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TRADE POLICY WITH INCREASING RETURNS AND IMPERFECT COMPETITION: CONTRADICTORY RESULTS FROM COMPETING ASSUMPTIONS

James R. Markusen

and

Anthony J. Venables

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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Trade Policy with Increasing Returns
and Imperfect Competition: Contradictory
Results from Competing Assumptions

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Abstract.

A number of recent papers derive different results about the effects of trade and industrial policy on imperfectly competitive industries; policy conclusions are sensitive to the specifications of both firm behaviour and market structure. This paper sets out a single model within which policy under different market structures can be examined. The model permits comparison of results already in the literature, as well as the further analysis of some cases. We consider the four types of market structure generated by oligopoly versus free entry, and segmented markets versus integrated markets. By employing simple functional forms we are able to make direct comparisons between these cases. We conclude that the effects of policy are greater when markets are segmented than when they are integrated, and that - if transport costs are small - policy is more potent when the number of firms is fixed than when there is free entry.

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1. INTRODUCTION

The sub-field of trade policy under conditions of imperfect competition and increasing returns to scale has reached a certain maturity, at least as measured by the number of published articles on the topic. But this does not seem to imply that we have a clear and complete understanding of either the positive or normative implications of these twin assumptions. The contents of the various contributions do not, in other words, aggregate into a coherent "model" in the sense we get from the factor proportions model. Different papers produce contradictory policy implications that aggregate into confusion and disarray.

An example of this can be provided by the various results on export subsidies which have emerged in the literature. If firms produce at price in excess of marginal cost then there is a possibility that welfare may be raised by using export subsidies to expand the output of domestic firms. This argument has been extensively analysed for oligopolistic industries (Krugman (1984), Brander and Spencer (1985), Dixit (1984), Eaton and Grossman (1986)). If the assumption that there is a fixed number of firms is replaced by free entry, then the export subsidy will attract new firms into the industry, so may not expand the output of individual firms or change their average costs. Recent papers by Horstmann and Markusen (1986) and Venables (1985) demonstrate that the role of export subsidies then depends crucially on whether international markets are segmented or integrated. In the former case firms can set sales in domestic and foreign markets independently, creating the possibility that the price of a product may be different in the two markets. In the latter case firms can control only their total world sales, and the allocation of this quantity between countries occurs so as to equalise product prices in all markets.

This example suggests that policy conclusions depend on industry structure assumptions (oligopoly (no entry) versus free entry), and market structure assumptions (segmentation versus integration). The purpose of this paper is to provide a single model from which to draw the four possible cases generated by combining the industry structure and the market structure assumptions. Our primary aim is to use the model to generate comparisons between results already in the literature. In addition, we obtain some new results concerning policy with oligopoly and integrated markets, and the role of transport costs in the case of free entry and segmented markets.

In order to accomplish this purpose in a relatively transparent way, we need to sacrifice generality in other directions. We have done this with a vengeance by making the following assumptions: (a) demand curves are linear, (b) only specific taxes and subsidies are considered, (c) marginal costs are constant, (d) conjectures are Cournot.

While many of the above-mentioned papers use these assumptions in any case, it is nevertheless true that the results generated by the four models are not robust with respect to variations in these assumptions. Many results can, for example, turn on whether or not conjectures are Cournot (Eaton and Grossman (1986)). But the purpose of this paper is to offer a meaningful comparison of models, not to examine in detail any single case. We thus feel that the sacrifice of generality is worthwhile, but urge those not familiar with the literature to remember that the policy implications of any particular model may not be robust.

2. DEMAND, SUPPLY, AND WELFARE

Each economy has a single factor of production; the domestic economy's share of the world endowment of this factor is denoted l, and in the foreign economy's denoted l^* $(l+l^*=1)$. This factor may be used to produce a tradeable composite commodity under perfect competition, and with identical constant returns to scale technologies in each country. Units are chosen such that the factor of production and the composite may be taken as numeraire.

In addition, each country contains firms from an imperfectly competitive industry. We assume that all firms from this industry in a particular country produce an identical product, but permit national product differentiation; the products produced by domestic and foreign firms will be denoted X and Y respectively. Stars denote foreign quantities so, for example, X^* is the total amount of X sold in the foreign market and X is the total sold in the domestic market. Lower case x (x^*) and y (y^*) denote the outputs per firm sold to the domestic (foreign) market. n_x and n_y are the numbers of firms in the X and Y industries so $X = n_x x$ and $X^* = n_x x^*$, etc. The same notational convention is employed on prices, so p_x (p_x^*) and p_y (p_y^*) denote the consumer prices of X and Y in the domestic (foreign) economy.

Domestic demands for the outputs of the imperfectly competitive industry take the linear form,

(1) $n_x x = X = l\{a - p_x - b(p_x - p_y)\}$

(2) $n_y y = Y = l\{a - p_y - b(p_y - p_x)\}$

and foreign demands are

(3) $n_x x^* = X^* = l^*\{a - p_x^* - b(p_x^* - p_y^*)\}$

(4) $n_y y^* = Y^* = l^*\{a - p_y^* - b(p_y^* - p_x^*)\}$.

Two remarks may be made about these demand functions. First, the demand functions are symmetric across both countries and products. That is, within each country demand functions for X and Y are the same, and for each product demand is the same in both countries, except for the terms l and l* which scale demand to the size of the countries' endowments. Second, the parameter b may be interpreted as a measure of closeness of substitution between output produced in each country; as $b \to \infty$, the products become perfect substitutes.

The unit revenue that a firm receives from sales is the consumer price, net of any taxes (t) or transport costs (s). We consider only specific taxes, so that producer prices (q) may be defined as,

(5) $q_x = p_x - t_x, \qquad q_x^* = p_x^* - t_x^* - s_x^*,$

(6) $q_y = p_y - t_y - s_y, \qquad q_y^* = p_y^* - t_y^*.$

The range of tax instruments captured in this formulation is quite wide. For example, $t_x^* > 0$ may represent either a foreign import tariff or domestic export tax, depending on which government receives the revenue.

Firms in the imperfectly competitive industry produce with a fixed cost F_x (F_y) and a constant marginal cost c_x (c_y). The profits of a single representative firm in the domestic economy, r_x, are defined as,

(7) $$r_x = (q_x - c_x)x + (q_x^* - c_x)x^* - F_x$$

Consider first this firm's supply decision under the hypothesis of segmented markets. The firm can then independently vary producer prices in each country, q_x and q_x^*, (and hence consumer prices p_x and p_x^*). With Cournot behaviour the firm conjectures that if it changes q_x the sales of all other firms are unchanged. In order to hold Y constant this implies (from demand equation (2) together with $dp_x = dq_x$ from (5)), that p_y changes to satisfy

$$(1+b)dp_y = bdq_x$$

Given this price change and the fact that the sales of other domestic firms are constant, the slope of the firm's perceived demand curve for domestic sales is, from the demand curve (1),

(8) $dX/dq_x = dx/dq_x = -l(2b+1)/(b+1) = -lB$

where B defined as $B = (2b+1)/(b+1)$. Analogous reasoning establishes that the slope of the firm's perceived demand curve on foreign sales, dx^*/dq_x^*, is

(9) $dx^*/dq_x^* = -l^*(2b+1)/(b+1) = -l^*B.$

Using (8) and (9) in (7), the first-order conditions for profit maximization are,

(10)
$$dr_x/dq_x = x - (q_x - c_x)lB = 0$$
$$dr_x/dq_x^* = x^* - (q_x^* - c_x)l^*B = 0$$

Equivalent first order conditions for a foreign firm are,

(11)
$$dr_y/dq_y = y - (q_y - c_y)lB = 0$$
$$dr_y/dq_y^* = y^* - (q_y^* - c_y)l^*B = 0.$$

Equations (10) and (11) give the sales of a firm from each country in each market as a function of the relevant producer price. Using these equations in the definition of profits we can obtain the maximized value of profits as a function of producer prices. That is, using (10) in (7),

(12) $r_x = lB(q_x - c_x)^2 + l^*B(q_x^* - c_x)^2 - F_x,$

and for a foreign firm,

(13) $r_y = lB(q_y - c_y)^2 + l^*B(q_y^* - c_y)^2 - F_y.$

Equilibrium with segmented markets is now characterised as follows. Equilibrium prices, conditional on the number of firms, n_x and n_y, can be found by equating demand (equations (1)-(4)), and supply (equations (10) and (11)) for each product in each market. Domestic producer prices are then implicitly defined by,

$$(14)\quad \begin{aligned} q_x\{n_xB+b+1\} - q_yb - n_xc_xB &= a - (1+b)t_x + b(t_y+s_y). \\ q_y\{n_yB+b+1\} - q_xb - n_yc_yB &= a - (1+b)(t_y+s_y) + bt_x. \end{aligned}$$

and foreign producer prices by

$$(15)\quad \begin{aligned} q^*_x\{n_xB+b+1\} - q^*_yb - n_xc_xB &= a - (1+b)(t^*_x+s^*_x) + bt^*_y \\ q^*_y\{n_yB+b+1\} - q^*_xb - n_yc_yB &= a - (1+b)t^*_y + b(t^*_x+s^*_x). \end{aligned}$$

With free entry n_x and n_y become endogenous, and the two industry equilibrium conditions of zero profits must hold, i.e., (12) and (13) are set equal to zero.

If markets are integrated then firms can no longer vary prices in each market independently; arbitrage ensures the equality of producer prices for each product,

$$(16)\qquad q_x = q^*_x \qquad\qquad q_y = q^*_y.$$

Furthermore, Cournot behaviour now implies that each firm takes the <u>total</u> output of other firms as constant, although the allocation of this output between markets may change. Suppose that the firm changes q_x (and q^*_x). In order to hold Y+Y* constant we have (adding (2) and (4) and using (5), (6) and (16))

$$(1+b)dp_y = (1+b)dp^*_y = bdq_x = bdq^*_x$$

Adding demand functions (1) and (3) and holding other firms' output of X constant, the perceived slope of a domestic firm's world demand function is,

(17) $d(X+X^*)/dq_x = d(x+x^*)/dq_x = -(2b+1)/(b+1) = -B$

Choosing $q_x (=q_x^*)$ to maximise profits therefore gives first order condition,

(18) $dr_x/dq_x = x + x^* - B(q_x - c_x) = 0.$

Foreign firms' choice of $q_y (=q_y^*)$ gives,

(19) $dr_y/dq_y = y + y^* - B(q_y - c_y) = 0.$

Equations (18) and (19) give each firm's world sales as a function of the producer price which is common to both markets. Since $(q_x - c_x) = (q_x^* - c_x)$ we may use these equations in equation (7) to give maximised profits as,

(20) $r_x = B(q_x - c_x)^2 - F_x$

(21) $r_y = B(q_y - c_y)^2 - F_y$

Notice that if (12) and (13) are evaluated at $q_x = q_x^*$, $q_y = q_y^*$, then they are identical to (18) and (19) respectively.

The integrated market equilibrium may now be obtained as follows. Given price equations (5), (6) and (16) there are only two independent producer prices. Equating supply ((18) and (19)) with with world demand ((1) plus (3), and (2) plus (4)), the producer prices of domestic and foreign output are implicitly defined by,

$$q_x\{n_x\beta+b+1\} - q_y b - n_x c_x \beta = a - (1+b)\{lt_x + l^*(t_x^*+s_x^*)\} + b\{l(t_y+s_y) + l^*t_y^*\}.$$

(22)

$$q_y\{n_y\beta+b+1\} - q_x b - n_y c_y \beta = a - (1+b)\{l(t_y+s_y) + l^*t_y^*\} + b\{l^*(lt_x + t_x^*+s_x^*)\}.$$

With free entry n_x and n_y are endogenous, and we have additional equations (20) and (21) set equal to zero.

In order to evaluate policy changes we need a welfare indicator. Welfare of consumers in the domestic economy is given by the indirect utility function

(23) $V(p_x, p_y, I), \qquad I = l + n_x r_x + G$

Income (I) is composed of wage income (l), domestic firms' profits, $n_x r_x$, and domestic government revenue, G. Let the parameters g_y and g_x^* take on the value of 1 for a trade tax or subsidy instrument employed by the domestic government, and 0 for a foreign instrument. Domestic government revenues are then equal to

(24) $G = g_y t_y Y + g_x^* t_x^* X^* + t_x X.$

Consider instituting small taxes or subsidies. Differentiating (23) and (24), normalizing the marginal utility of income at unity and using Roy's identity (so $dV/dp_x = -X$, $dV/dp_y = -Y$), gives, in the neighborhood of zero tax instruments,

(25) $dV = -Xdp_x - Ydp_y + r_x dn_x + n_x dr_x + g_y Y dt_y + g_x^* X^* dt_x^* + X dt_x$

It will be convenient to express the welfare change in terms of changes in tax instruments and producer prices. From (5) and (6) we have

(26) $dp_x = dq_x + dt_x, \qquad dp_y = dq_y + dt_y.$

The term $r_x dn_x$ is equal to zero, since, if there is free entry, $r_x = 0$, and if there is no entry $dn_x = 0$. dr_x can be obtained from (12) and (10) as

(27) $$dr_x = 2Bl(q_x - c_x)dq_x + 2Bl^*(q_x^* - c_x)dq_x^*$$
$$= 2xdq_x + 2x^*dq_x^*.$$

With $q_x = q_x^*$ this equation also holds for integrated markets, as can be checked from equation (18). Substituting (26) and (27) in equation (25) gives,

(28) $$dV = Xdq_x - Ydq_y + 2X^*dq_x^* + g_x^*X^*dt_x^* + (g_y - 1)Ydt_y$$

Equation (28) will be useful for subsequent comparative statics results insofar as the change in welfare is in terms of producer prices and tax parameters. Note in particular that it is completely general with respect to segmented versus integrated markets and free entry versus no entry (but would be modified by ad valorem taxes (subsidies)).

The welfare change described in (28) may be interpreted in terms of the effects of policy on domestic distortions, and on the terms of trade. Notice that, from equations (10), the change in a firm's supply with respect to a price change is

(29) $xdq_x = (q_x - c_x)dx, \qquad x^*dq_x^* = (q_x^* - c_x)dx^*.$

Differential (28) may now be decomposed into three terms.

Firm expansion effect;

$$Xdq_x + X^*dq^*_x = n_x\{(q_x - c_x)dx + (q^*_x - c_x)dx^*\}$$

Import terms of trade effect; $-Y\{dq_y - (1-g_y)dt_y\}$

Export terms of trade effect; $X^*(dq^*_x + g^*_x dt^*_x)$.

The firm expansion effect arises from the fact that, with prices in excess of marginal cost, a small expansion in firm output generates a welfare gain. The second and third terms measure terms of trade improvements due to changes in the import price of good Y, and export price of X respectively.

3. POLICY WITH SEGMENTED MARKETS

First we shall analyse the effects of policy under the segmented markets hypothesis; Dixit (1984) studies this case with the restriction that goods x and y are perfect substitutes. In order to find the effect of policy on producer prices equilibrium conditions (14) and (15) may be differentiated to give, in matrix form,

(30) $Qdq + Ndn = Tdt, \qquad Qdq^* + Ndn = Tdt^*,$

Lower case symbols denote vectors, with first element for the X industry, and second for the Y industry, so $dq = [dq_x, dq_y]'$, $dq^* = [dq^*_x, dq^*_y]'$, etc. From inspection of equations (14) and (15), the matrices are,

$$Q = \begin{bmatrix} n_x \beta + b + 1 & -b \\ -b & n_y \beta + b + 1 \end{bmatrix} \qquad T = \begin{bmatrix} -(1+b) & b \\ b & -(1+b) \end{bmatrix}$$

$$N = \begin{bmatrix} \beta(q_x - c_x) & 0 \\ 0 & \beta(q_y - c_y) \end{bmatrix} = \begin{bmatrix} x/l & 0 \\ 0 & y/l \end{bmatrix}$$

$$N^* = \begin{bmatrix} \beta(q_x^* - c_x) & 0 \\ 0 & \beta(q_y^* - c_y) \end{bmatrix} = \begin{bmatrix} x^*/l^* & 0 \\ 0 & y^*/l^* \end{bmatrix}$$

If the number of firms is constant, then $dn = 0$, so equations (30) become,

(31) $dq = Q^{-1}Tdt, \qquad dq^* = Q^{-1}Tdt^*$, where

(32) $$Q^{-1}T = \begin{bmatrix} -(1+b)(1+n_y) & bn_y \\ bn_x & -(1+b)(1+n_x) \end{bmatrix} \frac{1}{D}$$

and $D = (1+b)(1+n_x+n_y) + n_x n_y \beta > 0$.

Consider first a small tax on domestic imports, $dt_y > 0$. This tax effects prices in the domestic economy only. The price of domestic output, q_x, is increased by the tax; the producer price of domestic imports, q_y, is reduced, but their consumer price, p_y, is raised (from (32) with price equation (6)). These price changes are recorded in figure I.A, as changes from an initial symmetric equilibrium. It may be noted from this figure that the policy reduces domestic consumer surplus as both the domestic consumer prices are increased. Profits of domestic firms are increased by the policy, as a domestic firm's price in the home market is increased, and in the foreign market is unchanged. Incorporating these effects and government revenue in the welfare function (i.e., using derivatives obtained from (32) and (31) in (28)) gives,

$$dV/dt_y = X(dq_x/dt_y) - Y(dq_y/dt_y) + (g_y-1)Y$$

$$(33) \qquad = \{Xbn_y + Y(1+b)(1+n_x) + (g_y-1)YD\}/D$$

The implications of equation (33)) are summarized in Proposition 1.A.

Proposition I.A (Fixed numbers of firms: segmented markets).

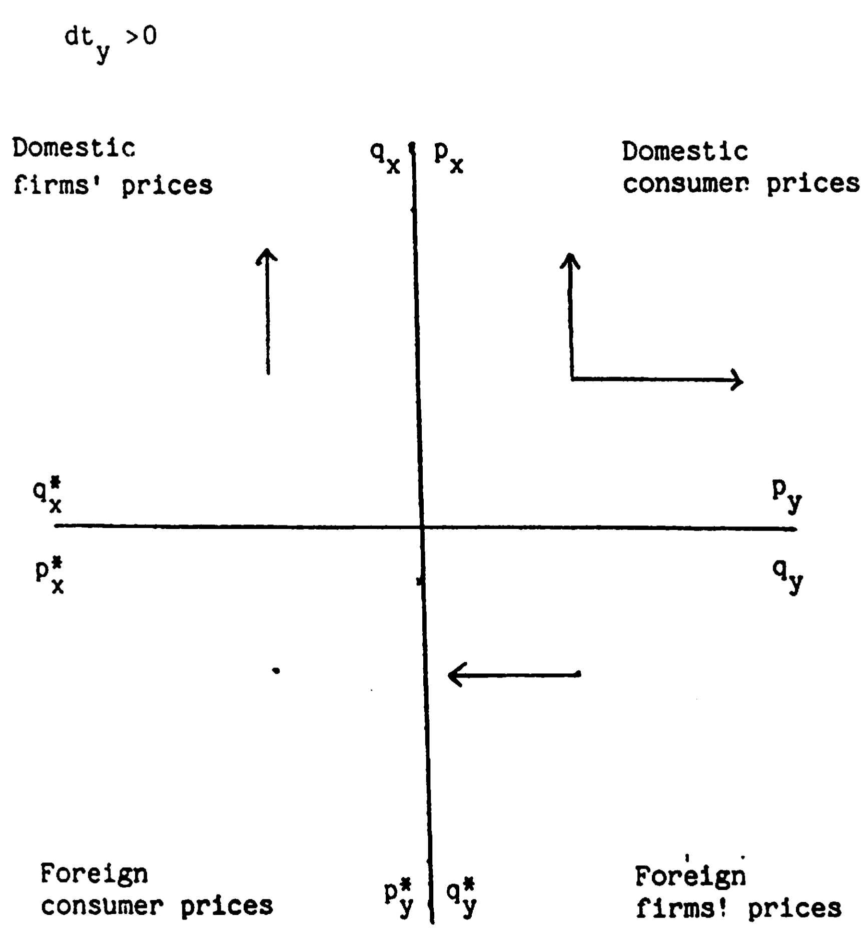
(i) An import tariff ($dt_y > 0$, $g_y = 1$) raises domestic welfare.

(ii) A foreign export tax ($dt_y > 0$, $g_y = 0$) has an ambiguous effect on domestic welfare.

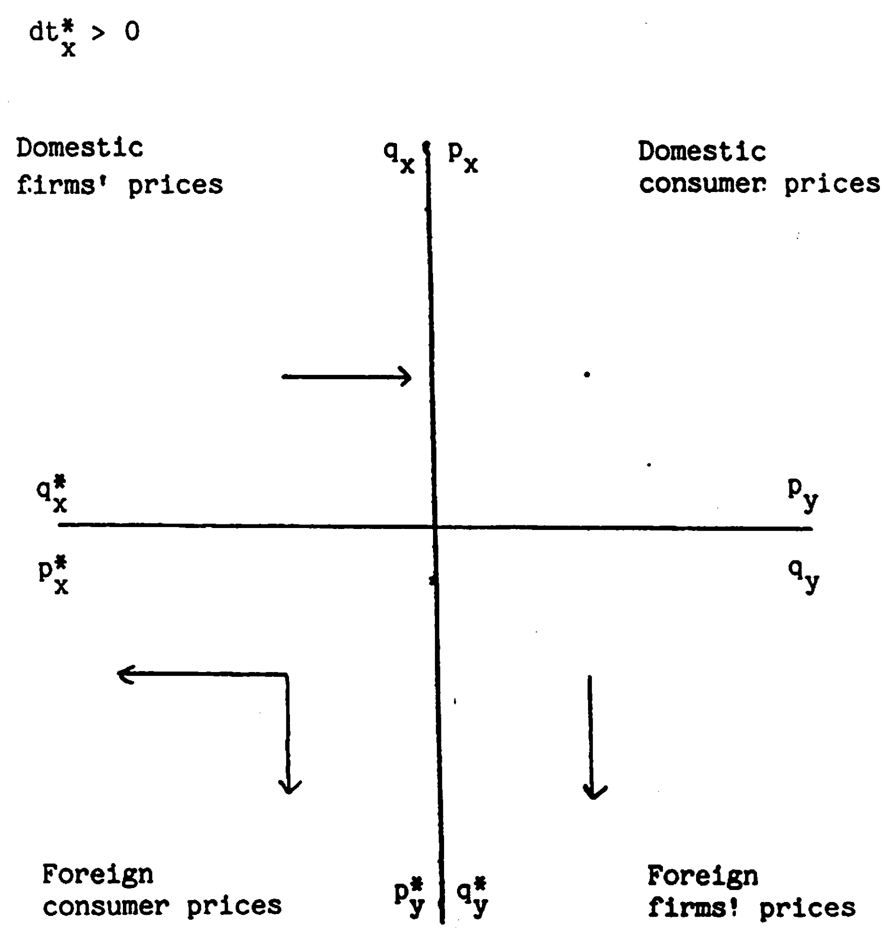
The welfare gains of I.A.(i) derive from the fact that the tariff has a positive firm expansion effect and improves the terms of trade ($dq_y/dt_y < 0$). However, if revenue from the taxation of imports accrues to the foreign government (I.A.(ii)) then the consumer price of imports, not the producer price is the measure of the terms of trade; policy then worsens the terms of trade ($dp_y/dt_y > 0$), creating the ambiguity of I.A.(ii). It may be established from equation (33) that domestic welfare is more likely to increase the larger is b or the smaller is n_x. In the former case there is a relatively large expansion of domestic output, and in the latter the domestic price-cost margin is relatively large.

Fixed number of firms: segmented markets

I.A



I.B



A small tax on domestic exports (dt_x^*) changes prices in the foreign market only. The price of good y in the foreign market, q_y^*, is increased; the producer price of domestic exports, q_x^*, falls, although their consumer price, p_x^*, rises, as recorded in figure I.B. The welfare effects of the policy are obtained by using (31) in (28) to give,

$$dV/dt_x^* = 2X^*(dq_x^*/dt_x^*) + g_x^* X^*$$

(34) $$= \{-2X^*(1+b)(1+n_y) + X^* g_x^* D\}/D,$$

and proposition I.B

Proposition I.B (Fixed numbers of firms: segmented markets)

(i) A foreign import tariff ($dt_x^* > 0$, $g_x^* = 0$ reduces domestic welfare.

(ii) An export tax ($dt_x^* > 0$, $g_x^* = 1$) has an ambiguous effect on domestic welfare.

The foreign import tariff (I.B.(i)) reduces domestic welfare by cutting the producer price of domestic exports, and hence reducing firm scale and domestic profit income. This negative effect on domestic firms means that a domestic export tax may also reduce welfare, despite its value to government revenue and its effect in improving the terms of trade. If this is the case then an export subsidy is required (I.B.(ii)). To investigate this further, (34) may be expanded for $g_x^* = 1$ to give

(35) $$dV/dt_x^* = X^*\{(1+b)(n_x - n_y - 1) + n_x n_y B\}/D$$

We see that if $n_x = n_y = 1$ and as the commodities tend to perfect substitutes ($b \rightarrow \infty$), then $dV/dt_x^* < 0$ so an export subsidy is required (Brander and Spencer (1985)). However, if b is finite and n_x, n_y get large, then the firm expansion effects diminishes with the increased competition and an export tax raises welfare (Eaton and Grossman (1986)).

Finally, we comment on the effect of reciprocal import tariffs or export taxes on world welfare. A measure of this may be obtained by assuming symmetry of the two economies, and adding together the effects of foreign and domestic tax instruments on domestic welfare. Symmetry implies that $n_x = n_y$ and $X^* = Y$ in equations (33) and (34). Noting also that $g_y = 1$ and $g_x^* = 0$, (33) and (34) sum to

$$(36) \quad dV/dt_y + dV/dt_x^* = \{Xbn - Y(1+b)(1+n)\}/D$$

If transport costs are zero then X = Y so $dV/dt_y < 0$: policies which subsidize trade raise world welfare as they expand a sector which operates at price in excess of marginal cost. If transport cost are relatively large so that $X >> Y$ then world welfare may be raised by restricting trade. This reflects the fact that with transport costs, the market equilibrium involves wasteful cross-hauling of X and Y (Brander (1981) and Brander and Krugman (1983)).

We now turn to policy when there is free entry of firms, while retaining the assumption of segmented markets.

dn may now be non-zero, but may be eliminated from equations (30) to give the change in producer prices as a function of tax changes as,

(37) $N^{-1}[Qdq - Tdt] = N^{*-1}[Qdq^* - Tdt^*]$.

Industry equilibrium requires that maximised profits are zero. Differentiating equations (12) and (13) and using the matrices N and N*, changes in producer prices must satisfy,

(38) $dr/2 = LNdq + L^*N^*dq^* = 0$

where L and L* are diagonal matrices with diagonal elements l and l* respectively.

General analysis of this system is undertaken in the appendix, and the text concentrates on two special cases. The first is that in which transport costs are zero; it is then the case that in the absence of policy a firm has the same price and market share in both its domestic and export markets, ($q_x = q_x^*$, $q_y = q_y^*$). Policy is therefore evaluated around a point at which $N^*N^{-1} = I$. Using this condition in (37) and (38) gives the effects of policy on producer prices as,

(39) $dq = L^*Q^{-1}T[dt - dt^*]$, $dq^* = LQ^{-1}T[dt^* - dt]$.

The way in which free entry (with zero transport costs) modifies the effects of policy is now apparent by comparing (39) with (31). The matrix $Q^{-1}T$ is as before, so the direction of change of domestic prices with respect to a domestic policy instrument is unchanged. However, the fact that the number of firms changes in response to policy has two implications. First, the magnitude of domestic price changes associated with domestic policy is reduced (by factor l^*); this is essentially because free entry raises supply elasticities. Second, tax policy in one country now changes prices in both, as entry and exit of firms changes supply in both countries. Furthermore, in order to maintain zero profits, it must be the case that if a firm's producer price in one market increases, its producer price in the other market falls.

The effects of a tax on domestic imports on producer prices are illustrated in figure II.A. The welfare implications of the tax are derived by using derivatives from (39) with (32) in (28) to give,

$$dV/dt_y = X(dq_x/dt_y) - Y(dq_y/dt_y) + 2X^*(dq_x^*/dt_y) + (g_y-1)Y$$

(40) $$= \{Yl^*(1+b)(1+n_x) - X^*lbn_y + Y(g_y-1)D\}/D$$

Proposition II.A: (Free entry: segmented markets: zero transport costs).

(i) If the two economies are symmetric, an import tariff ($dt_y > 0$, $g_y = 1$) raises domestic welfare.

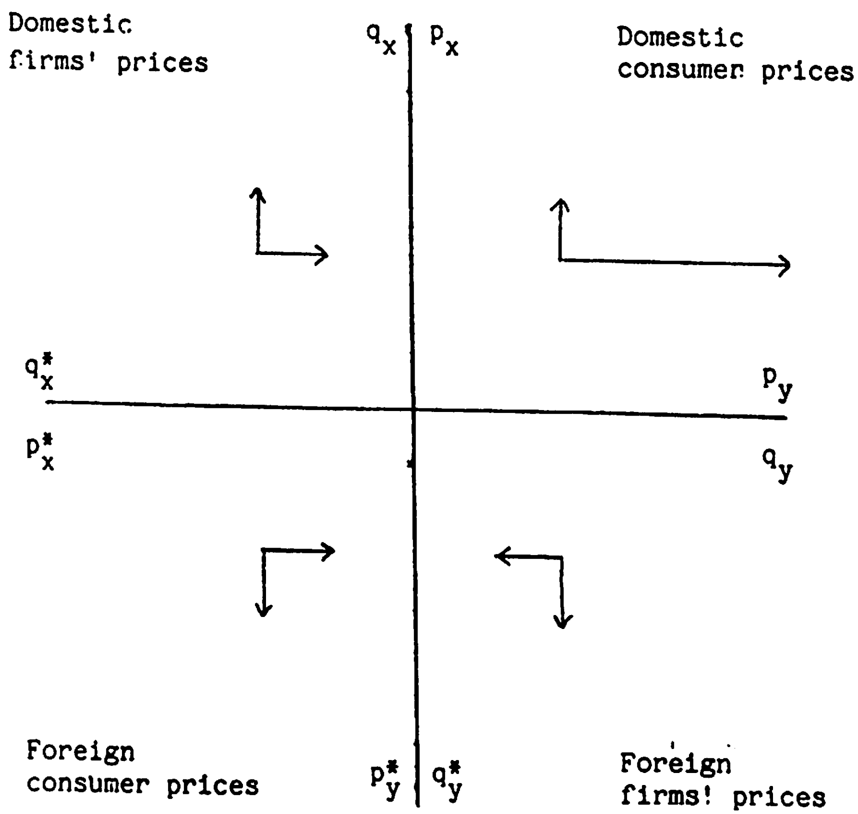
(ii) A foreign export tax ($dt_y > 0$, $g_y = 0$) reduces domestic welfare.

The import tariff (II.A.i) improves the domestic import terms of trade ($dq_y/dt_y < 0$) and increases the number of domestic firms. This causes an increase in domestic supply and hence a deterioration in the export price ($dq_y/dt_y < 0$). The magnitude of the former price change is greater

Free entry: segmented markets: zero transport costs

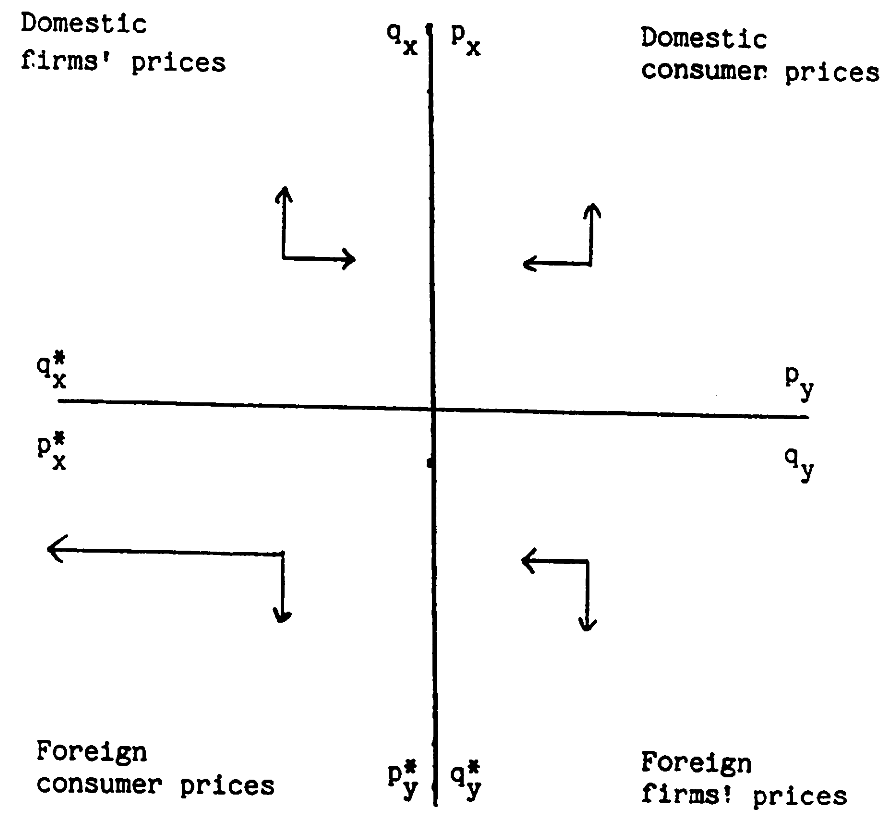
II.A

$dt_y > 0$



II.B

$dt^*_x > 0$



than the latter, but if the domestic economy is a large net exporter, the net effect of these price changes on welfare could be negative. A sufficient condition to ensure that the tariff raises domestic welfare is that intra-industry trade is balanced, as is the case when the economies are symmetric. If the tax revenue accrues to the foreign government (I.A.ii), then the tax causes a deterioration of both the import and export terms of trade, unambiguously reducing welfare.

The effects of a tax on domestic exports is illustrated in figure II.B The welfare effect of this tax is,

$$(41) \quad dV/dt^*_x = X(dq_x/dt^*_x) - Y(dq_y/dt^*_x) + 2X^*(dq^*_x/dt^*_x) + X^*g^*_x$$
$$= \{Y1^*bn_x - X^*1(1+b)(1+n_y) + X^*g^*_xD\}/D$$

Proposition II.B: (Free entry: segmented markets: zero transport costs).

(i) If the two economies are symmetric then a foreign import tariff ($dt^*_x > 0$, $g^*_x = 0$) reduces domestic welfare.

(ii) An export tax ($dt^*_x > 0$, $g^*_x = 1$) increases domestic welfare.

It is worth noting that with free entry and zero transport costs, the case for an export subsidy is removed (II.B.(ii)). The reason for this is that the expansion of domestic output caused by a subsidy is now met by an increase in the number of firms, rather than an increase in firm scale. There is therefore no firm expansion effect, and welfare is changed only by the adverse terms of trade effect of the export subsidy.

The second case of policy under segmented markets and free entry which we study in the text is that in which transport costs are positive, and commodities X and Y are perfect substitutes, as in Venables (1985). This means letting $b \rightarrow \infty$, in the demand system, so that at equilibrium $p_x = p_y$ and $p_x^* = p_y^*$. As elements of the matrices Q and T tend to infinity we obtain (from equations (30) or directly from (5) and (6))

$$(42) \quad \begin{aligned} dq_x &= dq_y + dt_y - dt_x \\ dq_y^* &= dq_x^* + dt_x^* - dt_y^* \end{aligned}$$

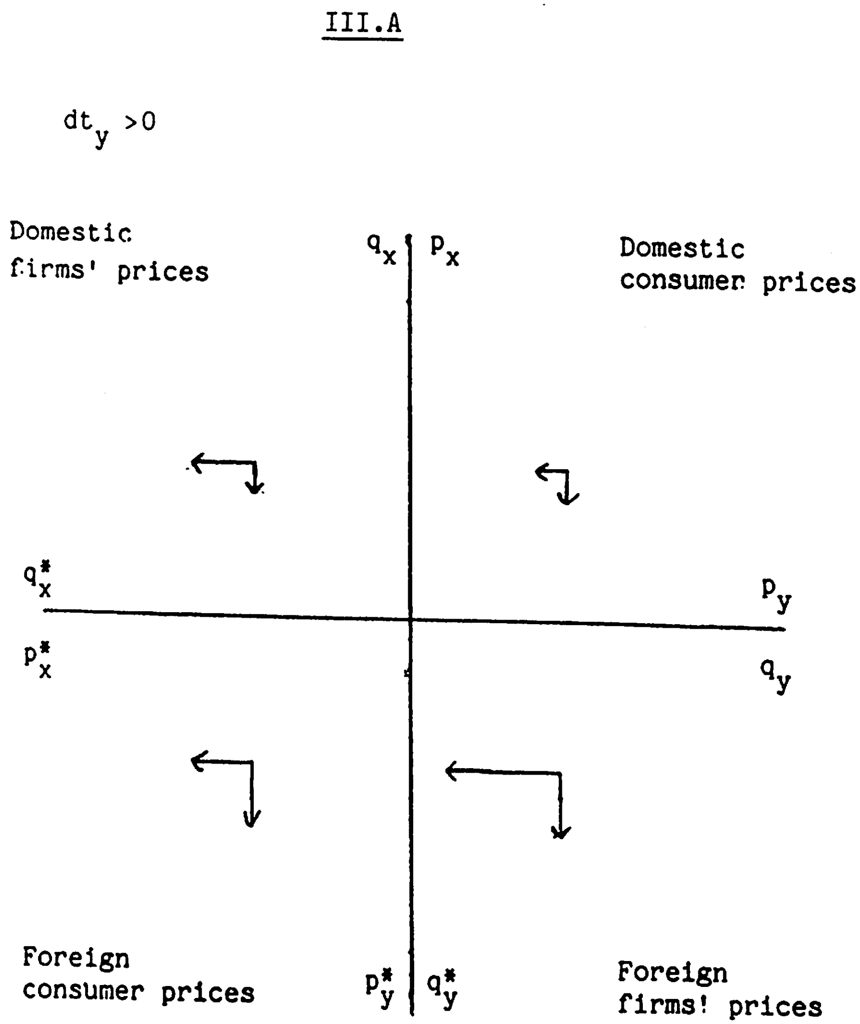
Using these with the zero profit conditions, (38), gives,

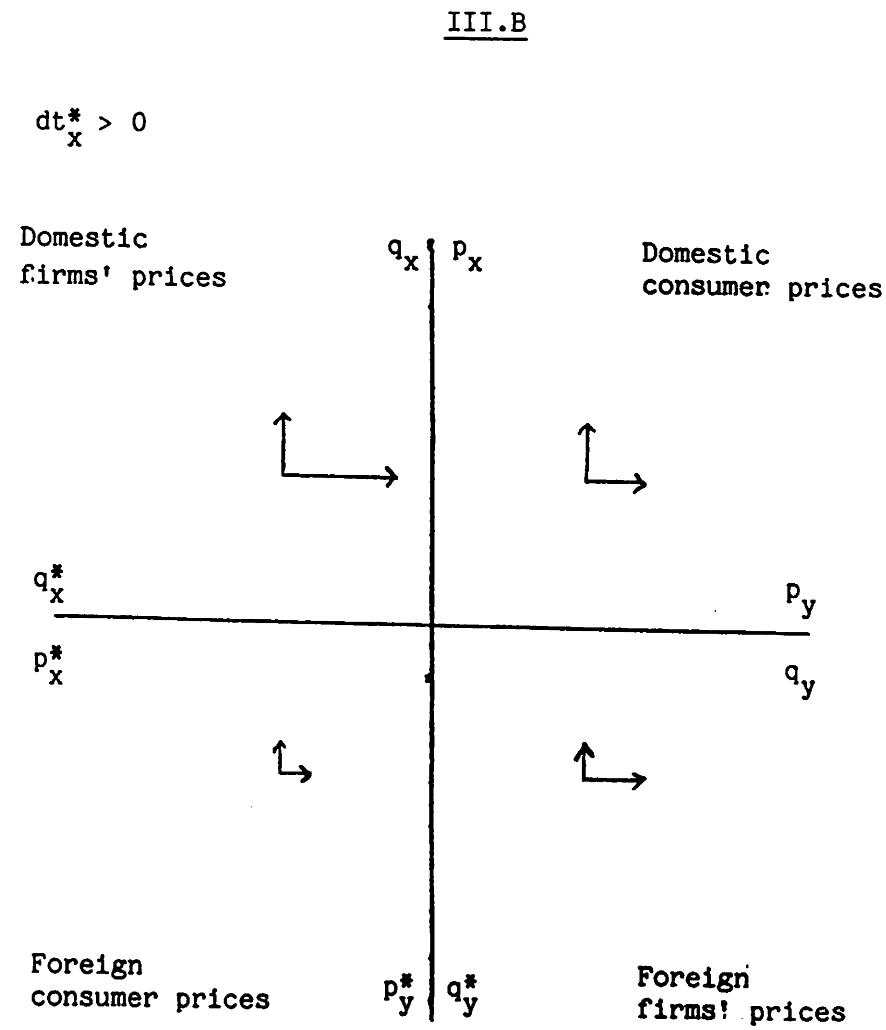
$$(43) \quad \begin{bmatrix} dq_x \\ dq_y^* \end{bmatrix} = \begin{bmatrix} dq_y + dt_y - dt_x \\ dq_x^* + dt_x^* - dt_y^* \end{bmatrix} = \frac{1}{xy^* - x^*y} \begin{bmatrix} y^* & -x^* \\ -y & x \end{bmatrix} \begin{bmatrix} x^*(dt_x^* - dt_y^*) \\ y(dt_y - dt_x) \end{bmatrix}$$

The determinant xy^*-x^*y is positive if either s_y or s_x^* is strictly positive. These transport costs ensure that the ratio of the sales of a domestic firm to the sales of a foreign firm in the domestic market (x/y) exceeds this ratio in the foreign market (x^*/y^*).

The price effects of a policy which taxes domestic imports are obtained from (43) and illustrated in figure III.A. The direction of change of prices in figure III.A are very significantly different from those of II.A, in which transport costs are zero and goods are imperfect

Free entry: segmented markets: perfect substitutes





substitutes. The reason for this is as follows. The import tariff falls on foreign firms, so there must be entry and exit of firms such that there is an increase in some weighted average of the consumer price of good y in each market, but not of good x; (this is in order to maintain zero profits, and the weights in the average are derived from equation (38)). These price changes can take two forms. One is an increase in the price of good y relative to good x in each market; the other is an increase in the price of both y and x in a market where y has a large share, and a fall in the price of both y and x in a market where y has a small share. In general both these effects occur. However, if there are zero transport costs (propositions II), then market shares are the same, so adjustment is entirely through the first route; if x and y are perfect substitutes (propositions III), then relative prices within each country cannot change, so adjustment is entirely through the second route. The import tax causes exit of foreign firms raising prices in the foreign market, attracting entry of domestic firms, and leading to reduction in prices in the domestic market. This domestic price reduction generates strong welfare results; using (43) in (28) gives,

$$dV/dt_y = X(dq_x/dt_y) - Y(dq_y/dt_y) + 2X^*(dq_x^*/dt_y) + (g_y-1)Y$$

$$= (xy^* - x^*y)^{-1}x^*y(X+Y) + g_yY, \quad (44)$$

and proposition III.A.

Proposition III.A: (Free entry: segmented markets: perfect substitutes).

(i) An import tariff ($dt_y > 0$, $g_y = 1$) raises domestic welfare.

(ii) A foreign export tax ($dt_y > 0$, $g_y = 0$) raises domestic welfare.

From III.A we see that taxing imports raises welfare even if revenue accrues to the foreign government. The exit of foreign firms and entry of domestic firms caused by the tax must unambiguously reduce consumer prices and raise welfare in the domestic economy.

A small tax on domestic exports falls on domestic rather than foreign firms, so necessitates a price increase in the domestic market, and permits a price fall in the foreign market as can be established from equations (45), and is illustrated in figure III.B. The welfare effects of the policy are,

$$dV/dt_x^* = (X-Y)(dq_x/dt_x^*) + 2X^*(dq_y^*/dt_x^*) + X^*(g_x^*-2)$$

$$= -x^*y^*(X+Y)(xy^* - x^*y)^{-1} - g_x^*X^*. \tag{45}$$

Proposition III.B: (Free entry: segmented markets: perfect substitutes).

(i) A foreign import tariff ($dt_x^* > 0$, $g_x^* = 0$) reduces domestic welfare.

(ii) An export tax ($dt_x^* > 0$, $g_x^* = 1$) reduces domestic welfare.

As is the case with tariffs, the sign of the welfare consequences of the policy are independent of which country receives the tax revenue. It is therefore certainly the case that welfare in the domestic economy is raised by a small export subsidy, $dt_x^* < 0$, -- the opposite result to that obtained in proposition II.B.(ii).

Propositions II and III deal with two polar cases. It is possible to partition parameter space into two regions within which the the price effects of policy are as described in the two sets of propositions. This task is undertaken in the appendix. We may note here that both these regions have non-empty interiors, and that the system is more likely to behave as in propositions II the lower are transport costs, and the greater is the degree of national product differentiation.

Finally, it may be demonstrated that in both cases II and III reciprocal tariffs or subsidies reduce welfare. If the two economies are symmetric then we may add (40) and (41), or (44) and (45) to establish that optimal coordinated policy requires zero trade taxes and subsidies.

3. POLICY WITH INTEGRATED MARKETS

With integrated markets firms no longer make independent choices of their sales in both markets, but only choose their total world supply. Arbitrage then ensures that producer prices for a particular product are the same in both countries, so $q_x^* = q_x$ and $q_y^* = q_y$. Price equilibrium, conditional on a given number of firms is characterised by equations (22). Differentiating this we obtain,

$$(46) \qquad dq = dq^* = Q^{-1}T[Ldt + L^*dt^*]$$

The way in which market integration modifies the effects of policy, under oligopoly is now apparent by comparing (46) with (31). The matrix $Q^{-1}T$ is as before, so the direction of change of domestic prices with respect to a domestic policy instrument is unchanged. However, the fact that market integration equates the producer prices of x (and of y) in both markets has two implications. First, the magnitude of price changes associated with domestic policy is reduced (by factor 1). Second, tax policy in one country now changes prices in both, because of the international equality of producer prices.

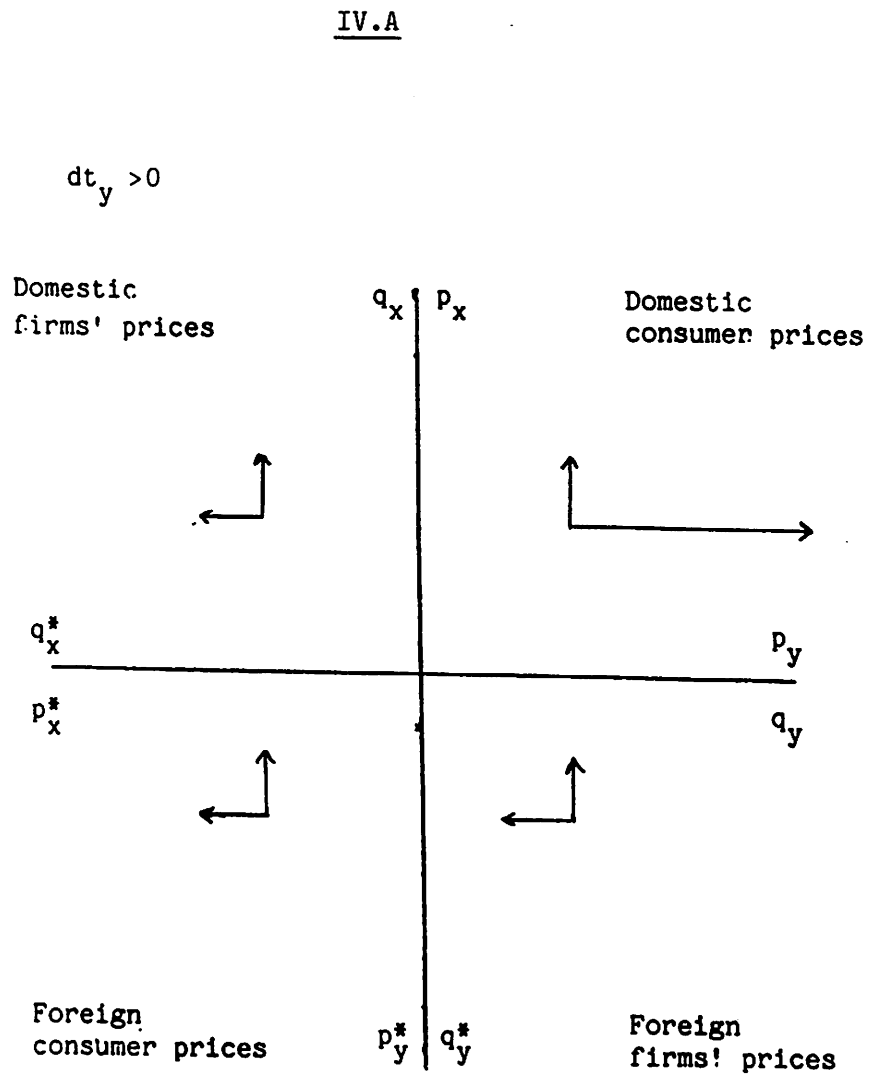
The effects of a tax on domestic imports, $dt_y > 0$, may be obtained from (46), and are illustrated on figure IV.A. The tax reduces the producer price of domestic imports, q_y, and must now also reduce q_y^*. The domestic price of domestic output, q_x, is increased by the tariff, and so also is q_x^*. The welfare effects of the policy are given by

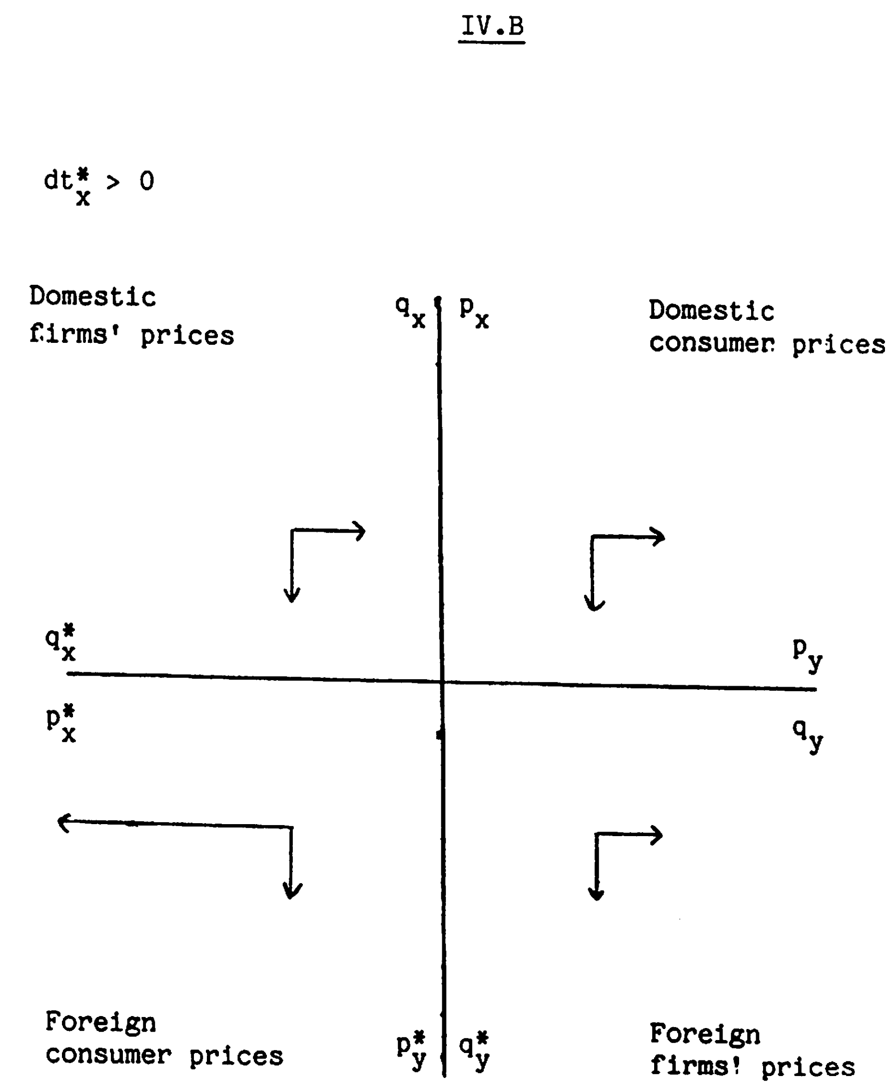
$$dV/dt_y = X(dq_x/dt_y) - Y(dq_y/dt_y) + 2X^*(dq_x/dt_y) + (g_y-1)Y$$

$$(47) \qquad = \{(X + 2X^*)bn_y/2 + Y(1+b)(1+n_x)/2 + DY(g_y-1)\}/D.$$

Proposition IV.A (Fixed number of firms: integrated markets).

Fixed number of firms: integrated markets





(i) An import tariff ($dt_y > 0$, $g_y = 1$) raises domestic welfare.

(ii) A foreign export tax ($dt_y > 0$, $g_y = 0$) has an ambiguous effect on domestic welfare.

Although Proposition III.A is not dissimilar from Proposition I.A market integration significantly changes the way in which policy works. Under both integrated and segmented markets the tariff reduces the cost to the domestic economy of its imports ($dq_y/dt_y < 0$) although this price change is smaller (by factor 1) with integrated markets. The tariff also increases the price of domestic output, and, with integrated markets, this (smaller) price change occurs in both markets. The tariff therefore improves the export side of the terms of trade.

The consequences of taxing exports are illustrated in figure IV.B. The ensuing welfare change is given by,

$$dV/dt^*_x = X(dq_x/dt^*_x) - Y(dq_y/dt^*_y) + 2X^*/dq^*_x/dt^*_x) + g^*_x X^*$$

$$= \{-(X+2X^*)(1+b)(1+n_y)/2 - Ybn_y/2 + DX^*g^*_x\}/D. \quad (48)$$

Proposition IV.B (Fixed number of firms: integrated markets).

(i) A foreign import tariff ($dt^*_x > 0$, $g^*_x = 0$) reduces domestic welfare.

(ii) An export tax ($dt^*_x > 0$, $g^*_x = 1$) has an ambiguous effect on domestic welfare.

Similar comments apply to export taxes as to import taxes.

With integrated markets the price changes caused by policy are smaller but apply in both markets. Welfare effects work in the same direction but are different in magnitude.

The effects of reciprocated policy on welfare may once again be investigated by assuming symmetry of the economies, and adding (44) and (45). It can be established that world welfare is raised by trade subsidies. The difference between segmented and integrated markets arises from the fact that if transport costs are positive, then the volume of trade is smaller with integrated markets then it is with segmented markets, and so therefore are the resources dissipated on transport. If there are no transport costs, the two cases are symmetric and bilateral subsidies increase welfare through the firm scale effect.

Finally, we may turn to policy with integrated markets and free entry (Horstmann and Markusen (1986)). n_x and n_y are now endogenous, and zero profit conditions hold. The integrated markets hypothesis implies that $q_x = q_x^*$ and $q_y = q_y^*$, so these conditions are (equations (20) and (21),

(49) $B(q_x - c_x)^2 = F_x, \qquad B(q_y - c_y)^2 = F_y.$

Producer prices are therefore independent of the policies being analyzed. Welfare changes come immediately from (28);

(50) $dV/dt_y = (g_y - 1)Y, \qquad dV/dt_x^* = g_x^* X^*,$

giving Propositions V.

Proposition V.A (Free entry: integrated markets).

(i) An import tariff ($dt_y > 0$, $g_y = 1$) has no effect on domestic welfare.

(ii) A foreign export tax ($dt_y > 0$, $g_y = 0$) reduces domestic welfare.

Proposition V.B (Free entry; integrated markets).

(i) A foreign import tariff ($dt^*_x > 0$, $g^*_x = 0$) has no effect on domestic welfare.

(ii) An export tax ($dt^*_x > 0$, $g^*_x = 1$) raises domestic welfare.

Propositions V derive their simplicity from the fact that producer prices are fixed. Policy changes lead only to entry and exit, at unchanged firm scale and producer price. Elasticities of supply are therefore infinite, although demand elasticities are finite. It follows from this that optimal import tariffs are zero (V.A.(i)), but that export taxes may be used to effect a transfer from foreign citizens to the domestic government (V.B.(ii). From the point of view of world welfare, free trade is optimal.

5. SUMMARY AND CONCLUSIONS

The purpose of this paper was to integrate competing models of trade with scale economies and imperfect competition into a common analytical framework. The idea was that this common framework would help us to better understand why different assumptions generate conflicting results. These assumptions were on the one hand integrated versus segmented markets and on the other hand free entry versus oligopoly (no-entry). We were able to do this using the assumptions of linear demand, constant marginal cost, and specific taxes and subsidies. But even with these assumptions one complication remains. In the case of free entry with segmented markets the qualitative behaviour of the model depends on the relative magnitudes of transport costs and the degree of substitutability between products.

The effects of tariffs and export subsidies in each of the four models are summarized in Propositions I - V. Do any broad conclusions emerge? Cross model comparisons can be made by comparing the welfare differentials which immediately precede each proposition. If we impose additional assumptions which limit still further the generality of the model then some clear comparisons are possible.

ADDITIONAL ASSUMPTIONS

(1) The two economies are symmetric, i.e., are the same size and have the same costs.

(2) The number of firms under oligopoly is less than or equal to the number at the free entry equilibrium.

(3) There are no transport costs.

(4) In the case of free entry with segmented markets, the commodities are not perfect substitutes.

Assumptions 3 and 4 mean that case III of the text is excluded from the comparisons below. Assumption 3 also ensures that, in the absence of policy, the segmented and integrated market equilibria coincide. Assumptions 1 and 2 permit analytical comparisons among remaining cases, and are sufficient, but not necessary for all the results which follow; assumption 2 will of course be satisfied unless firms make losses in the oligopoly cases. Our first comparison is between the segmented and integrated market hypotheses (propositions I and II compared to IV and V).

> RESULT 1; Segmented markets imply that a small import tariff or export subsidy improves welfare more (or reduces it less) than if markets are integrated. This result is independent of the free entry/oligopoly assumption.

The intuition behind this result is that with segmented markets, the effect of a policy is concentrated on the market in question. Thus an import tariff, for example, forces down the price of the import good without having any adverse consequences on the export market. Conversely, with integrated markets the effect of a tariff is spread out over two markets in a manner that makes it less beneficial.

> RESULT 2: Oligopoly implies that a small import tariff or export subsidy improves welfare more (or reduces it less) than if there is free entry. This result is independent of the segmentation/integration assumption.

Result 2 compares propositions I and IV with II and V. The intuition behind the result is fairly straightforward. Under oligopoly, these policies have a fairly strong firm expansion effect which, other things equal, tends to improve welfare. With free entry however, part of the industry expansion is in terms of new firms with a correspondingly smaller expansion in the outputs of existing firms.

RESULT 3: Free entry implies that an export subsidy reduces welfare. This result is independent of the segmentation/integration assumption.

Result 3 comes from propositions II.B and V.B; both this result and result 2 require assumption 3. If transport costs are positive and goods are close substitutes then, under free entry and segmented markets, an export subsidy will raise welfare, as in case III of the paper.

Our last two results conern the effect of policy on world welfare.

RESULT 4: Oligopoly implies that reciprocal import tariffs or export taxes reduce world welfare. This result is independent of the segmentation/integration assumption.

This is not quite so obvious if we recall that this is a local result in the neighborhood of zero taxes. In a competitive model there would be no local effect. But with the price/cost distortion of oligopoly, the reduction in firm output accompanying the reduced trade does have the local effect of reducing welfare.

RESULT 5: Free entry implies that world welfare is maximized by zero trade taxes and subsidies. This result is independent of the segmentation/integration assumption.

Unlike the oligopoly case, free entry implies that reciprocal tariffs or subsidies have no beneficial firm scale effect. Thus the consumption distortion implied by either taxes or subsidies is welfare reducing.

We should emphasize one final time that these results are not robust with respect to key assumptions, as is clear from our analysis of free entry with segmented markets when products are perfect substitutes and transport cost are positive. Nevertheless, we hope that the results are helpful in allowing us to organize our thinking and in enabling us to understand the roles of market structure and entry assumptions.

Appendix.

Free entry and segmented markets; From equations (37) and (38) we obtain,

(A1) $[Q + NN^{*-1}QN^{*-1}L^{*-1}LN]dq = Tdt - NN^{*-1}Tdt^{*}$

and $[Q + N^{*}N^{-1}QN^{-1}L^{-1}L^{*}N^{*}]dq^{*} = Tdt^{*} - N^{*}N^{-1}Tdt$

Suppose the two economies are symmetric. Then $L^{-1}L^{*} = I$ and

$$N^{-1}N^{*} = NN^{*-1} = \begin{bmatrix} m & 0 \\ 0 & m \end{bmatrix}$$

where $m = x/x^{*} = y^{*}/y$, i.e., is the ratio of a single firm's sales in its home market to its sales in its export market. m = 1 if transport costs are zero, and is strictly increasing in transport costs.

The quantitative difference between cases II and III of the text is that in the former $dq_x/dt_y > 0$, and in the latter $dq_x/dt_y < 0$, (or equivalently, $dq^{*}_y/dt^{*}_x > 0, < 0$). Using Cramer's rule in equation (A1) with the symmetry assumptions, we obtain the following condition.

Case II; $(dq_x/dt_y > 0) \iff n(2b+1)/(b+1)^2 > (m^2-1)/(m^2+1)$

Case III; $(dq_x/dt_y < 0) \iff n(2b+1)/(b+1)^2 < (m^2-1)/(m^2+1)$

It is clear that if m = 1 case II applies, while if m > 1 and b--> , case III applies. Along the dividing line between cases dm/db > 0; the system is more likely to be in case III the higher is b, and the higher are transport costs and hence m.

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