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# Import Quotas and VERs: A Comparative Analysis in a Three-Country Framework

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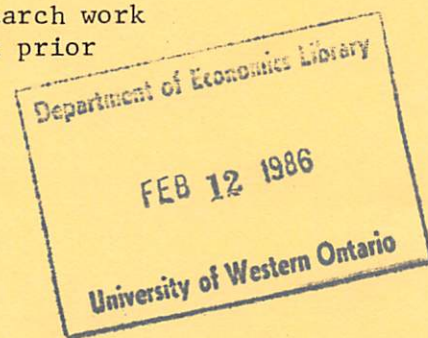
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This paper contains preliminary findings from research work still in progress and should not be quoted without prior approval of the authors.

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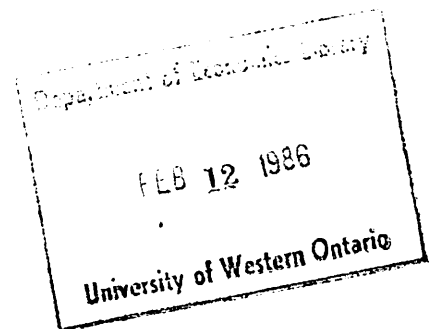


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IMPORT QUOTAS AND VRS: A COMPARATIVE  
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In A Three-Country Framework

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Introduction

In the strand of the literature concerned with the "equivalence" of tariffs and quotas, (see for example Bhagwati, 1965, 1968; and Kreinin, 1970, 1973) investigators employed a two-country framework to inquire into the comparative effects of the two policy instruments on economic welfare and other variables. When that literature was extended to a comparative analysis of import quotas and voluntary export restraints (VERs), the same two-country framework was maintained. (See for example Brecher and Bhagwati, 1984.) The difference discovered between the two instruments relates to the country receiving the economic rents: the importing country in the case of quotas and the exporting country in the case of VERs. As a consequence, the importing country is judged to fare better with a quota, while the exporting country is judged to be better off under a VER regime.

But that traditional analysis fails to capture an essential distinction between the two policy instruments: while an import quota is often levied on imports from all sources of supply, a VER is inherently discriminatory. It is usually negotiated with one supplying country at a time, leaving other suppliers free of restrictions. For example the U.S. auto VER was negotiated with Japan, while European suppliers were not subject to any quantitative limitations.

It is the purpose of this paper to capture this essential difference between quotas and VERs. To allow for discrimination it is necessary to develop a general equilibrium three-country framework, which we shall label

the U.S., E (Europe), and J (Japan). In line with previous work in this strand of the literature, perfect competition is assumed to prevail in all markets. We begin with a specific factor model that establishes the pattern of trade (section I). Then we employ a variant of the "offer curve--trade indifference curves" analysis (Meade, 1952 and Vanek, 1962), to examine the welfare effects of quotas and VERs (section II). Lastly, in line with the Dinopoulos-Bhagwati (1985) analysis of policy-induced capital flows, we examine the differential effects of quotas and VERs on capital movements, in a framework of a three-country two-goods model (section III). The final section summarizes the conclusions of the paper.

### (I) The Model

Assume that the world consists of three countries trading in two homogeneous commodities Y and X. The demand side of each economy is characterized by a well behaved social utility function representing homothetic and identical tastes. Perfect competition prevails in all product and factor markets. The supply side of a typical economy is represented by a specific factor model introduced by Jones (1971): Labor (L) is common to both industries and is mobile between them; Land (T) is specific to industry Y; while capital (K) is specific to industry X. Thus the supply side of an economy can be represented by the following equations:

$$(1) \quad Y^i = G(L_y^i, T^i) \quad \text{Supply of good Y}$$

$$(2) \quad X^i = F(L_x^i, K^i) \quad \text{Supply of good X}$$

$$(3) \quad T^i = L_x^i + L_y^i \quad \text{Full employment of labor condition}$$

where superscript  $i$  refers to each particular country ( $i = \text{US, E, J}$ ).

Equation (1) specifies the production function of commodity  $Y$  in country  $i$  which has as its argument:  $L_y^i$  the amount of labor used in sector  $Y^i$  and  $T^i$  the amount of land which is specific to sector  $Y^i$ . Similarly, good  $X^i$  is produced by sector-specific capital  $\bar{K}^i$  and labor  $L_x^i$ . The functions  $G$  and  $F$  exhibit constant returns to scale, have all the usual neoclassical properties, and are identical across countries. Finally equation (3) represents the full employment of labor condition, under the assumption that labor is perfectly mobile between the two sectors. The choice of this model is designed to capture the sector-specific nature of foreign investment (section III) and to reduce the algebraic complexity of a three country world. Section II, which uses the offer curve technique, is free of the sector-specificity assumption, but uses the trade pattern established in this section.

We stipulate  $p$  as the relative prices of good  $X$ :  $p = p_x/p_y$ . In the absence of international capital mobility, the following equations determine the returns to labor  $w^i$ , to capital  $r^i$ , and to land  $R^i$  expressed in terms of good  $Y$ :

$$(4) \quad G_L^i = p F_L^i$$

$$(5) \quad r^i = p F_K^i$$

$$(6) \quad R^i = G_T^i$$

The subscripts of  $F$  and  $G$  denote the derivative of a function with respect to the relevant argument. Equation (4) is the familiar condition of equality of the value of the marginal product of labor in both sectors, and determines the distribution of labor between the two sectors of the economy. By changing the relative price  $p$  we can trace the production possibility frontier of the economy which is concave to the origin.

In order to determine the pattern of trade, assume that the national endowments of the three economies are given by:

$$(7) \quad \bar{L}^{US} = \bar{L}^J = \bar{L}^E \quad \text{Equal endowments of labor}$$

$$(8) \quad \bar{K}^{US} = \bar{K}^J = \bar{K}^E \quad \text{Equal endowments of capital}$$

$$(9) \quad \bar{T}^{US} > \bar{T}^E > \bar{T}^J \quad \text{Unequal endowments of land}$$

Each country is characterized by the same amount of labor and capital, but the U.S. is land abundant relative to both Europe and Japan and Europe is land abundant relative to Japan. In the absence of international factor mobility and if every country is faced by the same price  $p$ , the following relative outputs are obtained:

$$(10) \quad \frac{Y^{US}}{X^{US}} > \frac{Y^E}{X^E} > \frac{Y^J}{X^J}$$

the relative autarky prices are inversely related to the output ratios:

$$(11) \quad \frac{P_A^{US}}{P_A} > \frac{P_A^E}{P_A} > \frac{P_A^J}{P_A}$$

With the opening of trade the U.S. will export  $Y$  to both Europe and Japan. It will import  $X$  from both countries, with Japan being the bigger of the two exporters to the U.S.

## (II) A Welfare Comparison of Quotas and VERs

In this section Japan and Europe are assumed to export commodity  $X$  to the U.S. (in return for  $Y$ ), with Japan being the bigger exporter. While this trade pattern is derived from a specific-factor model (section I), the analysis in this section is more general, as it employs the familiar offer curve technique.

### (II:A) Equivalence Defined in Terms of Quantity

In this subsection equivalence between import quotas and VER is defined in terms of quantity: The VER that excludes from the importing country total imports equal in amount to that excluded by an equivalent quota. We proceed to inquire into the effects of these two instruments on the welfare of each country.

(1) Free-Trade Equilibrium. In Figure 1 O.U.S. represents the U.S. free-trade offer curve. The U.S. faces two separate offer curves from its two trading partners: OE for Europe and OJ for Japan. The latter two are aggregated by adding up the two quantities traded along each terms of trade line (straight ray from the origin), to generate OE+J. Price line  $\alpha$  from the origin is the free-trade terms of trade, given by the intersection of the O.U.S. and OE+J offer curves.

In line with Meade's analysis, the free-trade welfare levels of each country are represented respectively by the trade indifference curves (TIC)  $W_{U.S.}^{FT}$ ,  $W_J^{FT}$ , and  $W_E^{FT}$ . Note that the welfare levels of Japan and Europe ( $W_J^{FT}$ ,  $W_E^{FT}$ ) are shown separately and are not aggregated. All three TICs are tangent to price line  $\alpha$ .

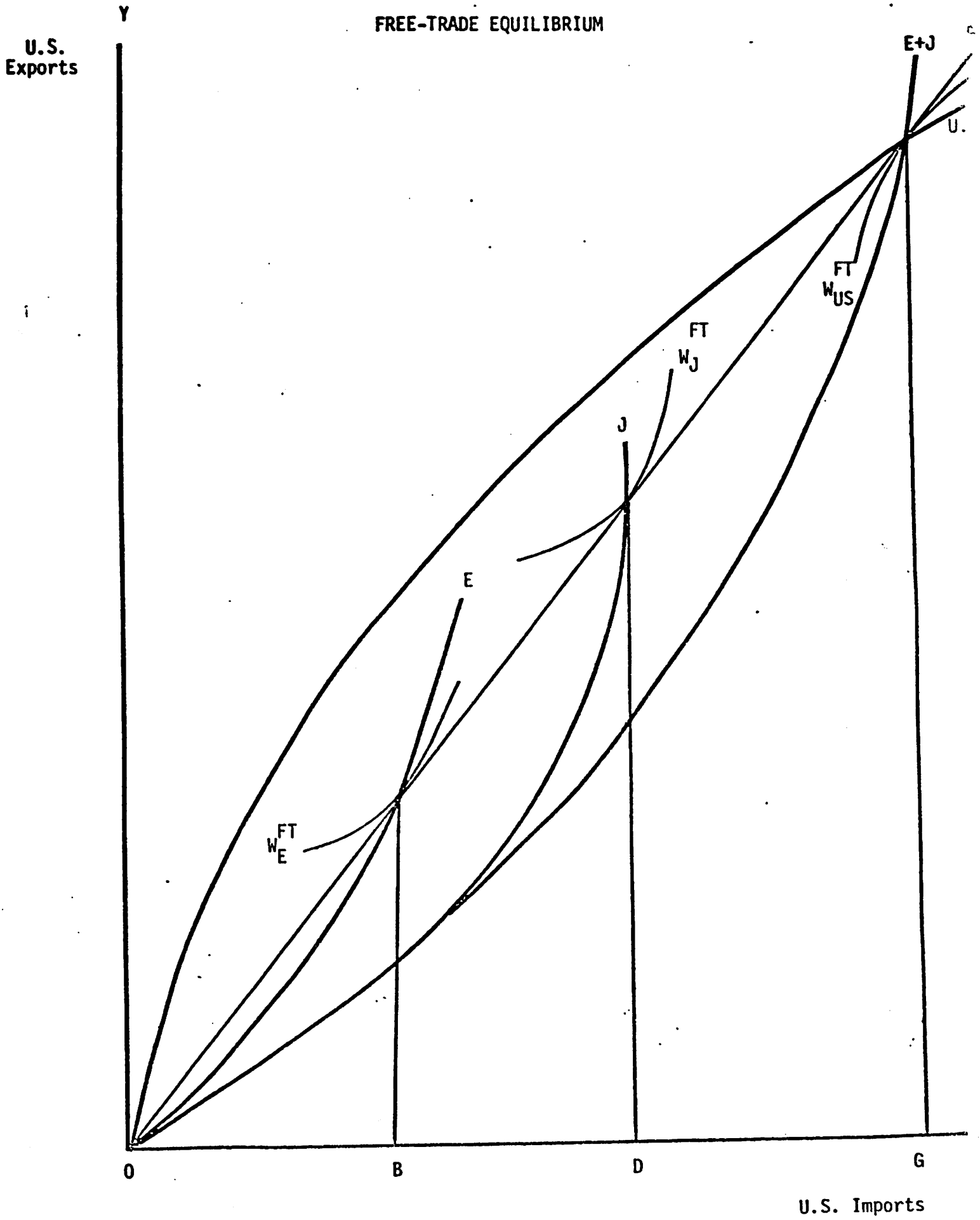
(2) A U.S. Import Quota. Free-trade imports into the U.S. is OG, of which Europe supplies OB while Japan provides OD. By construction:  $OB + OD = OG$ . U.S. exports is GS. Suppose that U.S. imports are restricted by a global quota (as is the usual practice) to OH in Figure 2, with HG being excluded. The U.S. quota-ridden offer curve becomes OVH, with a kink at point V. It intersects OE+J at Q. Hence point Q represents the quota-ridden trade equilibrium.

There are different ways of allocating the quota between the two sources of supply. Pursuant to the strand of the literature that compares tariffs and



FIGURE 1

FREE-TRADE EQUILIBRIUM

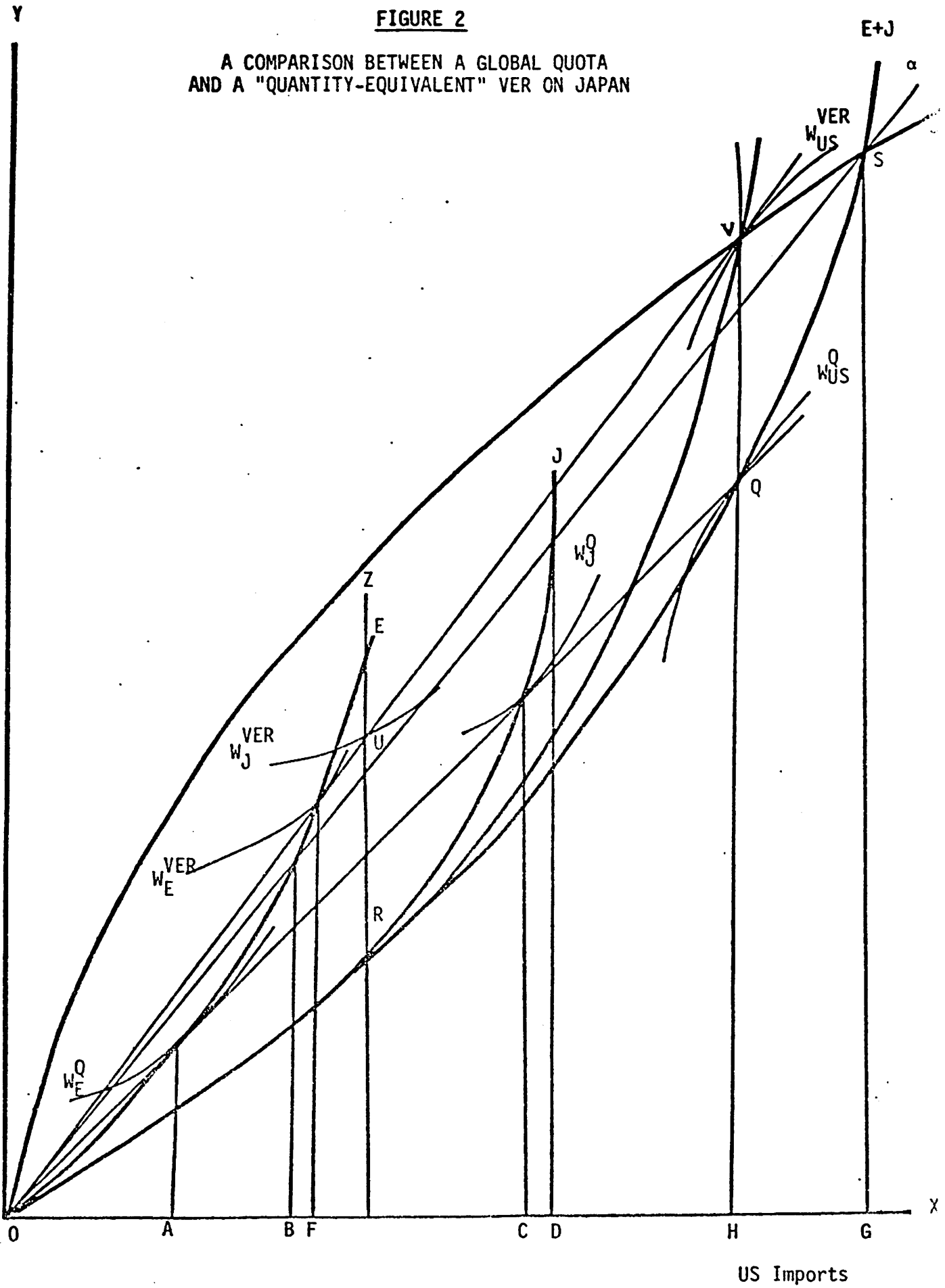


U.S. Imports

US Exports

**FIGURE 2**

A COMPARISON BETWEEN A GLOBAL QUOTA  
AND A "QUANTITY-EQUIVALENT" VER ON JAPAN



US Imports

quotas we choose to treat OH as a "tariff equivalent" quota. In other words, the quota-ridden terms of trade line is OQ, and the exports of Europe and Japan under the quota are determined by the intersection of OQ with their offer curves. Respectively these exports are OA and OC, which by construction add up to OH. The quantity of European exports excluded by the quota is AB, and that of Japan, CD, which add up to HG.

Not only is this a non-arbitrary way of allocating the quota, but it would render the comparison with VER more general: The VER-quota comparison becomes also a VER-tariff comparison.

As a result of the quota U.S. welfare changes to  $W_{U.S.}^Q$  (the U.S. TIC that passes through Q). Because U.S. terms of trade improve, while its volume of trade declines, the change in U.S. welfare from  $W_{U.S.}^{FT}$  is indeterminate.<sup>1</sup> But the outcome for Europe and Japan is different. In these countries the volume of trade declines and the terms of trade deteriorate. Consequently, Europe's welfare is reduced to  $W_E^Q$  and Japan's welfare is lowered to  $W_J^Q$ .

(3) An "Equivalent" VER. Next, we convert the global quota to a VER imposed on Japan, the largest trader of the two U.S. partners. Unlike a quota the Japanese exporters capture the rent.

In line with our definition of equivalence, the VER is set at such a level that it excludes from the U.S. total imports in an amount equal to that excluded by the quota. Namely the VER would exclude Japanese exports in the amount HG.

However, to attain that amount of exclusion, the negotiated quantity allowed into the U.S. must be lower than OC. Because the VER is expected to improve Japan's terms of trade (since the Japanese exporters capture the rent), and thereby stimulate additional exports, the direct exclusion negotiated with Japan would have to be greater than HG. Only after allowing for the

offsetting rise in exports, should the quantity excluded equal HG. Graphically, this is derived by redrawing the VER-ridden OE+J offer curve in a way that it crosses the U.S. free-trade offer curve at point V. With the VER Japan's offer curve is ORZ, with a kink at R.<sup>2</sup> Note that after the VER Japan remains the larger of the two exporters to the U.S.

Since the Japanese exporters receive part of the rents, the VER-ridden terms of trade line is OV. The U.S. welfare is at  $W_{U.S.}^{VER}$ . It is lower than the welfare under either free trade or an import-quota regime. This is a known result: The quantity of imports are set at the same level as under a quota, but now the Japanese and Europeans capture the rents, so that the U.S. terms of trade deteriorate.

Europe's welfare is represented by  $W_E^{VER}$ . It improves relative to a U.S. import-quota regime. And that for two reasons: Europe's export volume rises by AF relative to that under a U.S. quota, and its terms of trade improve to OV. In other words European exports substitute for part of the excluded Japanese exports.<sup>3</sup> Europe's welfare under a U.S. VER is also higher than its counterpart under free-trade.

Japan's welfare is subject to two conflicting effects: Its terms of trade improve relative to a U.S.-quota regime (and relative to free trade). But its volume of exports declines by a greater quantity than HG--the total amount excluded by the U.S. quota, let alone Japan's share of that quota-exclusion, CD. The reason for that reduction is substitution from European sources. Japan's new welfare is represented by the TIC passing through point U,  $W_J^{VER}$ .

It is now not clear whether Japan is better off under a U.S. quota or an equivalent VER. In Figure 2 Japan is shown to be better off under a U.S. VER. But this outcome depends strictly on the shapes of the TICs and of the offer

curve. It is obvious from our construction that the slope of  $W_J^{VER}$  can vary, placing it either above or below  $W_J^Q$ .

This result is a drastic departure from the theory developed in a two-country framework. The intuitive reason is the existence of another source of supply (Europe) which substitutes for Japanese exports, and "forces" the quantity excluded by Japan under the VER to be greater than the global quota. In the two-country analysis the quantity excluded by Japan is the same under the two policy instruments.

(4) A European VER. A parallel outcome obtains had the VER been negotiated with Europe instead of Japan. In that case Japan is better off under a VER than under a U.S.-quota regime, while the result for Europe is ambiguous.

#### (II:B) Equivalence Defined in Terms of Price

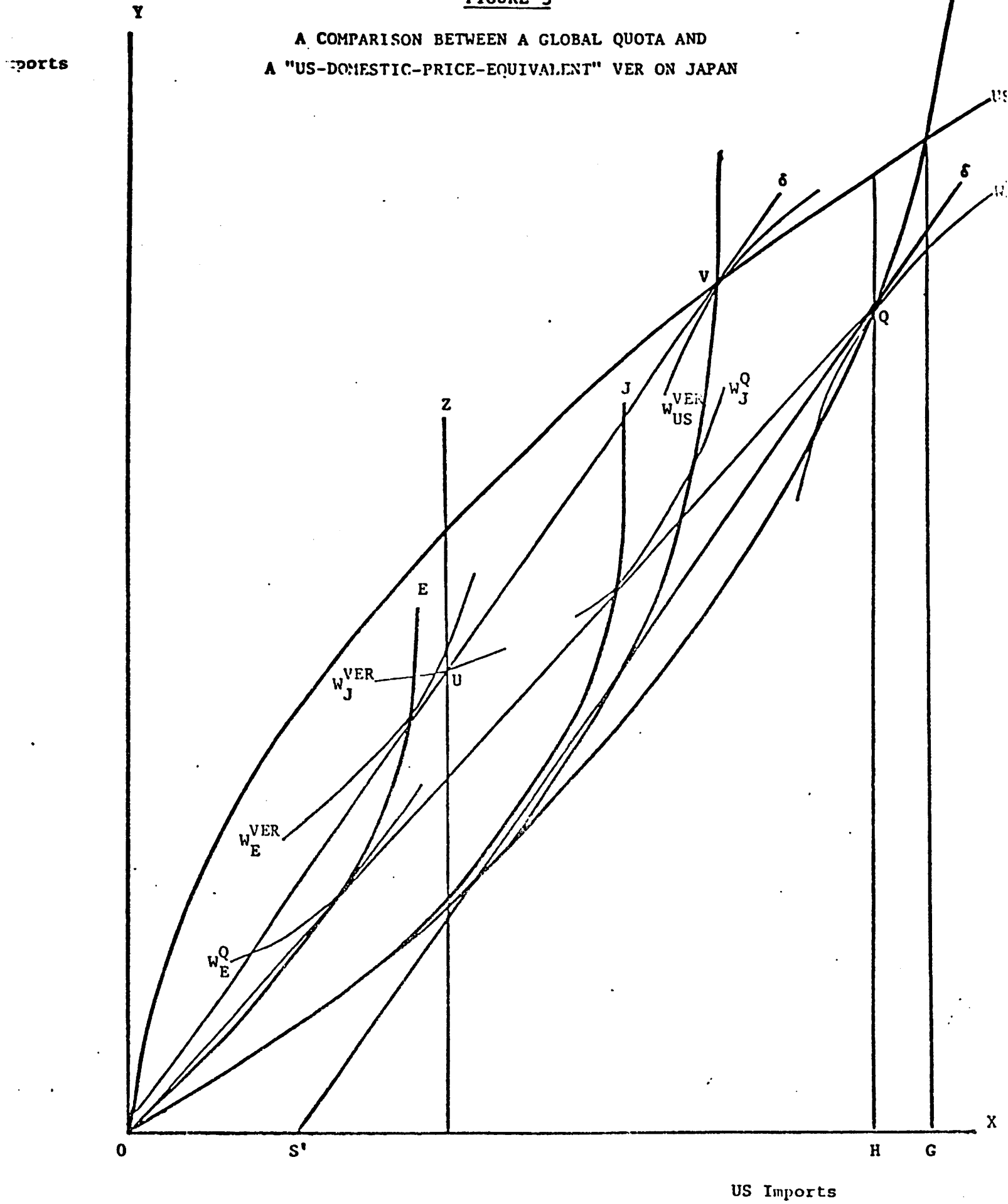
As an alternative to the quantity "equivalence" used in the previous section we may wish to redefine equivalence in terms of price: A VER that would generate the same domestic (relative) price in the importing country as a given quota.

Figure 3 duplicates Figure 2, but with the price objective in mind. The quota-ridden international price ratio is  $OQ$  with the welfare of the three countries given by the three TICs:  $W_{U.S.}^Q$ ,  $W_J^Q$  and  $W_E^Q$ . The domestic U.S. price ratio is the line  $S'Q$  tangent to  $W_{U.S.}^Q$  at point  $Q$ .

It is that price ratio that the "equivalent" VER is designed to preserve. To accomplish this on the diagram we shift  $S'Q$  to the left in a parallel fashion (namely, retaining its slope), until it becomes a ray from the origin  $OV$ . This is the new VER-ridden international price line.

**FIGURE 3**

**A COMPARISON BETWEEN A GLOBAL QUOTA AND  
A "US-DOMESTIC-PRICE-EQUIVALENT" VER ON JAPAN**



This price line yields the following VER outcome for the three countries: The U.S. welfare declines to  $W_{U.S.}^{VER}$ . European welfare rises to  $W_E^{VER}$  because Europe's volume of trade rises, and its terms of trade improve. Japan's welfare is represented by a TIC passing through U, such as  $W_J^{VER}$ . The welfare outcome for Japan is again ambiguous. As is observable on the diagram it depend on the shape of its TICs.

As with the quantity equivalence, Japan is subject to two conflicting influences. Its terms of trade improve under the VER since the Japanese exporters capture the rent. But its volume of exports declines relative to a U.S.-quota regime because of substitution from European sources, triggered by the improved European terms of trade.<sup>4</sup>

In sum, the introduction of a third country (or any larger number) changes the equivalence results of VERs and quotas or for that matter of VERs and tariffs. The outcome of the two-country analysis does not hold when substitution from a third supplier is possible.

### (III) The Effects of Quotas and VERs on Direct Foreign Investments

#### (III: A) The Model

This section examines the differential effects of quotas and VERs on direct foreign investment. Suppose that the world economy is characterized by equations (1) through (9) and that the sector-specific capital is now internationally mobile. This implies that the return on capital will be equalized across countries within sector X. Such equalization would not necessarily occur under free trade in the absence of capital mobility because the number of productive factors exceeds the number of goods. Rather, under these conditions the returns to capital will be as follows:

$$(12) \quad r_{FT}^{US} < r_{FT}^E < r_{FT}^J$$

As capital becomes internationally mobile (but within sector X) it would flow out of the U.S. Likewise capital would flow into Japan. This would reinforce the pattern of trade examined in the previous section.

The national labor markets and the (now integrated) world capital market can be represented by the following system of equations:

$$(13) \quad G_L^i = p^i F_L^i \quad \text{The wage rate in each country}$$

$$(14) \quad \bar{L}^i = L_X^i + L_Y^i \quad \text{The full employment of labor conditions}$$

$$(15) \quad r = p^i F_K^i \quad \text{The return on capital, equal in all countries}$$

$$(16) \quad K^{U.S.} + K^J + K^E = \bar{K}^W \quad \text{The full employment of capital condition.}$$

where  $i = U.S., E, J.$  and  $\bar{K}^W$  is the capital stock of the world. Equations (13) and (14) represent the labor market of each country under the assumption that labor is perfectly mobile between sectors but immobile internationally. Equation (15) states that the return on capital,  $r$ , is equal in all three countries, because capital is mobile internationally. Finally equation (16) is the full employment condition of capital in the world. Given the relative commodity prices  $p^i$ , the national labor endowments  $\bar{L}^i$ , the land endowments  $\bar{T}^i$  and the world capital stock  $\bar{K}^W$ , the above system of ten equations (three each for 13, 14, and 15 plus no. 16), determines ten endogenous variables: the quantity of labor in industry X of each of three countries; the quantity of labor in industry Y of each country; the amount of capital in industry X of each country; and the return on capital:  $L_X^i, L_Y^i, K^i$  and  $r$ .

Differentiating totally the system of equations (13) through (16), we develop an expression for the changes in the quantity of capital in each



country that would result from a small variation in commodity prices around the free-trade, free capital mobility equilibrium:

$$(17) \quad dK^{US} = \frac{1}{D} [A^J B^E dp^J - (B^E + B^T) A^{US} dp^{US} + A^E B^J dp^E]$$

$$(18) \quad dK^E = \frac{1}{D} [A^{US} B^J dp^{US} + A^J B^{US} dp^J - (B^{US} + B^J) A^E dp^E]$$

$$(19) \quad dK^J = \frac{1}{D} [A^{US} B^E dp^{US} - (B^E + B^{US}) A^J dp^J + A^E B^{US} dp^E]$$

where  $A^i$ ,  $B^i$ , and  $D$  are:

$$(20) \quad A^i = F_k^i - \frac{p^i F_{LK}^i F_L^i}{G_{LL}^i + p^i F_{LL}^i}$$

$$(21) \quad B^i = p^i F_{kk}^i - \frac{(F_{KL}^i)^2 p^i}{p^i F_{LL}^i + G_{LL}^i}$$

$$(22) \quad D = B^{US} B^E + B^J B^{US} + B^J B^E > 0.$$

$A^i$  represents the increase in capital rental when the price of the capital-intensive commodity rises without any capital inflow induced by the increase in  $r$  ( $dK^i=0$ ). Similarly,  $B^i$  is the reduction of the capital rental caused by an inflow of capital  $dK^i$  at constant commodity prices ( $dp^i=0$ ). In other words:

$$(22) \quad dr^i = A^i dp^i + B^i dK^i$$

Equations (17) through (19) imply that the inflow of capital into a country varies positively with the increase of that country's relative price of the capital-intensive good, and negatively with price increases in the other two countries.

We are now in a position to evaluate the differential effects of quotas and VERs on capital movements, through the effects of these policy instruments on commodity prices.

(IIIB) A U.S. Import Quota

A U.S. import quota would increase the U.S. relative domestic price ( $dp^{US} > 0$ ) and would reduce the relative commodity price in Japan and Europe ( $dp^J = dp^E < 0$ ) compared to the free-trade and free capital mobility equilibrium. Substituting the above price changes in equations (17-19) we obtain:

$$dK^{US} > 0; \quad dK^E \stackrel{?}{<} 0; \quad dK^J \stackrel{?}{<} 0$$

In other words, the imposition of a non-discriminatory quota (or tariff) by a country (U.S.) induces capital inflow but the source of that capital (Europe or Japan) is indeterminate.

(IIIC) A U.S. VER on Japan's Imports

A discriminatory U.S. VER imposed on Japanese exports would result in the following changes of domestic commodity prices relative to a regime of free-trade and free capital mobility:

$$dp^{US} = dp^E > 0 > dp^J$$

Substituting this into equations (17-19) we obtain:

$$dK^J < 0; \quad dK^{U.S.} \stackrel{?}{<} 0; \quad dK^E \stackrel{?}{<} 0.$$

In other words capital would flow out of Japan, but the destination of that capital is indeterminate.

In contrast to the differential results obtained here for a quota and a VER, the two-country framework yields identical movements of investment capital. In the absence of Europe, we obtain  $dK^{US} = -dK^J > 0$  for both

instruments. Thus, the presence of a third country is crucial in comparing the effect of a quota and VER. And this point applies to any discriminatory policy instrument.

#### (IV) Conclusions

Because a VER is inherently discriminatory, a comparison between quotas and VERs necessitates a three-country framework. Such a framework is adopted in this paper, coupled with a general equilibrium approach. The results differ from those obtained either in partial equilibrium or a two-country framework.

First we compare a U.S. import quota (or tariff) with a U.S. VER imposed only on Japanese exports, when capital is immobile internationally. U.S. welfare is higher under a quota than under an equivalent VER, as is the outcome of a two-country analysis. This is true for two alternative definitions of equivalence. However, in contrast to the two-country case, the relative effects of the two instruments on Japan's welfare is indeterminate, while for Europe (the third country) a U.S. VER is preferable to a quota.

Next we introduce international capital mobility within one sector. A U.S. import quota produces capital inflow into the U.S. with its source indeterminate, while a U.S. VER imposed on Japan produces a capital outflow from Japan with an indeterminate destination.

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Footnotes

<sup>1</sup>If HG were the "optimum quota," that TIC would be tangent to OE+J. In that case we can be certain that U.S. welfare has improved.

<sup>2</sup>This is Japan's offer curve which, when added to OE would generate OV.

<sup>3</sup>Empirically this is known to have happened in the case of the auto VER (Kreinin, 1984).

<sup>4</sup>These results do not depend on an assumption that goods are not normal.

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