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# Tariffs, Quotas and Voluntary Export Restraints with and without Internationally Mobile Capital

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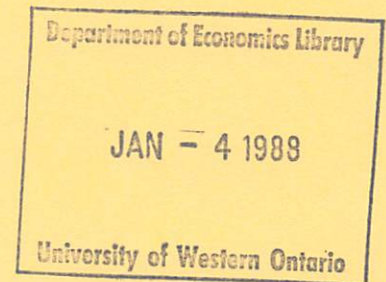
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TARIFFS, QUOTAS AND VOLUNTARY EXPORT RESTRAINTS  
WITH AND WITHOUT INTERNATIONALLY MOBILE CAPITAL

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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 author.

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**TARIFFS, QUOTAS AND VOLUNTARY EXPORT RESTRAINTS  
WITH AND WITHOUT INTERNATIONALLY MOBILE CAPITAL\***

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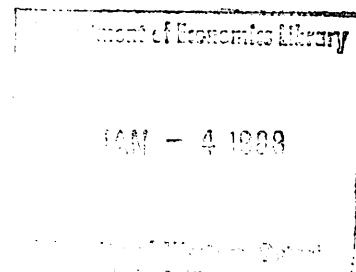
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**TARIFFS, QUOTAS AND VOLUNTARY EXPORT RESTRAINTS  
WITH AND WITHOUT INTERNATIONALLY MOBILE CAPITAL**

**Abstract**

This paper presents a general framework for comparing the effects of tariffs, quotas and VER's (voluntary export restraints) both with and without international capital mobility. Expressions for the shadow price of foreign exchange and the shadow price of capital under each type of trade restriction are derived, and it is shown that, although international capital mobility *raises* the welfare cost of tariff protection, it *lowers* the welfare cost of quantitative restrictions. In all cases the effects of exogenous shocks in the presence of quotas are intermediate between those in the presence of tariffs and those in the presence of VER's.

JEL Classification: 422, 441.

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# TARIFFS, QUOTAS AND VOLUNTARY EXPORT RESTRAINTS WITH AND WITHOUT INTERNATIONALLY MOBILE CAPITAL

## 1. Introduction

An increasing trend in the world economy is for restrictions on trade to take the form of quantitative rather than price controls, of which the two most commonly encountered are import quotas and voluntary export restraints (VER's). Naturally, an extensive body of writings has developed concerned with the effects of such measures. However, most of these writings are deficient in two important respects: they adopt an exclusively partial equilibrium perspective, neglecting the implications of quantitative trade restrictions for factor prices and industrial structure; and they ignore the effects of quotas and VER's on the international flow of mobile capital.<sup>1</sup> The objective of the present paper is to remedy this deficiency, by developing a general framework within which the implications of tariffs, quotas and VER's may be compared both with and without international capital mobility.

The framework I adopt in this paper is that of a competitive non-stochastic small open economy.<sup>2</sup> It is well known that in such a framework tariffs and quotas are "equivalent" in the sense that an equilibrium generated by one type of restriction could also be generated by appropriately chosen values of the other type. However, it is less widely appreciated that, even when they are equivalent in this sense, the response of the economy to exogenous shocks can be very different depending on whether tariffs or quotas are in force. In addition, the equivalence results hinge on the assumption that the disbursement of tariff revenues and quota rents

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1 A number of papers should be exempted from this general criticism, and their specific contributions will be noted later where appropriate. The effects of quotas and VER's have been considered in a general equilibrium context by Falvey (1975), Lizondo (1984), Buffie (1985), Dei (1985a, 1985b), Anam (1985, 1986), Bhagwati and Brecher (1987) and Dinopoulos and Kreinin (1986); and Falvey (1976) has compared the effects of tariffs and quotas when capital is internationally mobile.

2 I thus ignore the issues of market imperfections, uncertainty or retaliation on which much of the literature on quantitative restrictions has focussed. See Bhagwati (1965), Takacs (1978), Harris (1985) and Krishna (1983) on market imperfections; Fishelson and Flatters (1975), Pelcovits (1976) and Dasgupta and Stiglitz (1977) on uncertainty; and Rodriguez (1974), Tower (1975), Falvey (1985) and Melvin (1986) on retaliation.

is identical. They therefore do not apply to comparisons between tariffs, where the resulting revenue is redistributed in a lump-sum fashion (as is usually assumed) and quantitative restrictions where the resulting rents are either dissipated (if “rent seeking” occurs) or accrue to foreign exporters, as in the case of VER’s.

The plan of the paper is as follows. Section 2 outlines the framework to be adopted and presents some preliminary derivations. Sections 3 and 4 consider the case where capital is internationally immobile, and examine respectively the shadow price of foreign exchange and the welfare cost of tariffs and quantitative trade restrictions. Section 5 then looks at the effects of exogenous changes in the stock of foreign-owned capital and derives expressions for the shadow price of capital under different trade regimes. While some of the results in Sections 4 and 5 have been derived by other authors in special models,<sup>3</sup> Section 6 breaks new ground by examining how international mobility of capital influences the effects of tariffs and quantitative restrictions. Finally, Section 7 summarises the principal conclusions of the paper and notes some directions for further research as well as some policy implications of the analysis; and two tables in the Appendix present the paper’s results in a general schematic form.

## 2. The Setting

Throughout the paper, I consider three types of trade restriction, which differ in their mode of operation and in the destination of the revenues they generate. On the one hand, tariffs impose a fixed gap between world and domestic prices of importables, whereas both quotas and VER’s are quantitative restrictions, fixing the quantity of imports but allowing their

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<sup>3</sup> In particular, some of the results have been proved in the context of the two-sector two-factor Heckscher-Ohlin model. This is potentially misleading since, as we shall see, almost none of the results hinge on details of the economy’s production structure. The major exceptions are the results for international capital mobility of Section 6: these do not apply in models of the Heckscher-Ohlin type, since international capital mobility tends to lead to specialisation. As I have argued in Neary (1985), this makes the Heckscher-Ohlin model an inappropriate framework for the study of international capital mobility. In any case, a different analysis is required for this model, and it is set out in Neary and Ruane (1986).

domestic prices to be determined endogenously.<sup>4</sup> On the other hand, tariff revenues and quota rents are assumed to be returned in a lump-sum fashion to domestic consumers, whereas the rents generated by VER's are assumed to be lost to the home country and to accrue exclusively to foreign exporters. Both assumptions about rent disbursement are extreme. Although they may be rationalised in terms of plausible real-world institutions (competitive auctioning of import licences by the home government in the case of quotas; competitive auctioning of export licences by the foreign government in the case of VER's), they are probably best seen as analytic fictions which place bounds on the likely outcome in practice.<sup>5</sup>

Except for the questions to which it is applied, the analytic framework used in this paper is the standard one of a competitive, small (i.e., price-taking) open economy.<sup>6</sup> The model of the domestic economy is thus extremely general: in particular, no restrictions are placed on the economy's production structure or on the number of goods or factors, except as are necessary to rule out changes in the pattern of specialisation. In specifying the model, it is convenient to make explicit only those goods which are subject to trade restrictions and only those factors which may be internationally traded.<sup>7</sup> Thus, I assume that there are  $h$  imported goods, with exogenous world prices  $p^*$  and domestic prices  $p$ . The vector of differences be-

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<sup>4</sup> These definitions seem to conform to the manner in which the three types of trade restriction operate in practice. VER's could alternatively be modelled as price rather than quantity instruments. (See Bhagwati and Brecher (1987).) In that case they are identical to an export tax imposed by the foreign country, and, from the perspective of a small importing country, are indistinguishable from a deterioration in the terms of trade.

<sup>5</sup> Under these assumptions, a VER is exactly equivalent to a quota, all of the revenues from which are dissipated by competitive rent seeking. See Krueger (1974) and Bhagwati and Srinivasan (1980). I am not aware of any systematic study of the final destination of VER rents in practice, though anecdotal evidence suggests that some Japanese auto exporters used their VER rents to finance the establishment of dealership networks in the U.S.

<sup>6</sup> The assumption of fixed world prices for all traded goods may seem strange in the context of VER's, but in fact it is quite appropriate: since the rents accrue to foreign consumers, there is no reason for the world price or the behaviour of foreign producers to change. Endogenising world prices would merely introduce extraneous complications (such as the possibility of a Metzler paradox whereby foreign export restrictions *lower* import prices) which are not central to the comparison between the three types of trade restriction. This assumption is also consistent with the available empirical evidence. For example, Tarr (1987) estimates that, following voluntary restraints on exports to the U.S. and the European Community, the world prices of Korean and rest-of-the-world steel fall by only nine per cent and one per cent respectively of the increase in the differential between the world price of imported steel and its price in the U.S. and E.C. markets. See his Table 1C. Tarr uses an Armington model which is likely to over- rather than underestimate the price effects of quantitative restrictions.

<sup>7</sup> Implicit throughout are at least one good not subject to trade restrictions (which I take as numeraire) and at least as many non-traded factors as there are distinct production processes.

tween domestic and foreign prices is denoted by  $t (= p - p')$ , irrespective of whether these differences are exogenously fixed, as in the case of tariffs, or endogenously determined, as in the cases of quotas and VER's. In addition, I allow for  $n$  factors of production which are potentially mobile between countries; for concreteness it is convenient to refer to these as "capital", although no explicit accumulation mechanism is specified. If these factors are internationally immobile, their returns, denoted by  $r$ , are domestically determined, whereas if they are internationally mobile, their returns are fixed exogenously by world capital markets. In either case the quantities owned by residents of the home country, denoted by  $\bar{k}$ , may differ in general from the quantities located in the home country, denoted by  $\bar{k} + k$ . Throughout the paper I assume for concreteness that the home country is a net importer of capital services (so that  $k$  represents positive levels of foreign-owned capital) and that rental payments to foreign capital owners are untaxed. (It is straightforward to relax these assumptions.)

Under this specification, the equilibrium of the economy is easily determined. Firstly, the household sector is assumed to spend all its income:

$$e(p,u) = I. \tag{2.1}$$

Here,  $e(p,u)$  is an expenditure function and  $u$  is aggregate welfare. (The household sector could be disaggregated without difficulty, but this would add nothing which is specific to the issues under consideration.) Income in turn equals gross national product (i.e., gross domestic product less factor payments to foreign capital owners) plus a lump-sum transfer  $T$  (to be discussed in Section 3) plus any revenue which accrues from trade restrictions. The precise form which the latter takes depends on the particular type of trade restriction which is in operation. With tariffs, all the revenue is assumed to be costlessly redistributed to the household sector, so that its total income is:

$$I = g(p, \bar{k} + k) - r'k + T + t'm, \tag{2.2}$$



where a prime denotes the transpose of a vector. Here,  $g(p, \bar{k} + k)$  is a GDP function, giving the value of total production in the home country at given domestic prices and endowments of mobile factors. From this must be subtracted the rentals which accrue to foreign capital owners,  $r'k$ . Whether or not capital is internationally mobile, the domestic rental and capital stock are related by the standard condition:<sup>8</sup>

$$r = g_k(p, \bar{k} + k). \quad (2.3)$$

In addition, households also receive the tariff revenue,  $r'm$ , where  $m$  is the vector of imports:

$$m = e_p(p, u) - g_p(p, \bar{k} + k), \quad (2.4)$$

invoking standard properties of the expenditure and GDP functions.

Totally differentiating (2.1) and (2.2) yields:

$$(e_p - g_p)dt + dy = m'dt + r'd\bar{k} - k'dr + dT + r'dm. \quad (2.5)$$

Here I have used  $dy$  (equal to  $e_u du$ ) as a shorthand for the change in real income (strictly, the change in utility measured in numeraire units). From (2.4), it is clear that the first term on the left-hand side of (2.5) cancels with the first term on the right. The former represents the welfare loss to consumers less the gain to producers of an increased tariff arising from the higher domestic price of existing units; but this simply equals the change in tariff revenue,  $m'dt$ , which by assumption is returned in full to consumers. Hence these redistributions cancel and (2.5) reduces to:

$$dy = r'd\bar{k} - k'dr + dT + r'dm. \quad (2.6)$$

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<sup>8</sup> Subscripts denote partial derivatives throughout. Thus,  $g_k$  is the vector of partial derivatives of the function  $g$  with respect to  $r$ .

This shows that, in the presence of a tariff, imports have a “volume-of-trade” effect on welfare but, with fixed world prices, no “terms-of-trade” effect; whereas the converse is true of international capital movements since they are untaxed and the home and foreign rentals are not necessarily equal.<sup>9</sup>

If imports are restricted by quotas rather than tariffs, the determination of income is unchanged (since I assume that all the quota rents accrue to the household sector), although the interpretation of (2.2) and (2.6) is rather different: imports are now fixed at the given quota levels,  $\bar{m}$ , and the implicit tariff rates are determined endogenously. The same is true in the case of VER's, but, as already noted, the key difference from quotas is that the rents now accrue to *foreign* rather than to *domestic* residents. Hence income in this case equals:

$$I = g(p, \bar{k} + k) - r'k + T. \quad (2.7)$$

Totally differentiating this, the cancelling of terms which led from (2.5) to (2.6) does not apply, since the VER rents accrue to foreign residents. Equations (2.1) and (2.7) now yield instead of (2.6):

$$dy = -\bar{m}' dt + r'd\bar{k} - k'dr + dT. \quad (2.8)$$

This shows that, when the revenue from restricting trade does not accrue to domestic residents, international transactions in both goods and capital have terms-of-trade effects only. In particular, a tightening of VER levels is equivalent in effect to a worsening of the terms of trade: even though world prices of imports are fixed, the induced rise in domestic prices means that higher and higher rents must be paid to foreigners on each unit of imports.

This completes the specification of the model. Before considering its properties, it is convenient to present the total derivatives of equations (2.3) and (2.4), which take the same

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<sup>9</sup> This type of equation is familiar from Jones (1967).

form irrespective of the type of trade restriction considered.<sup>10</sup> Differentiating (2.3), which links the domestic rental to the tariff and the capital stock, yields:

$$dr = g_{kp}dt + g_{kk}d(\bar{k} + k). \quad (2.9)$$

Here  $g_{kp}$  measures the relative factor intensity of importables, and is positive if and only if they are capital-intensive (in the general equilibrium sense that an increase in the amount of capital employed in the whole economy raises the output of importables). Thus, (2.9) gives the familiar Stolper-Samuelson result that relative factor intensities determine the sign of the relationship between the tariff and the rental, while an increase in the usage of capital cannot increase the rental, since  $g_{kk}$  is non-positive.<sup>11</sup>

The second equation which must hold at all times, whatever the form of trade restriction considered, is the import demand equation, (2.4), since home consumers and producers are assumed to be trading voluntarily. Totally differentiating this (setting  $t = p - p'$ ) gives the following:

$$dm = -Sdt + x_I dy - g_{pk}d(\bar{k} + k). \quad (2.10)$$

Here,  $S$  equals  $g_{pp} - e_{pp}$ , the price responsiveness of excess supply of importables, with real income held constant. Under the assumptions made, this must be positive.<sup>12</sup> The income effect on the demand for imports is captured by the next term in (2.10), where  $x_I$  (equal to  $e_{pu}/e_u$ ) is the income derivative of demand. Finally,  $g_{pk}$  (like  $g_{kp}$  in (2.9)) measures the relative factor

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<sup>10</sup> Here and throughout the rest of the paper, in order to provide intuitive explanations for the results, I will discuss them for the most part in terms of a single import and a single traded factor only. Of course, as already noted, all the results hold for the general case of  $h$  imported goods and  $n$  traded factors; the additional issues raised by the  $h$ -by- $n$  case will be noted in footnotes as necessary.

<sup>11</sup> When  $k$  is a vector,  $g_{kk}$  is a negative semi-definite matrix and the statement in the text continues to hold provided it is interpreted as referring to the effect on total rental payments,  $(\bar{k} + k)'r$ , of an equiproportionate increase in usage of all the capital stocks:  $(\bar{k} + k)'dr = (\bar{k} + k)'g_{kk}(\bar{k} + k)d\alpha$ , where  $\alpha$  is a scalar.

<sup>12</sup> With many imports,  $S$  is a positive definite matrix. To rule out the possibility of its being singular (or being zero in the case of a single import), I assume that there is some substitutability in either production or consumption between imports and other goods.

intensity of importables, indicating that an increase in either home or foreign-owned capital raises the demand for imports if and only if they are relatively labour-intensive.

### 3. The Shadow Price of Foreign Exchange

The first step in understanding the workings of the model is to consider the welfare effect of a unit increase in the transfer from abroad,  $T$ , under each of the three types of trade restrictions. In the literature on project appraisal, it has become conventional to label this effect the "shadow price of foreign exchange." I will follow this convenient usage here, although since the model is a real one there is no role for foreign exchange as such, and the transfer in fact takes the form of a unit of the numeraire good.

Assume initially that there is no foreign-owned capital, so that  $k$  is zero. Consider first the effect of a transfer in the presence of a tariff. Substituting into (2.6) for the induced change in import demand from (2.10) (with  $dt = d\bar{k} = 0$ ) yields:

$$dy = (1 - t'x_I)^{-1}dT. \quad (3.1)$$

Following Jones (1969), the shadow price of foreign exchange in this case is usually called the "tariff multiplier," since it arises because any exogenous shock induces changes in the demand for imports which alter tariff revenue and thus feed back on income. In the absence of unusually perverse income effects this term will be positive and greater than unity and I shall assume this henceforward.<sup>13</sup> Intuitively, a dollar transfer from abroad raises utility (measured in numeraire units) by more than a dollar because it encourages additional imports and thus helps to return imports to their free-trade level.

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<sup>13</sup> Sufficient conditions for a positive tariff multiplier are that the equilibrium is stable under plausible adjustment mechanisms or that non-importables are normal in demand. (See Neary and Ruane (1988) for further discussion.) A sufficient condition for the multiplier to be greater than unity is that importables be normal goods.

Equation (2.6) also leads directly to the shadow price of foreign exchange in the presence of a quota. The difference now is that no induced change in imports can occur as long as the quota continues to bind. Hence the shadow price of foreign exchange is simply unity: since imports are fixed by hypothesis, the channel whereby a transfer could lead to an additional welfare gain in the presence of a tariff is closed off. Matters are even worse with a VER. To solve for the induced change in the differential between the world and domestic price, we invert the import demand equation (2.10). Substituting the result into (2.8) yields:

$$dy = (1 + \bar{m}'S^{-1}x_I)^{-1}dT. \quad (3.2)$$

As with a quota, the volume of imports cannot increase, and so, assuming that imports are normal goods, the transfer leads to an increase in demand for them and so tends to raise their domestic prices. With a quota, this merely induces redistribution effects within the country and national welfare is unaffected. But with a VER the redistribution effects are international as the rents which accrue to foreigners rise. Hence the benefit of a dollar transfer from abroad is less than a dollar.<sup>14</sup> Summing up our results so far:

*Proposition 1:* The shadow price of foreign exchange equals its undistorted value of unity in the presence of a quota, whereas it is greater than unity when tariffs are in force and less than unity when VER's are in force.

The presence of foreign-owned capital, whose level is assumed to be unaffected by changes in trade policy, modifies the above conclusions if the domestic rental is affected by the transfer. This does not occur with a tariff, since (from (2.3)) the rental depends only on domestic prices and the total capital stock, both of which are unaffected by a transfer. However, with quantitative restrictions, the transfer tends to drive up the domestic prices of importables, as we have seen. This will raise domestic rentals if and only if importables are

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<sup>14</sup> If many goods are subject to VER's, this requires that imports be normal in demand in the average sense that the term  $\bar{m}'S^{-1}x_I$  be positive. I assume this henceforward.

relatively capital-intensive, in which case more must be paid out to foreign capital owners, thus constituting an extra source of welfare loss. Formally, repeating the derivations which led to (2.6) and (3.2) but now allowing  $k$  to be non-zero leads to the following expression in the case of a quota:

$$dy = (1 + k'g_{kp}S^{-1}x_I)^{-1} dT, \quad (3.3)$$

and in the case of a VER:

$$dy = [1 + (\bar{m}' + k'g_{kp})S^{-1}x_I]^{-1} dT. \quad (3.4)$$

To summarise:

*Proposition 2:* Fixed stocks of foreign-owned capital leave the shadow price of foreign exchange unchanged in the presence of a tariff but raise it in the presence of a quota or a VER if and only if importables are relatively capital-intensive.<sup>15</sup>

This completes our analysis of the shadow price of foreign exchange. The importance of this concept derives not only from its intrinsic interest but also from the fact that the total effect of *any* exogenous shock equals its impact effect multiplied by the appropriate shadow price of foreign exchange. To avoid unnecessary qualifications to later results, I will therefore assume that this shadow price is positive in the remainder of the paper. (In each case this can be justified by appeal to a stability argument.)

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<sup>15</sup> The second part of the proposition continues to hold if many goods are subject to quantitative restrictions, provided imports which are normal in demand are capital-intensive in the average sense that the term  $k'g_{kp}S^{-1}x_I$  be positive.

#### 4. The Cost of Protection with Immobile Capital

In this section, I wish to determine the welfare costs of the three different kinds of trade restrictions under the assumption that capital is internationally immobile. I consider first the case where all capital is domestically-owned and then examine how the results are altered by the presence of some foreign-owned capital. To begin, I concentrate on tariffs and quotas: although the mechanisms whereby they affect the economy are very different, they are similar in that the change in income is given by (2.6) in both cases. Setting  $d\bar{k}$ ,  $dT$  and  $k$  equal to zero in this equation and using (2.10) to eliminate the change in imports gives an expression for the cost of tariff protection:

$$(1 - t'x_I)dy = - t'Sdt. \quad (4.1)$$

The implications of this equation are familiar. The right-hand side shows that the cost of protection is greater, the higher the initial tariff and the more elastic is the excess supply of importables. However, the introduction of a small tariff when the initial situation is one of free trade has no first-order effect on welfare. The same is true in the case of a quota, whose welfare cost can be determined directly from (2.6):

$$dy = t'd\bar{m}. \quad (4.2)$$

Consider next the case of a VER. As we have seen, the change in income in this case is given not by (2.6) but by (2.8). We again use the import demand equation to simplify this, this time inverting it to solve for the change in domestic prices. This yields:

$$(1 + \bar{m}'S^{-1}x_I)dy = \bar{m}'S^{-1}d\bar{m}. \quad (4.3)$$

The most striking difference is that, even when the initial situation is one of free trade ( $t=0$ ), the introduction of a VER has a first-order effect on welfare, whereas the introduction of a quota does not. This difference arises from the very different income effects of the two forms

of trade restriction. As the right-hand side of (4.3) shows, the welfare cost of a VER is greater the larger the initial level of imports.<sup>16</sup>

The same difference in income effects is apparent from a comparison between the expressions for the effects of a quota and a VER on the domestic prices of importables. In the case of a quota, we use (2.6) to eliminate the change in income from the import demand equation (2.10) and invert to obtain:<sup>17</sup>

$$dp = -S^{-1}(I_h - x_1 t') d\bar{m}. \quad (4.4)$$

In the case of a VER we substitute from (2.8) instead to obtain:

$$dp = -(S + x_1 \bar{m}')^{-1} d\bar{m}. \quad (4.5)$$

Summarising the results of equations (4.2) to (4.5):

*Proposition 3:* The welfare cost of a VER is greater the larger the initial level of imports, whereas that of a quota is greater the larger the gap between domestic and world prices. Moreover, for small departures from free trade (so that  $t$  is close to zero), a quota raises the domestic price of the import by more than does a VER; however, for large departures from free trade this ranking may be reversed.<sup>18</sup>

These results for the effects of quotas and VER's on welfare and domestic prices are summarised in Figure 1. As the diagram shows, the two measures must have identical effects

<sup>16</sup> With many goods, this also holds for an equiproportionate tightening of the restriction: when  $d\bar{m} = \bar{m}d\alpha$  where  $\alpha$  is a scalar, the left-hand side of (4.3) is a quadratic form in a positive definite matrix and so is unambiguously positive.

<sup>17</sup> The expression in parentheses on the right-hand side is a "matrix tariff multiplier" in the general case, with  $I_h$  equal to the identity matrix of order  $h$ . With only a single import good, this obviously reduces to  $(1 - tx_1)$ .

<sup>18</sup> These results for the effects on domestic prices continue to hold if many imports are subject to quantitative restrictions, provided a more restrictive trade policy is interpreted as an equiproportionate reduction in permitted levels of imports ( $d\bar{m} = \bar{m}d\alpha$ ) and the change in domestic prices is measured by the change in the appropriate index,  $\bar{m}dp$ . It may be checked that the difference between this change following a tightening of quotas and following a tightening of VER's is proportional to:  $(1 - t'\bar{m})\bar{m}'S^{-1}x_1 - t'\bar{m}$ , which is positive for small  $t$  but ambiguous otherwise.



if they eliminate trade (at the autarky points A and A') or if they are non-binding (at the free trade points F and F'). Starting from free trade, tighter values of the quota initially have smaller effects on income but larger effects on prices than a VER set at the same level. The direct effect of the VER in driving up the home price is diluted by the loss of rent income. However, as the two types of restrictions are progressively tightened, their effects on income and prices tend to converge. Progressive tightenings of the quota have larger effects on income whereas the effect of a tightening of the VER depends on the volume of imports and so falls steadily. To formalise this intuition, it is easily checked that welfare is a concave function of the quota level,<sup>19</sup> whereas it is approximately a convex function of the VER level.<sup>20</sup>

Finally, how are these results altered when there is some foreign-owned capital? In this context the key feature of all three forms of trade restriction is that they raise domestic prices of importables. This in turn raises the domestic rental (so requiring higher payments to foreign capital owners and imposing an additional welfare loss) if and only if importables are capital-intensive.<sup>21</sup> Summarising:

*Proposition 4:* The presence of existing stocks of foreign-owned capital tends to raise the welfare cost of all three forms of trade restriction, if and only if importables are relatively capital-intensive.

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19 Since  $dy = r'd\bar{m}$ , the second derivative of welfare with respect to  $\bar{m}$  equals the *first* derivative of price with respect to  $\bar{m}$ , which is negative. Essentially the same result is obtained by Young and Anderson (1982). (See their equation (10).) This result generalises to the multi-commodity case, if a tightening of the level of quotas is interpreted as an equiproportionate reduction in the quota level on each import.

20 Differentiating (4.3), on the assumption that  $S$  and  $x_1$  are constant, yields:

$$d^2y / d\bar{m}^2 = S / (S + x_1\bar{m})^2,$$

which is positive.

21 The relevant equations are given in Table A.1. With many foreign-owned capital factors, this result still holds for uniform proportionate increases in tariffs or uniform proportionate reductions in permitted import levels, provided importables are capital-intensive in the appropriate average sense: viz., that the term  $k'g_{kp}t$  be positive in the case of tariffs; and that the term  $k'g_{kp}S^{-1}\bar{m}$  be positive in the case of quantitative restrictions.

## 5. Shadow Prices of Capital and the Welfare Effects of Exogenous Capital Inflows

In this section, I wish to examine the effects on welfare of exogenous changes in the stock of capital, under each of the three types of trade restriction. To begin, I look at the effects of an exogenous increase in the stock of domestically-owned capital. Following standard practice I use the term "shadow price of capital" to denote the *impact* effect on welfare of a unit increase in the stock of domestic capital. This must then be multiplied by the shadow price of foreign exchange to obtain the full effect.

In the case of a tariff, this issue has been widely considered.<sup>22</sup> Combining equations (2.10) and (2.6):

$$(1 - t'x_I)dy = (r' - t'g_{pk})d\bar{k}. \quad (5.1)$$

Obviously, the shadow prices of capital are simply the market rentals,  $r$ , if there are no tariffs or other distortions in place. In the presence of tariffs, any change in the output of importables has an additional effect on welfare, which is negative if and only if importables are relatively capital-intensive in the general equilibrium sense (i.e., if and only if the elements of the matrix  $g_{pk}$  are positive).

A very different picture emerges when we turn to consider the effects of additional capital in the presence of quotas. From (2.6), with  $m$  held constant by assumption, it follows that:

$$dy = r'd\bar{k}. \quad (5.2)$$

With the volume of imports fixed, the secondary channel whereby welfare can be affected vanishes for the same reason that the shadow price of foreign exchange collapses to unity. If the only distortion in the economy is a set of quotas, it follows that market rentals give an exact

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<sup>22</sup> See Neary and Ruane (1988) for further discussion and references.

measure of the marginal contribution to welfare of a unit increase in the endowment of capital. Hence immiserizing growth cannot occur in the presence of quotas.<sup>23</sup> However, a key condition for this result is that all the quota rents accrue to the private sector. To see this, consider the effects of an increment in capital in the presence of a VER rather than a quota. Since the determinants of income are very different in this case, it is now necessary to combine equation (2.8) rather than (2.6) with (2.10), and to recognise that the differential between home and foreign prices is now endogenous. This yields:

$$(1 + \bar{m}'S^{-1}x_I) dy = (r' + \bar{m}'S^{-1}g_{pk}) d\bar{k}. \quad (5.3)$$

The shadow price of capital now differs from that in (5.2) because, although the volume of imports cannot be altered by the additional capital, the amount of rents paid out to foreigners in general will be. Suppose for concreteness that there is a single importable subject to a VER, and that it is capital-intensive. An increased endowment of capital therefore raises home output of the importable, and induces a fall in the domestic price. This reduces the total rents arising from the restrictions on imports and therefore reduces the amount paid to foreign exporters. This effect is greater the more sensitive are domestic prices to shifts in supply or demand, which is why the term  $S^{-1}$  appears on the right-hand side of (5.3). To summarise:

*Proposition 5:* The shadow price of capital (which measures the impact effect on welfare of an increased endowment of domestically-owned capital) equals the market rental when quotas are in force and (if and only if importables are relatively capital-intensive) is less than the market rental with a tariff but greater than it with a VER.

The results so far in this section relate to the effects on welfare of an exogenous increase in the capital stock, assuming that all capital is domestically-owned. The effects of an exogenous increase in the stock of foreign-owned capital are different in two respects. Firstly,

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<sup>23</sup> This was pointed out by Alam (1981) in the two-by-two Heckscher-Ohlin context.

the additional unit of foreign-owned capital must be paid its return, which is simply the domestic rental,  $r$  (since I am assuming no taxation of capital). This must therefore be subtracted from the impact effect of an increase in home-owned capital derived above. Secondly, account must be taken of any change in the rental itself which the new inflow induces, since this will alter the amount paid out on *existing* units of foreign-owned capital. Ignoring the second effect for the present, subtracting  $r'd\bar{k}$  from equations (5.1), (5.2) and (5.3) yields immediately:

*Proposition 6:* If there is no existing foreign-owned capital or if there is but the domestic rental remains constant,<sup>24</sup> then a small inflow of foreign-owned capital leaves welfare unchanged in the presence of a quota and (if and only if importables are relatively capital-intensive) lowers it in the presence of a tariff and raises it in the presence of a VER.<sup>25</sup>

What about the second effect, the change in rental outflows on intramarginal units of foreign-owned capital? It is immediately clear that an increased inflow must depress domestic rentals and so lead to a welfare *gain*. While this is true under all three forms of trade restriction, the magnitudes of the welfare gain involved differ. In the case of tariffs, it is shown by the second term in the coefficient of  $dk$  in (5.4):

$$(1 - t'x_I)dy = - (t'g_{pk} + k'g_{kk})dk. \quad (5.4)$$

The standard property of competitive models, that an increase in endowments cannot raise and may lower the returns of the factors in question (so that  $g_{kk}$  is non-positive for a single mobile factor and negative semi-definite for many) ensures a welfare gain from this effect. This term continues to apply in the presence of quantitative restrictions but to it must be added an additional effect arising from the change in the domestic market-clearing prices of importables in-

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<sup>24</sup> This is the case if the home country's technology is of the Heckscher-Ohlin kind, since then the factor-price equalization property applies and the domestic rental is unaffected by capital inflows (i.e., the elements of the matrix  $g_{kk}$  are zero). This case is discussed further in Neary and Ruane (1986).

<sup>25</sup> This proposition generalises results obtained in the two-good two-factor Heckscher-Ohlin model by Brecher and Diaz (1977) in the case of a tariff, Anam (1985), Dei (1985a) and Buffie (1985) in the case of a quota, and Anam (1986) and Dei (1985b) in the case of a VER.

duced by a capital inflow. This effect works through the production side of the economy, but its outcome is independent of relative factor intensities: in the case of a single importable, the capital inflow raises the domestic output of the importable if and only if it is relatively capital-intensive, so driving down its domestic price and lowering the rental; whereas if the importable is relatively labour-intensive the capital inflow lowers its domestic output which drives up its price which again lowers the rental. The chain of causation is very different in the two cases but the effect on the rental is the same. Formally, this may be seen from the expression for the welfare impact of an inflow of foreign-owned capital in the presence of a quota:

$$(1 + k'g_{kp}S^{-1}x_I)dy = -k'(g_{kk} - g_{kp}S^{-1}g_{pk})dk. \quad (5.5)$$

(The coefficient of  $dy$  is the inverse of the shadow price of foreign exchange appropriate in the presence of a quota and with some preexisting foreign-owned capital, derived in (3.3) above.)

The expression in parentheses on the right-hand side is the effect of an increased capital endowment on domestic rentals when imports are subject to quantitative controls, and is unambiguously greater in absolute value than  $g_{kk}$ , the effect when domestic prices are fixed.<sup>26</sup> This strong result is an example of the Le Chatelier Principle: the depressing effect of an exogenous capital inflow on the domestic rental is unambiguously greater when the level of importables is quota-constrained than when it is free to adjust. It is easily checked that exactly the same effect applies if a VER is in force.<sup>27</sup> (See column 1 of Table A.1 for an explicit expression.) Hence we may summarise our results as follows:

*Proposition 7:* Because of the induced fall in domestic rentals, the presence of existing foreign-owned capital encourages a welfare gain from a capital inflow, in addition to the effects noted in Proposition 6. This holds for all three types of trade restriction, with the gain in the

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<sup>26</sup> With many importables and many internationally mobile factors, the expression  $-g_{kp}S^{-1}g_{pk}$  is a negative definite matrix, so the statement in the text continues to hold.

<sup>27</sup> This generalises a result obtained by Dei (1985a) in a two good two-factor model.

presence of a quota or a VER being greater due to the induced changes in the domestic prices of quantity-constrained imports.

## 6. Trade Restrictions when Capital is Internationally Mobile

The general expressions derived in the last two sections allowed for the possibility that some of the domestic capital stock was foreign-owned. However, the extent of foreign ownership was assumed to be invariant to changes in the level of trade restrictions. As noted by Neary and Ruane (1988), this makes sense (in the absence of exogenous capital controls) only as a description of a short-run equilibrium, before foreign capital-owners have had an opportunity to reallocate their portfolios in response to the changes in incentives brought about by changes in trade policy. In this section, I turn to the more interesting case where capital moves internationally in response to deviations between the domestic and the world rental. Since I confine attention to a small open economy, the world rental is assumed to be exogenously given throughout. Moreover, I continue to assume that repatriated capital earnings are untaxed.

The first point to note is that the only difference which international capital mobility makes to the behaviour of the model is to its supply side: for given prices and utility, demand continues to be represented by the aggregate expenditure function (2.1). As for supply behaviour, I have shown in Neary (1985) that this is altered in a determinate way: international capital mobility leads to a larger price-output response, irrespective of the relative factor intensity of the sectors in which the mobile capital is used.<sup>28</sup> Hence, the responsiveness of import demand to price, represented (in absolute value) by  $\tilde{S}$ , is greater than the responsiveness in the absence

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<sup>28</sup> The technical device used to demonstrate this is a *mobile capital GNP function*, defined as  $\tilde{g}(p,r) = \max_k [g(p,k) - r'k]$ . The only extra restriction is that the matrix  $g_{kk}$  must be non-singular; it is for this reason that the approach cannot be applied to models of the Heckscher-Ohlin type.

of international capital mobility, denoted by  $S$ .<sup>29</sup> But this change in supply responsiveness applies equally to all three forms of trade restriction, and so cannot affect the relative rankings of their welfare costs: all the equations in Section 4 above continue to hold except that  $S$  is replaced by  $\tilde{S}$ . Hence, given that capital is internationally mobile, the comparison between the effects of the three types of trade restriction, as summarised in Proposition 3 and Figure 1, continue to hold.

A different question which can be asked is what effect international capital mobility has on the welfare costs of any particular form of trade restriction. The case of tariff protection has been extensively considered by Neary and Ruane (1988) and need not detain us. (See also Jones (1984) and Ohyama (1986).) The larger domestic supply response in the presence of internationally mobile capital means that tariffs reduce imports and income by more than when capital is internationally immobile.<sup>30</sup> Thus international capital mobility unambiguously *raises* the cost of tariff protection.

Turning next to the quota case, from equation (4.2) the effect of a tightening of the quota constraint is the same whether capital is internationally mobile or not:  $dy = t'd\bar{m}$ . However, the greater supply response when capital is internationally mobile continues to play a role, since it implies, from (4.4), that a tightening of the quota raises domestic prices by less when capital is internationally mobile than when it is not:  $dp = -S^{-1}(I_h - x_t t')d\bar{m}$  in the former case and  $-\tilde{S}^{-1}(I_h - x_t t')d\bar{m}$  in the latter. Thus, while international capital mobility has no first-order effect on the welfare cost of protection by means of a quota, the fact that it leads to lower domestic prices of importables means that it has a second-order effect which tends to lower the cost of protection.

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29 With many internationally mobile capital goods,  $\tilde{S} - S$ , which equals  $-g_{pk} g_{kk}^{-1} g_{kp}$ , is a positive definite matrix. This is, of course, another example of the Le Chatelier principle and is subject to the well-known qualification that the two matrices must be evaluated at the same point. See Neary (1985), especially footnote 13.

30 Note that in this and subsequent comparisons between the mobile and immobile capital cases, I do not allow for any foreign-owned capital in the initial situation ( $k$  is zero); this reflects the fact that a fixed stock of foreign-owned capital makes sense only with exogenous capital controls or in a short-run disequilibrium situation.

The outcome in the VER case is similar, although the chain of causation is different. As equation (2.8) showed, the effect of a VER on domestic welfare depends solely on the response of domestic prices, whether capital is mobile or not (given that  $k$  is zero in the immobile capital case). But as equation (4.5) and the last row of Table A.2 show, a VER raises prices by less when capital is internationally mobile than when it is not, once again because the greater supply response arising from capital mobility requires a smaller price rise to reduce imports to the constrained level. Hence income also falls by less, implying that international capital mobility unambiguously reduces the welfare cost of a VER. To summarise:

*Proposition 8:* International capital mobility has no first-order effect on the cost of quota protection, raises the cost of tariff protection and lowers the welfare cost of a VER. Since international capital mobility dampens the welfare-reducing impact of a quota on domestic prices, there is a general presumption that it reduces the welfare cost of both types of quantitative restrictions.

The difference which international capital mobility makes to the welfare costs of the three kinds of trade restriction may be illustrated in Figure 2. This is only a partial equilibrium diagram, and so it fails to capture all aspects of the comparison (such as the tariff multiplier for example). Nevertheless, it illustrates adequately the different ways in which the three measures lower welfare. The curves labelled  $p^*$  and  $D$  are the foreign supply and home demand curves respectively, while  $S_{NCM}$  and  $S_{ICM}$  are the home supply curves without and with international capital mobility respectively. Both pass through the initial free-trade production point  $A$ , and the curve with international capital mobility is the more elastic. A tariff raises the supply price of imports to  $p^* + t$  and imposes a consumption welfare cost equal to the triangle  $DEF$ . If capital is immobile the production welfare cost equals the triangle  $ABC$ , whereas if it is internationally mobile the production cost is  $AGH$ ; the latter is clearly larger, which illustrates the result of Neary and Ruane (1988). Now consider the effects of a quota which raises the domestic price to  $p^* + t$  when capital is internationally immobile. It therefore has the same



welfare cost as the equivalent tariff, i.e., the sum of the areas ABC and DEF. However, if capital is internationally mobile, the same restriction of imports requires a smaller rise in the home price. The precise price rise necessary is derived by drawing through B a curve which is a lateral displacement of the home demand curve D; this intersects the  $S_{ICM}$  curve at I, and so the import volumes IL and BE are equal. The welfare cost of a quota with international capital mobility therefore equals the sum of the areas AIJ and KLF, which is clearly less than that when capital is internationally immobile.<sup>31</sup> Finally, the same comparison applies in the case of a VER, since the only additional cost is the rent rectangle, CBED when capital is internationally immobile and JILK when it is internationally mobile.

## 7. Summary and Conclusion

This paper has presented a general framework for the analysis of different types of trade restrictions, within which the general equilibrium effects of tariffs, quotas and voluntary export restraints have been compared. Some of the principal results which deserve mention include the following: starting from free trade, a VER has a finite effect on welfare whereas a quota set at the same level has not; by contrast, as the two types of restriction become progressively more restrictive, welfare tends to fall faster with a quota than with a VER; under a quota, the shadow price of foreign exchange is unity and the shadow price of capital equals its market price; by contrast, the shadow price of foreign exchange is greater than unity under a tariff and less than unity under a VER; whereas shadow prices of capital depend on the relative factor intensity of importables, being less than the market price under a tariff and greater under a VER if and only importables are capital-intensive; finally, although international capital mobility *raises* the welfare cost of tariff protection, it *reduces* the welfare cost of protection by

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<sup>31</sup> This may be seen as follows:

$$\begin{aligned}
 AIJ + KLF &= ABC + CBIJ - ABI + KLF \\
 &= ABC + DELK - ABI + KLF \text{ (since BI is a lateral displacement of D)} \\
 &= ABC + DEF - ABI.
 \end{aligned}$$

means of quantitative restrictions. The key to many of these results is that, in the presence of a tariff, an increase in the domestic output of importables tends to reduce welfare, since lower-cost imports are displaced. By contrast, in the presence of a quantitative restriction, the volume of imports is fixed by assumption, and a change in the domestic output of importables has no first-order effect on welfare. However, since the extra domestic supply tends to lower the domestic price of importables, it reduce the rents which accrue to foreigners under a VER and so raises welfare.

While the paper has hopefully succeeded in its aim of synthesizing and extending our understanding of tariffs and quantitative trade restrictions in a general equilibrium framework, there are a great many issues which it has ignored. As already noted, all issues relating to uncertainty and departures from competitive behaviour have been assumed away. The latter omission is particularly crucial, since the work of Harris (1985) and Krishna (1983) in a partial equilibrium context has shown that quantitative restrictions alter the strategic interdependence between oligopolistic firms in ways which are fundamentally different from the effects of tariffs. I have also ignored the effects of trade restrictions in influencing the average quality of imports, which has been the focus of much recent theoretical and empirical analysis. (See Falvey (1979), Rodriguez (1979) and Feenstra (1984).) A different limitation of the present paper is its exclusive concern with a small open economy. I have argued that this is not a serious limitation within a competitive framework in which strategic considerations are ignored. But it would clearly be desirable to relax these assumptions. As Greenaway (1983) and Hamilton (1986) note, VER's unlike quotas are usually discriminatory between countries and form part of a package of trade policies negotiated bilaterally between governments.<sup>32</sup> Another issue which is ignored by the assumption of a small open economy is that the short-run effects of quotas and VER's are likely to differ significantly from those of tariffs when there is unemployment in the exporting country. Finally, the identification of the effects of the different kinds of trade re-

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<sup>32</sup> Dinopoulos and Kreinin (1986) examine VER's in a three-country framework.

restrictions on aggregate welfare needs to be supplemented by an examination of their effects on the welfare of individual agents, if our understanding of the political economy of trade restrictions is to be furthered.<sup>33</sup> These are only some of the directions in which further research is badly needed.

Despite these limitations, the results of this paper have many important implications. One which deserves particular mention is that of the appropriate order of liberalisation of trade and factor markets in a highly distorted economy. If it is easier to remove controls on capital movements than on international trade, then it should be done provided the latter take the form of quantitative restrictions but *not* if they take the form of tariffs. In this context too it is precisely the least desirable aspect of quantitative restrictions from a welfare point of view - the fact that they freeze the level of imports and so prevent any adjustment to shocks - which makes the welfare analysis of their consequences more clearcut and less subject to second-best qualifications than that of tariffs.

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<sup>33</sup> Findlay and Wellisz (1986) make a start at examining some of the political economy issues which arise in the choice between tariffs and quotas.

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APPENDIX

Table A.1: Changes in Welfare

Type of Trade Restriction	Capital Internationally Immobile but Partly Foreign Owned	Capital Internationally Mobile
Tariff	$(1 - t'x_I) dy = -a'dt - b'dk$	$(1 - t'x_I) dy = -t' \dot{S} dt - b' g_{kk}^{-1} dr$
Quota	$(1 + k' g_{kp} S^{-1} x_I) dy = a'S^{-1} d\bar{m} - k' \bar{g}_{kk} dk$	$dy = t' d\bar{m} - k' dr$
VER	$[1 + (\bar{m}' + k' g_{kp}) S^{-1} x_I] dy =$ $(\bar{m}' + k' g_{kp}) S^{-1} d\bar{m} + (\bar{m}' S^{-1} g_{pk} - k' \bar{g}_{kk}) dk$	$(1 + \bar{m}' \dot{S}^{-1} x_I) dy = \bar{m}' \dot{S}^{-1} d\bar{m}$ $+ (\bar{m}' \dot{S}^{-1} g_{pk} - k' \bar{g}_{kk}) g_{kk}^{-1} dr$

Symbols:

$$a' \equiv t' S + k' g_{kp}$$

$$b' \equiv t' g_{pk} + k' g_{kk}$$

$$\bar{g}_{kk} \equiv g_{kk} - g_{kp} S^{-1} g_{pk}$$

$$S \equiv g_{pp} - e_{pp}$$

$$\dot{S} \equiv \dot{g}_{pp} - e_{pp} = S - g_{pk} g_{kk}^{-1} g_{kp}$$

Table A.2: Changes in Imports or in Domestic Prices

Type of Trade Restriction	Capital Internationally Immobile but Partly Foreign Owned	Capital Internationally Mobile
Tariff	$Cdm = - (S + x_I k' g_{kp}) dt - Ddk$	$Cdm = - \dot{S} dt - D g_{kk}^{-1} dr$
Quota	$(S + x_I k' g_{kp}) dp = -Cdm - Ddk$	$\dot{S} dp = -Cdm - D g_{kk}^{-1} dr$
VER	$[S + x_I (\bar{m}' + k' g_{kp})] dp = -d\bar{m} - Ddk$	$(\dot{S} + x_I k') dp = -d\bar{m} - D g_{kk}^{-1} dr$

Symbols (additional to those in Table A.1):

$$C \equiv I_h - x_I t'$$

$$D \equiv g_{pk} + x_I k' g_{kk}$$

$I_h$ : The identity matrix of order  $h$ .

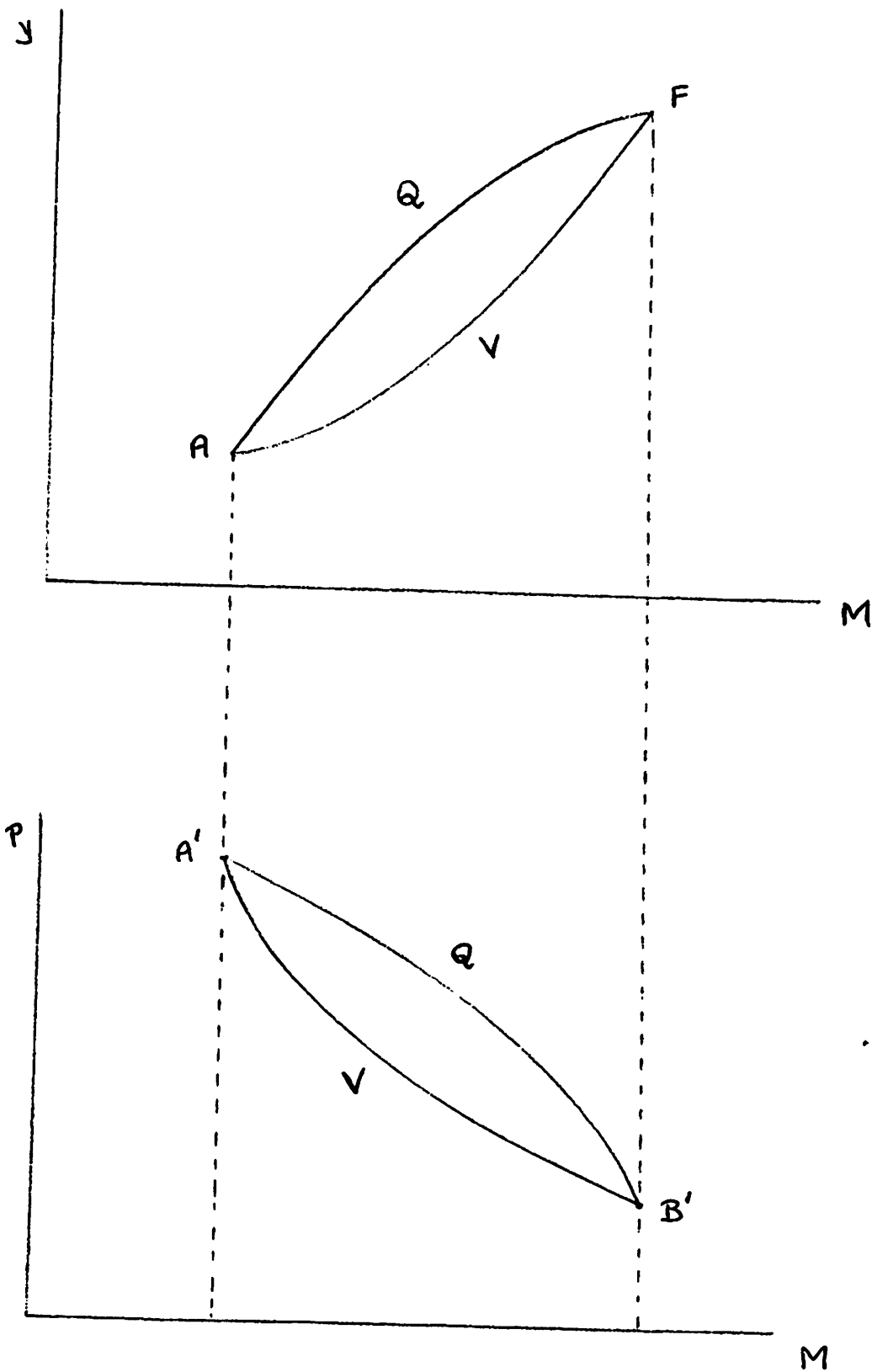


Figure 1: Effects of Quota and VER on Welfare and Domestic Prices



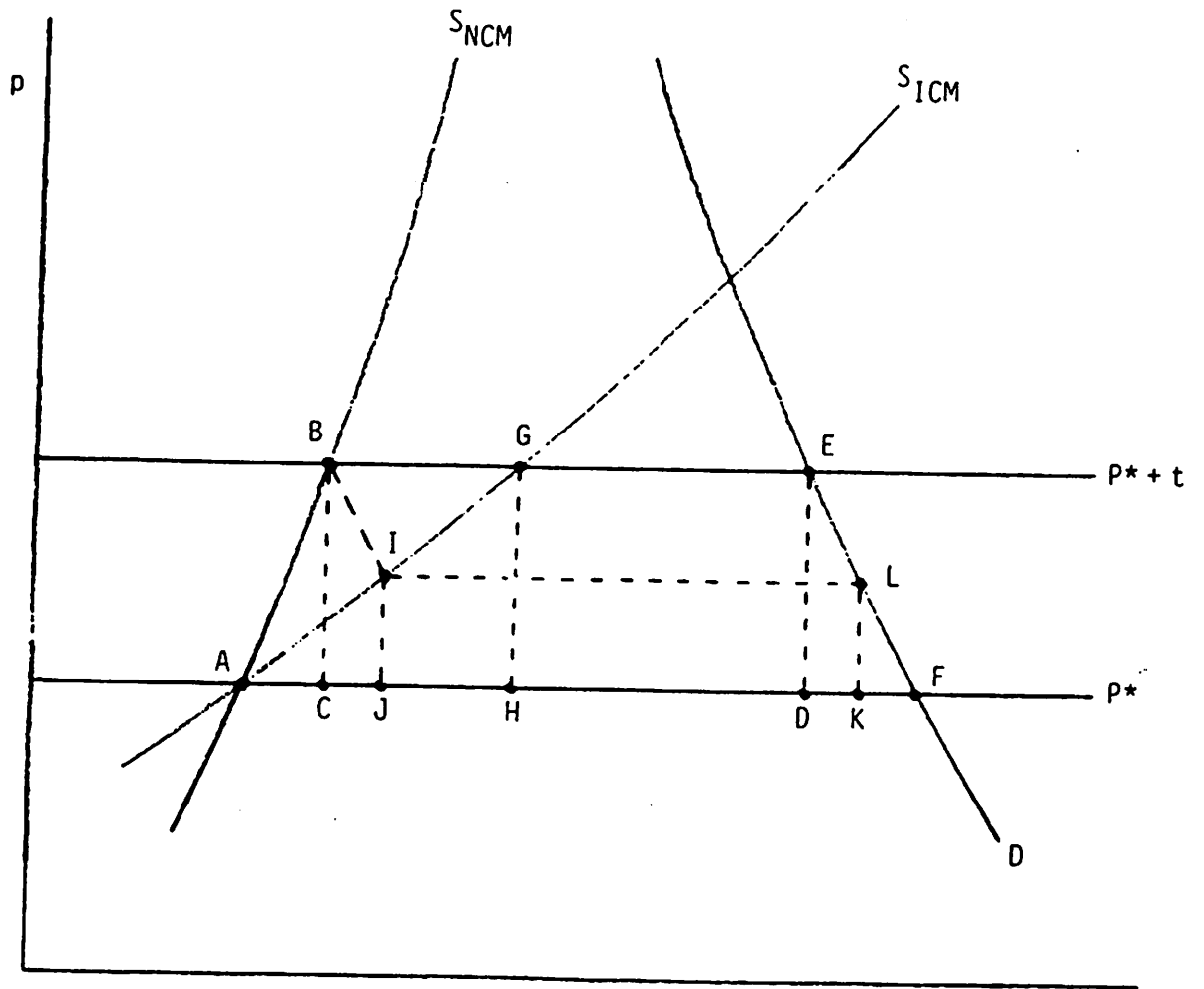


Figure 2: Partial Equilibrium Illustration of the Welfare Costs of Tariffs, Quotas and VER's, with and without International Capital Mobility

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- 8519C Huffman, Gregory W. ASSET PRICING WITH HETEROGENEOUS ASSETS.

1985

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- 8703C Ryan, Cillian. TRADE IN THE PRESENCE OF ENDOGENOUS INTERMEDIATION IN AN ASYMMETRIC WORLD.
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- 8705C Feenstra, Robert C., and Tracy R. Lewis. NEGOTIATED TRADE RESTRICTIONS WITH PRIVATE POLITICAL PRESSURE.
- 8706C Brecher, Richard A. POLICY-INDUCED INFLOWS OF FOREIGN CAPITAL IN THE PRESENCE OF RIGID-WAGE UNEMPLOYMENT.
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- 8708C Jones, Richard and John Whalley. REGIONAL BALANCE SHEETS OF GAINS AND LOSSES FROM NATIONAL POLICIES.
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