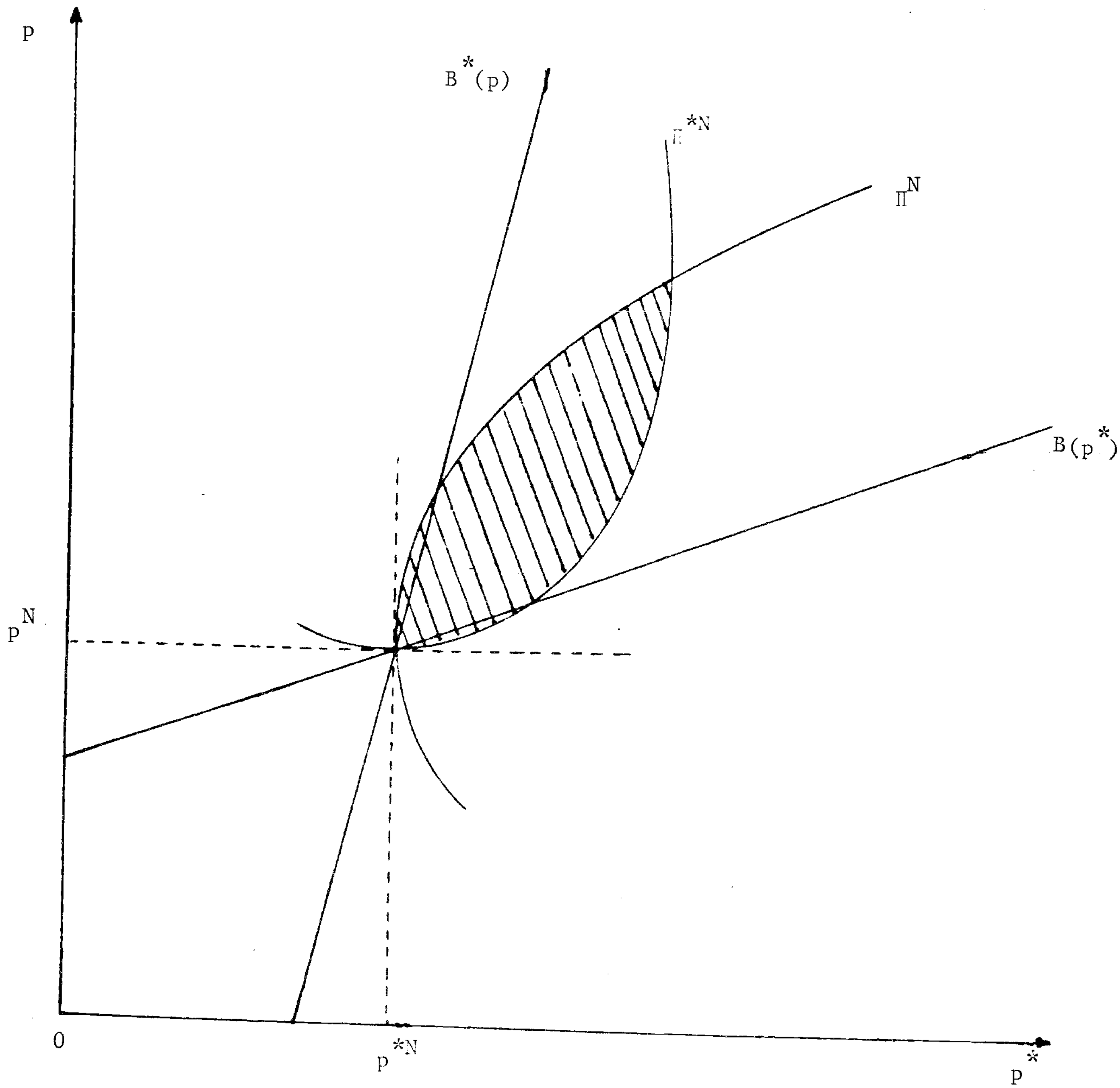
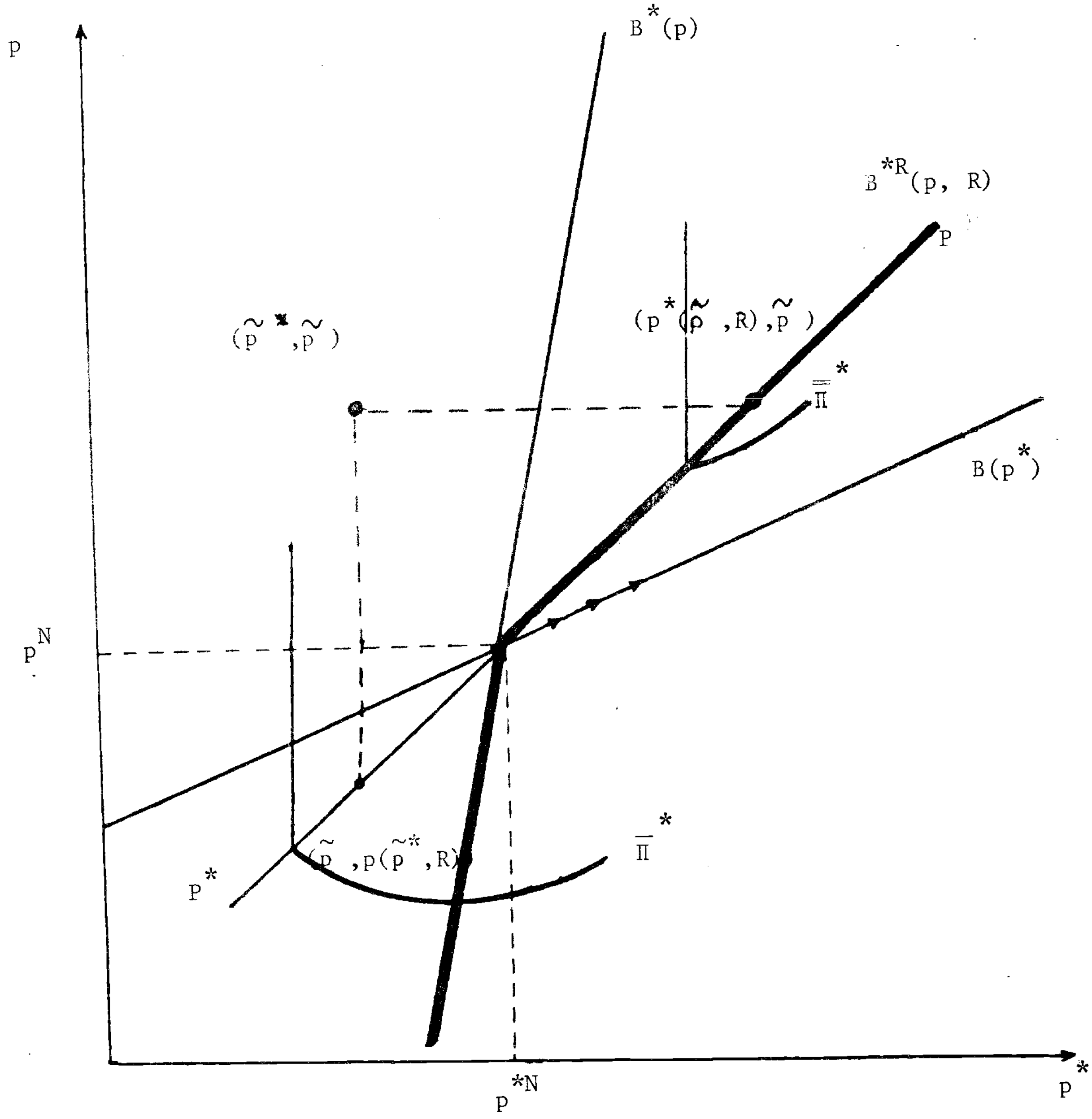


Diagram 1



p
$B^*(p)$
$B^{*R}(p, R)$
p
$(\tilde{p}^*, \tilde{p})$
$(p^*(\tilde{p}, R), \tilde{p})$
$\bar{\bar{\Pi}}^*$
$B(p^*)$
p^N
$(\tilde{p}, p(\tilde{p}^*, R))$
$\bar{\Pi}^*$
p^*
p^{*N}
p^*

Diagram 2

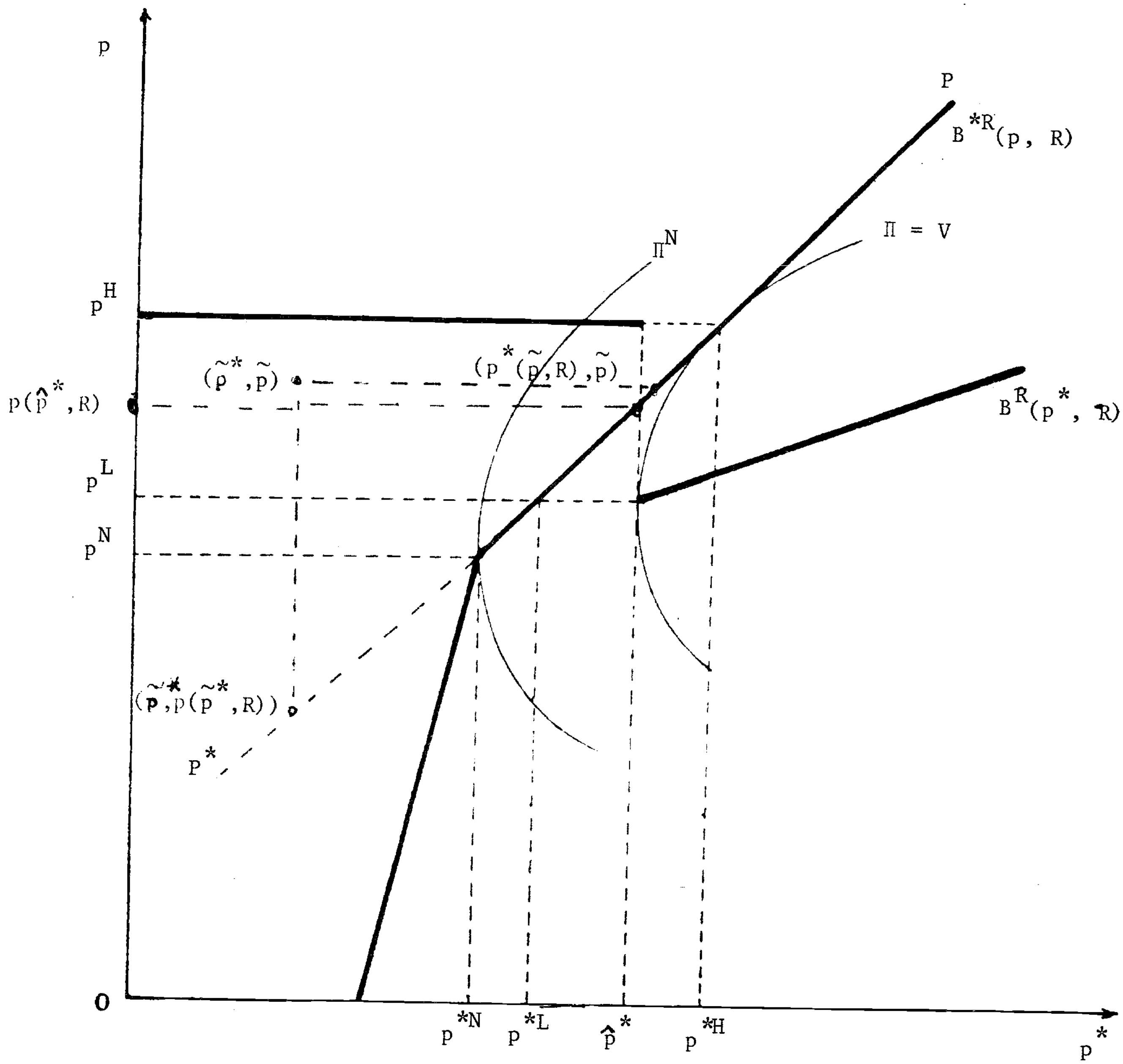

p
P
$B^{*R}(p, R)$
Π^N
$\Pi = V$
p^H
$(\tilde{p}^*, \tilde{p})$
$(p^*(\tilde{p}, R), \tilde{p})$
$p(\hat{p}^*, R)$
$B^R(p^*, R)$
p^L
p^N
$(\tilde{p}^*, p(\tilde{p}^*, R))$
p^*
0
p^{*N}
p^{*L}
$\hat{p}^*$
p^{*H}
p^*

Diagram 3

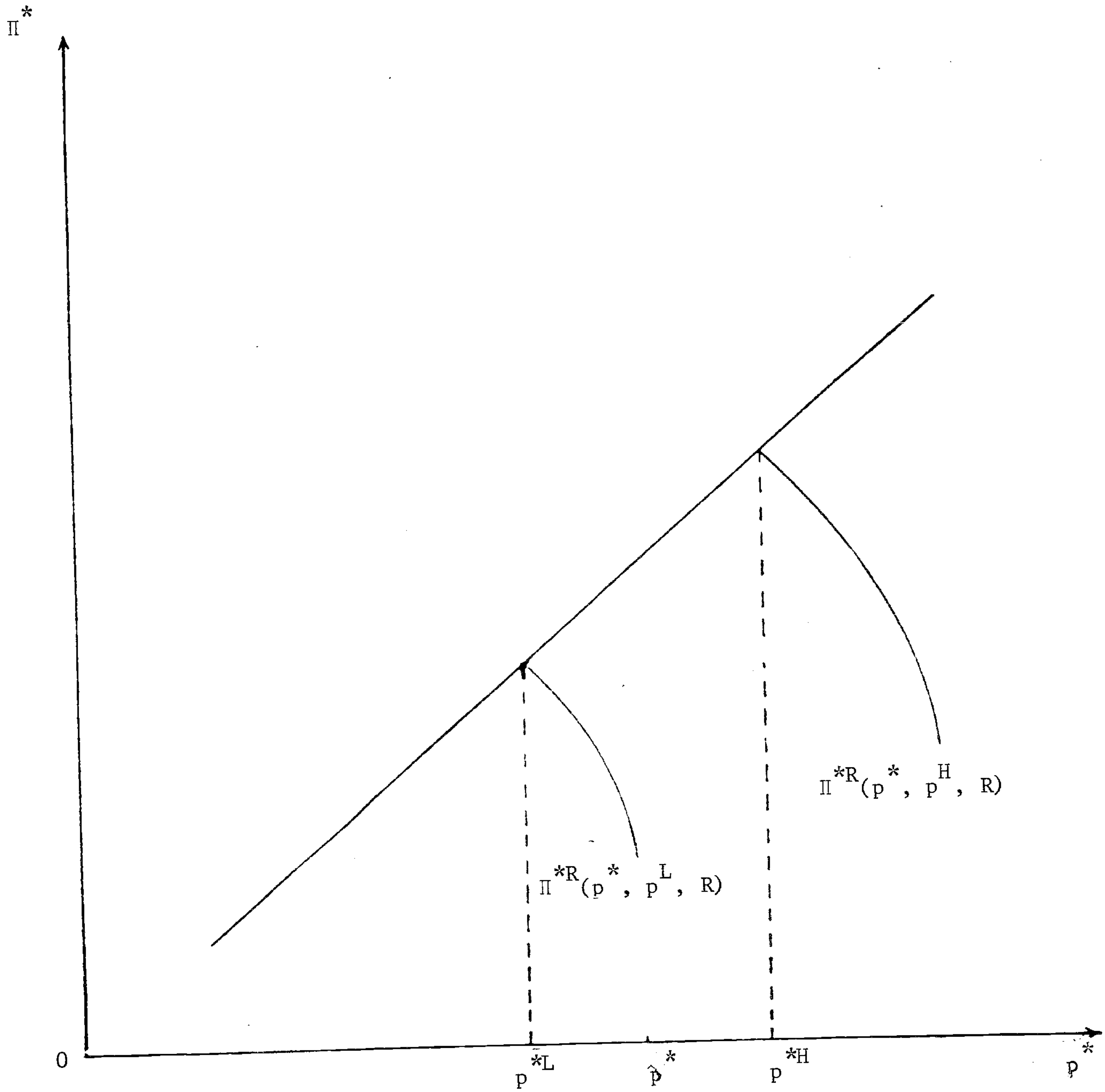


Diagram 4

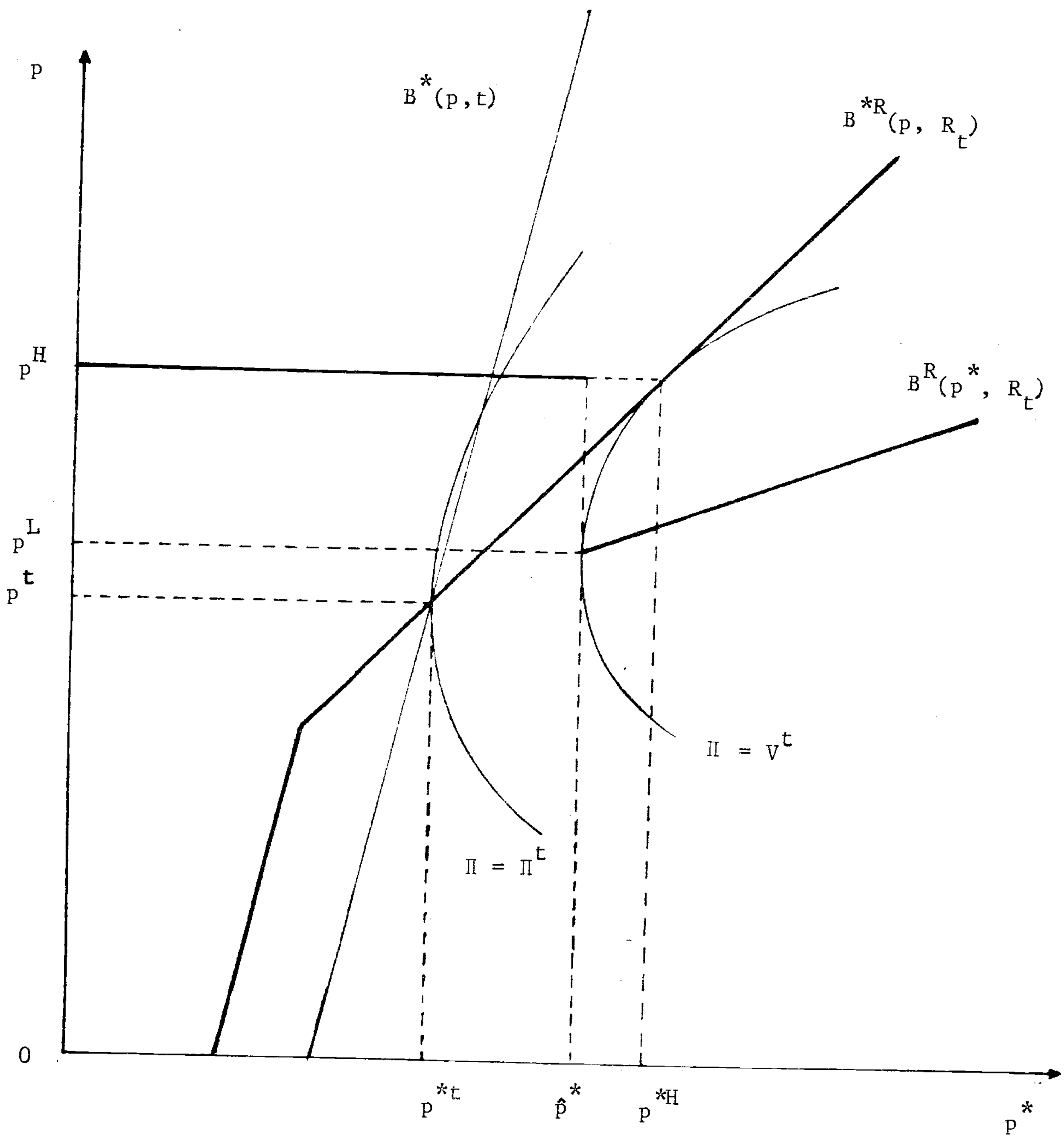


Diagram 5