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Specific and Ad Valorem Tariffs are not Equivalent in Trade Wars*

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Specific and Ad Valorem Tariffs are not Equivalent

in Trade Wars

Abstract

This note argues that when two countries choose optimal tariffs in a trade war, specific tariffs are not equivalent to ad valorem tariffs even if all markets are competitive. In particular, it shows that if a country's trading partner switches from a specific tariff to an ad valorem tariff that yields the same revenue at the initial trade point, the former country has an incentive to lower its tariff. When two identical countries choose the types and magnitudes of tariffs in a two-stage game, they will choose ad valorem tariffs, making the trade war less severe.

Keywords: Equivalence between Specific and Ad Valorem Tariffs, Trade War

JEL Code: F11, F13

1. Introduction

The relationship between ad valorem and specific taxes have long been an issue in the literature on international trade and public finance. With competitive firms and consumers, ad valorem and specific taxes are equivalent for a closed economy or for an open economy facing a given foreign offer curve in the sense that given a domestic specific tax, an valorem tax can be found that will lead to the same resource allocation and the same per unit tax revenue. The equivalence between ad valorem and specific taxes breaks down, however, when either the domestic or foreign industries are not competitive. For an analysis, see de Meza (1979) or Stiglitz (1988: 434–435) for a closed economy, or see Helpman and Krugman (1989: 65–69) or Wong (1995: 527–528) for an open economy facing a foreign monopolist.[1] In all these cases, the monopolistic firm is not a price taker, and when a government switches from a specific tax to an ad valorem tax, the monopolistic firm has an incentive to change its production and the market price in such a way to lower its tax liability. Thus the two types of taxes have different implications on resource allocation and welfare.

It is tempting to assume that with competitive firms, the equivalence between specific and ad valorem taxes generalises to the case of optimal tariffs with retaliation (i.e., Nash equilibria in tariffs, or trade wars) between two (or more) countries, and conclude that the equilibrium in tariffs is independent of whether the two countries use specific or ad valorem import tariffs. It is the purpose of this note to show that such a generalisation is incorrect. The reason is as follows. A switch from a specific to ad valorem tariff by the foreign country will in general change the foreign country's offer curve, and hence the home country's optimal tariff per unit of the good. Specifically, we show that a switch from a specific to an ad valorem tariff by the foreign country that is constructed to yield the same revenue at the initial trade equilibrium will increase the slope of the foreign offer curve (the elasticity of foreign export supply) and so reduce the home country's optimal tariff. It is then possible to compare the outcome of trade wars with specific and ad valorem tariffs. We show that in the ad valorem case, at least one Nash equilibrium tariff is lower, and at least one country is strictly better off, than in the specific case.

The rest of this note is organised as follows. The model is briefly outlined in Section 2. In Section 3, the optimal response of the home country to foreign offer curves generated by ad valorem and specific foreign tariffs is analysed. Nash equilibrium in tariffs is analysed in Section 4,

and Section 5 concludes.

2. The Model

There are two countries labeled "home" and "foreign." They consume two tradable goods called 1 and 2, which are produced by competitive firms. Trade with negligible transport costs exists between the countries.[2] Without loss of generality, we assume that within the price ranges under consideration the home country exports good 1 and imports good 2. Let p_i (p_i^*), $i = 1, 2$, be the price of good i in the home (foreign) country. Both countries have convex technologies and preferences, although their technologies and preferences may be different. They may also have different factor endowments. The preferences of each country are assumed to be represented by a social utility function which is continuous, strictly increasing and quasi-concave. It is assumed that there are no domestic distortions in each country.

Trade between the countries is not free, as both governments are active in choosing the optimal tariff (import tax). Denote the ad valorem (specific) tariff imposed by the home government on the imported good 2 by τ (t). Similarly, the corresponding taxes imposed by the foreign government on imported good 1 are denoted by τ^* and t^*, respectively. Tariff revenue of each country, if positive, is distributed to the consumers in a lumpsum fashion. Each government chooses the optimal tariff, either at an ad valorem rate or of a specific rate, to maximize its social utility level while taking the policy of the other government as given. With offer curves strictly concave toward the origin, the Nash equilibrium occupies at a point at which both offer curves are positively sloped, i.e., the import demands at the Nash equilibrium of both countries are elastic.

3. The Optimal Response of the Home Government to Foreign Tariffs

Before the effects of these types of tariffs on the Nash equilibrium are compared, we first examine the response of the home government to an ad valorem or a specific tariff imposed by the foreign government. In this section, the foreign tariff policy is treated as a parameter. Suppose that the foreign government has chosen a non-prohibitive specific tariff (on good 1) of an arbitrary rate, t^*, under which the foreign offer curve is represented in Figure 1 by OC_s^*, where E_1 (M_2) is the home country's export of good 1 (import of good 2). The trade policy of the home government can now be considered. Let us suppose that it has chosen to impose a non-prohibitive specific tariff

(on good 2) of rate t, and let the resulting home offer curve cut OC_s^* at point T in Figure 1. In equilibrium the domestic and foreign prices are related by

$$p_1 + t^* = p_1^* \tag{1}$$

$$p_2 = p_2^* + t. \tag{2}$$

If the home government chooses an ad valorem tariff of τ instead, equation (2) is replaced by

$$p_2 = p_2^*(1 + \tau). \tag{2'}$$

If it is given that

$$t = p_2^* \tau, \tag{3}$$

then point T remains an equilibrium because all firms and consumers, which are price and income takers, will be facing the same prices and generate the same tariff revenue.

In the present paper, we are more interested in optimal tariffs. The optimal ad valorem tariff of the home country, which is denoted by $\widetilde{\tau}$, is equal to[3]

$$\widetilde{\tau} = \frac{1}{\varepsilon^*}, \tag{4}$$

where ε^* is the elasticity of foreign export supply (of good 2) evaluated at point T. Denote the prevailing home (foreign) price of good i by $\widetilde{p}_i$ ($\widetilde{p}_i^*$). The optimal specific tariff rate of the home country is equal to

$$\widetilde{t} = \widetilde{\tau}\widetilde{p}_2^* = \frac{\widetilde{p}_2^*}{\varepsilon^*}. \tag{5}$$

Note that *either* an ad valorem tariff of $\widetilde{\tau}$ *or* a specific tariff of $\widetilde{t}$ will yield the same maximum welfare to the home country when given the foreign offer curve OC_s^*.

The optimal ad valorem tariff with elastic foreign import demand can be illustrated in Figure 2. Schedule τ shows the dependence of the export level of the home economy when facing a given foreign offer curve. This schedule is downward sloping due to the fact that a higher tariff dampens trade. Schedule $1/\varepsilon^*$ shows how the reciprocal of foreign export supply elasticity varies with the economy's import. It is well known that a country's import demand elasticity, and thus its export

supply elasticity, increase with its import level.[4] This means that schedule $1/\varepsilon^*$ is positively sloped. The optimal tariff occurs at the intersecting point between the two schedules, point G.

So far, we have been assuming that the foreign government has chosen a fixed specific tariff. Suppose that it chooses instead an ad valorem tariff equal to

$$\tau^* = t^*/\widetilde{p}_1. \tag{6}$$

It is clear that if the home government does not alter its policy, point T will remain an equilibrium, and these two policies of the foreign government will generate the same tariff revenue for either government.

The important question is of course whether the home goverment would choose to alter its policy in response to the switch of the foreign tariff from specific to ad valorem. To answer this question, let us first examine how this new foreign trade policy may affect the offer curve that the home government faces.

Proposition 1. Given an elastic import demand, a switch of the foreign policy from a non-prohibitive specific tariff to an ad valorem tariff that yields the same tariff revenue at the original trade equilibrium will increase the elasticity of foreign export supply.

Proof. Let the initial foreign offer curve under an arbitrary, non-prohibitive, specific tariff t^* be represented by curve OC_s^* in Figure 3. Since we want to examine how a change in the type of tariff may affect the foreign offer curve, imagine for the moment that the foreign country is a small open economy, facing exogenously given world prices. (This is how an offer curve is derived in a trade textbook.) Denote the prevailing world price line by line P in Figure 3. This means that the equilibrium is at point T at which line P cuts OC_s^*.

Suppose now that the foreign government imposes instead an ad valorem tariff of rate τ^* that is related to t^* as given by (6). As explained earlier, under given world prices, ad valorem tariffs and specific tariffs are equivalent, implying that the foreign country's equilibrium remains unchanged at point T. In other words, the new foreign offer curve under an ad valorem tariff, denoted by OC_a^*, must also pass through point T.

To compare the elasticities of the two offer curves at point T, suppose that there is a small change in the world prices. Specifically, assume that there is a small drop in the relative price of

good 1. In terms of Figure 3, this is represented by a clockwise rotation of the world price line. Denote the new price line by P′, and let it cut the foreign specific-tariff offer curve, OC_s^*, at point S. We want to compare this point with the intersection point, denoted by point R, between line P′ and the foreign ad-valorem-tariff offer curve, OC_a^*.

Since points S and T are on the same foreign specific-tariff offer curve, they represent the same specific tariff rate, t^*. However, because point S is associated with a lower relative world price of good 1, equation (6) implies that the corresponding ad valorem tariff rate, denoted by $\tau^{*\prime}$, is greater than the ad valorem tariff rate τ^* that corresponds to point T, i.e., $\tau^{*\prime} > \tau^*$. This means that there is one ad-valorem-tariff offer curve at rate τ^* that passes through point T and another one at rate $\tau^{*\prime}$ (not shown in Figure 3) that passes through point S. How can these two curves compared? We know that for this small, open economy, a non-prohibitive tariff with a higher (ad valorem or specific) rate leads to a smaller volume of trade. Thus the ad-valorem-tariff offer curve at rate τ^* is higher and further away from the origin (with a larger volume of trade) than that at rate $\tau^{*\prime}$. This implies that point R is above point S, both being on the same world price line P′. Combining the above arguments, we conclude that the foreign ad-valorem-tariff offer curve, OC_a^*, is steeper than the corresponding specific-tariff offer curve, OC_s^*, at point T. A steeper foreign offer curve thus implies a more elastic foreign import demand, and, with an elastic import demand, a more elastic foreign export supply.[5] □

The economic intuition behind Proposition 1 is simple. Suppose that the foreign country, facing exogenously given world prices, is currently imposing a non-prohibitive specific tariff. Let there be a drop in the relative price of its importable, good 1. At the given specific tariff, this encourages it to import. Now suppose that before the drop in the relative price the foreign country instead imposes an ad valorem tariff of the same tariff revenue. The drop in the relative price of the importable also encourages the country's import. However, if the ad valorem rate is fixed, condition (6) implies that in this case the country is facing two effects: the original drop in the relative price of the importable and a corresponding drop in the specific tariff rate. This means that the import demand responds more to a drop in its relative price under a fixed ad valorem tariff than under a fixed specific tariff. If the import demand is elastic, then the corresponding export supply is also

more elastic under an ad valorem tariff than under a specific tariff.

Proposition 1 has an important implication, as stated in the following proposition:

Proposition 2. Suppose that the home country is pursuing an optimal tariff policy, using either an ad valorem or a specific tariff while taking the foreign tariff as given. If the foreign country switches from a specific tariff to an ad valorem one that would yield the same revenue to the foreign government at the initial trade point, the home country will lower its tariff and reach a higher level of welfare.

Proof. Suppose that initially the foreign country is using a specific tariff policy and that the home country is under an ad valorem tariff regime. The home country's optimal tariff can be derived using condition (4), as illustrated in Figure 2, and can be denoted by $\widetilde{\tau} = 1/\varepsilon^*$. Suppose now that the foreign country switches to an ad valorem tariff with the same tariff revenue at the initial trading point generated. By Proposition 1, ε^* at the original trading equilibrium increases. In terms of Figure 2, this means a downward shift of schedule $1/\varepsilon^*$ to, say, schedule $1/\varepsilon^{*\prime}$. On the other hand, Figure 3 shows that as the foreign country switches its tariff policy, its offer curve shifts from CS_s^* to OC_a^*, so that for trading points on the RHS (LHS) of point T and for any given domestic tariff, OC_a^* leads to a higher (lower) export level of the home country. In terms of Figuere 2, this means that schedule τ shifts to schedule τ', which is negatively sloped and cuts schedule τ at point G. The new optimal point is at G$'$, implying a lower optimal tariff rate for the home country. To determine the change in home welfare, note that if the home country does not change its ad valorem tariff rate, the trading equilibrium stays unchanged and so does the home welfare. That the home country chooses to lower its ad valorem tariff means that it can achieve a higher utility. If the home country is initially under a specific tariff regime, the above argument is still applicable. □

The intuition behind Proposition 2 can be explained using Figure 3. When given the foreign offer curve OC_s^* under a fixed foreign specific tariff, the optimal point for the home country is at point T at which the home trade indifference curve $\widetilde{u}$ is tangent to OC_s^*. When the foreign government switches to an ad valorem tariff that produces the same tariff revenue at the original

point, the foreign offer curve shifts to OC_a^* which is steeper than OC_s^* at point T. The optimal point for the home country is now at point T′, at which a higher trade indifference curve is tangent to OC_a^*.

When the home country lowers its tariff in response to a switch of the foreign policy from a specific tariff to an ad valorem tariff, foreign welfare is affected. The welfare effects on the foreign country can be analyzed in terms of its terms of trade. Lerner (1936) showed that in the normal case, a decrease in the home country's tariff will cause a deterioration of this country's external terms of trade.[6] If the initial home tariff is an optimal one when given a foreign specific tariff, then a decrease in the home tariff must cause a deterioration of the home country's external terms of trade, or equivalently, an improvement in the foreign country's external terms of trade.[7] Thus in the absence of Lerner's case or when the home country initially has an optimal tariff, the foreign country can benefit from a reduction in the home tariff per unit.[8]

4. Trade Wars

We now turn to the analysis of a trade war in which both countries are choosing optimal tariffs. Figure 4 shows the reaction curves of both countries, depending on whether they choose ad valorem or specific tariff rates. In order to put the reaction curves in the same diagram, we let the axes represent the countries' tariffs per unit of the appropriate good.

In Figure 4, H_sH_s (H_aH_a) is the reaction curve of the home country, assumed to be negatively sloped, when *the foreign country* is imposing a specific tariff (an ad valorem tariff of the same revenue at any given trade point). By Proposition 2, curve H_aH_a is on the left hand side of curve H_sH_s. Similarly, F_sF_s (F_aF_a) is the reaction curve of the foreign country when *the home country* is imposing a specific tariff (an ad valorem tariff of the same revenue at any given trade point). Again by Proposition 2, curve F_aF_a is below curve F_sF_s. By making use of these reaction curves, it is easy to see that if both countries use specific (ad valorem) tariffs, the Nash equilibrium is at point S (A).

Proposition 3. Suppose that both countries switch from specific tariffs to ad valorem tariffs. Then in a Nash equilibrium in tariffs, at least one of the countries' tariff per unit is lower, and the country(ies) that experiences a drop in the tariff per unit imposed by its trading partner has a

higher welfare.

Proof. By the above argument, when both countries choose ad valorem tariffs instead of specific tariffs, their reaction curves shift to the left and downward. Therefore at least one of the countries must experience a drop in the tariff per unit imposed by its trading partner. As argued earlier, the country that experiences a drop in the tariff on its exportable has an improvement in welfare. □

Collorary: In the symmetric case with two identical countries, both countries' Nash equilibrium tariffs per unit are lower and their welfare higher if they use ad valorem tariffs instead of specific tariffs.

Figure 4 and Proposition 3 can be used to determine what type of tariff each country will choose in a trade war. Two games can be examined. Consider first a two-stage game: in the first stage, both countries determine what types of tariffs, but not their magnitudes, they will impose, and in the second stage, they determine the optimal magnitudes of the tariffs. It is assumed that their decisions in the first stage are irreversible and that in making the decisions in the first stage they are aware of what they will choose in the second stage.

Figure 4 shows the Nash equilibria when the countries choose different types of tariffs. For example, if the home country chooses a specific tariff and the foreign country chooses an ad valorem tariff, the Nash equilibrium is at point X. As explained earlier, if both countries choose the type of tariff and the magnitude of the tariff in two separate stages, an ad valorem tariff dominates a specific tariff for both countries. This thus implies that the Nash equilibrium of the game is for both of them to impose an ad valorem tariff, with the magnitudes represented by point A in Figure 4.

We next consider a one-stage game in which both countries choose both the type and magnitude of tariff simultaneously. In this game, all the four intersecting points in Figure 4, A, S, X and Y are Nash equilibria. The reason is that if a country takes the type and magnitude of tariff imposed by the other country as given, it is indifferent between a specific tariff and an ad valorem tariff of the same revenue at the initial trade point. For example, if the home country chooses a specific tariff and the foreign country chooses an ad valorem tariff, both of the magnitudes represented by

point X, then point X is a Nash equilibrium of this game. At this point and while taking the home policy as given, the foreign country has no incentive to change the magnitude of its tariff, or to switch to a specific tariff. Similarly, the home country has no incentive to change its policy.

5. Concluding Remarks

We have shown that while for a country facing a fixed foreign offer curve either specific or ad valorem tariffs can be used to achieve the same optimal point, the switch from a specific tariff to an ad valorem tariff by the foreign country shifts the latter country's offer curve. Such shift in the foreign offer curve gives an incentive to the home country to lower its per unit tariff and the effective trade restriction imposed by the foreign country. As a result, the home country reaches a higher welfare level. This result implies that in a trade war in which both countries are imposing the optimal tariff, the trade restriction is less severe if both countries are using ad valorem tariffs instead of specific tariffs.

Our result that specific and ad valorem tariffs are not equivalent even when industries are competitive may seem to be contradictory to the common belief that with competitive industries specific taxes are equivalent to ad valorem taxes, but the contradiction is only apparent. In the presence of a trade war, the tariffs are set by the governments, and neither of them is a price taker. Thus when a country switches from a specific tariff to an ad valorem tariff, the other country will want to affect the external terms of trade in such a way to lower the effective trade restriction that its exports are subject to. In the present framework, lowering its own per unit tariff implies a less severe effective trade restriction. This means that in a trade war in which the countries are committed to using ad valorem instead of specific tariffs, at least one of the countries is better off.[9]

Our results are related to Tower (1975), who shows that a Nash equilibrium with at least one country using either import or export quota as the strategic instrument is autarky. For example, suppose that in Figure 3 the foreign country had as its trade instrument a quota on its exports, E_2^* of size equal to the vertical distance from the horizontal axis to point T. Then, to the right of T, its offer curve would be horizontal. Alternatively, if it had a quota on its import, M_1^* of size T its offer curve would go from the origin to point T and then drop vertically. Thus, a specific tax is closer to a quota than an ad valorem tax; so we should expect that a Nash equilibrium in specific taxes brings us closer to no trade than equilibrium in specific taxes, which is exactly what we find.

Tower's result and the result obtained in this paper thus show that quotas, specific tariffs, and ad valorem tariffs are all non-equivalent in a trade war.

On the implementation side, specific tariffs usually have lower administrative and enforcement costs associated with them, and are particularly popular in some countries where the costs of implementing ad valorem tariffs are high. Our results indicate that there may be a trade-off between administrative savings on specific tariffs and welfare losses due to the high levels of the ad valorem tariffs in a non-cooperative Nash equilibrium.

The choice between specific and ad valorem tariffs also exists in a political-economy context.[10] Because in a trade war countries using ad valorem tariffs tend to impose less severe trade restrictions, consumers usually prefer ad valorem tariffs while producers in the protected industries would prefer specific tariffs. Therefore which type of protection a country chooses may depend on whether the consumer groups or producer groups are stronger in the political system in which trade policies are determined.

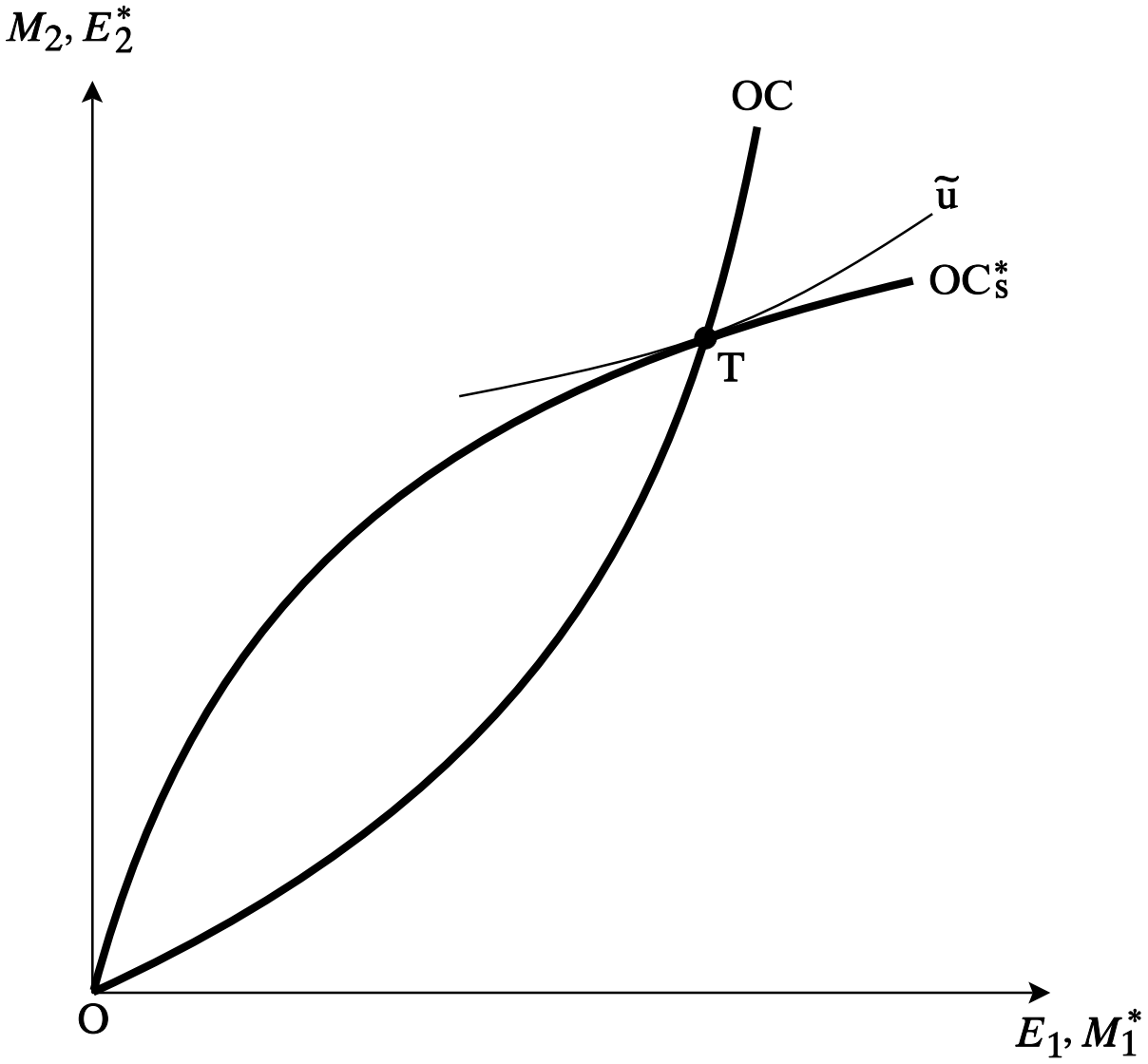

Figure 1

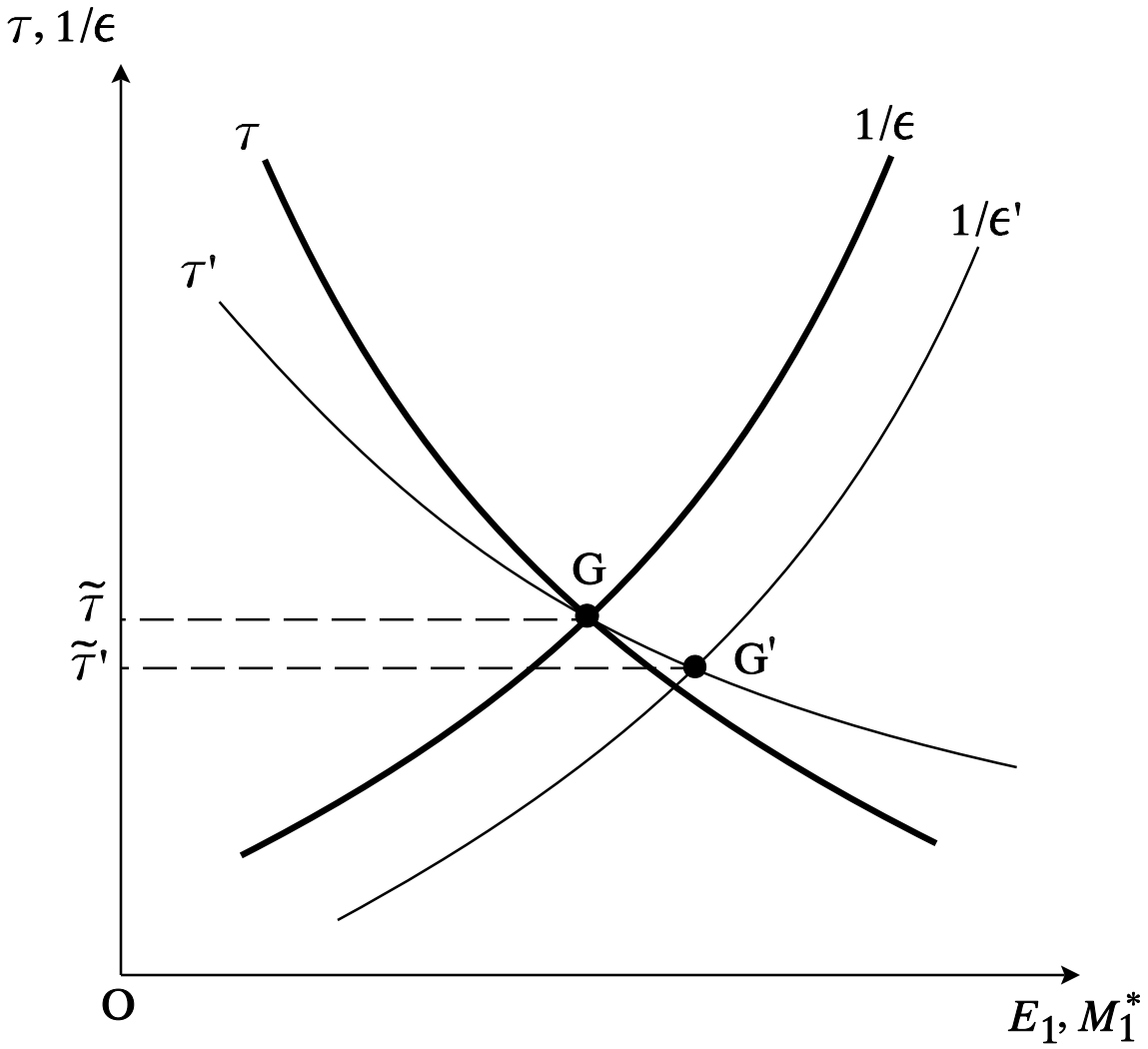
$\tau, 1/\epsilon$
τ
$1/\epsilon$
$1/\epsilon'$
τ'
G
$\tilde{\tau}$
$\tilde{\tau}'$
G'
O
E_1, M_1^*

Figure 2

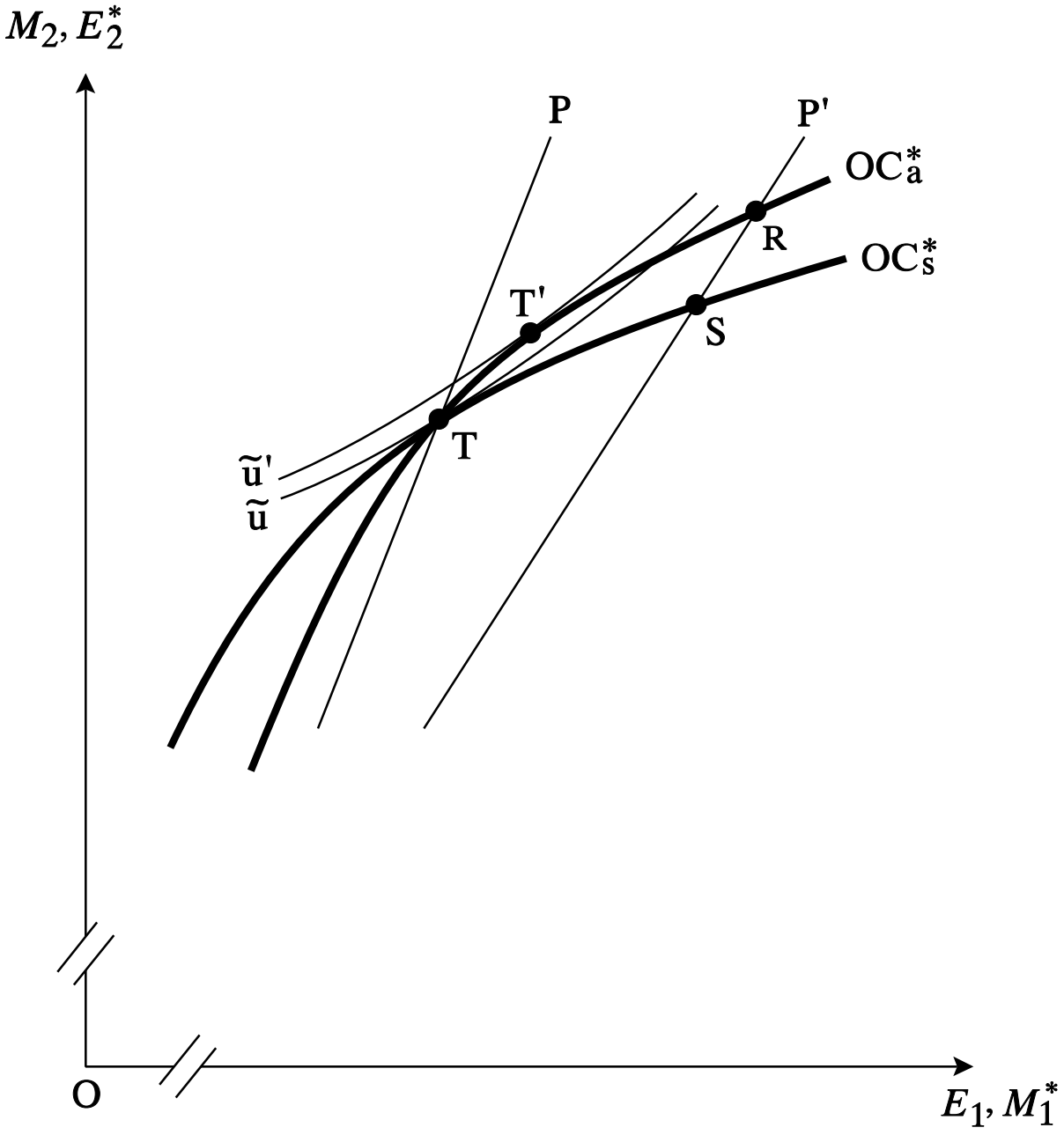

Figure 3

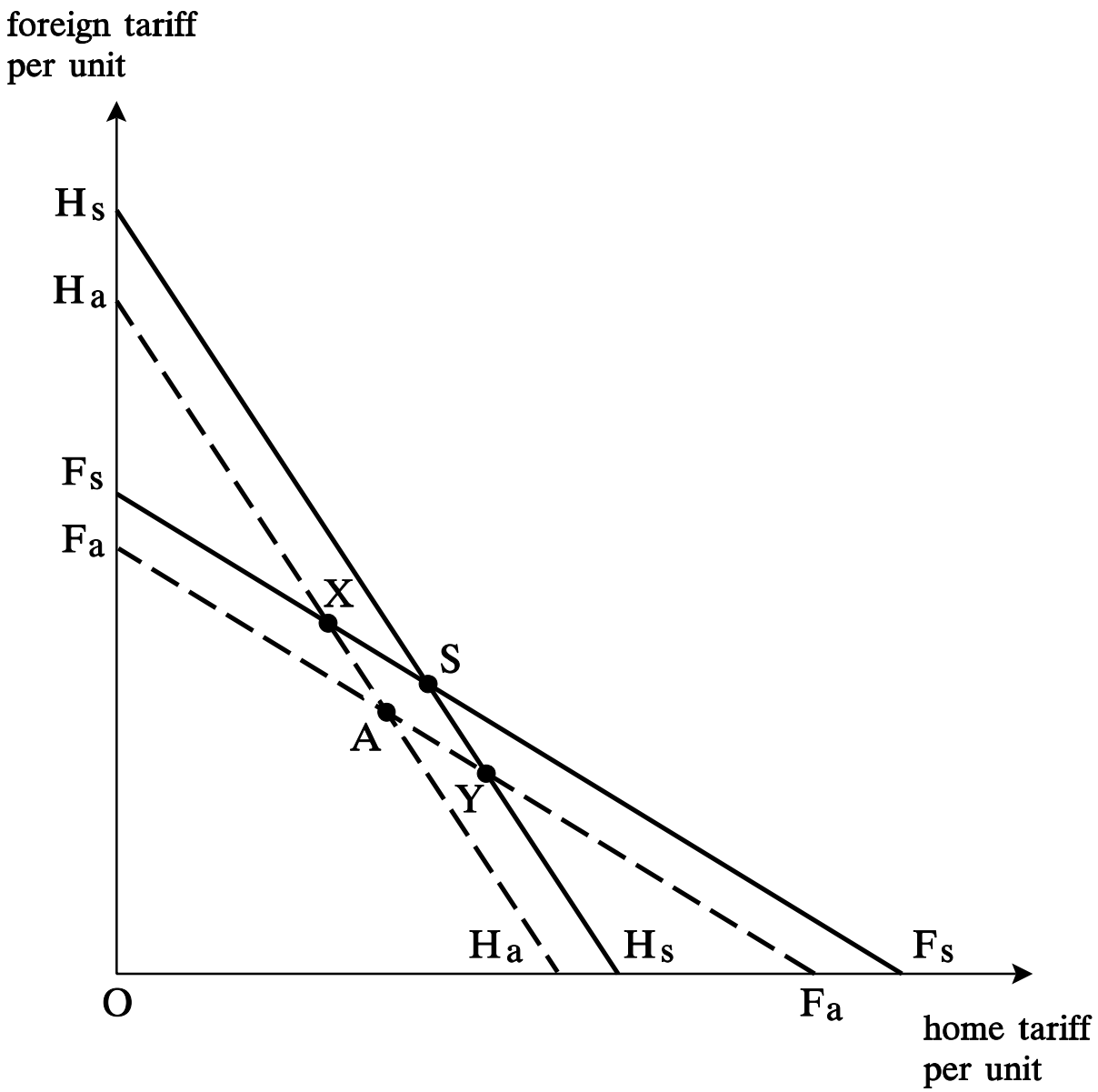
foreign tariff
per unit
Hs
Ha
Fs
Fa
X
S
A
Y
Ha
Hs
Fs
O
Fa
home tariff
per unit

Figure 4

FOOTNOTES

1. Recently, Hwang, Miyagiwa and Wong (1997) provide another example of non-equivalence between specific and ad valorem subsidies: When the local government is subject to a binding budget constraint, a specific export subsidy is superior to an ad valorem export subsidy in shifting the profit of the foreign firm to the domestic firm when the firms compete in a Cournot way in a third market.
2. The assumption of negligible transport costs is made for convenience. The results in this paper hold even if transport costs are positive but less than prohibitive.
3. For the formulars of the optimal tariff rates given in (4) and (5), see, for example, Wong (1995: 486–487).
4. For the relationship between import demand elasticity and export/import levels, see, for example, Appleyard and Field (1995: 108). For the relationship between import demand elasticity and export supply elasticity, see, for example, Wong (1995: 80).
5. With a balanced trade the elasticity of foreign export supply is equal to

$$\begin{aligned} \varepsilon^* &= \frac{p^w}{E_2^*}\frac{\mathrm{d}E_2^*}{\mathrm{d}p^w} \\ &= \frac{M_1^*}{E_2^*(\mathrm{d}M_1^*/\mathrm{d}E_2^*) - M_1^*}, \end{aligned} \tag{7}$$

   where p^w is the world relative price of good 2 (inclusive of the home tariff) that the foreign country faces. With a balanced trade, $p^w E_2^* = M_1^*$. In (7), $\mathrm{d}M_1^*/\mathrm{d}E_2^*$ is the reciprocal of the slope of the foreign offer curve. As the foreign offer curve becomes steeper, ε^* increases.
6. In the present framework, the world's relative price of good 1 is p_1/p_2^*, which is the home country's external terms of trade and the reciprocal of the foreign country's external terms of trade. For an analysis of Lerner's case, see Chacholiades (1978: 470–473).
7. The reason is that when given a foreign tariff, the source of gain for the home country from a trade restriction is an improvement in its external terms of trade.
8. For a tariff-ridden, small economy, an improvement in its external terms of trade may deteriorate its welfare, but another equilibrium with a higher welfare than the initial one can always be found. For more discussion, see Kemp (1969: 268–270). With the existence of a social utility function, Kemp's argument does not depend on the size of the country.

9. It is interesting to point out that the present argument in favor of ad valorem tariffs is not the same as that for the use of an ad valorem tariff by a country that imports a good produced by a monopolist in a foreign country (Helpman and Krugman, 1989: 65–69 and Wong, 1995: 527–528). In the present case, a country gains with an optimal tariff as its trading partner chooses an ad valorem tariff instead of a specific tariff, while in the Helpman-Krugman-Wong argument, an importing country chooses an ad valorem instead of a specific tariff in order to capture a higher share of the monopoly rent and to induce the monopolist to export more.
10. We are grateful to an anonymous referee for suggesting this point to us.

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