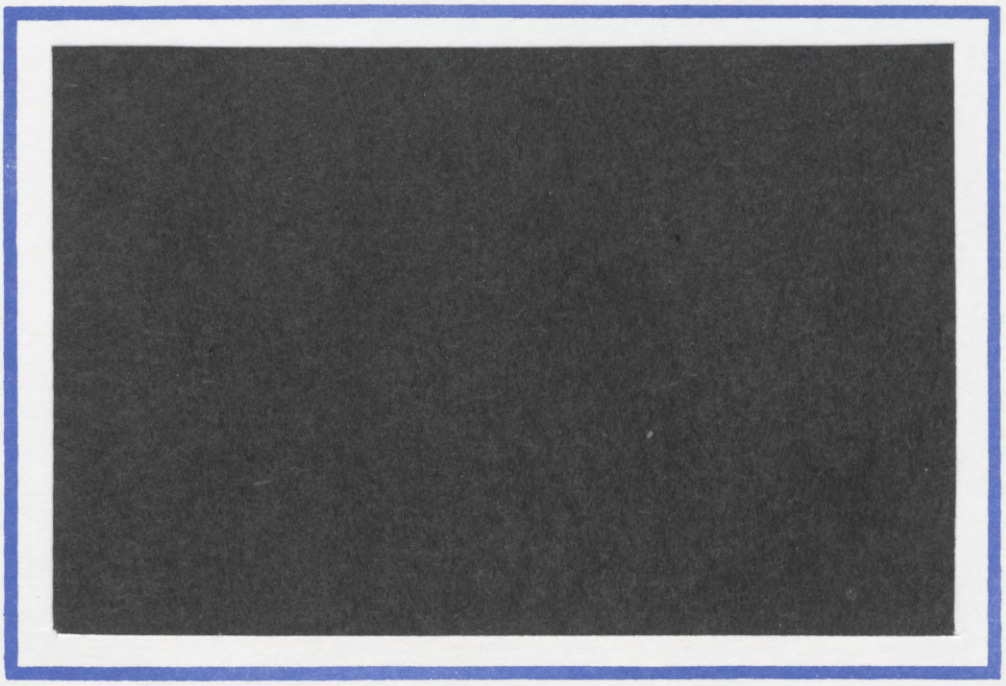
TEL-AVIV

18-87

THE FOERDER INSTITUTE FOR ECONOMIC RESEARCH
TEL-AVIV UNIVERSITY
RAMAT AVIV ISRAEL



מכון למחקר כלכלי ע"ש ד"ר ישעיהו פורדר ז"ל
ע"י אוניברסיטת תל-אביב

TRADE LIBERALIZATION AND IMPERFECT COMPETITION: A WELFARE ANALYSIS*

by

Rafael Eldor** and Dan Levin***

Working Paper No.18-87

First Draft: August, 1986

Revised, August, 1 9 8 7

* We would like to thank Elhanan Helpman and Roy Ruffin for helpful comments on an earlier draft. Part of this research took place while Dan Levin was visiting at Tel-Aviv University in the summer of 1986.

** Boston University and Tel-Aviv University

***University of Houston, Texas.

This research was supported by funds granted to the Foerder Institute for Economic Research by the NUR MOSHE FUND

FOERDER INSTITUTE FOR ECONOMIC RESEARCH
Faculty of Social Sciences
Tel-Aviv University, Ramat Aviv, I s r a e l.

ABSTRACT

This paper identifies sufficient conditions for an increase/decrease in a country's welfare due to partial trade liberalization where the domestic industry is characterized by a monopoly or Cournot oligopoly. Different trade restrictions are considered. Those are quotas imposed by the foreign country (VERs), quotas imposed by domestic country and tariffs. In the case of VERs, welfare unambiguously decreases when the first unit of trade is introduced into the economy. It is shown that the decrease in welfare due to additional import under VERs may take place for a substantial range. On the other hand, as we leave free trade position to restrict the last unit of trade, under VER, welfare unambiguously decreases even in the large country case. In the case of quotas, if the domestic marginal cost is greater or equal than the foreign price cum transportation cost, then importing country's welfare rises due to additional import. When he marginal cost is lower than the foreign price cum transportation cost, and export is not possible, then welfare may decrease with additional import. Thus, in general, there is no monotonic relationship between the reduction in the degree of quota (both export and import quota) and importing country's welfare. In the case of tariffs, as the tariff is reduced from the prohibitive rate, welfare rises.

I. Introduction

An alternative approach to international trade based on increasing returns to scale and imperfect competition has been developed in recent years. This theory succeeded in explaining trade phenomena that could not be explained by the traditional factor's proportions approach (see, for example, Dixit and Norman [1980], Ethier [1979], Helpman [1984], Helpman and Krugman [1985], Krugman [1979, 1981, 1984], and Lancaster [1980]). Industrial policy under imperfect competition and increasing returns to scale has also been investigated recently (see, for example, Brander and Spencer [1984, 1985], Dixit [1984], Eaton and Grossman [1983], Flam and Helpman [1985], Krugman [1984], and Spencer and Brander [1985]). On the other hand, most of the analysis of trade liberalization that has been developed lately assumed a competitive environment (see, for example, Aizenman [1981, 1983], Baldwin, Mutti and Richardson [1980], Bhagwati [1978], Buffie [1984], Krueger [1978], and Markussen [1981]).[1]

Trade liberalization is often partial. In many trade agreements the movement toward free trade is step-by-step (see, for example, different rounds of GATT or different countries' agreements with the E.E.C.). Not only the decrease in the trade restrictions is partial, but also it may not be valid in all the industries (across the board).

The purpose of this paper is to identify sufficient conditions for an increase/decrease in country's welfare when (i) we move one small step out of autarky position, (ii) along the way to free trade and (iii) when we start to use commercial policy from a free trade position. It also sheds some light on

the magnitude of trade liberalization that has to take place until gains from trade can be established.

This paper considers a monopoly or Cournot oligopoly in the industry which its product is imported in free trade. The rest of the industries are characterized by constant returns to scale and perfect competition. It shows that in the case of a voluntary export restraint by the foreign country (VER), opening the country to the first unit of trade unambiguously decreases welfare. It might be a substantial volume of trade until country's welfare rises above autarky level. In the linear demand linear cost case, under a VER, as long as the quantity produced domestically is greater than the quantity imported, we find a decrease in welfare due to additional increase in imports. It also shows that moving out of a free trade position, disallowing the last unit of trade to enter the country, under VER country's welfare unambiguously decreases even in the large country case. However, in the case of tariffs, as we decrease the tariff from the prohibitive rate, welfare rises. In the case of quotas, country's welfare improves for any increase in the quota if the foreign price cum transportation cost is equal or lower than the domestic marginal cost. If the foreign price cum transportation cost is greater than the domestic marginal cost, and this industry does not export (because of transaction costs, for example), then country's welfare could decrease or increase due to a change in import restrictions. Thus, in general, there is no monotonic relationship between the reduction in the degree of quota (both export and import quota) and importing country's welfare.

The plan of the paper is as follows. In section II a domestic monopoly case is analyzed and in section III we analyze a Cournot oligopoly. The final section concludes the paper with some remarks.

II. Monopoly and Trade Restrictions

Consider an industry in the domestic country where a monopoly exists in autarky. In order to focus on the welfare implications of the industry under investigation we assume that the rest of the economy is characterized by constant returns to scale and perfect competition. We do not rule out increasing returns for the industry analyzed by us.

Let M denote the quantity of imports sold in the domestic country at the monopolist price, and let X be the quantity produced and sold by the domestic monopoly. Let $P(X+M)$ be the (inverse) demand for the product with $P' < 0$ and $C(X)$ its cost function with $C' > 0$. The demand function and the cost function are assumed to be twice continuously differentiable. The monopolistic problem is to choose X so as to maximize $[P(X+M)\cdot X - C(X)]$. Let $X(M)$ be the internal solution to the monopolist problem, then the first and the second order conditions are respectively

$$(1) \qquad P(X(M)+M) + P'(X(M)+M)\cdot X(M) - C'(X(M)) = 0$$

$$(2) \qquad 2P'(X(M)+M) + P''(X(M)+M)\cdot X(M) < 0.$$

Assumption 1 (A1). At all possible outputs, the marginal revenue faced by the monopolist is steeper than the demand function, i.e., $2P' + P''X < P'$.[2]

An increase in the import quota causes a reduction in the residual demand facing the monopolist. Hence:

Lemma 1: Under (A1), an increase in import results in a decrease in the monopolist's output, i.e., $\frac{dX(M)}{dM} < 0$.

Proof: Differentiating (1) yields:

$$(3) \qquad dX(M)/dM = (P'+P''\cdot X)/-[2P'+P''\cdot X-C''].$$

By the second order conditions the denominator is always positive, using (A1), we obtain $\frac{dX}{dM} < 0$.[3]

Let us use as a welfare measure the sum of consumer and producer surplus, and government revenues. At the monopolist equilibrium we have

$$(4) \qquad W(M) = \int_0^{X(M)+M} [P(s)-P(X(M)+M)]ds + P(X(M)+M)\cdot X(M)-C(X(M)) + [P(X(M)+M) - P^*(M)]M$$

where $W(\cdot)$ is the welfare level and P^* is the foreign price cum transportation cost. The last term on the RHS of (4) is government's revenues from auctioning off the quota licenses. In the case of a voluntary exports

restraint (VER) by the foreign country, which may well be the most rapidly spreading of protectionism instrument in developed countries, this term does not exist, i.e.

$$(4') \qquad W^V(M) = \int_0^{X(M)+M} [P(s)-P(X(M)+M)]ds+P(X(M)+M)\cdot X(M)-C(X(M))$$

when $W^V(M)$ is the welfare level in the VER case.[4]

In many situations the relaxation of import restrictions is partial, or industry specific and the movement toward free trade is step by step. Therefore, it is interesting to evaluate the changes in W due to a change in M, i.e., the impact of increasing imports. For the case of a VER (4') with simple manipulations we obtain:

$$(5) \qquad dW^V(M)/dM = (P-C')\frac{dX}{dM} - P'M(\frac{dX}{dM} + 1).$$

Thus, voluntary export restraint by the foreign country influences domestic welfare in two ways (as is observed from equation (4)). First, an increase in import shifts the domestic demand faced by the monopolist inward which in turn causes a contraction in dometic output. Since price is above marginal cost, this constitutes a negative effect on welfare. The second way is an opposite term of trade effect. That is, an increase in import **decreases** the price the domestic country pays for its import (a positive effect). A conclusion that follows from this analysis is formulated in proposition 1.

Proposition 1: Assume a monopoly in the domestic importing industry and voluntary export restraint by the foreign country, then under A1, the introduction of the "1st unit" of import reduces welfare.

Proof: $$\left.\frac{dW^V(M)}{dM}\right|_{M=0} = (P-C')\frac{dX}{dM} = -P'X\frac{dX}{dM} < 0.$$

The last inequality follows from Lemma 1.

□

Proposition 1 implies that in the VER case no trade is better than a little trade; or a small increase in competition decreases welfare. The economic forces at work in the proposition can be described in two stages. In the first stage, before the domestic industry adjusts its output, as the first unit of import is introduced into the domestic economy domestic price falls at a rate of P'. Thus, consumer surplus increases by the fall in price times domestic consumption. But at $M = 0$, domestic consumption equals monopoly's output, hence producer's surplus falls exactly by the same amount. However, in the second stage, domestic monopoly reacts by contracting output produced (Lemma 1) so as to maximize its profits. This contraction when $P > C'$ results in a decrease in economy's welfare.[5]

The following example shows that the decrease in welfare due to additional import under VERs may take place for a substantial range. Assume a linear demand function, a linear monopoly cost function, and a voluntary

export restraint by the foreign country (i.e., $P'' = C'' = 0$). Under these assumptions, equation (3) is reduced to $dX(M)/dM = -1/2$. Thus, using (1) and (5) one obtains

$$\text{sign}[\frac{dW^V}{dM}] = \text{sign}[M-X].$$

In other words, in the linear demand linear cost case, under a VER, as long as the quantity produced domestically is greater than the quantity imported, we find a decrease in welfare due to additional increase in import. At $X = M$, country's welfare is globally minimum (since at $M < X$ $dW^V/dM > 0$ and at $M > X$ $dW^V/dM > 0$). With the additional assumption that $P* = C'$, it is shown in the appendix that country's welfare reaches autarky's level at $M = 4X$ (i.e., when import constitutes 80 percent of domestic consumption), and reaches its maximum at free trade. Figure 1 depicts this case.

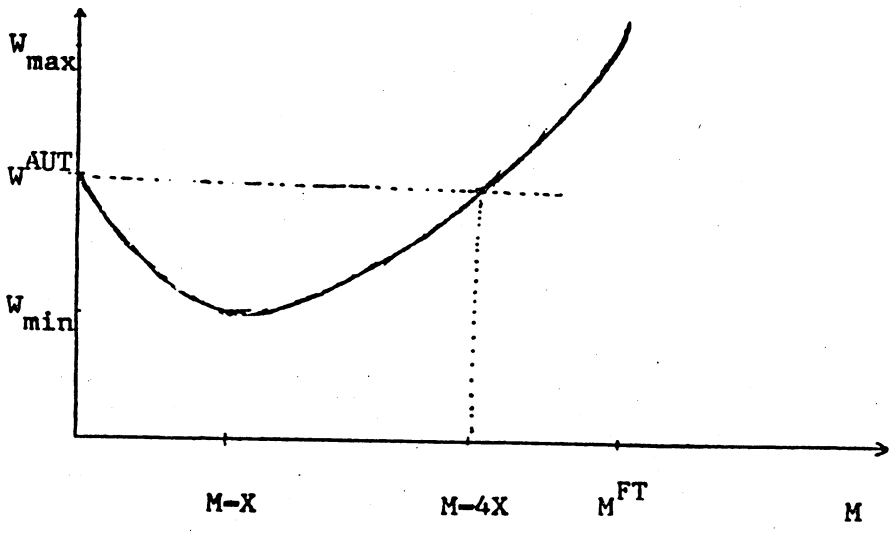


Figure 1

It can also be seen from figure 1 that in this case importing country's welfare unambiguously decreases as import is voluntarily restricted from the

point of free trade. In the general case, there are three cases for the marginal cost curve, as depicted in figure 2. Only case (a) is relevant for the VER because in cases (b) and (c) there is no import in free trade.

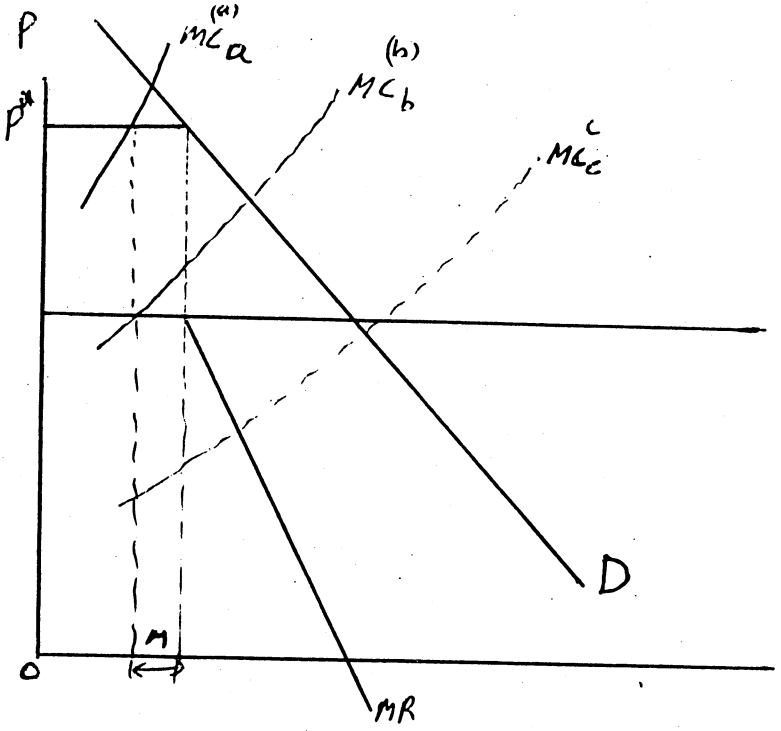


Figure 2

In case (a), the domestic price equals the monopolist's marginal costs at free trade. Using (5) to analyze the welfare consequence of admitting the last unit of import (abolishing the VER) we find that the first term on the RHS disappears. When domestic output contraction is less than 1 (as implied by the following assumption), the second term is always positive, i.e., the level of welfare rise as a result of abolishing the VER.

Assumption 2 (A2). At all possible outputs, the slope of the monopolists' marginal cost function (strictly) exceeds the slope of the demand function, i.e., $C''(X) > P'(X+M)$.[6]

The above analysis is summarized in the following proposition.

Proposition 2: Assume a monopoly in the domestic importing industry, (A1) and (A2), then restricting the "last unit" of import of entering the country by VER unambiguously reduces welfare.

We now turn to the analysis of the impact of an increase in import in the case of quota licenses. We first analyze a small country case (i.e., P^* is exogenously given). Using (4) with simple manipulations we obtain

$$(6) \qquad \frac{dW^S(M)}{dM} = (P-C')\frac{dX}{dM} + (P-P^*)$$

where $W^S(\cdot)$ denotes the small country welfare level. The economics interpretation of equation (6) can be described again in two stages. At the first stage (before the domestic industry responds), due to the introduction of additional units of import, consumer surplus rises by the fall in price P' times the amount consumed. This equals precisely the fall in government revenues and producer surplus. In the second stage, government revenues increase by $P-P^*$ (a positive effect). One may consider the importers as producers with a unit cost equal to P^*. Thus, if domestic output contraction is less than one, and domestic marginal cost is greater than the importers' unit cost, the net effect is an increase in welfare. This is summarized in proposition 3.

Proposition 3: Assume a monopoly in the domestic importing industry of a small country and import restriction in the form of quota licenses

which are auctioned off. If (A1) and (A2) hold and the domestic marginal cost is greater or equal to the foreign commodity price, any increase in import increases welfare until free trade, i.e.,

if $P^* \leq C'$ then $\frac{dW^S}{dM} > 0$.

Proof: Equation (3) may be rewritten as $\frac{dX(M)}{dM} = -1 + \frac{P' - C''}{2P'+P''X-C''}$.

Using (A2) and the second-order condition imply that $\frac{dX}{dM} > -1$. Thus, using (6) one obtains

$$\frac{dW^S(M)}{dM} = (P-C')(1 + \frac{dX}{dM}) + (C' - P^*) > 0.$$

□

In the large country case, where the foreign price P^* is a function of M we have to consider also the terms-of-trade effects of relaxing the quota restriction. Hence (6) becomes

$$(7) \qquad \frac{dW(M)}{dM} = (P-C')\frac{dX}{dM} + (P-P^*(M)) - M\frac{dP^*(M)}{dM}.$$

It can be seen from (6) and (7) that at $M = 0$, the introduction of the first unit of import in the case of quota licenses may decrease welfare. This result is summarized in the following proposition.

Proposition 4: Assume a monopoly in the domestic importing industry, import restrictions in the form of quota licenses and the industry does not export (because of transportation costs, for example). If (A1) holds and if $\left|[P - C'(X(0))]\frac{dX}{dM}\right| > (P-P*)$ then the introduction of the first unit of import decreases welfare.

In words, if the monopolist's marginal cost at the autarky level $C'(X(0))$ are low enough and the own production effect $\frac{dX}{dM}$ is sufficiently large in absolute value, then no trade is better than a little trade.

In the case of a tariff, the monopolist's marginal revenues coincides with the foreign price plus the tariff, until it reaches the domestic demand function. Then it jumps either to marginal revenue derived from the domestic demand function or to the infinite elastic demand from abroad at $P*$. This is called the "effective marginal revenue curve" (see Fishelson and Hillman (1979) for an elaborate discussion). If we start from the autarky price of the importing industry, as the (prohibitive) tariff rate decreases, the monopolist output increases and so does country's welfare. But import does not increase immediately. The country starts to import only when the monopolist marginal cost equals to the domestic price ($C' = P$). At that point, the firm's monopoly power disappears.

The above results are summarized in Table A where t denotes the tariff rate. For completeness, we also bring the well-known effect of a tariff on a large country (see Ethier (1983), p.551).

In the next section we will show the results arrived at for the monopoly case hold also for the Cournot oligopoly case where the number of firms is fixed.

III. Trade Restrictions and Cournot Oligopoly

Consider an industry in the domestic country where a Cournot oligopoly exists, i.e., $n \geq 2$ Cournot firms each produces output $X_i > 0$ with cost function $c_i(X_i)$ where $C_i'(X_i) > 0$. The rest of the economy is characterized by constant returns-to-scale and perfect competition. Let $X = \sum_{j=1}^{n} X_j$ be the total quantity produced domestically and $X^k = X - X_k$.

Assumption 1'(A1)': $P'(X+M) + P''(X+M)\cdot X_i < 0$ for $M \geq 0$, $X_j \geq 0$, $j = 1,\ldots,n$.

Assumption 2'(A2)': $P'(X) - C_i''(X_i) < 0$ for $X_j \geq 0$, $j = 1,\ldots,n$. (A1)' and (A2)' are Hahn's well-known sufficient conditions for the stability of the Cournot oligopoly.[7] It can be shown that (A1)' and (A2)' assure the existence and uniqueness of the Cournot-Nash-Equilibrium (CNE) of this model.[8]

The problem of each Cournot firm is

$$(8) \qquad \underset{X_i}{\text{Max}} \ \pi_i = P(X+M)\cdot X_i - C_i(X_i)$$

Let $X_i^* = X_i(X^i, M)$ be the internal solution to (8) for $i = 1,\ldots,n$.

The first-order conditions for maximization are:[9]

$$(9) \qquad P(X^i+X_i^*+M) + P'(X^i+X_i^*+M)\cdot X_i^* - C_i'(X_i^*) = 0 \quad i = 1,\ldots,n.$$

Differentiating (9) with respect to M yields, after some manipulations:

$$(10) \qquad \frac{dX_i}{dM} = \frac{(P'+P''\cdot X_i)}{(C_i'' - P'')}\left[\frac{dX}{dM} + 1\right], \text{ where } \frac{dX}{dM} = \sum_{i=1}^{n}\frac{dX_i}{dM}.$$

Using (A1)' and (A2)' we have

$$(11) \qquad \text{sign}\left[\frac{dX_i}{dM}\right] = \text{sign}\left[-\left(\frac{dX}{dM} + 1\right)\right].$$

Lemma 1':

(a) $dX_i/dM < 0 \qquad i = 1,\ldots,n$

(b) $\frac{dX}{dM} + 1 > 0,$

Proof: (a) (11) implies that sign $[dX_i/dM]$ = sign$[dX_j/dM]$ for all $i \neq j$. Thus, if $dX_i/dM \geq 0$ then $dX/dM \geq 0$ which contradicts (11)

(b) Directly from (a) and (11).

□

In the case of a VER, the welfare measure $W^V(M)$ at the CNE is

$$(12) \qquad W^V(M) = \int_0^{X(M)+M} [P(s) - P(X(M)+M)]ds + P(X(M)+M)\cdot X(M) - \sum_j C_j(X_i(M)).$$

Differentiating (12) with respect to M, one obtains, after some manipulations:

$$(13) \quad dW^V(M)/dM = -P'(X(M(+M)\cdot M(\frac{dX}{dM} + 1) + \sum_j [P(X(M)+M) - C_j'(X_j(M))]\frac{dX_j(M)}{dM}.$$

Using (9) and (13) we have

$$(14) \qquad \text{sign}[dW^V(M)/dM] = \text{sign}[M\frac{dX}{dM} + 1) + \sum_j X_j(M)\frac{dX_j(M)}{dM}].$$

Proposition 1': Assume the existence of a Cournot oligopoly with a fixed number of firms in the domestic importing industry and a voluntary export restraint. Then, under (A1)' and (A2)', the introduction of the first unit of import reduces welfare, i.e., $\left.\frac{dW^V(M)}{dM}\right|_{M=0} < 0.$

Proof: When $M = 0$, (14) and Lemma 1 imply $\frac{dW^V(M)}{dM} < 0.$

□

In the linear demand linear cost case (i.e., $P'' = C_j'' = 0$, $j = 1,\ldots,n$) it can be shown that $dW^V/dM \gtrless 0$ as $M \gtrless X$.

In the case of quota, government revenues are added to (12). Therefore, we obtain in the small country case:

$$(14) \qquad \frac{dW^S(M)}{dM} = (P-P^*) + \sum_j [P(X(M)+M) - C_j'(X_j(M)]\frac{dX_j(M)}{dM}.$$

In order to establish a parallel result to proposition 3 in this case we require P^* to be lower or equal $\min_j[C_j']$. Hence one concludes:

Proposition 3': Assume that Cournot oligopoly with a fixed number of firms exists in the domestic importing industry of a small country and there are import restrictions in the form of quota licenses. If (A1)' and (A2)' hold and $P^* \leq \min_j[C_j]$ then $dW^S/dm > 0$.

Similarly, one can show that the similar result to Proposition 4 also holds in the oligopoly case. That is

Proposition 4': Assume that Cournot oligopoly with a fixed number of firms exists in the domestic importing industry, there are import restrictions in the form of quota licenses and this industry does not export. If (A1) holds and $|\sum_j (PX(M)+M) - C_j'(X_j(M)]\frac{dX_j(M)}{dM}| > (P-P^*)$ then the introduction of the first unit of import decreases welfare.

IV. Concluding Remarks

This paper has analyzed the welfare effect of partial trade liberalization where the domestic industry is characterized by a monopoly or Cournot oligopoly. Different trade restrictions were considered. Those are

quotas imposed by the foreign country (VERs), quotas imposed by domestic country and tariffs. In the case of a VER, welfare unambiguously decreases when the first unit of trade is introduced into the economy. It was shown that the decrease in welfare due to additional import may take place for a substantial range. In the case of quotas, if the domestic marginal cost is greater or equal than the foreign price cum transportation cost, then little trade is better than no trade (the importers can be considered as producers with unit cost equal to the foreign price). When marginal cost is lower than foreign price cum transportation cost, and export is not possible, then welfare may decrease with units of trade. In the case of tariffs, as we decrease the prohibitive tariff welfare rises. Bhagwati's result (1971, p.835) that the reduction in the "degree" of (and only) distortion are successively welfare increasing until distortion is fully eliminated does not hold here since the competition is not perfect.

Emerging from our analysis is an important distinction between price restriction (i.e., tariffs) and quantity restrictions. While decreasing the rate of the tariff, from a prohibitive point and on raises domestic output, i.e., creates a procompetitive effect (see Helpman and Krugman, Ch.5), which results in an increase in welfare, increasing the allowed quota from $M = 0$ has a contractionary effect which may cause a reduction in country's welfare.

Our analysis emphasizes the short-run effect in the oligopoly case (the number of firms were fixed) since gradual trade liberalization has a short-run effect at each round. However, welfare analysis of the long-run are needed for trade liberalization that does not end up in free trade.

FOOTNOTES

1 An exception is Buffie and Spiller's (1986) paper which analyzes the impact of trade liberalization in oligopolistic industries on domestic output and prices. However, they stopped short of analyzing its welfare consequences. Buffie and Spiller emphasize perverse effects of trade liberalization on domestic output and price using assumptions that, among other things, rule out linear demand curves (those assumptions also violate Hahn's (1962) stability conditions).

2 Ruffin (1971, pp.494-495) makes this assumption and demonstrates its reasonableness. An alternative interpretation to (A1) is that the marginal revenue faced by the monopolist at a given output of his is a diminishing function of import, i.e., $P' + P'' \cdot X < 0$. In the next section, (A1) with another assumption are invoked in order to ensure stability.

3 Note that the reaction of the domestic industry to the increase in import depends, among other things, on the concavity/convexity of the domestic demand curve ($P''(\cdot)$). For example, the more negataive $P''(\cdot)$ is, other things being equal, the larger is the decrease in the monopolist's output. This, in turn, affects country's welfare in both the monopoly and oligopoly cases (see equations (4) and (12)).

4 An example of voluntary export restraint is the restriction on Japanese automobile exports to the United States (see Ethier 1983, pp.186-189). For many more examples, see Hamilton (1986).

5 This paper concentrates on the welfare effects that result from a decrease in the degree of artificial trade restrictions. The welfare analysis of the effect of a decrease in the natural barriers of trade, i.e. transportation cost of a country facing upward sloping supply of import curve is precisely the same as in our VER case. That is, a small decrease in transportation cost from a prohibitive level may create trade and decrease welfare.

6 (A1) and (A2) are Hahn's well-known conditions for the stability of the Cournot oligopoly case. Note only that (A1) and (A2) imply (3).

7 A recent paper by Al-Nowaihi and Levine (1985) shows that Hahn's conditions assure global stability only for the case of $n \geq 5$. Otherwise these conditions assure only local stability.

8 It can be shown that existence and uniqueness of the CNE is a special case of Rosen (1965). (See, for example, Levin (1982)).

9 The second-order conditions are: $2P'(X^i+X_i^*+M) + P''(X^i+X_i^*+M)X_i^* - C_i''(X_i^*) < 0$ for $i = 1,\ldots,n$.

APPENDIX

Assume that the domestic demand curve faced by the monopolist is

(A1) $$P = P_0 - (M+X)$$

The marginal revenue is (P_0-M-2X) and the marginal cost is constant and equal to c. From the first-order condition of the monopolist problem we have

(A2) $$X = (P_0-M-c)/M$$

Country's welfare as a function of import is

(A3) $$W(M) = W_0 + \int_0^M W'(t)dt = W_0 + \Delta W$$

where $W_0 = W(M = 0)$ is the autarky's welfare. In our case (2) in the text is reduced to $dX/dM = -1/2$ and (4) is reduced to $W'(M) = (M-X)/2$. Hence,

(A4) $$\Delta W = \frac{1}{4}\int_0^M (3t-P_0-c)dt = \frac{1}{4}M[\frac{3}{2}M-(P_0-c)].$$

We now investigate the sign of ΔW at free trade. Denote by $\bar{M}$ the quantity imported at free trade and assume that $P* = c$. Since $P(\bar{M}) = P*$ where $\bar{M}$ is also the amount consumed; then $\bar{M} = P_0 - P*$. Hence

(A6) $$\Delta W(\bar{M}) = \frac{1}{4}(P_0-P*)[\frac{3}{2}(P_0-P*) - (P_0-c)] = \frac{1}{8}(P_0-P*)^2 > 0.$$

In words, the free trade welfare level is greater than autarky welfare.

It is also interesting to find out at what stage of $M > 0$, $\Delta W(M) = 0$. Integrataing ΔW by parts yields:

(A6) $$\Delta W = \frac{1}{2}\int_0^M (t-x)dt = \frac{1}{2}[(t-X)t\Big|_0^M - \int_0^M t(1-dX/dt)dt = \frac{M}{4}[M-4X].$$

Thus $\Delta W \gtrless 0$ as $M - 4X \gtrless 0$ or $\frac{M}{X} \gtrless 4$.

In words, country's welfare rises above autarky level in our case only when the quantity imported is larger than 80 percent of domestic consumption.

REFERENCES

Aizenman, J., Devaluation and Liberalization in the presence of tariff and quota restrictions: An equilibrium model, **Journal of International Economics**, 1981.

————————, Dynamics of trade liberalization policy, **Journal of Development Economics**, 1983.

Al-Nowaihi, and P.Levine, The Stability of the Cournot Oligopoly Model: A Reassessment, **Journal of Economic Theory**, 1985.

Baldwin, R.E., J.H.Mutti, and J.D.Richardson, Welfare effects on the United States of a significant multiateral tariff reduction, **Journal of International Economics**, 1980.

Bhagwati, J., The generalized theory of distortions and welfare, In: J.Bhagwati, et al., eds. (Amsterdam: North Holland Publishing Co.), 1971.

————————, Anatomy and consequences of exchange control regimes (Cambridge, MA: Ballinger Publishing Co.), 1978.

Brander, J., and B.Spencer, "Tariff protection and imperfect competition," In: Kieszkowski, H. (ed.), **Monopolist Competition and International Trade** (Oxford: Clarendon Press), 1984.

————————————————, "Export subsidies and international market share rivalry," **Journal of International Economics**, 1985.

Buffie, E., The macroeconomics of trade liberalization, **Journal of International Economics**, 1984.

———— and P.Spiller, Trade liberalization in oligopolistic industries: the quota case, **Journal of International Economics**, 1986.

Dixit, A., "International trade policy for oligopolistic industries," **Supplement to Economic Journal**, 1984.

———— and V.Norman, **Theory of International Trade** (New York: Cambridge University Press), 1980.

Eaton, J., and G.Grossman, "Optimal trade and industrial policy under oligopoly," Woodrow Wilson School Discussion Paper No.50, 1983 forthcoming in **Quarterly Journal of Economics**.

Ethier, W.J., "Internationally decreasing costs and worlds trade," **Journal of International Economics**, 1979.

————, **Modern International Economics**, WW. Norton & Company, 1983.

Fishelson, G., and A.Hillman, "Domestic Monopoly and Redundant Tariff Protection," **Journal of International Economics**, 1979.

Flam, H., and Helpman, E., "Industrial policy under monopolistic competition," Foerder Institute for Economic Research, Working Paper No.33-85, 1985.

Hahn, F.H., "The stability of the Cournot oligopoly solution, **Review of Economic Studies**, 1962.

Hamilton, C., "An Assessment of Voluntary Restraints on Hong Kong Exports to Europe and the U.S.A., **Economica**, 1986.

Helpman, E., "International trade in the presence of product differentiation, economies of scale and monopolistic competition: A Chamberlin-Heckscher-Ohlin approach," **Journal of International Economics**, 1981.

———————, "Increasing returns, imperfect markets, and trade theory," In: R.W.Jones and P.B.Kenen (eds. **Handbook of International Economics**, Vol.1 (New York: North Holland Publishing Company), 1984.

——————— and P.R.Krugman, **Market Structure and Foreign Trade** (Cambridge: M.I.T.Press), 1985.

Krueger, A., **Liberalization Attempts and Consequences** (Cambridge, MA: Ballinger Publishing Co.), 1978.

Krugman, P.R., "Increasing returns, monopolistic competition, and international trade," **Journal of International Economics**, 1979.

———————, "Intra-industry specialization and the gains from trade," **Journal of Political Economy**, 1981.

———————, "Import protection as export promotion," In: Kieszkowski, H. (ed.), **Monopolistic Competition and International Trade** (Oxford: Clarendon Press), 1984.

Lancaster, K., "Intra-industry trade under perfect monopolistic competition," **Journal of International Economics**, 1980.

Levin, D., "Cournot oligopoly and government regulation," the third essay in unpublished doctoral dissertation, Massachusetts Institute of Technology, 1982.

Markussen, J.R., "Trade and gains from trade with imperfect competition," **Journal of International Economics**, 1981.

———————, The distribution of gains from bilateral tariff reductions, **Journal of International Economics**, 1981.

Rosen, J.B., Existence and Uniqueness of Equilibrium points for concave N-person games. **Econometrica**, 1965.

Ruffin, R.J., "Cournot oligopoly and competitive behavior," **Review of Economic Studies**, 1971.

Spencer, B., and Brander, J., "International R and D. rivalry and industrial strategy," **Review of Economic Studies**, 1985.

Veneables, A.T., "Trade and trade policy under imperfect competition: the case of identical products and free entry," **Journal of International Economics**, 1985.

case	M = 0	M > 0	$M=M^{FT}$
VER	(-)	as $(P-C')\frac{dX}{dM}-P'M(\frac{dX}{dM}+1) \gtrless 0$	(+)
Quota in a small country $c' \geq P^*$	(+)	(+)	(+)
Quota in a small country $c' < P^*$	as $(P-C')\frac{dX}{dM}+(P-P^*) \gtrless 0$	as $(P-C')\frac{dX}{dM} + (P-P^*) \gtrless 0$	
Quota in a large country $c' \geq P^*$	(+)	as $(P-C')\frac{dX}{dM} + (P-P^*) = M\frac{dP^*(M)}{dM} \gtrless 0$	
Quota in a large country $c' < P^*$	as $(P-C')\frac{dX}{dM}+(P-P^*(M)) \gtrless 0$		
Tariff in the small country case	(+)	(+)	(+)
Tariff in the large	(+)	as $(P-P^*(M))\frac{dX}{dM} - M\frac{dP^*}{dt} \gtrless 0$	(-)

Table A*

* The Table's entries denote the sign of dW/dM at the corresponding case.