Export Subsidies and National Welfare

by

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ABSTRACT

This paper synthesises the recent theoretical literature on export subsidies. Second-best arguments for subsidies in a competitive framework are reviewed and it is noted that subsidies may form part of the first-best policy package in a large open economy. By contrast, subsidies are unambiguously desirable in a simple Cournot duopoly model although this result is highly sensitive to changes in the underlying assumptions. Most justifications for subsidies reflect a general principle: the inevitable direct welfare loss from subsidisation must be at least partly offset by a terms-of-trade improvement induced by the subsidy's effects in the markets for related goods.

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Introduction

Export subsidies have become a major influence on world trade, as rival governments vie to assist their home firms penetrate foreign markets. Yet the economic case for export subsidies remains of questionable status. In a traditional competitive framework they are usually seen as inducing either allocative inefficiency or a worsening of the terms of trade. And while some recent work on trade in oligopolistic markets has suggested a role for export subsidies, the arguments put forward have been shown to be highly non-robust.

In this paper I attempt to provide an overview and assessment of the issues that have been raised in the recent theoretical literature on export subsidies. I begin by reviewing the standard arguments in the competitive literature. In a small open economy the case against subsidies is a corollary of the standard case for free trade. While if a country has monopoly power in trade it should exploit it by taxing rather than subsidising its exports in order to raise their world prices. But recent work has questioned these well-rehearsed arguments. Even in a small open economy second-best considerations may justify subsidising rather than taxing some exports. More surprisingly, the encouragement of exports may form part of the first-best package of intervention in a large open economy. Such an outcome is more likely if demand and supply conditions differ between the home and foreign countries or if subsidisation can induce the entry into exporting of industries which would otherwise not produce at all. Finally, increasing returns to scale even in the absence of strategic behaviour by firms provide a familiar first-best argument for production subsidies, which

are identical to export subsidies if the goods are not consumed at home.

In Sections 2 and 3 of this paper I provide an overview of these considerations, drawing on techniques which I have developed in two recent papers (Neary, 1987, 1988). These allow me to illustrate explicitly the relationship between national welfare and the values of available policy instruments in a simple diagram. Whereas the earlier papers focussed on the general analysis of tariffs, in this paper I concentrate on export subsidies and make a number of key assumptions which greatly simplify the analysis. These are in fact the same assumptions which are often made in studies of export subsidies and oligopolistic interdependence: linear behavioural functions, no income effects and absence of home consumption.

In Section 4 I turn to the analysis of export subsidies in oligopolistic markets. Since the work of Brander and Spencer (1985) it is well-known that subsidies may serve to raise welfare by transferring profits from foreign to domestic firms. But this argument is extremely non-robust. I therefore review the different ways in which the simple Cournot duopoly model of Brander and Spencer has been extended. I consider successively the implications of different assumptions concerning firm interdependence (introducing a new diagram to illustrate the results of Eaton and Grossman (1986)), the number of firms and the degree of entry. I also show how the Brander-Spencer argument relates to the terms-of-trade-improving arguments of competitive models, paralleling recent work by Krishna and Thursby (1987).

The last section of the paper takes a different approach to modelling government behaviour from the previous two. Following Carmichael (1987), I note that export subsidy schemes in practice typically involve negotiations between exporters and the relevant government agency only *after* the export

contract has been secured. Modelling this process gives rise to a very different picture, in which the subsidy rate is endogenous and both home and foreign firms anticipate its value in making their output and price decisions. As extended by Gruenspecht (1988), this model implies that export subsidies may be adopted even when firms are price competitors, contrary to the implications of the Brander-Spencer model. However, I note that this argument leaves unresolved the rationale for an export subsidy programme in the first place: alternative forms of intervention are likely to secure higher welfare than an export subsidy programme in which firms are first movers.

Throughout the paper I concentrate on the implications of export subsidies for *national* welfare, ignoring both the repercussions on foreigners' welfare and the possible responses of foreign governments. This naturally robs the analysis of some realism but it serves a dual purpose of simplifying the problem and eliminating some obvious arguments against subsidies. Subsidies are unlikely to raise world welfare and are likely to invite punitive retaliation by other countries. Eliminating these considerations allows me to concentrate on the issue of whether there are direct justifications for subsidies from a single country's point of view.

Export Subsidies in a Competitive Environment

The case against export subsidies in a competitive small open economy is easily made. Suppose that a subsidy is offered to domestic producers of a good which is not consumed at home. The price received by home producers therefore exceeds the world price: in obvious notation, $p^h = p + s$. As long as the world price p remains fixed and assuming that there are no other

distortions in the economy, domestic welfare (measured in units of the numeraire good and denoted by W) is affected only by a "volume-of-trade effect": any *reduction* in the volume of exports below their subsidy-induced level will raise welfare. Formally:[1]

(2.1) $dW = -sdx.$

Since the export good is not consumed at home and the world price is given, the only endogenous determinant of export volume is the subsidy level itself. Writing x_p for the price responsiveness of supply (which must be non-negative in a competitive economy) therefore yields:

(2.2) $dW = -sx_p ds.$

This shows that welfare is maximised when the subsidy is zero *and* that any reduction in the level of subsidy must be welfare-improving.

Of course, a second-best justification for an export subsidy can be given even in this simple framework if there is some other distortion in the system. The easiest way to illustrate this, and one which introduces a technique that will prove useful later, is to suppose that there are *two* export goods, on one of which an immovable subsidy is already in place. Labelling the two goods "1" and "2", with the subsidy on good 2 fixed at $\bar{s}_2$ by assumption, equation (2.2) now becomes:

(2.3) $dW = -(s_1 x_{11} + \bar{s}_2 x_{21})\, ds_1.$

Here, x_{11} is the supply responsiveness of good i to an increase in the price

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[1]This equation may be derived from the national income identity, $e(u) = g(p^h) - sx$. Here, e(u) is an expenditure function, independent of p^h because the export good is not consumed at home and with dW defined to equal $e_u du$; and $g(p^h)$ is a GNP function whose first derivative, g_p, equals the competitive level of output, x.

of good 1. Unless the two goods are independent in supply (so that the cross-price effect x_{21} is zero), a zero subsidy to good 1 will not in general be optimal. On the contrary, (2.3) may be solved explicitly for the optimal second-best value of s_1:

$$\tilde{s}_1 = -x_{11}^{-1}x_{21}\bar{s}_2. \tag{2.4}$$

Since x_{11} is positive, this shows that the optimal second-best subsidy on good 1 and the immovable subsidy on good 2 will have the same sign provided the two goods are substitutes in production (i.e., provided x_{21} is negative).[2] Such a relationship is shown by the upward-sloping locus $\tilde{s}_1$ in Figure 1. Intuitively, the justification for a non-zero subsidy to good 1 can be given by referring back to (2.1). Starting with a positive subsidy on good 2 and a zero one on good 1, *any* policy which reduces exports of good 2 will be welfare-improving. The direct policy of a reduction in s_2 is ruled out by assumption but an alternative route is to *increase* the subsidy on its substitute, x_1. Resources are thus encouraged to move out of the x_2 sector and so its exports are indirectly reduced. This is

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[2] If good 1 is also a substitute for the composite numeraire commodity, x_0, then the optimal second-best subsidy *rate* must be less than the immovable subsidy rate. Substituting in (2.4) from the homogeneity restriction on price effects gives:

$$\frac{\tilde{s}_1}{p_1^h} = \frac{p_2^h x_{12}}{p_0^h x_{10} + p_2^h x_{12}} \frac{\bar{s}_2}{p_2^h} \tag{2.4a}$$

This result has been noted by Jones (1977) in the tariff context. A well-known corollary is that, if all goods are substitutes, then welfare will be increased by a reduction in the *higher* rate of subsidy.

illustrated in Figure 1: starting from point A, welfare is increased by a rise in s_1. Indeed, the special case of supply functions which are linear in prices (so that the coefficients in (2.4) are constants and the locus $\tilde{s}_1$ is itself linear) ensures that *any* movement in s_1 towards its optimal second-best level must raise welfare. This may be seen by substituting from (2.4) into (2.3):

$$(2.5) \qquad dW = -(s_1 - \tilde{s}_1)\, x_{11}\, ds_1.$$

So far, I have shown only how the welfare-maximising value of s_1 depends on the exogenous value of s_2. However, consideration of Figure 1 suggests that this dependence is merely one aspect of the relationship between utility and the values of the subsidy levels, and it is instructive to build up the complete picture. This may be done by noting that if the roles of the two subdidies were reversed (so that we sought the optimal second-best subsidy on good 2, given an irremovable subsidy on good 1), an expression exactly analogous to (2.4) could be derived:

$$(2.6) \qquad \tilde{s}_2 = -x_{22}^{-1}x_{12}\bar{s}_1.$$

This defines a second locus in Figure 1, which must also be upward-sloping provided the two goods are substitutes in production.[3] Furthermore, these two loci may be used to define a family of iso-welfare contours in the diagram, one of which is illustrated in Figure 1. As drawn, it has the form

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[3]The condition for the $\tilde{s}_2$ locus to be more steeply sloped than the $\tilde{s}_1$ locus when the two goods are substitutes is that $x_{11}x_{22}-x_{12}x_{21}$ be positive, a property which competitive general equilibrium supply functions must exhibit, provided the two goods are not perfect substitutes.

of an ellipse[4] with an upward tilt, the latter property following from the assumption that the two goods are substitutes in production. This yields a number of useful results: because the two goods are substitutes, there is generally a positive trade-off between their effects on welfare, and there are many circumstances in which a reduction in the levels of *both* subsidies will *reduce* welfare.[5]

3. First-Best Arguments for Export Subsidies in a Competitive Environment

The arguments of the last section provide at best a weak argument for export subsidies: they can be justified only as part of a second-best policy package and only if accurate measures of subtle cross-price supply relationships are available. In this section I use the same framework to consider two possible first-best justifications for export subsidies. Consider first the case where domestic production of exportables is subject to increasing returns to scale. Postpone for now the implications of imperfect competition by assuming that the returns to scale are external to individual firms and assume also that they are not sufficiently great to induce specialisation in production. Equation (2.2) now needs only minor

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[4]With linear supply functions, the iso-welfare contours must be concave to the origin: d^2s_1/ds_2^2 is proportional to $-(x_{11}x_{22} - x_{12}x_{21})$, which is negative.

[5]For example, a movement from B in Figure 1 to any point in the region between AB and the iso-welfare contour through B. Of course, a uniform proportionate reduction in both subsidies (such as a movement from point B towards the no-intervention point 0) must raise welfare; this is implied by equation (2.2), with s reinterpreted as a vector of subsidies.

modification: an increase in export volume tends to lower welfare for the same reason as before (because more subsidy payments must be made) but it also has a positive effect as costs fall for all domestic producers. Denoting the value of extra GNP arising from this cost-reduction effect by g_x, the equation therefore becomes:[6]

(3.1) $\quad dW = (g_x - s)dx.$

It follows immediately that the first-best subsidy level is not zero but g_x: at the margin the cost of the subsidy should be equated to its (general equilibrium) return.[7] Writing s^o for the first-best subsidy, equation (2.2) therefore becomes:[8]

(3.2) $\quad dW = -(s-s^o)x_p ds,$

implying that any move towards the first-best subsidy level will be welfare-improving.

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[6]The derivation of this equation is the same as that of equation (2.1), except that because of external effects the GNP function now depends directly on x as well as on p^h. This way of modelling external economies in general equilibrium was introduced by Helpman (1984).

[7]If some of the good were consumed at home, the first-best intervention would be a production rather than an export subsidy. The relationship between the optimal production and export subsidy rates is considered in Neary (1988).

[8]The supply derivative x_p takes account of the induced changes in unit costs arising from changes in scale. By differentiating the modified GNP function, it may be shown to equal $(1-g_x)^{-1}g_p$. Even without specialisation, it is possible for this to be negative if returns to scale increase sufficiently rapidly. (See Jones (1967).) However, in a price-taking open economy such as I am considering here, equilibria of this type are likely to be dynamically unstable: see Mayer (1974). I therefore assume that x_p is positive at all observed equilibria.

As with equation (2.2), it is possible to interpret (3.2) as applying to a situation where subsidies are provided to two rather than one export product. Provided export supply functions continue to be linear in prices and assuming for simplicity that the external economies term g_x is constant, the previous analysis applies with only one modification: the iso-welfare contours are still centred around the first-best intervention point but the latter is now a point of positive subsidies rather than the free-trade point. This raises a variety of possibilities for complicated interactions between the subsidies on different goods. For example, Figure 2 illustrates the case where only x_2 is subject to increasing returns, so that the first-best policy at F requires a subsidy to this good but no intervention in the market for x_1. Nonetheless, if subsidisation of x_2 is precluded for exogenous reasons, the optimal second-best policy is to subsidise its *complement* x_1, so attaining a higher level of welfare at point B than at the free trade point 0.

A second reason why export subsidies might form part of a first-best policy package is that the economy may possess monopoly power in trade. At first sight, this may seem paradoxical. In the external economies case, intervention is justified because of an externality which leads individual firms to produce *below* socially optimal levels. The policy prescription of a subsidy follows immediately. By contrast, if the country possesses monopoly power in trade, the externality operates in the opposite direction: individual firms fail to take account of the effect of their sales in reducing world prices at the margin and so they tend to *overproduce*. Hence the optimal policy would appear to be an export *tax*, by analogy with the standard optimal tariff argument.

Provided pathological foreign demand conditions are ruled out,[9] this argument does indeed have some validity. To see this, note that, with variable foreign prices, equation (2.1) must be modified to include a "terms-of-trade effect":[10]

(3.3) $dW = -sdx + xdp.$

This equation leads directly to a characterisation of the optimal trade policy. For ease of comparison with the small open economy results, it is easiest to relate the change in world prices to changes in foreign imports, m^*, via the derivatives of the *inverse* foreign import demand functions:

(3.4) $dp = p_m dm^*.$

Since home exports must equal rest-of-the-world imports ($x=m^*$), substitution into (3.3) leads immediately to an expression for the optimal export subsidy:

(3.5) $s^o = xp_m.$

This is clearly negative (implying that the optimal policy is an export tax) in the case of a single export good. With many goods, it is not possible to rule out subsidies to some as part of the optimal policy package.[11] However, it is possible to show that exports must be taxed in an *average* sense. Treating s and x as vectors, postmultiply (3.5) by x to obtain:[12]

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[9] Kemp (1967) presents a two-good example where a doubly-inflected foreign offer curve justifies a positive import subsidy (equivalent to a positive export subsidy) at the global optimum. However, foreign excess demands of this type are inconsistent with the maximisation of a single aggregate utility function.

[10] For simplicity, I return to the case of constant returns to scale.

[11] This was pointed out by Graaff (1949-50).

[12] A prime denotes the transpose of a vector.

(3.6) $s^{o\prime}x = x'p_m x.$

The left-hand side is the total net disbursement on subsidies at the optimum and may be interpreted as the correlation between export volumes and subsidy levels. While, if income effects in the foreign country are ignored (which I shall do henceforward), the right-hand side is a quadratic form in the negative definite matrix, p_m. Hence, an optimal policy designed to exploit monopoly power in trade must on average tax rather than subsidise trade, exactly as the simple intuitive argument would lead us to expect.[13]

When would it nonetheless be desirable to subsidise an individual export good?[14] To answer this, assume that there are only two export goods and consider the implications of (3.5) for the first-best optimal subsidy to good 1:

(3.7) $s_1^o = x_1 p_{11} + x_2 p_{21}.$

This states that, at the optimum, the marginal cost of a unit increase in exports (equal to the extra subsidy that must be paid on it) should equal the marginal return arising from the induced improvement (if any) in the terms of trade on *both* goods. Since the own-price effect p_{11} is negative, a *necessary* condition for a positive subsidy to good 1 at the optimum is that the two goods be complements in the inverse demand sense that p_{21} be positive. I will refer to this as the case where the goods are *Antonelli complements:* it implies that an increase in imports of good 1 by the rest of

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[13]This result is due to Feenstra (1986). See also Bond (1987).

[14]Strictly speaking, the answer to this question is not independent of the choice of numeraire, although the latter does not affect the ranking of goods by the *ratio* of their domestic to world prices. See Bond (1987).

the world raises their marginal valuation of good 2.[15] In addition, a subsidy is more likely to be optimal if exports of x_1 itself are small whereas those of the other good are large. The subsidy is desirable therefore despite rather than because of its effect on the terms of trade of the subsidised good: these must deteriorate. The reason it is welfare-improving is a cross-price effect (or what Feenstra (1986) calls a "market linkage") such that the terms of trade of the *other* good improve.[16] Clearly this subtle interaction is not at all the type of justification for an export subsidy which is to be found in popular writings.

Naturally, when we do not confine attention to the optimum position, it is possible to have cases where there is a stronger presumption in favour of subsidising individual export goods. To see how, I first calculate the effects of an arbitrary change in subsidy levels on exports. Substituting from (3.4) into the expression $dx = x_p dp$ yields:

$$(3.8) \qquad dx = (I - x_p p_m)^{-1} x_p ds,$$

where I is the identity matrix. Finally, substituting this and (3.4) into (3.3) yields:

$$(3.9) \qquad dW = -(s' - x' p_m)(I - x_p p_m)^{-1} x_p ds.$$

With linear supply and demand functions at home and abroad, the coefficients

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[15] See Deaton (1979) for discussion and further references.

[16] An extreme case of the desirability of providing an export subsidy to a good whose exports are small in volume is provided by Itoh and Kiyono (1987). They show, in a model where the pattern of specialisation is endogenous, that export subsidies are welfare-improving to the extent that they encourage "marginal" industries, which would not export at all in the absence of subsidies.

in (3.9) relating changes in welfare to changes in subsidy levels are themselves linear in s, and so an analysis very similar to that carried out for (2.2) is possible. Iso-welfare contours are again ellipses in subsidy space, centred now around the first-best intervention point rather than around the free-trade point. Figure 3 illustrates a case where (3.7) dictates a positive subsidy to good 1 at the optimum and in addition where an increase in the subsidy to *either* good at the free trade point is welfare-improving.[17]

4. Export Subsidies to Oligopolistic Industries

So far we have seen that arguments in favour of export subsidies as part of the first-best policy package exist but are not very compelling. However, a remarkable result due to Brander and Spencer (1985) seems to suggest that a much stronger case for subsidisation can be constructed when the competitive framework which I have assumed until now is abandoned. They presented a simple Cournot duopoly model in which a subsidy to the home firm turns out to be mandated at the optimum.

Figure 4 illustrates the Brander-Spencer result. A single home firm competes in foreign markets with a single foreign firm. I assume an extremely simple parameterisation of demand: the firms produce differentiated

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[17]By explicitly parameterizing the difference between the home and foreign countries, it can be shown that subsidisation of a good is more likely to be justified if it is a better substitute for the other good at home than abroad. (See Neary (1988).) This extends a result due to Feenstra (1986).

products and face symmetric linear inverse demand schedules.[18] Thus, writing x and y for home and foreign outputs and p and q for home and foreign prices:

(4.1) $p = a - bx - ey$ and $q = a - ex - by$.

I now adopt the Cournot assumption that each firm maximises its profits taking the other firm's output as parametric. The resulting first-order conditions, equating marginal revenue to marginal cost (assumed constant and equal to c for each firm) define linear "reaction functions", giving each firm's profit-maximising output as a function of the other firm's. The equations for these functions, labelled HH' and FF' respectively in Figure 4, are as follows:

(4.2) HH': $2bx + ey = a - c + s$,

(4.3) FF': $ex + 2by = a - c$.

When the home subsidy is zero (s=0), the intersection point of these two schedules at C therefore represents the Cournot equilibrium outputs of the two firms in the absence of government intervention. Because of the symmetric assumptions I have made, the output levels of the two firms are the

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[18] Brander and Spencer allow for general demand functions. However, just as in extending the analysis of Sections 2 and 3 to non-linear cases, it is necessary to make essentially arbitrary assumptions to ensure that the model's properties do not diverge "too far" from those of the linear case. On the other hand, Brander and Spencer assume that the two firms produce identical products: this corresponds to the special case of (4.1) where b equals e. Following standard practice, I assume that e is positive, since this ensures that both reaction functions are downward sloping. In the terminology of the last section, this amounts to assuming that the two goods are Antonelli substitutes.

same.[19]

The possibility of a welfare gain for the home country is now easily demonstrated by noting that home welfare (in the absence of domestic consumption) equals the firm's gross profits *less* the cost of subsidy payments:

(4.4) $W = \Pi - sx = (p-c)x.$

Iso-welfare loci are therefore given by iso-profit loci in the no-intervention case, each of which (by construction) is horizontal at the point where it crosses the home firm's reaction curve. Clearly, home welfare can be raised above the level attained in the no-intervention equilibrium, represented by the locus labelled W_0. The mechanism for doing so is for the government to grant a subsidy to the home firm, causing its reaction curve to shift outwards. Welfare is maximised when the outward shift is such that the highest attainable iso-welfare locus is reached, subject to the constraint that the foreign firm remain on its initial reaction curve. This occurs at point C' in the diagram: relative to the no-subsidy equilibrium, the home firm's market share has risen so that the extra profits on additional sales more than offset the fall in price and the cost of the subsidy payments. Consumers of the product as well as the home firm and government gain at the expense of the foreign firm.

The rationalization provided by Brander and Spencer for this remarkable result is that the government is able to precommit the home firm to a higher output plan than it could credibly undertake in the absence of intervention. From a trade theoretic perspective, the most striking feature

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[19] Straightforward calculations show that they equal $(a-c)/(2b+e)$.

of the policy is that it works precisely *because* it worsens the home country's terms of trade. Only by doing so in order to engineer an increase in the domestic firm's market share can profits be shifted away from the foreign firm. However, this feature of the model is unlikely to be highly robust. To see this, differentiate the welfare function (4.4a) and substitute from the home firm's first-order condition to obtain:

(4.5) $dW = (bx - s)dx + xdp.$

Comparing this with equation (3.3) in the competitive model, it is clear that *both* the volume-of-trade and the terms-of-trade effects continue to apply in oligopolistic markets and that both warrant an optimal export tax rather than a subsidy. The new term, bxdx, is the gap between price and marginal production cost, or the *gross price-cost margin*, times the increase in export sales, and it is the increase in home profits arising from this term which introduces the possibility that an export subsidy may be optimal. Even with that, it is only in this particular model that the first term dominates the others, starting from free trade. To see how this occurs, differentiate the demand function (4.1) to obtain:

(4.6) $dp = -bdx - edy,$

and substitute into (4.5):

(4.7) $dW = -sdx - bxdy.$

This takes such a simple form because the terms of trade deterioration arising from an increase in the output of the home good (-bdx) is exactly offset by the welfare gain from the increase in profits(bxdx). What is left is the contribution to a terms of trade *improvement* of the induced *fall* in the foreign firm's output (y is negatively related to x along FF' so that dy is negative) and it is this which makes a subsidy welfare-improving. Note

the parallel with the results in the competitive case of Section 3: the possibility of a welfare gain from granting a subsidy to one good arises solely from the potential terms of trade improvement caused by induced changes in the market for the *other* good.

This fortuitous cancelling of two effects (the own terms-of-trade effect and the marginal profitability effect) turns out to be highly sensitive to the assumptions made about the nature of strategic interdependence between firms. The importance of this is illustrated in Figure 4. Adopting an approach pioneered by Eaton and Grossman (1986), suppose that each firm anticipates a determinate response (not necessarily zero) by the other firm to an increase in its own output.[20] Denoting this expected response or *conjectural variation* by γ, the first-order condition for the home firm now becomes:

$$(4.8) \qquad p - c + s - x(b + e\gamma) = 0.$$

Substituting from (4.1) and performing similar calculations for the foreign firm (assumed for simplicity to have the same conjectural variation parameter) yields expressions for the modified "reaction functions" in this case:

$$(4.9) \qquad HH'': \quad (2b + e\gamma)x + ey = a - c + s,$$

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[20]This approach to modelling firm interdependence has been widely criticized as a crude attempt to model the essentially dynamic phenomenon of sequential decision-making by rival firms in a static framework. In the present state of our knowledge, only the Cournot and Bertrand cases can be given a rigorous justification in terms of a properly specified game. Nevertheless, at the very least, the conjectural variations approach has a useful pedagogic role, as I show below.

(4.10) F'F": $ex + (2b + e\gamma)y = a - c.$

In the absence of a subsidy, these may be solved to give the symmetric output levels as functions of the parameter γ:

(4.11) $x = y = (a - c) / (2b + e\gamma + e).$

Note that both are *decreasing* in γ: as that parameter falls below the Cournot value of zero, firms compete more aggressively and outputs expand outwards along a ray from the origin to C. (See Figure 4.)

How does the optimal subsidy change as γ falls? Differentiating the welfare function in this case and substituting from (4.8) yields:

(4.12) $dW = [(b+e\gamma)x - s]dx + xdp.$

Because the market is now more competitive than in the Cournot case, the gross price-cost margin is lower ($b+e\gamma$ is less than b) and so the case for expanding output by subsidisation is weakened. Following the same steps which led to (4.7) now yields:

(4.13) $dW = (e\gamma x-s)dx - exdy$

$= [(\gamma-g)ex-s]dx.$

Here the parameter g has been introduced as a shorthand for the *actual* output response by the foreign firm to an increase in home output; from (4.10) this equals $-e/(2b+e\gamma)$. The implication is clear: a positive subsidy is justified only if the home firm's conjecture of its rival's response exceeds algebraicly the actual response (which the home government is assumed to know). If the home firm were to anticipate a response smaller than will actually ensue, then its excessive optimism would justify an export *tax* rather than a subsidy. The case of *consistent conjectures*, denoted by point R in Figure 4, where the home firm correctly anticipates the foreign

firm's response, is precisely the one where no intervention is called for.[21]

These results, due to Eaton and Grossman, are ilustrated for the case of linear demands in Figure 4. Calculating explicitly the levels of home and foreign output at the optimum, they may be shown to be:[22]

$$(4.14)\quad x^o = \frac{a-c}{2}\,\frac{2b+e\gamma-e}{(2b+e\gamma)b-e^2} \qquad \text{and} \qquad y^o = \frac{a-c-ex^o}{2b+e\gamma}$$

It may be checked that x^o is increasing and y^o is decreasing in γ. Thus as γ falls, the optimum moves in a north-east direction along the C'NB' locus as indicated by the arrows. It is striking that results directly opposite to those of the Cournot case are obtained in the Bertrand case where each firm expects the other to maintain a fixed *price* in the face of a change in its own price. This would require a large *fall* in the rival's output in response

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[21]Equating conjectured and actual responses γ and $-e/(2b+e\gamma)$ shows that the consistent conjectural variation is $-(b \pm \sqrt{b^2-e^2})/e$. Substituting from (4.8) into the expression for profits, $\Pi = (p-c+s)x$, the latter are only positive in the absence of a subsidy for values of γ greater than $-b/e$; hence only the larger of the two roots need be considered.

[22]The case where the two goods are identical (b=e) permits even stronger implications to be drawn for policy. From (4.14), x^o is now *independent* of γ. Thus the socially optimal level of home output in the linear symmetric case does not depend on firms' perceptions; the task of policy is to bring about this level of output by offering whatever level of subsidy is appropriate. This striking result highlights the importance of the assumptions made about the strategic environment of firms as a determinant of the nature and magnitude of the optimal policy.

to an increase in the home firm's;[23] and this "overoptimistic" expectation induces the home firm to increase its output above the socially optimal level, thus justifying an export tax. The equilibria with and without intervention in this case are illustrated by points B' and B respectively in Figure 4. Geometrically, these points are found by locating in the diagram the particular foreign "reaction function" (4.10) corresponding to the Bertrand case. (As γ falls below zero, the point F' on the x axis is unaffected but the point on the y axis, F", rises steadily. Hence the locus pivots clockwise around point F'.) The intersection of this locus with the projection of OC denotes the Bertrand outcome with no intervention, B, while its intersection with the curve C'RB' denotes the Bertrand outcome with optimal intervention, B'.

In other respects too, the Brender-Spencer policy prescription of a subsidy is sensitive to changes in underlying assumptions. For example, Dixit (1984) has noted that, even in the Cournot framework, the addition of extra home firms reduces the likelihood that a subsidy will be optimal. The reason is precisely the same as the usual optimal tariff argument: competition between domestic firms leads to overproduction from a social point of view as each firm fails to take account of the reduction in price occasioned by a marginal increase in its output. This consideration calls for an export tax and must be traded off against the profit-shifting motive to determine the sign of the optimal policy. A second consideration is that

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[23]The Bertrand quantity conjecture is -e/b, derived by setting dq equal to zero in (4.1). This is algebraicly less than the consistent conjecture derived in an earlier footnote.

even the possibility of a subsidy being optimal in this case arises only from the fact that the number of firms is *fixed*. If entry into the domestic industry is free, then domestic profits are competed away and there is no justification for subsidising exports.[24] Finally, a different set of issues is raised by relaxing the assumption which I have made so far that marginal costs are constant. In particular, Dixit and Grossman (1987) have noted that marginal costs are likely to be *increasing* if the subsidised industry draws on specific factors of production which are limited in supply to the economy as a whole. If these factors are also employed in other oligopolistic exporting sectors, then the application of the optimal subsidy argument to all sectors suffers from a fallacy of composition: to the extent that all sectors are subsidised, the output effects will only arise from *differences* betweeen sectors; the average effect of the combined subsidy programs will merely be to drive up the wages of the specific factors. This argument may be seen as the first attempt to imbed the partial equilibrium oligopoly model in a general equilibrium framework and it is noteworthy that it serves to qualify further the case for subsidising exports.

5. Post-Contract Export Subsidies

The last set of considerations I wish to discuss concerns the manner in which export subsidies are actually paid in practice. So far, I have followed the literature in assuming that they take the form of subsidies paid to firms on the basis of the volume of their exports and at a rate fixed in

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[24]The importance of the assumption of restricted entry is stressed by Markusen and Venables (1988).

advance of the actual sales being made. However, as Carmichael (1987) has noted, this description does not fit the actual pattern of many real-world subsidy programmes. He notes in particular that the programme administered by the United States Export-Import Bank differs in two important respects: firstly, the subsidy is paid on the basis of the *price* secured for an export contract; secondly, and more importantly, the level of the subsidy is determined only *after* an export contract has been secured and a price agreed with the foreign buyer. The latter consideration suggests that the framework used in the last section reversed the true order of decisions: instead of governments choosing subsidy levels to which firms then adapt, the true situation may be closer to one in which firms take into account the subsidy which the relevant government agency will provide in entering into negotiations with prospective foreign buyers.

An immediate difficulty with modelling this process is that the home firm has no incentive to keep its price within bounds, if it anticipates an accomodating subsidy from its home government. Carmichael posits an arbitrary upper limit on the contract price as a way of avoiding this difficulty, but this begs the question of how the government agency chooses the limit. A more satisfactory approach to this problem is proposed by Gruenspecht (1988), who assumes that government revenue has a positive shadow price, such that additional profits for the home firm are valued at only a fraction of the value of subsidy payments. This approach not only gives an interior solution to the choice of subsidy level. More interesteringly, it also justifies a positive subsidy (for a reasonably wide range of the shadow price of government funds parameter) in the case of Bertrand price competition - where the standard Brander-Spencer paradigm of the government

as first mover implies that an export tax rather than a subsidy is optimal.

Since the government is not optimising conditional on firms' actions in this framework, there is no guarantee that the level of welfare in the presence of a subsidy program will exceed the no-intervention level. Nonetheless, Gruenspecht shows that this may indeed be the case in many circumstances. However, what he does not do is to compare the level of welfare under this policy rule with that which could be attained under an optimal subsidy where the government anticipates firms' responses (as in the model of the last section). It seem highly unlikely that the abandonment of a significant degree of autonomy by the government could increase welfare and so, as in Section 2, the case for subsidies in this model would appear to be a second- rather than a first-best one.

6. Conclusion

In this paper I have tried to synthesise the recent theoretical literature on export subsidies. The main principle which has emerged is that export subsidies always lead to a *direct* welfare loss, arising from their effects in the market for the subsidised good; but that this effect may be offset by various by-product effects of the subsidy. The direct welfare loss has two components: the actual cost of the subsidy payments themselves and the deterioration in the country's terms of trade as home output of the subsidised good expands. Possible offsets to this loss include a reduction in costs if the subsidised good is produced under conditions of increasing returns to scale; an increase in profits of home producers; and a welfare gain from repercussions of the subsidy in the markets for related goods. Interestingly, the latter type of gain is shown to underlie a variety of

recent arguments for export subsidies, in both competitive and oligopolistic environments.

As far as practical policy is concerned, the general thrust of the paper is that economic theory provides little justification for the widespread use of export subsidies. Although I have noted a number of cases where such policies are justified, the arguments in each case are suspect on a variety of grounds. In a competitive framework, export subsidies may be justified only by invoking complex patterns of intercommodity substitution: as an indirect means of reducing the exports of substitute goods or expanding those of complementary goods. Increasing returns to scale may of course provide a first-best argument for subsidies but the possibility of "exploiting" foreigners by manipulating the terms of trade is more likely to require tariffs, unless very detailed information on cross-price relationships are available. As for the possibility of using subsidies to shift profits from foreign to domestic oligopolists, I have argued that this novel argument is relatively non-robust, and relies on the questionable assumption that the home government has more credibility in the eyes of foreign competitors than has the home firm.

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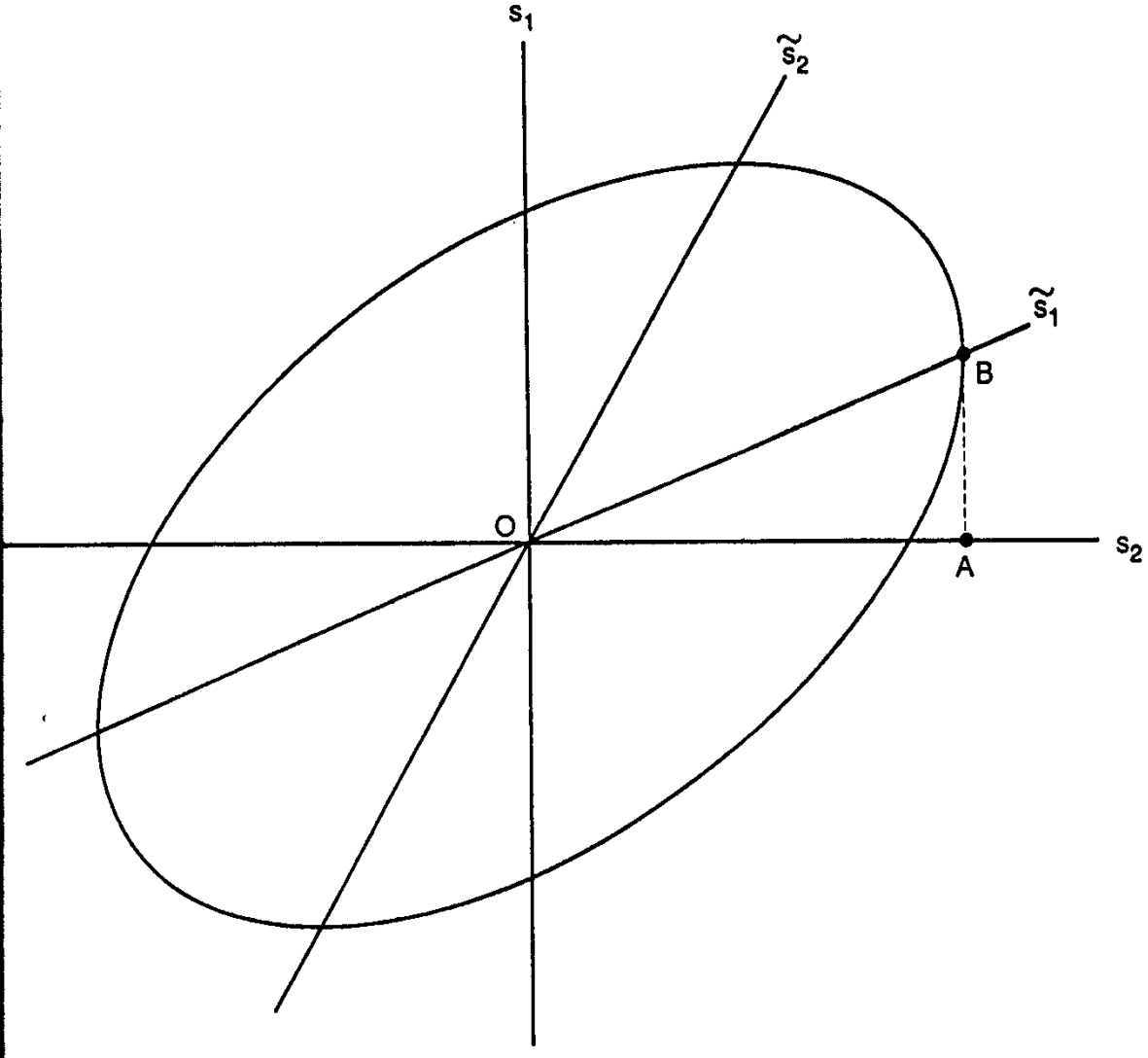

Figure 1

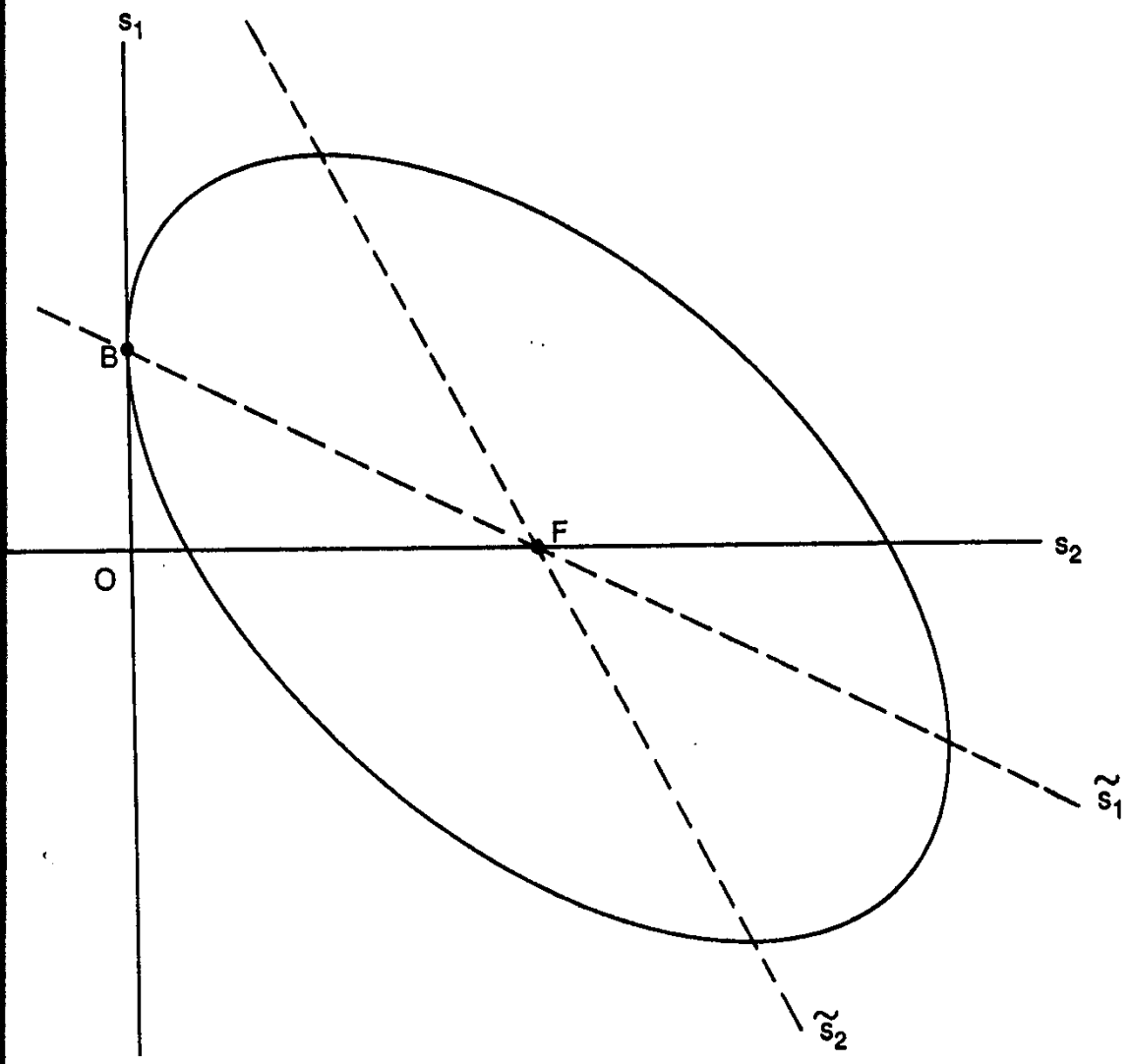

Figure 2

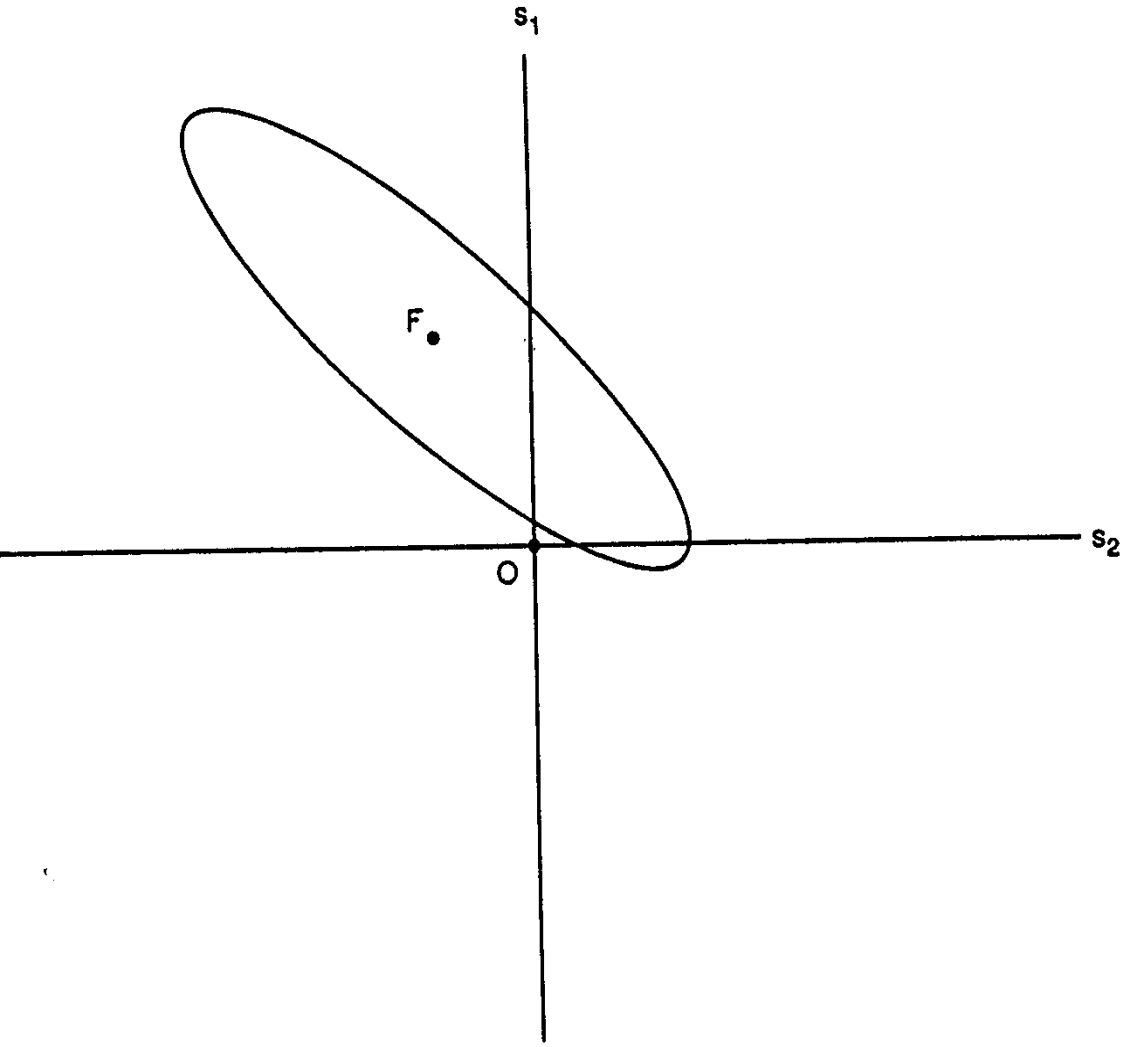

Figure 3

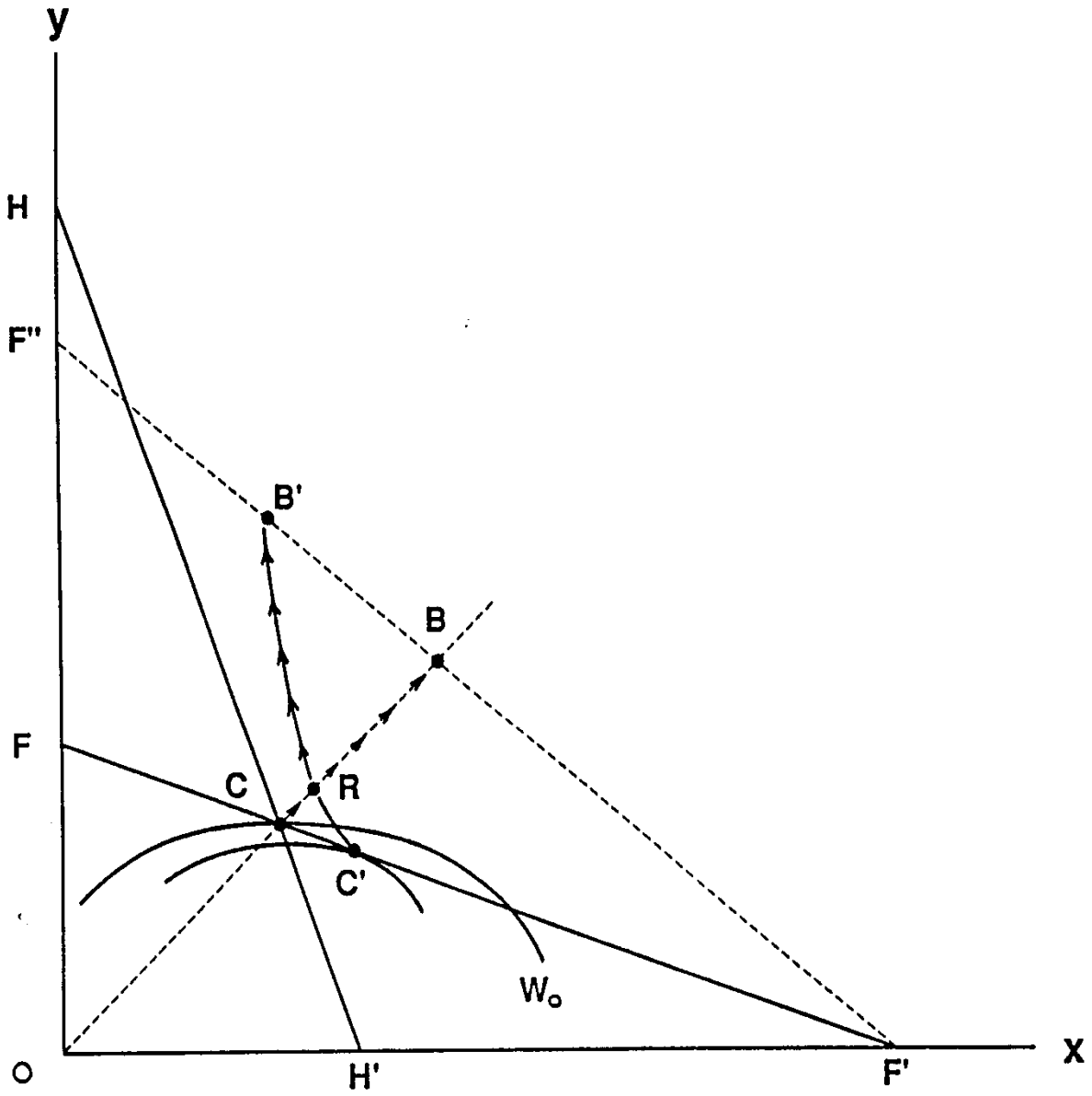

Figure 4

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