NBER WORKING PAPER SERIES

INCENTIVE COMPATIBLE TRADE POLICIES

Robert C. Feenstra

Working Paper No. 1977

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 1986

Financial support from the Ford Foundation is gratefully acknowledged. To be published in a conference issue of the Scandanavian Journal of Economics, 1987. The research reported here is part of the NBER's research program in International Studies. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

Working Paper #1977
July 1986

Incentive Compatible Trade Policies

ABSTRACT

We consider a two country trade model with production uncertainty. If complete contingent markets do not exist, it is desirable for governments to adopt some trade policies to share the production risk. A full information policy involves income transfers across countries, which can be achieved by equal import tariffs and export subsidies. With incomplete information we consider incentive compatible trade policies, which are designed to be truth revealing while partially sharing the production risk. In this case the tariff in one country may differ from the export subsidy abroad.

Robert C. Feenstra
Department of Economics
University of California
Davis, CA 95616

I. Introduction

Under international trade laws, the application of import restrictions often depends on some special conditions in the trading industry. For example, Article XIX of the General Agreement on Tariffs and Trade (GATT), known as the "escape clause" provision, states that a tariff concession (reduction) can be withdrawn if "any product is being imported...in such increased quantities and under such conditions as to cause or threaten serious injury to domestic producers in that territory of like or directly competitive products" (sec. 1.(a)). In this case the special conditions are that imports have increased and that the domestic industry faces actual or potential injury (as often measured by unemployment or excess capacity). Similiar provisions are made in section 201 of the U.S. Trade Act of 1974.

The conditional feature of these trade laws is meant to limit their range of application. However, such a limitation may be ineffective when one country cannot actually verify the conditions faced by an industry in the other country. Indeed, under this scenario of incomplete information, each country may be tempted to misrepresent the conditions faced by their own industries and thereby obtain import protection. We feel that the assumption of incomplete information is useful in analysing trade negotiations between countries. In this paper we shall consider the design of socially optimal trade policies under incomplete information.

In section II we outline a two good, two country trade model with production uncertainty at home. A social optimum in this model will generally require a set of contingent commodity markets, with goods sold contingent on the state of nature. In reality an equivalent set of contingent commodity markets may not exist, but we argue in section III that the social optimum can be still be achieved by income transfers across countries. These income

transfers can occur through a tariff in one country combined with an equal export subsidy in the other. These trade policies support the first-best equilibrium, but are contingent on the state of nature at home.

In section IV we analyse whether the home country has any incentive to falsely announce the state of nature, and we find that it may wish to do so. This means that the full information trade policies described above are not incentive compatible, that is, they do not lead to a true revelation of the state of nature. Accordingly, in section V we consider second-best trade policies which maximize world welfare subject to the constraint of being incentive compatible. We find that these trade policies may involve a tariff in one country which differs from the export subsidy abroad, so that consumer prices are not equalized internationally. This distortion is optimal given incomplete information. Directions for further research are discussed in section VI.

Our paper is related to those of Eaton and Grossman (1984) and Staiger and Tabellini (1986) by examining trade policy under uncertainty. In contrast to these papers, the markets which are assumed to be absent are international rather than domestic. The application of incentive compatibility to trade policy appears to be new, though it has received substantial attention in the implicit contracts literature, recently surveyed by Holmstrom and Hart (1985) and Rosen (1985). The reader is also referred to the papers in the 1983 Supplement to the Quarterly Journal of Economics, especially Azariadis (1983).

II. Equilibrium with Complete Markets

We shall consider a two good, two country model with production uncertainty at home. We assume that consumers are identical within countries, with each population then set at unity, but allow for different degrees of risk

aversion across countries. With the additional assumption that preferences are homothetic, we write the utility function for the home consumer as $U[g(x)]$ where $x = (x_1,x_2)$ is the consumption vector; we assume that g is homogeneous of degree one, concave and increasing in x, with $U' > 0$, $U'' < 0$. The function g summarizes the indifference curves of the home consumer, while the concavity of U determines the degree of risk aversion. We suppose that the foreign consumer has the same indifference curves as at home, but may differ in risk aversion, and write the foreign utility function as $U^*[g(x^*)]$ with $U^{*\prime} > 0$ and $U^{*\prime\prime} < 0$.

We let $s = a,b$ denote the two states of nature at home, with the feasible output vector $y = (y_1,y_2)$ satisfying $f(y,s) \leq 0$.[1] We suppose that the set of feasible outputs is convex and that production decisions are made ex-post.[2] Let $z = (z_1,z_2)$ denote imports into the home country. Then we can summarize the utility obtained through trading opportunities at home using the <u>trade utility function</u>, defined as:

$$h(z,s) \equiv \max_{x \geq 0} \; g(x) \text{ subject to } f(x-z,s) \leq 0 \; . \tag{1}$$

Note that the trade utility function $h(z,s)$ is measured in the same units as $g(x)$. The actual utility obtained by the home consumer is $U[h(z,s)]$. From the first order conditions for (1) we see that the partial derivatives of h and g are equal, $h_z(z,s) = g_x(x)$. An analogous trade utility function denoted by $h^*(z^*)$ holds for the foreign country, where the production set $f^*(y^*) \leq 0$ is not subject to uncertainty. This function is measured in the same units as $g(x^*)$ and actual foreign utility is $U^*[h^*(z^*)]$. We also have that $h^*_z(z^*) = g_x(x^*)$.

We can now state the equilibrium conditions for the economies under free trade. We first consider the case of complete contingent commodity markets, with prices $p_s = (p_{1s}, p_{2s})$ depending on the state of nature s = a,b. Purchasing good 1 in state a means that the good is delivered only if state a occurs, while the payment p_{1a} is made regardless of the state. Using the condition of balanced trade the home consumer faces the budget constraint $\sum_s p_s' z_s = 0$, where imports $z_s = (z_{1s}, z_{2s})$ are also contingent on the state of nature, and all vectors are treated as columns unless transposed using a prime.

Let π_s denote the probability of state s occurring, s = a,b. Then the home consumer solves the problem:

$$\max_{z_s} \sum_s \pi_s U[h(z_s, s)] \quad \text{subject to} \quad \sum_s p_s' z_s = 0 \ , \tag{2}$$

with the first order conditions,

$$\pi_s U' h_z(z_s, s) = \lambda p_s \quad , \quad s = a,b. \tag{3}$$

The foreign consumer solves a problem analogous to (2), facing the same price vector p_s under free trade. The first order conditions are:

$$\pi_s U^{*\prime} h_z^*(-z_s) = \lambda^* p_s \quad , \quad s = a,b, \tag{4}$$

where $-z_s = z_s^*$ since home exports are foreign imports.

From (3) and (4) it is immediate that the marginal rates of substitution between goods are equal in the two countries. This equality holds when we compute (A) the ratio of marginal utilities from goods 1 and 2 in a given state, or (B) the ratio of marginal utilities from good i in states a and b.

In contrast, the free trade equilibrium which would occur under spot markets would only satisfy equality of (A) across countries. We illustrate the spot and contingent market equilibria in Figure 1.

In Figure 1 OF* is the foreign offer curve, while OF_a and OF_b are the home offer curves in the two states of nature. In the case we have shown the home country desires to trade less at any price ratio in state a, which can occur if state a has higher productivity in the home import industry. The spot market equilibria would be A_0 in state a and B_0 in state b. At each of these equilibrium the trade balance is zero. However, with complete contingent markets the trade balance need not be zero within each state: from the constraint in (2) trade is balanced only when summing across all states. For example, if $p_a'z_a < 0$ then the home country has a trade surplus in state a, but an equal trade deficit in state b. The use of contingent contracts permits implicit income transfers across countries, which are a means of sharing risk and raising expected utility.

In general, the following condition holds in the first-best equilibrium, obtained with complete markets:[3]

$$U'[h(z_a,a)]/U'[h(z_b,b)] = U^{*\prime}[h^*(-z_a)]/U^{*\prime}[h^*(-z_b)] \quad . \tag{5}$$

Condition (5) corresponds to optimal risk sharing. It implies that the marginal utilities of the countries are perfectly correlated, and therefore, the utility levels of the countries are positively correlated across states. We shall use this result repeatedly.

Several examples can illustrate the direction of income transfer. Suppose that state a has higher productivity in the import industry at home, as in Figure 1. Then the home consumer has higher utility in state a than in b (with higher output and a positive terms of trade effect) while the foreign

consumer has lower utility (due to a negative terms of trade effect). To satisfy (5) the home consumer would give an income transfer in state a and receive it in b. This would move the equilibrium in state a along a contract curve towards A_1 or A_2 in Figure 1. In state b the equilibrium would move towards B_1 or B_2.

Alternatively, suppose that state a has higher productivity in the export industry at home (not drawn). There are two possibilities. First, if the home country experiences immiserizing growth then it is worse off in state a, while the foreign country is better off (due to a positive terms of trade effect). To satisfy (5) the home country would receive an income transfer in state a and give it in b. Second, if the home country does not experience immiserizing growth in state a then both countries are better off, and the direction of income transfer will depend on the relative degrees of risk aversion. It is possible that (5) could hold by coincidence in the spot market equilibrium, so the optimal transfer would be zero.

In the complete markets equilibria at least one country must be better off than with spot markets, even after compensating the other country for any drop in utility. Under the special assumptions we have made on preferences, however, we obtain a stronger result: so long as (5) does not with spot markets, then <u>both</u> countries are better off under complete contingent markets. This follows from the assumption that consumers in the two countries have the same indifference curves, so that any income transfer has no effect on equilibrium prices. Thus, the price ratio p_{1s}/p_{2s} faced by consumers under spot or contingent markets are identical, but with spot markets consumers face the <u>additional</u> constraint that trade must be balanced within each state. Therefore, utility in each country must be lower if only spot markets are available.

III. Full Information Trade Policies

Contingent contracts for commodities are a claim to future output. In some cases stock markets may serve the same role, as in Helpman and Razin (1978) who obtain the complete markets equilibrium using stocks.[4] However, there are several reasons why markets for claims to future output may by imperfect or absent. In our international setting, consumers in one country may lack the information needed to make fully diversified stock purchases abroad. More generally, a firm which has has sold claims to all of it future output may lack an incentive to produce efficiently - this is a moral hazard problem, often cited as an explanation for missing insurance markets.

Henceforth, we shall suppose that only spot markets for commodities are available, and investigate government trade policies to improve welfare. These policies will take the form of international rules on the application of tariffs and subsidies, as could be negotiated in a GATT forum. The highest goal for the policies would be to restore welfare to the first-best, complete markets equilibrium, which in our model would give both countries higher utility than with spot markets.

If both governments can observe the state of nature at home then trade policies can be made contingent on the true state. Then the first-best equilibrium can be restored by a system of import tariffs and equal export subsidies abroad. The revenue collected from the tariff and lost by the subsidy is a means of achieving the income transfers discussed in section II (alternatively, explicit transfers could be used). For example, if state b has lower productivity in the import industry at home, the home country would set an import tariff matched by an equal subsidy abroad. The level of tariff and subsidy would be chosen to exactly achieve the income transfer obtained in the complete markets equilibrium. Note that consumer prices would be equalized across countries since the tariff and subsidy are equal. In state a the

foreign country would set an import tariff matched by an equal subsidy at home, to achieve the reverse income transfer.

It is useful to compare the tariff revenue collected in one state with that lost in the other. In the contingent market equilibrium we have $p_a'z_a = -p_b'z_b$ which is not generally zero, reflecting the income transfer. Using (3) we can compute the corresponding spot market prices as $P_s \equiv U'h_z(z_s,s)/\lambda = p_s/\pi_s$, so that $\pi_s P_s = p_s$. Then from the budget constraint in (2),

$$\sum_s \pi_s P_s' z_s = 0 \quad . \tag{6}$$

The term $P_s'z_s$ is the trade balance evaluated at international spot prices, which equals the revenue collected or lost in that state. Condition (6) states that tariff revenue weighted by the expected frequency of each state must sum to zero. Thus, a country which uses a tariff in one state of nature will have commensurate tariffs levied against it in other states, as measured by the corresponding revenues.[5]

IV. Incentive Compatibility

We next consider the case where the foreign government cannot observe that state of nature at home. Then the home government can choose to announce that either state has occurred. A policy in which the home government has no incentive to falsely announce the state is referred to as incentive compatible, and must satisfy the following constraints:

$$U[h(z_a,a)] \geq U[h(z_b,a)] \quad , \tag{7a}$$

$$U[h(z_b,b)] \geq U[h(z_a,b)] \quad . \tag{7b}$$

Constraint (7a) states that when the true state of nature is a, the home

country would prefer to announce that a has occurred and receive the trade bundle z_a rather than announcing b and receiving z_b. Conversely, (7b) ensures that when the true state of nature is b the home country has not incentive to announce that state a has occurred.

We need to determine whether either of the constraints (7) are violated in the first-best equilibrium. First, consider the special case where the home consumer is risk neutral, so that U' is a constant. Then from (5) we see that $U^{*\prime}$ will be equal in the two states, which implies that foreign utility U^* is equal across states. This equilibrium is shown as A_1, B_1 in Figure 1, with the foreign consumer receiving constant utility of U^*. The home consumer, who is risk neutral, has absorbed all of the fluctuation in utility. In this case we can see that the first-best equilibrium satisfies (7): when the true state of nature is a, the home consumer obtains highest utility at A_1 where a home trade-indifference curve is tangent to U^*_1 (as drawn), and similiarly when the true state is b. Note that this result does not depend on which industry at home is affected by the uncertainty. Whenever the home consumer is risk neutral, the equilibrium obtained with full information trade policy is incentive compatible.[6]

Now suppose that the home country is risk averse, with $U'' < 0$. Label states of nature so that state a has the higher productivity at home (in either industry).[7] Then from (5) both countries will have higher utility in state a under complete markets. In Figure 1, as the home country becomes more risk averse the equilibrium must move from A_1 towards A_2, raising foreign welfare in state a, and from B_1 towards B_2 lowering welfare. This will ensure that the foreign country has higher utility in state a than b, with the same condition holding at home.

Suppose that the home country is sufficiently risk averse to move the equilibria to A_2, B_2. If state a occurs then the home country receives

utility U_a from the trade bundle A_2, as shown by the trade-indifference curve, but would receive higher utility from the trade bundle B_2 (a higher trade-indifference curve, not drawn, would pass through B_2). Thus, the home country would prefer to falsely announce that state b has occurred, violating constraint (7a). On the other hand, if state b occurs the home country would have no incentive to announce otherwise (compare B_2 with A_2), so constraint (7b) is always satisfied. In general, given our labelling of states, the only constraint which can be violated with the full information trade policy is (7a).[8] Henceforth we shall consider only this contraint.

V. Incentive Compatible Trade Policies

In this section we shall construct second-best trade policies which maximize welfare subject to the constraint (7a). Under such policies the home country has no incentive to falsely announce the state of nature. We consider solving the problem:

$$\max_{z_s} \sum_s \pi_s U[h(z_s,s)]$$

subject to,

$$\begin{aligned} &U[h(z_a,a)] \geq U[h(z_b,a)] \ , \\ &\sum_s \pi_s U^*[h^*(-z_s)] \geq \bar{U}^* \ . \end{aligned} \tag{8}$$

The first constraint in (8) is repeated from (7a), while the second constraint puts a lower bound on expected utility abroad. Note that if the constraint (7a) were omitted then the solution to (8) would be a Pareto optimum, and for suitable choice of $\bar{U}^*$ would yield the first-best equilibrium.

Forming a Lagrangian with $\theta \geq 0$ as the multiplier for the first constraint in (8), and $\phi > 0$ as the multiplier for the second, we obtain the first order conditions:[9]

$$\pi_a[U'h_z(z_a,a) - \phi U^{*\prime}h_z^*(-z_a)] + \theta U'h_z(z_a,a) = 0 \quad , \tag{9a}$$

$$\pi_b[U'h_z(z_b,b) - \phi U^{*\prime}h_z^*(-z_b)] - \theta U'h_z(z_b,a) = 0 \quad . \tag{9b}$$

From (9a) it is immediate that marginal rates of substitution are equal across countries when state a (the good state) occurs. However, when state b occurs the marginal rates of substitution may not be equalized. Condition (9b) can be rewritten as,

$$\frac{h_2^*(-z_b)}{h_1^*(-z_b)} = \frac{h_2(z_b,b)}{h_1(z_b,b)}\left\{1 + \frac{1}{D}\left[\frac{h_2(z_b,b)}{h_1(z_b,b)} - \frac{h_2(z_b,a)}{h_1(z_b,a)}\right]\right\} \quad , \tag{10}$$

where D has the same sign as θ: $D = 0$ if (7a) is not binding and $D > 0$ otherwise. The relation between the marginal rates of substitution across countries depends on the right-most expression in square brackets in (10). We shall now determine the sign of this expression.

Suppose that good 1 is exported by the home country, and consider Figure 2. We show the home consumption and production points in state b as X_b and Y_b, respectively, with imports as the difference between them. Note that the consumption and production points are chosen to maximize utility for the given import vector $z_b = X_b - Y_b$, as in (1). The expansion path corresponding to domestic prices in state b is OE, and a parallel line Y_bE' is drawn.

Now suppose that, at the same domestic prices, production in state a lies on the line Y_bE'. Then consumption would lie on X_bE, and this point would be optimal (satisfy (1)) for the import vector z_b. In this case the marginal

rate of subtitution would not change across states of nature, so the right-most expression in (10) is zero.

Alternatively, suppose that at the original domestic prices production in state a is Y_a, lying above Y_bE'. In this case we shall say that uncertainty occurs in the import industry.[10] For given imports z_b consumption would be at X_a, lying above X_bE. To satisfy (1), however, it will generally be optimal to choose other consumption and production points where the marginal rates of substitution and transformation are equal. Even after this optimal choice consumption will lie above X_bE. With relatively more of good 2 consumed in state a than in b, the marginal rate of substitution h_2/h_1, is lower in state a. It follows that the right-most expression in (10) is positive. Finally, with uncertainty occurring in the export industry as shown by Y_b'', X_b'' in Figure 2, the right-most expression in (10) would be negative.

Consider the former case where uncertainty occurs in the import industry at home. In state b the home country suffers both a production and terms of trade decline, and would receive an income transfer from abroad under complete markets. This income transfer could be achieved under a full information trade policy by an export subsidy abroad and equal import tariff at home. However, if the incentive compatibility constraint (7a) is binding then the full information policy cannot be used. Instead, with the right-most expression in (10) positive, the relative price of good 2 abroad will exceed that at home. This means that the import tariff at home is less than the subsidy abroad. Thus, less than the full amount of the export subsidy is captured by the home import tariff. This will ensure that when the good state a occurs, the home country has no incentive to falsely announce that b has occurred (i.e. (7a) is satisfied).

This incentive compatible policy is illustrated in Figure 3. First, consider the equilibrium A_3, B_3. The home country is giving an income transfer in state a (compare A_0 with A_3) and receiving it in state b. If the state of nature is a then the home consumer receives U_a from either of the trade bundles A_3 or B_3. Thus, the home consumer would be indifferent between announcing the true or false state when state a occurs, so constraints (7) are satisfied. If it happened that condition (5) for optimal risk sharing were satisfied at A_3, B_3, then this equilibrium would be the first-best. It could be implemented even if information were incomplete.

Suppose, however, that to satisfy (5) the home country must give a greater transfer in state a and receive more in b, as illustrated by A_4, B_4. Now when state a occurs the home consumer would receive U_a' from the trade bundle A_4 but higher utility from B_4, so constraint (7a) is violated. To satisfy incentive compatibility, the home consumer could instead receive B_4' in state b. Then the home consumer would again be indifferent between announcing states a or b and receiving A_4 or B_4', respectively, when state a occurs. When state b occurs the home consumer obtains utility of U_b'. Note that the equilibrium B_4' has a greater volume of trade than positions such as B_3 where domestic and foreign consumer prices are equal. This is consistent with our result above that the home tariff is less than the foreign subsidy in state b.

If instead the uncertainty occurs in the export industry and constraint (7a) is binding, then from (10) the relative price of good 2 abroad is less than at home in state b. Since the productivity fall in the export industry is accompanied by a terms of trade gain the direction of income transfer is ambiguous. If the home county is receiving an income transfer in state b then its import tariff on good 2 will exceed the foreign subsidy. Alternatively, if the home country is giving an income transfer then its subsidy on good 1 is

less than the foreign tariff. In each case the trade volume would shrink below that achieved with equal consumer prices across countries.

Summing up, we have found that the only incentive compatibility constraint which may be violated in the first-best is (7a): when the good state a occurs, the home consumer may prefer to announce that state b occurred. It is possible to design policies which avoid this problem, but they have the feature that in state b consumer prices are not equalized across countries. This distortion is optimal given the incomplete information. The exact relation between consumer prices, and the corresponding trade policies, are sensitive to the industry affected by the uncertainty. In state a equality of consumer prices across countries is maintained.

VI. Direction for Research

The result that the incentive compatible trade policies are sensitive to the industry affected by the uncertainty is disappointing from a policy viewpoint. In practice, it may be difficult to identify the source of uncertainty and design corresponding trade policies. In this section we will argue that in a multiperiod game between the countries simpler policies may be available to maximize welfare. Our results are meant to be suggestive rather than conclusive.

Recall from section III that with full information trade policy the expected value of revenue spent or collected is zero. Consider our model repeated over many periods, and suppose that over this time horizon the countries agree that the revenue spent or collected must sum to zero exactly. For simplicity suppose that each state is equally likely to occur and that uncertainty affects the import industry.

In this setting if the home country ever falsely announces that state b has occurred, there by receiving rather than giving an income transfer, this will raise its "net indebtedness" as measured by revenue collected. To achieve zero net revenue at the end of the game the home country may have to forfeit an income transfer, i.e. announce state a, even when state b occurs. Thus, it appears that the incentive to falsely announce the bad state and receive an income transfer will be moderated by its effect on revenue collected, and the subsequent need to transfer income abroad. The critical element in the choice of which state to announce is the probability α that after one false announcement is made (to receive income), another false announcement (giving income) must be made later in the game to achieve zero net revenue.

We would generally expect that $\alpha < 1$, but let us consider the case $\alpha = 1$.[11] If the home consumer falsely announces that state b occurs, a welfare gain of $U[h(z_b,a)] - U[h(z_a,a)]$ is obtained. If a false announcement of state a must be made later, a welfare loss of $U[h(z_b,b)] - U[h(z_a,b)]$ is obtained. This set of two false annoucements will be taken by the consumer if and only if,

$$U[h(z_b,a)] - U[h(z_a,a)] > U[h(z_b,b)] - U[h(z_a,b)] \ , \tag{11a}$$

or rewriting,

$$U[h(z_b,a)] + U[h(z_a,b)] > U[h(z_a,a)] + U[h(z_b,b)] \ . \tag{11b}$$

Note that whether the home country makes both false announcements or not, the utility obtained by the foreign country in those two periods would be unchanged at $U^*[h^*(-z_a)] + U^*[h^*(-z_b)]$.

We assert that in the first-best equilibrium (11) could never hold. The reason is that the right side of (11b) is the maximized value of expected utility with equally probable states, while the left side of (11b) is a feasible choice of trade bundles for the home consumer. Thus, in the first-best equilibrium the right side of (11b) must exceed the left. It follows that the home consumer would never wish to make the two false announcements. This means that the first-best equilibrium would always be incentive compatible. Such a strong result is obtained under the artificial assumption that $\alpha = 1$. More generally, with $0 < \alpha < 1$ in a multi-period model, we could expect that the first-best equilibrium is more likely to be incentive compatible than in the one-period model considered in this paper. Establishing such a result appears to be a useful area for further research.

Footnotes

1. We also assume that the feasible production set in the bad state of nature is contained within the feasible set in the good state. This assumption is needed to ensure that it is feasible for the home country to falsely announce that the bad state has occurred.

2. By assuming ex-post production decisions and a single consumer in each country we ensure that there is no need for contingent markets under autarky, in contrast to Newbery and Stiglitz (1982), Eaton and Grossman (1984) and Staiger and Tabellini (1986).

3. From (3) and (4) we have (A) $h_1(z_s,s)/h_2(z_s,s) = h_i^*(-z_s)/h_2^*(-z_s)$, and (B) $U'h_i(z_a,a)/U'h_i(z_b,b) = U^{*\prime}h_i^*(-z_a)/U^{*\prime}h_i^*(-z_b)$. (A) implies that $g_1(x_s)/g_2(x_s) = g_1(x_s^*)/g_2(x_s^*)$. Since g is homogenous of degree one its first derivatives can be written as functions of the ratios x_{1s}/x_{2s} and x_{1s}^*/x_{2s}^*. It follows that these ratios are equal and, therefore, $g_i(x_s) = g_i(x_s^*)$ for $i = 1,2$ and $s = a,b$. From (B) we have that $U'g_i(x_a)/U'g_i(x_b) = U^{*\prime}g_i(x_a^*)/U^{*\prime}g_i(x_b^*)$, and so (5) follows.

4. Newbery and Stiglitz (1982) argue that optimality in the model of Helpman and Razin (1978) depends on the multiplicative production uncertainty which is used.

5. Article XIX of the GATT states that if one country withdraws tariff concessions then the affected parties may withdraw "substantially equivalent concessions" (sec. 3.(a)), though it is unclear how the equivalence is to be judged.

6. An analogous result for labor contracts is obtained by Azariadis (1983, sec. II), when the firm is risk neutral. That result depends on consumption and leisure being perfect substitutes for the worker.

7. If the productivity shock helps one industry but harms the other, then label state a as the state where both countries have utility greater than or equal to state b, in the complete markets equilibrium. Recall that from (5) the utility levels of the countries must be positively correlated.

8. An analogous result for labor contracts in obtained By Azariadis (1983, sec. V) and Holmstrom and Hart (1985, sec. 4.3). That result is sensitive, however, to the relative risk aversion of firms and workers; see Azariadis and Stiglitz (1983, sec. V).

9. The Lagrangian is $L = \sum_s \pi_s U[h(z_s,s)] + \theta\{-U[h(z_b,a)] + U[h(z_a,a)]\} + \phi\{-\bar{U}^* + \sum_s U^*[h^*(-z_s)]\}$.

10. Findlay and Grubert (1959) analyse the types of production uncertainty which lead to output changes biased towards one good or the other.

11. Note that since we have assumed the states are equally probable, from (6) the revenue spent in one state would equal the revenue collected in the other. Thus, making two false announcements as we consider below would offset each other in their effect on net revenue.

References

Azariadis, C.: Employment with asymmetric information, Quarterly Journal of Economics 98, Supplement, 157-172, 1983.

Azariadis, C. and J. E. Stiglitz: Implicit contracts and fixed-price equilibria, Quarterly Journal of Economics 98, Supplement, 1-22, 1983.

Eaton, J. and G. M. Grossman: Tariffs as insurance: optimal commercial policy when domestic markets are incomplete, Canadian Journal of Economics, 1984.

Findlay, R. and H. Grubert: Factor intensities, technological progress and the terms of trade, Oxford Economic Papers, 111-121, 1959, reprinted as Chapter 20 in Jagdish N. Bhagwati, ed.: International Trade: Selected Readings. MIT Press, Cambridge, MA, 1981.

Helpman, E. and A. Razin: Welfare aspects of international trade in goods and securities, Quarterly Journal of Economics, 489-508, 1978.

Holmstom, B. and O. Hart: The theory of contracts, presented at the Fifth World Congress, Econometric Society, August 1985.

Newbery, D.M.G. and J.E. Stiglitz: The choice of techniques and the optimality of market equilibrium with rational expectations, Journal of Political Economy 90(2), 223-246, April 1982.

Rosen, S.: Implicit contracts, Journal of Economic Literature 23(3), 1144-1175, September 1985.

Staiger, R. and G. Tabellini: Discretionary trade policy and excessive protection, Stanford University, revised May 1986.

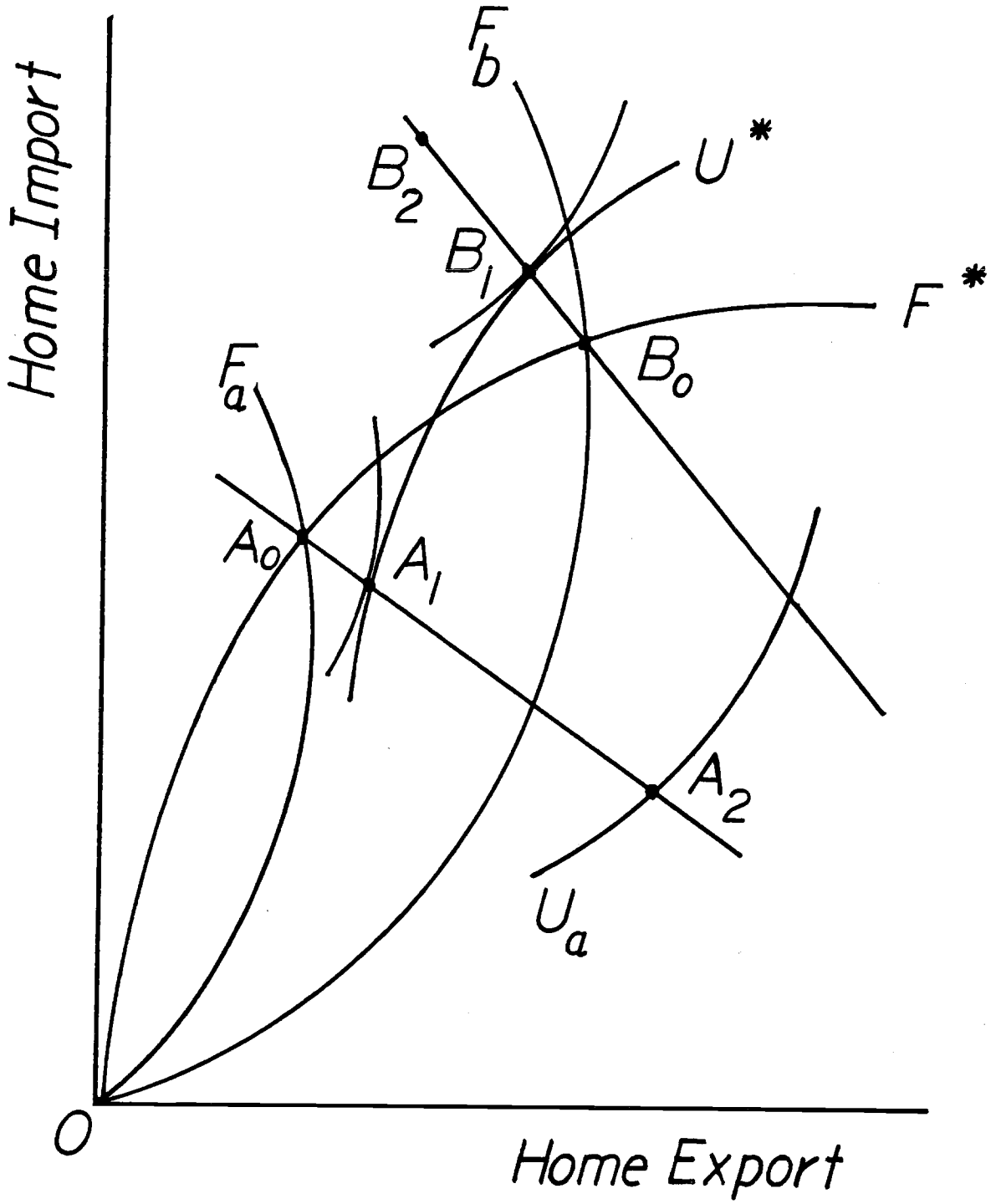

Figure 1

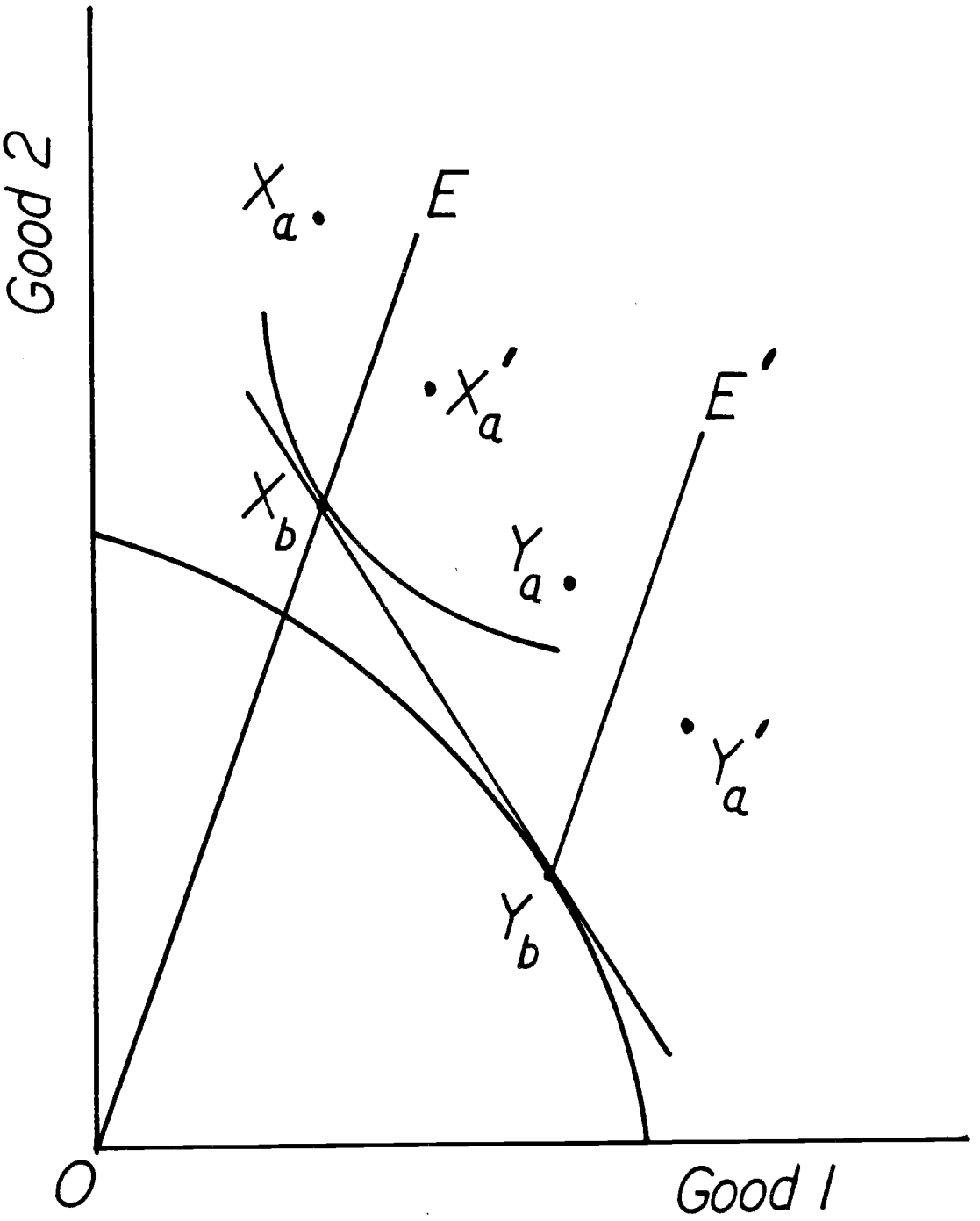

Figure 2

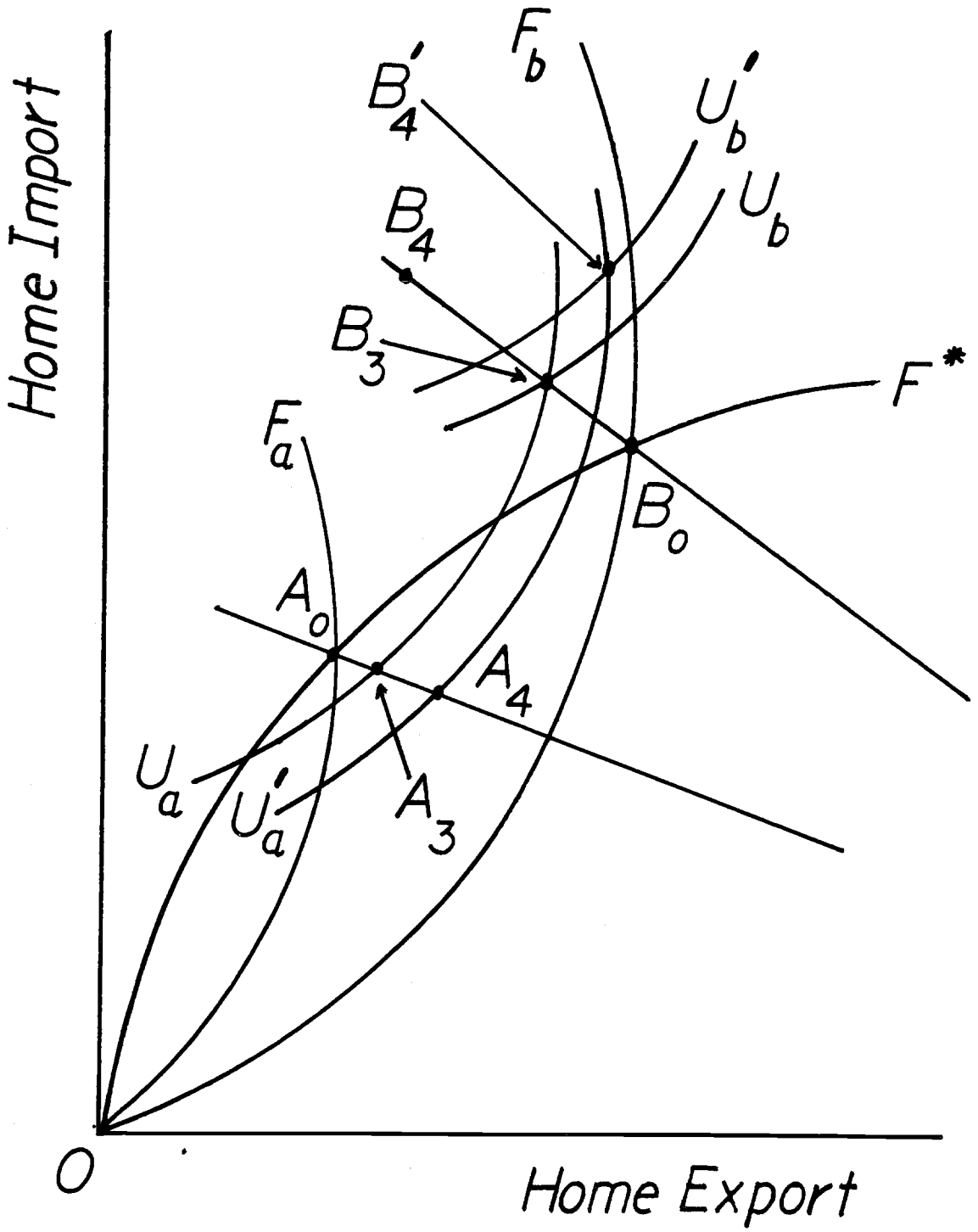

Figure 3