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Optimal Foreign Aid and Tariffs*

By

Sajal Lahiri [a], Pascalis Raimondos-Møller [b], Kar-yiu Wong [c†],

and Alan D. Woodland [d]

Abstract

This paper investigates the optimal choice of foreign aid when trade policies are decided in a non-cooperative fashion. Three alternative scenarios, depending on the timing of the actions, and on whether aid is tied, are analyzed. It is shown that, in the case where aid is decided before tariffs, untied aid can lead to the reduction of the recipient's optimal trade tax. This opens up the possibility that optimal aid is positive and that the world achieves a Pareto-efficient equilibrium. When the donor can tie the aid to a reduction in the recipient's tariff, the optimal aid level is always positive, and the world can always achieve a Pareto-efficient equilibrium.

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[a] University of Essex, Colchester CO4 3SQ, U.K. (lahiri@essex.ac.uk)
[b] Copenhagen Business School, Denmark; EPRU and CEPR (prm.eco@cbs.dk)
[c] University of Washington, Seattle, WA 98195-3330, U.S.A. (karyiu@u.washington.edu)
[d] University of Sydney, NSW 2006, Australia (A.Woodland@econ.usyd.edu.au)
[†] Corresponding author.

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1 Introduction

The study of international income transfers has received a great deal of attention in the theory of international trade.[1] One major issue about income transfers is how they affect the welfare levels of the donor and recipient countries.[2] The existing literature on income transfers is characterized by three main assumptions (or, limitations). First, trade policies of both countries are assumed to be given exogenously.[3] Second, the donor and the recipient countries do not behave optimally with respect to the transfer, i.e. the transfer is exogenously given. Third, when transfers are assumed to be part of a contract that ties the use of aid to some policy variables, the details of such contracts are not optimally chosen by the donor country. In other words, the tying rule is exogenous.[4] All these assumptions restrict the applicability of the existing literature. Even though altruism and politics are two important rationales for giving aid, there is evidence that in many cases economic self-interest is a major reason for income transfers.[5] In this sense, the existing literature is not well equipped for analyzing why some countries give aid, why some countries receive aid, and how the amounts of aid and the tying rules are chosen.

The purpose of the present paper is to relax the above three assumptions, viz. the exogeneity of trade taxes, transfers, and the tying rule, and to analyze the

[1] The terms income transfers and foreign aid are used throughout this paper interchangeably.

[2] One interesting result is the so-called transfer paradox. Early work by Samuelson (1954) was followed by demonstrations of paradoxes by Gale (1974), Ohyama (1974), Brecher and Bhagwati (1982), Bhagwati, Brecher and Hatta (1983), Turunen-Red and Woodland (1988), and Kemp and Wong (1993), among others. Some of the early literature is reviewed by Bhagwati, Brecher and Hatta (1984); a more recent survey is provided by Kemp (1992).

[3] A possible exception in the literature is the paper by Bhagwati, Brecher and Hatta (1985), who consider transfers in a model in which the tariff is influenced endogenously by rent-seeking, lobbying activities.

[4] In the literature of tied aid, typically aid is tied to the recipient country's expenditure, not to the country's trade policy (see, for example, Kemp and Kojima, 1985; Schweinberger, 1990; and Hatzipanayotou and Michael, 1995). Two exceptions are Lahiri and Raimondos (1995) and Lahiri and Raimondos-Møller (1997a), who examine the welfare effects of aid tied to the reform of exogenously given quotas and tariffs, respectively.

[5] Economic motivation for donation is well documented in the literature. See, for example, United States General Accounting Office (1995).

welfare implications of transfers in a welfare maximizing context where the trade policies of both countries, along with the amount of aid, are endogenously determined.

We begin with the fundamental premise: since making and receiving donations are voluntary actions, a country will not give aid unless it gains in the sense of attaining higher welfare, and a country will not receive aid if it is harmful to that country. In other words, if foreign aid is observed, it must be beneficial to both countries. This premise sets this paper apart from the existing static literature on the transfer paradox.[6]

Another feature of the present paper is that it analyzes how aid is chosen optimally, subject to the constraint that neither the donor nor the recipient country is hurt. In particular, we try to analyze the choice of aid in a strategic policy context in which the actions of both countries are taken into account. For example, in some cases, the trade policies of the countries are determined in a Nash fashion. Thus one major objective of this paper is to find out whether a Pareto-improving aid can be found in a strategic policy environment. Our answer is in the affirmative.

Following the formulation of the model (section 2) that consists of two countries engaged in trade with perfectly competitive industries, we consider three alternative policy games. Section 3 deals with the first policy game in which both countries' governments choose their trade taxes and aid simultaneously in a non-cooperative Nash fashion. It is shown that it is never optimal for the country to give any aid. In section 4, we consider a two-stage game in which the trade taxes are chosen at the second stage, given the first-stage choice of aid. In this game, aid affects the Nash tariff equilibrium and thus opens up the possibility for strategic effects.[7] We will show that this strategic effect can have a positive influence on the donor's welfare and thus

[6]Inclusion of dynamic aspects of foreign aid does open up the possibility of strict Pareto improvements; see Galor and Polemarchakis (1987) and Djajić et.al. (1999).

[7]Lahiri and Raimondos-Møller (1997b) also examine the strategic effect of foreign aid on recipient countries' optimal trade policy. There, however, the amount of aid is fixed and there are two recipient countries that compete for aid.

it may pay the potential donor to offer aid. The third game, covered in section 5, suggests a case in which the donor offers *tied* aid to the recipient country under the condition that the latter modifies its trade policy in a predetermined way. In this case, there will always exists a feasible tying rule for aid that will benefit both countries within a non-cooperative game context.

We take our results to suggest an important, primary role for international income transfers as a lever for the encouragement of tariff reforms in the world economy. This is in contrast to most of the existing literature that provides transfers with a secondary role of accommodating tariff reforms.[8] In this respect, our paper supports the argument for international income transfers as a primary policy instrument as developed by Kowalczyk and Sjöström (1994, 1998).

2 The Basic Framework

There are two countries labeled donor (α) and recipient (β), and two tradable goods, 1 and 2. All product and factor markets are assumed to be perfectly competitive. Both countries have convex technologies and preferences, but their technologies, preferences, and factor endowments may be different. Without loss of generality, good 1 is chosen as the numeraire, and p denotes the international relative price of good 2.

Both countries are active in choosing trade policies. The specific trade tax imposed by country i on good 2 is denoted by t^i, $i = \alpha, \beta$. A positive t^i is interpreted as a tax if good 2 is imported and as a subsidy if good 2 is exported, with the opposite interpretation if t^i is negative. Country α, the donor, gives aid of $T \geq 0$ to country β, the recipient, in terms of good 1, the numeraire good.

[8]See, for example, Turunen-Red and Woodland (1991) who prove the existence of a variety of Pareto-improving multilateral tariff reforms assuming that accompanying international income transfers are possible.

We denote the revenue and expenditure functions of country i by $r^i(1, p + t^i)$ and $e^i(1, p + t^i, u^i)$, respectively, where u^i is the social utility level, and $p + t^i$ is the domestic relative price of good 2. The trade expenditure function of country i is defined as $E^i(1, p + t^i, u^i) \equiv e^i(1, p + t^i, u^i) - r^i(1, p + t^i)$. The (compensated) import demand function for good 2 in country i is equal to $m^i(1, p+t^i, u^i) = E^i_p(1, p+t^i, u^i) \equiv \partial E^i/\partial(p+t^i)$. We assume that the trade expenditure of each country is strictly concave in the price of the non-numeraire good p, implying that $E^i_{pp} \equiv \partial^2 E^i/\partial(p + t^i)^2 < 0$.[9]

Assuming that the entire trade tax revenue and foreign aid is distributed to the consumers in a lump-sum fashion, we can write the national budget constraints of the countries as:

$$E^\alpha(1,\ p + t^\alpha,\ u^\alpha) \ = \ -T + t^\alpha m^\alpha, \tag{1}$$

$$E^\beta(1,\ p + t^\beta,\ u^\beta) \ = \ T + t^\beta m^\beta. \tag{2}$$

The model is completed with the equilibrium condition for the world market of the non-numeraire good:[10]

$$m^\alpha(1, p + t^\alpha, u^\alpha) \ + \ m^\beta(1, p + t^\beta, u^\beta) = 0. \tag{3}$$

Given the policy instruments (the tariff rates t^α and t^β and the income transfer T) equations (1)–(3) determine the equilibrium price ratio, p, and the countries' utility levels, u^α and u^β. Accordingly, the welfare levels of the two countries can be expressed as reduced-form functions of the aid and the tariff rates: $u^i = u^i(T, t^\alpha, t^\beta)$, $i = \alpha, \beta$.

Totally differentiating (1)–(3) we get the dependence of the welfare of the coun-

[9] The revenue function is convex, and the expenditure function concave, in commodity prices, implying that the trade expenditure function is concave in commodity prices. Hence the Hessian matrix of the trade expenditure function is negative semidefinite. To facilitate the comparative static exercises in the present paper, we make a slightly stronger assumption that $E_{pp} < 0$, i.e. the compensated demand for each good declines with its own price. See Dixit and Norman (1980), Woodland (1982) and Wong (1995) for textbook expositions of duality in trade theory.

[10] The world market clearing equation for the numeraire commodity has been omitted due to Walras's law.

tries on the various policy parameters:

$$\widetilde{Z}\ E_u^\alpha\ du^\alpha \quad = \quad -A\ dT + BE_{pp}^\alpha dt^\alpha + (m^\alpha - t^\alpha E_{pp}^\alpha)E_{pp}^\beta dt^\beta, \tag{4}$$

$$\widetilde{Z}\ E_u^\beta\ du^\beta \quad = \quad C\ dT + DE_{pp}^\beta dt^\beta + (m^\beta - t^\beta E_{pp}^\beta)E_{pp}^\alpha dt^\alpha, \tag{5}$$

where

$$\begin{aligned}
A &= E_{pp}^\beta + E_{pp}^\alpha[1 - (t^\beta - t^\alpha)c_y^\beta], \\
B &= m^\alpha(1 - t^\beta c_y^\beta) + t^\alpha(E_{pp}^\beta - m^\beta c_y^\beta), \\
C &= E_{pp}^\alpha + E_{pp}^\beta[1 - (t^\alpha - t^\beta)c_y^\alpha], \\
D &= m^\beta(1 - t^\alpha c_y^\alpha) + t^\beta(E_{pp}^\alpha - m^\alpha c_y^\alpha), \\
\widetilde{Z} &\equiv Z(1 - t^\alpha c_y^\alpha)(1 - t^\beta c_y^\beta), \\
Z &= \frac{E_{pp}^\alpha - m^\alpha c_y^\alpha}{1 - t^\alpha c_y^\alpha} + \frac{E_{pp}^\beta - m^\beta c_y^\beta}{1 - t^\beta c_y^\beta}.
\end{aligned}$$

The slope of the uncompensated world excess demand function is Z. For the system to be Walrasian stable this slope needs to be negative, i.e. $Z < 0$, an assumption we make throughout the paper. The marginal propensity to consume the non-numeraire good is $(p + t^i)c_y^i$, where $c_y^i \equiv E_{pu}^i / E_u^i$, and the Hatta normality condition (which is always satisfied when both goods are normal) implies $1 - t^i c_y^i > 0$, for $i = \alpha, \beta$. Thus, normality in consumption and Walrasian stability together imply that $\widetilde{Z} < 0$.

To set up a benchmark for the analysis below, let us for the time being assume that the level of aid is arbitrarily given and that the two countries choose their optimal tariff rates in a non-cooperative way: each country chooses its tariff optimally, taking the tariff of the other country as given. In this benchmark model, which is usually characterized in the literature as a trade war between two countries, the tariff rates are determined as solutions to the first-order optimality conditions $B = 0$ and $D = 0$

(for countries α and β, respectively). In other words, the optimal tariff rates solve

$$B = m^{\alpha}(1 - t^{\beta}c_y^{\beta}) + t^{\alpha}(E_{pp}^{\beta} - m^{\beta}c_y^{\beta}) = 0, \tag{6}$$

$$D = m^{\beta}(1 - t^{\alpha}c_y^{\alpha}) + t^{\beta}(E_{pp}^{\alpha} - m^{\alpha}c_y^{\alpha}) = 0, \tag{7}$$

which can be interpreted as the implicit tariff reaction functions of the two countries. For a given transfer T, equations (1)–(3), (6) and (7) can be solved for the two Nash equilibrium tariff rates, which are denoted by $\widetilde{t^i} = \widetilde{t^i}(T)$, $i = \alpha, \beta$. Under the assumed normality of preferences, we can readily establish from (6) and (7) that: $\text{sign}(\widetilde{t^i}) = \text{sign}(m^i)$.[11] Thus, as well known in the literature, if a country exports the non-numeraire good, i.e. if $m^i < 0$, its optimal policy is an export tax, $\widetilde{t^i} < 0$. Conversely, if a country imports the non-numeraire good, i.e. if $m^i > 0$, its optimal policy is an import duty, $\widetilde{t^i} > 0$.

3 Optimal Foreign Aid in a One-Shot Game

In the rest of this paper, we relax the assumption in the above benchmark, namely, the arbitrarily given level of aid. We consider three alternative games in which the level of aid is determined optimally by the donor country. In the present section, the game being considered is one in which both countries choose their optimal trade taxes and the amount of aid simultaneously.

In the present game, the first-order conditions are given by (6) and (7) for the tariff rates and by a Kuhn-Tucker condition for the amount of aid to be chosen by country α:

$$A = E_{pp}^{\beta} + E_{pp}^{\alpha}[1 - (t^{\beta} - t^{\alpha})c_y^{\beta}] \leq 0,\ T \geq 0,\ AT = 0, \tag{8}$$

[11] In addition to normality (implying that $1 - t^i c_y^i > 0$), this result also depends upon the condition $E_{pp}^i - m^i c_y^i < 0$. The latter condition states that the non-numeraire good has negatively sloped uncompensated excess demand functions, which will be satisfied under normality at the Nash equilibrium.

subject to the condition that the aid chosen by country α does not harm country β. From (5), it is noted that a small extra aid does not hurt country β if

$$C = E^{\alpha}_{pp} + E^{\beta}_{pp}[1 - (t^{\alpha} - t^{\beta})c^{\alpha}_{y}] \leq 0. \tag{9}$$

or that country β benefits from a small extra aid if $C < 0$.

Proposition 1: *Assuming normality of goods and $E^{i}_{pp} < 0$, if the trade taxes and aid are chosen simultaneously, the optimal aid is zero.*

Proof. Assuming normal goods, it is readily shown that $[1 - (t^{\beta} - t^{\alpha})c^{\beta}_{y}] > 0$ and $[1 - (t^{\alpha} - t^{\beta})c^{\alpha}_{y}] > 0$.[12] These inequalities and the assumption that $E^{i}_{pp} < 0$ imply that $A < 0$ and $C < 0$ for *any* chosen tariff rates (and thus for the Nash tariffs as well). Thus country α chooses to give zero aid. Q.E.D.

Proposition 1 has two important implications. First, $(0, t^{\alpha n}, t^{\beta n})$ is a Nash equilibrium in the present game, where $t^{in} = \widetilde{t}^{i}(0)$, $i = \alpha, \beta$. Second, because $C < 0$ at all levels of aid, country β always benefits from aid.

The above results extend the existing transfer literature by allowing endogeneity of trade taxes. We found that even if trade taxes are determined endogenously by both countries in a non-cooperative game, aid still hurts the donor country and benefits the recipient country. There is no paradox here.[13]

[12] These inequalities are proved using the fact that the marginal propensities to consume the two goods add up to unity, viz., $(p + t^{i})c^{i}_{y} + c^{i1}_{y} \equiv 1$, where c^{i1}_{y} is the marginal propensity to consume the numeraire good. This identity may be used to rewrite the bracketed expression in (8) as $[1 - (t^{\beta} - t^{\alpha})c^{\beta}_{y}] = 1 - t^{\beta}c^{\beta}_{y} + t^{\alpha}c^{\beta}_{y} = 1 - (p + t^{\beta})c^{\beta}_{y} + (p + t^{\alpha})c^{\beta}_{y} = c^{\beta 1}_{y} + (p + t^{\alpha})c^{\beta}_{y} > 0$, the strict inequality following since the domestic price $(p + t^{\alpha})$ cannot be negative and since both goods are assumed to be normal. A similar proof yields the other inequality.

An alternative, but more cumbersome method, would be to substitute the Nash tariff values into the A and C formulas and derive their sign.

[13] Of course, paradoxes can be obtained in the usual way; for example, by allowing inferiority of goods in consumption. See Bhagwati, Brecher and Hatta (1985) and Turunen-Red and Woodland (1988), for example.

4 Optimal Foreign Aid in a Two-Stage Game

We showed that if trade taxes and aid are chosen simultaneously, the optimal aid is zero. The natural question is whether a donor has an incentive to choose positive aid before trade taxes are determined. In other words, it is interesting to find out whether a donor is willing to commit itself to positive aid before trade taxes are chosen in a Nash way.[14]

To analyze the present case, we introduce a two-stage game. In stage one, the donor chooses non-negative aid T, and in the second stage, both countries determines the trade taxes in a non-cooperative fashion, taking T as given.

4.1 Stage two of the game

To ensure a subgame perfect equilibrium, we first analyze the second stage. The first-order conditions for optimality of the two countries' tariff rates are again given by (6) and (7). By totally differentiating these two conditions, and after some manipulation, we obtain an expression for the effect of a small change in the level of aid upon the Nash tariff rates:

$$\Delta\frac{dt^\beta}{dT} = \Omega^\alpha\Phi^\beta + \Omega^\beta\Theta^\alpha, \qquad \text{and} \qquad \Delta\frac{dt^\alpha}{dT} = \Omega^\beta\Phi^\alpha + \Omega^\alpha\Theta^\beta, \tag{10}$$

[14] In the opposite timing with trade taxes chosen before aid, it is easy to conclude from Proposition 1 that the optimal aid is zero since in both cases aid has not effect on trade taxes. Thus the textbook result applies, namely, aid hurts the donor.

where $\Delta \equiv \Theta^{\alpha}\Theta^{\beta} - \Phi^{\alpha}\Phi^{\beta} > 0$ is the stability condition of the Nash tariff game, and where

$$
\begin{aligned}
\Theta^{\alpha} &= \widetilde{Z}\left(E^{\beta}_{pp} - m^{\beta}c^{\beta}_{y}\right) + S^{\beta}_{p}E^{\alpha}_{pp}\left(1 - t^{\beta}c^{\beta}_{y}\right) - S^{\beta}_{u}E^{\alpha}_{pp}\left(m^{\beta} - t^{\beta}E^{\beta}_{pp}\right), \\
\Phi^{\alpha} &= S^{\beta}_{p}\left[\widetilde{Z} - \left(1 - t^{\alpha}c^{\alpha}_{y}\right)E^{\beta}_{pp}\right] - \widetilde{Z}m^{\beta}c^{\beta}_{y}, \\
\Omega^{\alpha} &= S^{\beta}_{p}\left[c^{\alpha}_{y}\left(1 - t^{\beta}c^{\beta}_{y}\right) - c^{\beta}_{y}\left(1 - t^{\alpha}c^{\alpha}_{y}\right)\right] + S^{\beta}_{u}\left[E^{\alpha}_{pp} + E^{\beta}_{pp}\left(1 - (t^{\alpha} - t^{\beta})c^{\alpha}_{y}\right)\right], \\
\Theta^{\beta} &= \widetilde{Z}\left(E^{\alpha}_{pp} - m^{\alpha}c^{\alpha}_{y}\right) + S^{\alpha}_{p}E^{\beta}_{pp}\left(1 - t^{\alpha}c^{\alpha}_{y}\right) - S^{\alpha}_{u}E^{\beta}_{pp}\left(m^{\alpha} - t^{\alpha}E^{\alpha}_{pp}\right), \\
\Phi^{\beta} &= S^{\alpha}_{p}\left[\widetilde{Z} - \left(1 - t^{\beta}c^{\beta}_{y}\right)E^{\alpha}_{pp}\right] - \widetilde{Z}m^{\alpha}c^{\alpha}_{y}, \\
\Omega^{\beta} &= S^{\alpha}_{p}\left[c^{\alpha}_{y}\left(1 - t^{\beta}c^{\beta}_{y}\right) - c^{\beta}_{y}\left(1 - t^{\alpha}c^{\alpha}_{y}\right)\right] - S^{\alpha}_{u}\left[E^{\beta}_{pp} + E^{\alpha}_{pp}\left(1 - (t^{\beta} - t^{\alpha})c^{\beta}_{y}\right)\right],
\end{aligned}
$$

and, for $i, j = \alpha, \beta$ and $i \neq j$,

$$
\begin{aligned}
S^{i}_{p} &= E^{i}_{pp}\left[1 - \left(t^{i} - t^{j}\right)c^{i}_{y}\right] - t^{j}E^{i}_{ppp} - m^{i}\left(t^{i} - t^{j}\right)c^{i}_{yp}, \\
S^{i}_{u} &= c^{i}_{y}\left[1 - \left(t^{i} - t^{j}\right)c^{i}_{y}\right] - t^{j}\frac{E^{i}_{ppu}}{E^{i}_{u}} - m^{i}\left(t^{i} - t^{j}\right)\frac{c^{i}_{yu}}{E^{i}_{u}}.
\end{aligned}
$$

The second-order sufficiency conditions for welfare maximization determines the signs of some of the above coefficients, viz. $\Theta^{\alpha} > 0$ and $\Theta^{\beta} > 0$, but the rest remain ambiguous. As a consequence of these ambiguities, the sign of dt^{i}/dT also turns out to be ambiguous in general.[15]

The following rather general example illustrates this ambiguity arising in the effect of foreign aid upon the level of optimal tariffs imposed by the recipient of aid. In particular, it shows that, depending upon the pattern of trade and the relative size of tariffs, foreign aid may cause the recipient to raise its import duty or, alternatively, reduce its export tax. In the latter case, aid induces the recipient to take a more open

[15] Indeed, the assumption that trade taxes are strategic substitutes (which here implies that $\Phi^{i} > 0, i = \alpha, \beta$) — an assumption that seems to be accepted in the literature on tariff games (e.g. Staiger, 1996) but which, according to Johnson (1953), needs not arise in general — turns out *not* to be sufficient for determining the sign of dt^{i}/dT.

trade policy stance.[16]

Example: *Consider the case where the donor has a very small marginal propensity to consume the non-numeraire good while the recipient has a very large propensity to consume that good. Take this case to the extreme and assume that* $c_y^\alpha = 0$ *and* $(p + t^\beta)c_y^\beta = 1$. *Assume also that the excess import demands of the non-numeraire good are linear, i.e.* $E_{ppp}^i = 0$ $(i = \alpha, \beta)$. *Using these assumptions in equation (10) and focusing on the effect of a transfer on the recipient's trade tax, we can derive the following condition for the change of the recipient's Nash trade tax (see appendix):*

$$\frac{dt^\beta}{dT} > 0 \quad \text{iff} \quad 1 > \frac{t^\alpha}{p} - \frac{t^\beta}{p}. \tag{11}$$

Clearly, when $t^\beta > 0$ *and* $t^\alpha < 0$ *(which is true when* $m^\beta > 0$ *and* $m^\alpha < 0$*) the above condition is trivially satisfied, and thus the import tariff of the recipient will always rise as the country receives more aid. In this case, aid induces the recipient to be more protective in its trade policy. However, when* $t^\beta < 0$ *and* $t^\alpha > 0$ *(*$m^\beta < 0$ *and* $m^\alpha > 0$*) the above condition says that the export tax of the recipient will fall (absolutely) as a result of a transfer (*$dt^\beta/dT > 0$*) if, and only if, the sum of the ad-valorem trade taxes (in absolute form) is below 100% (*$1 > t^\alpha/p - t^\beta/p$*).*[17] *In this case, aid induces the recipient to be more open in its trade policy. Thus, and taking these results together, the example shows that the aid donor may induce the recipient to reduce its trade tax (become more open) only if the recipient is an exporter of the non-numeraire good.*[18] *It should be noted that in developing (developed) countries, the marginal propensity to consume a basic good is very high (low), and these countries also tend to be exporters*

[16] Another way of proceeding would be to assume specific functional forms and to engage in simulation techniques. Specific functional forms would determine the sign of the third order derivatives of the trade expenditure functions, viz. $c_{yp}^i, c_{yu}^i, E_{ppp}^i, E_{ppu}^i$, and would simplify the above expressions. Choosing the right set of parameter values would allow us to sign dt^i/dT.

[17] *Note that* t^i/p *can be viewed as an ad valorem trade tax rate since* $p + t^i = p(1 + t^i/p)$.

[18] *It is easy to check that if we had assume the opposite differences in marginal propensities to consume (*$(p + t^\alpha)c_y^\alpha = 1$ *and* $c_y^\beta = 0$*), symmetric results would have been derived, i.e. the strategic effect would be positive for the donor only if the donor was an exporter of the non-numeraire good.*

(importers) of such goods. In our example, therefore, m^β is likely to be negative and, thus, foreign aid would induce the recipient country to follow a more open trade policy.

The intuition behind this result hinges on the assumed differences in marginal propensities to consume the non-numeraire good. It is well known that a transfer from a country with a low marginal propensity to consume a good to a country with a high marginal propensity to consume the good will increase the world price of that good in a Walrasian stable market with given trade taxes. If this good is exported by the recipient, the terms-of-trade effect of the transfer is against the donor's interest. However, in the case where tariffs are optimally set, there exists an additional (strategic) effect that may reduce the donor's losses, viz. the recipient may reduce its export tax. The reason for this hinges on optimal tax design, and it seems to go beyond the particular example considered above. Optimal trade taxes are designed as are all other optimal taxes: they are set to the level where their marginal cost equals their marginal benefit. The benefits of trade taxes come through the terms of trade, while the costs are the traditional consumption and production inefficiencies that they create. If, however, the terms of trade have already been moved to the advantage of a country by use of a different instrument (here a transfer), the optimal trade tax should, ceteris paribus, be reduced in that country. In other words, transfers do, in part, the work that optimal trade taxes do: they affect world prices.

4.2 Stage one of the game

In this stage, the donor chooses the level of aid to maximize its welfare, fully aware of how aid may affect the trade taxes to be decided in stage two. To analyze the donor's problem we note that as trade taxes are chosen optimally, $B = D = 0$ and conditions

(4) and (5) reduce to:

$$\widetilde{Z}\ E_u^\alpha\ \frac{du^\alpha}{dT} \quad = \quad -A + (m^\alpha - t^\alpha E_{pp}^\alpha) E_{pp}^\beta\ \frac{dt^\beta}{dT}, \tag{12}$$

$$\widetilde{Z}\ E_u^\beta\ \frac{du^\beta}{dT} \quad = \quad C + (m^\beta - t^\beta E_{pp}^\beta) E_{pp}^\alpha\ \frac{dt^\alpha}{dT}. \tag{13}$$

Conditions (12) and (13) suggest that welfare of each country is affected by a transfer in two ways: (i) by the transfer itself and (ii) by the effect that the transfer has on the trade policy of the other country. Since $A < 0$ and $C < 0$, the former effect is negative for the donor country and positive for the recipient country and they represent the well-known general equilibrium effects of a transfer under the existence of given tariffs (see Bhagwati, Brecher and Hatta (1985)). The latter effect is the strategic effect, which is the focus of this paper. It is obvious from these welfare relations that the donor will decide to give aid *only if* the strategic effect benefits the donor, i.e. only if aid results in a reduction of the recipient's trade tax.[19] Condition (12) immediately implies the following proposition:

Proposition 2: *The optimal transfer is positive if the right-hand side of (12) is negative when evaluated at $T = 0$. A necessary condition for a positive optimal transfer is that a small transfer induces the recipient to liberalize trade.*

One case with a positive optimal transfer is illustrated in Figure 1. Curve OC_0^i is the offer curve of country i, $i = 1, 2$, when the two countries choose the optimal trade taxes non-cooperatively in the absence of any transfer, with point N_0 as the Nash equilibrium point. Country i's resulting welfare is equal to u_0^i. Suppose that a transfer equal to T in terms of good 1 is given by country α to country β in stage one.

[19]It is also obvious that the recipient will accept aid under the sufficient condition that the aid will reduce the trade tax of the donor. If the donor is an exporter (importer) of the good this will mean that $dt^\alpha/dT > 0$ (< 0). However, this is only a sufficient condition and thus even if the aid increases the trade tax of the donor (as will be the case in the next section) the recipient may well accept the aid (the positive standard effect may be larger than the negative strategic effect).

Taking this transfer as given, both countries choose the trade taxes in stage two. The new Nash point is N_1, when countries α and β shift their offer curves to OC_1^{α} and $OC_1^{\prime\beta}$, respectively. In the case, shown, both countries gain from the strategic transfer, and it is clear from the diagram that the recipient responds to the transfer with a lower trade tax.[20]

5 Pareto-Improving Tied Aid

The previous section shows that if the donor makes a precommitment in terms of transfer before trade taxes are chosen, there are cases in which the optimal transfer is positive. However, it cannot be ruled out that there are cases in which the optimal transfer is zero.

In this section, we analyze another rule for choosing a transfer. The interesting thing is that under such a rule, the optimal transfer is positive and both countries can be made better off. It should be noted that trade is not efficient because of the presence of trade taxes. So if both countries cooperate, free trade (possibly in the presence of transfers) can always benefit both countries. The primary contribution of this section is to demonstrate that, even when two countries are not cooperating, the outcome nevertheless involves an international transfer of income that makes both countries better off. This outcome arises from one country tying its transfer to tariff reductions by the other country in a strategic policy game.

In our set-up, the donor country α solves the following problem:

$$u^{\alpha}(T_1, t_1^{\alpha}, t_1^{\beta}) \equiv \max_{T, t^{\alpha}, t^{\beta}} \{u^{\alpha}(T, t^{\alpha}, t^{\beta}) : u^{\beta}(T, t^{\alpha}, t^{\beta}) = u_0^{\beta} \text{ and } T \geq 0\}, \tag{14}$$

where $u_0^{\beta} = u^{\beta}(0, t^{\alpha n}, t^{\beta n})$ and $t^{in} = t^{in}(0)$, $i = \alpha, \beta$, are the Nash equilibrium tariffs corresponding to no aid. That is, the donor country offers aid to the recipient, requiring

[20]The transfer shown in the diagram may not be an optimal one for country α.

that it sets its tariff rate at the level of t_1^β. The donor country chooses the values of t_1^β, its own tariff, and the amount of aid, T_1, subject to the constraint that the recipient is as well off as at the Nash equilibrium of the benchmark model with zero aid. Accordingly, the recipient is not hurt, and has no reason to reject the aid. The question is whether there exists the triplet $(T_1, t_1^\alpha, t_1^\beta)$, $T_1 > 0$, such that the donor is not worse off, i.e. $u^\alpha(T_1, t_1^\alpha, t_1^\beta) \geq u^\alpha(0, t^{\alpha n}, t^{\beta n})$.

The answer to the above question is in the affirmative. To see why, let us formally analyze our problem as follows. Without loss of generality, and for helping the exposition of our ideas, let us take the donor to be an exporter of the non-numeraire good, i.e. $m^\alpha < 0$.[21] Consider again the Nash equilibrium of the benchmark model with no aid being provided. From this initial situation, we now examine the effect of a small amount of aid under the condition that the recipient's welfare does not change. Using the condition that $du^\beta = 0$, equation (13) yields the required change in the donor's trade tax from the initial Nash equilibrium as:

$$\frac{dt^\alpha}{dT} = -\theta_1 \equiv -\frac{C}{(m^\beta - t^\beta E_{pp}^\beta)E_{pp}^\alpha} < 0, \tag{15}$$

which implies that, because of the aid, the donor has the option of raising its export tax (reducing $t^\alpha < 0$) without hurting the recipient's welfare. Moreover, (12) implies that $du^\alpha > 0$ if and only if:

$$\frac{dt^\beta}{dT} < -\theta_2 \equiv \frac{A}{(m^\alpha - t^\alpha E_{pp}^\alpha)E_{pp}^\beta} < 0. \tag{16}$$

Given that the right-hand side of (16) is negative, a small amount of aid that is tied to a reduction in the recipient's tariff in accordance with this inequality, but maintains the welfare of the recipient, is beneficial to the donor. This is a strong result since it requires only fairly general assumptions such as competitive markets and convex

[21] If, alternatively, it is assumed that the donor imports the non-numeraire good then the inequalities in the text leading up to Proposition 2 are reversed. The statement of Proposition 2 would also require appropriate alteration.

preferences and technologies. In fact, the aid can be made Pareto-improving (instead of merely making the recipient as well off as before) by having the donor provide an additional small transfer to the recipient. This result is summarized in the following proposition.

Proposition 3: *Starting from the Nash equilibrium with zero aid, a small amount of aid tied to a reduction in the recipient's tariffs, as given in (16) for the case where the recipient imports the non-numeraire good, is Pareto-improving.*

The key to the tied aid being Pareto-improving is that the recipient reduces its tariff, avoiding any detrimental effect of the aid on the donor country. A Pareto-improving aid exists because the initial Nash equilibrium is not efficient. Note that with positive aid tied to the recipient's reduction of its tariff, the outcome is no longer a Nash equilibrium.

We now turn to the determination of the optimal amount of aid that solves the problem described by (14). Being away from the Nash equilibrium implies that $B \neq 0$ and $D \neq 0$. As the welfare of the recipient is maintained at its initial Nash level, as required by the problem in (14), equation (5) gives:

$$\frac{dt^\alpha}{dT} = -\frac{C + DE^\beta_{pp}(dt^\beta/dT)}{(m^\beta - t^\beta E^\beta_{pp})E^\alpha_{pp}}. \tag{17}$$

Substituting this relationship into (4) yields the following reduced-form expression for the change in α's welfare:

$$\widetilde{Z}\ E^\alpha_u\ du^\alpha = -\left[A + \frac{BC}{(m^\beta - t^\beta E^\beta_{pp})}\right] dT + E^\beta_{pp}\left[(m^\alpha - t^\alpha E^\alpha_{pp}) - \frac{BD}{(m^\beta - t^\beta E^\beta_{pp})}\right] dt^\beta. \tag{18}$$

At the constrained optimal solution to the problem in (14), the bracketed coefficients in (18) are equal to zero:

$$T_1 \quad : \qquad A + \frac{BC}{(m^\beta - t^\beta E^\beta_{pp})} = 0, \tag{19}$$

$$t_1^\beta \quad : \qquad (m^\alpha - t^\alpha E^\alpha_{pp}) - \frac{BD}{(m^\beta - t^\beta E^\beta_{pp})} = 0. \tag{20}$$

These two first-order conditions for the constrained optimum, along with the constraint that $u_0^\beta = u^\beta(T, t^{\alpha n}, t^{\beta n})$, can be solved for the optimal values of t_1^α, t_1^β, and T_1.

Since we showed earlier that a small amount of aid is beneficial to the donor under the condition that the recipient is not worse off, and since a sufficiently large amount of aid is detrimental to the donor, continuity implies that the optimal amount of aid is positive, i.e. $T_1 > 0$. Furthermore, as explained earlier, by providing additional aid both countries can be made better off.[22] We thus have established:

Proposition 4: *In a game in which the donor can tie its aid to changes in the tariff of the recipient country, the optimal amount of aid provided by the donor is positive. If the donor is willing to forego a small amount of welfare, both countries benefit from the tied aid.*

The solution to the policy problem (14) is illustrated in Figure 2. Point N, the intersecting point between country α's offer curve, OC_0^α, and country β's offer curve, OC_0^β, is the initial Nash equilibrium with no aid.[23] The donor's problem described by (14) is to choose a point along the indifference curve u_0^β to maximize its welfare. The solution calls for an amount OT of aid (in terms of the numeraire good) to be transferred from country α to country β, with both countries altering their trade taxes

[22] The intuition behind the above Pareto-improving tied aid result can be seen readily by examining the optimality conditions (19) and (20). Since $A < 0$, $C < 0$, $m^\alpha - t^\alpha E^\alpha_{pp} < 0$ and $m^\beta - t^\beta E^\beta_{pp} > 0$, it follows from (19) and (20) that $B < 0$ and $D > 0$. The first inequality suggests that the donor's optimal export tax is larger than its Nash value. Similarly, the second inequality suggests that the recipient's import tariff level at the (donor's) optimum is lower than its Nash value.

[23] Point N is also the point of tangency between a trade indifference curve of each country and the offer curve of the other country.

appropriately. The new offer curves are OC_1^α and OC_1^β, which intersect at the new equilibrium point, point P. This equilibrium point P has the following features:

Figure 1: around here

1. It is the point of tangency between a trade indifference curve of country α, which is labeled u_1^α, and the initial trade indifference curve of country β, u_o^β. This implies that the equilibrium is Pareto-efficient. Furthermore, country α has extracted all the gain from the tied aid, with country β not being worse off than at N. In other words, point P is (weakly) Pareto-superior to point N.

2. Country α's trade indifference curve u_1^α is not tangent to the new offer curve of country β, OC_1^β.

3. Country β's trade indifference curve u_0^β is not tangent to the new offer curve of country α, OC_1^α. In fact, subject to the offer curve OC_1^α, country β would impose a higher trade tax, if it were not constrained by the tying rule. In Figure 1, point S is the point of tangency between OC_1^α and a trade indifference curve of country β (the latter not shown). Country β is willing to not impose the higher tariff since by doing so would forfeit the aid.

Before concluding, there are four more remarks to be made. First, points 2 and 3 above imply that point P is not a Nash equilibrium for the trade taxes. Second, the fact that point P is a Pareto-efficient point is not obvious because it is *not* a free-trade equilibrium. Essentially what has been demonstrated is the movement of the world equilibrium from a tariff-ridden point to another. The reason that point P is Pareto-efficient is that country α uses the transfer and the tying rule to shift the countries' offer curves and extract the entire economic benefit. Third, Figure 1 can also be used to show a Pareto-improving aid, i.e. any Pareto-efficient point along the efficiency locus between point P and point Q in Figure 1, such as R, which can be obtained by appropriately designed tying rules. Fourth, the mechanism described here for attaining the Pareto-efficient point as the final outcome is different from a cooperative bargaining mechanism between the two countries. In the present context, the donor country α is unilaterally attempting to maximize its own welfare. The tied aid is used to induce the recipient country to reduce its tariff rate, making sure that the aid does not hurt the donor. The recipient is willing to do so because it is not hurt by, and could possibly gain from, the tied aid.

6 Conclusion

We have examined the choice of trade taxes and income transfers (aid) in a strategic context, that is in an context where we allow both trade taxes and income transfers to be endogenously determined.

Our analysis suggests that if an *untied* income transfer is chosen by the donor as a distinct policy instrument then it is possible that it is optimal for this country to give aid. What gives rise to this possibility is the strategic effect of aid, viz. the effect that aid will have on the trade tax of the recipient country. Interestingly enough, the optimality-of-aid result does not appear in the literature of exogenously given tariff rates and income transfers when goods are normal and markets are stable.

Moreover, we show the existence of a case in which the donor will always choose to give a positive amount of aid. This is the case where the transfer is *tied* to a reduction in the recipient's tariff rate. Specifically, the donor can expect to gain if the recipient's tariff rate can be reduced sufficiently. Our analysis shows that, starting from a Nash equilibrium with zero transfer, a small transfer can always improve the welfare of the donor country without hurting the recipient country. In fact, Pareto-improving transfers can also be designed.[24] As the donor chooses the optimal transfer, the world reaches a Pareto-efficient point even though we trade taxes have not been reduced in both countries. This result is interesting because it shows how two countries can achieve Pareto efficiency in the world without relying on simultaneous trade liberalization as suggested by recent multilateral trade talks, or without bargaining and cooperation between the countries.

[24]In this respect, our results bear some similarity to those of Kowalczyk and Sjöström (1994, 1998), who show that international income transfers can be used to induce countries to alter their trade policies in a way that facilitates Pareto improvement through coalition formation. In the present model, a Pareto improvement can be achieved without coalition.

Appendix

In this appendix we derive condition (11) in the text.

Suppose $c_y^\alpha = 0$ and $(p+t^\beta)c_y^\beta = 1$. Under these assumptions we get that $c_{yp}^\alpha = c_{yu}^\alpha = c_{yu}^\beta = E_{ppu}^\alpha = E_{ppu}^\beta = 0$, and $c_{yp}^\beta = -1/(p+t^\beta)^2$. Assume also that $E_{ppp}^i = 0$ $(i = \alpha,\ \beta)$. Substituting these relations into the coefficients defined after (11) we obtain:

$$\begin{aligned}
S_p^\alpha &= E_{pp}^\alpha, \\
S_u^\alpha &= 0, \\
S_p^\beta &= \frac{(p+t^\alpha)E_{pp}^\beta}{p+t^\beta} + \frac{m^\beta(t^\beta - t^\alpha)}{(p+t^\beta)^2}, \\
S_u^\beta &= \frac{p+t^\alpha}{(p+t^\beta)^2}, \\
\Omega^\beta &= -\frac{E_{pp}^\alpha}{p+t^\beta}, \\
\Omega^\alpha &= \frac{(p+t^\alpha)E_{pp}^\alpha}{(p+t^\beta)^2} - \frac{m^\beta(t^\beta - t^\alpha)}{(p+t^\beta)^3}, \\
\Phi^\beta &= E_{pp}^\alpha\left[\tilde{Z} - \frac{pE_{pp}^\alpha}{p+t^\beta}\right], \\
\Theta^\alpha &= \tilde{Z}\left(E_{pp}^\beta - \frac{m^\beta}{p+t^\beta}\right) + E_{pp}^\alpha\left(\frac{(p+t^\alpha)E_{pp}^\beta}{p+t^\beta} + \frac{m^\beta(t^\beta - t^\alpha)}{(p+t^\beta)^2}\right)\frac{p}{p+t^\beta} \\
&\quad - \frac{(p+t^\alpha)E_{pp}^\alpha(m^\beta - t^\beta E_{pp}^\beta)}{(p+t^\beta)^2}, \\
\tilde{Z} &= \frac{pE_{pp}^\alpha}{p+t^\beta} + E_{pp}^\beta - \frac{m^\beta}{p+t^\beta}.
\end{aligned}$$

Using these simplified expressions for the coefficients, equation (10) yields the following result:

$$\Delta\frac{dt^\beta}{dT} = \left[-1 + \frac{m^\beta}{E_{pp}^\beta}\frac{p+t^\alpha}{(p+t^\beta)^2}\right]\frac{\tilde{Z}E_{pp}^\alpha E_{pp}^\beta}{p+t^\beta}.$$

Finally, making use of the fact that (6) gives $\left[m^\beta\left(p+t^\alpha\right)\right] / \left[E_{pp}^\beta\left(p+t^\beta\right)\right] = t^\alpha$,we can rewrite this result as:

$$\Delta\frac{dt^\beta}{dT} = -p\left[1 + \frac{t^\beta}{p} - \frac{t^\alpha}{p}\right]\frac{\tilde{Z}E_{pp}^\alpha E_{pp}^\beta}{\left(p+t^\beta\right)^2}$$

Condition (11) in the text is derived directly from this relationship.

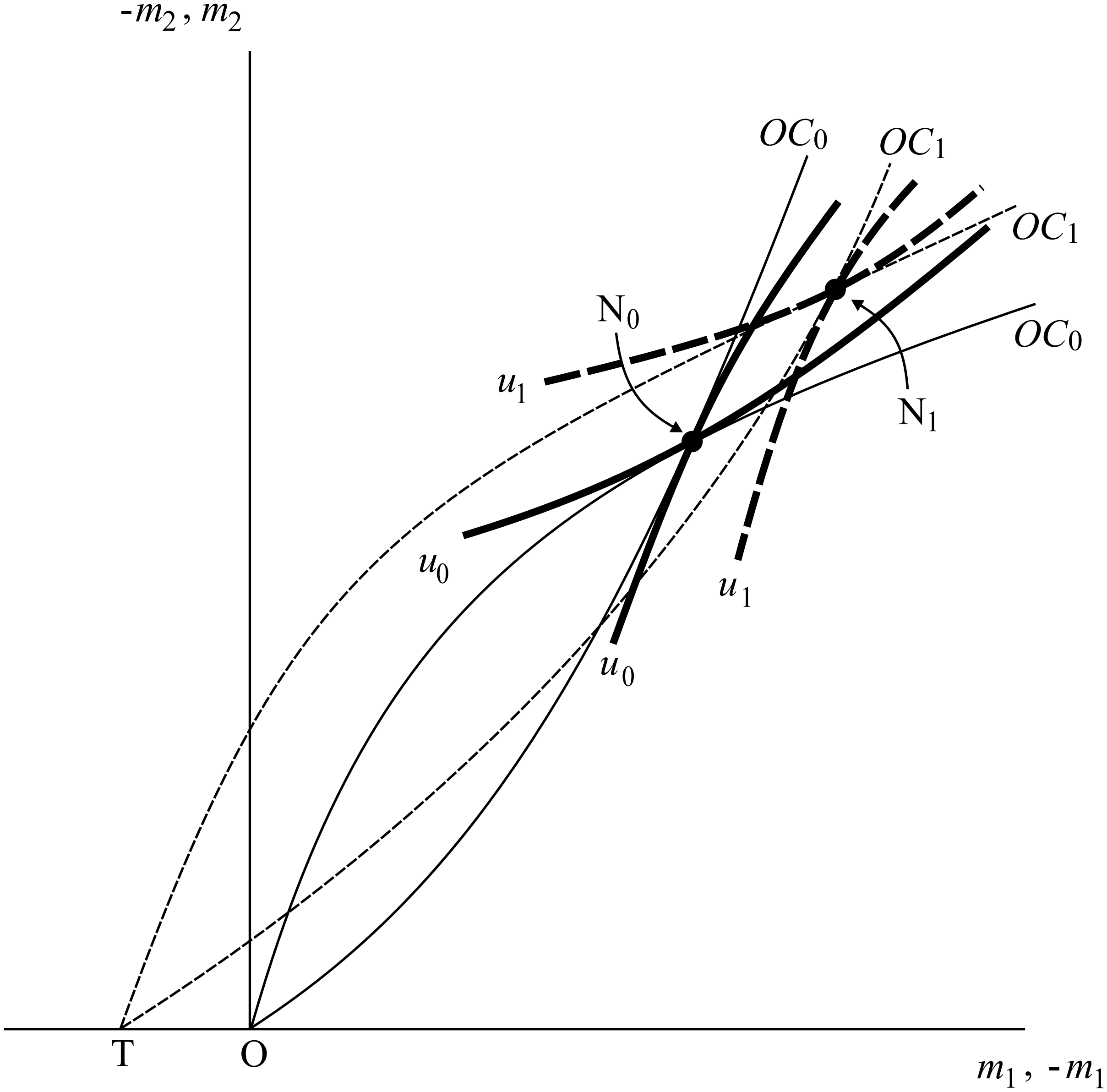

Figure 1:

A Beneficial Transfer As the Recipient Liberalizes Trade

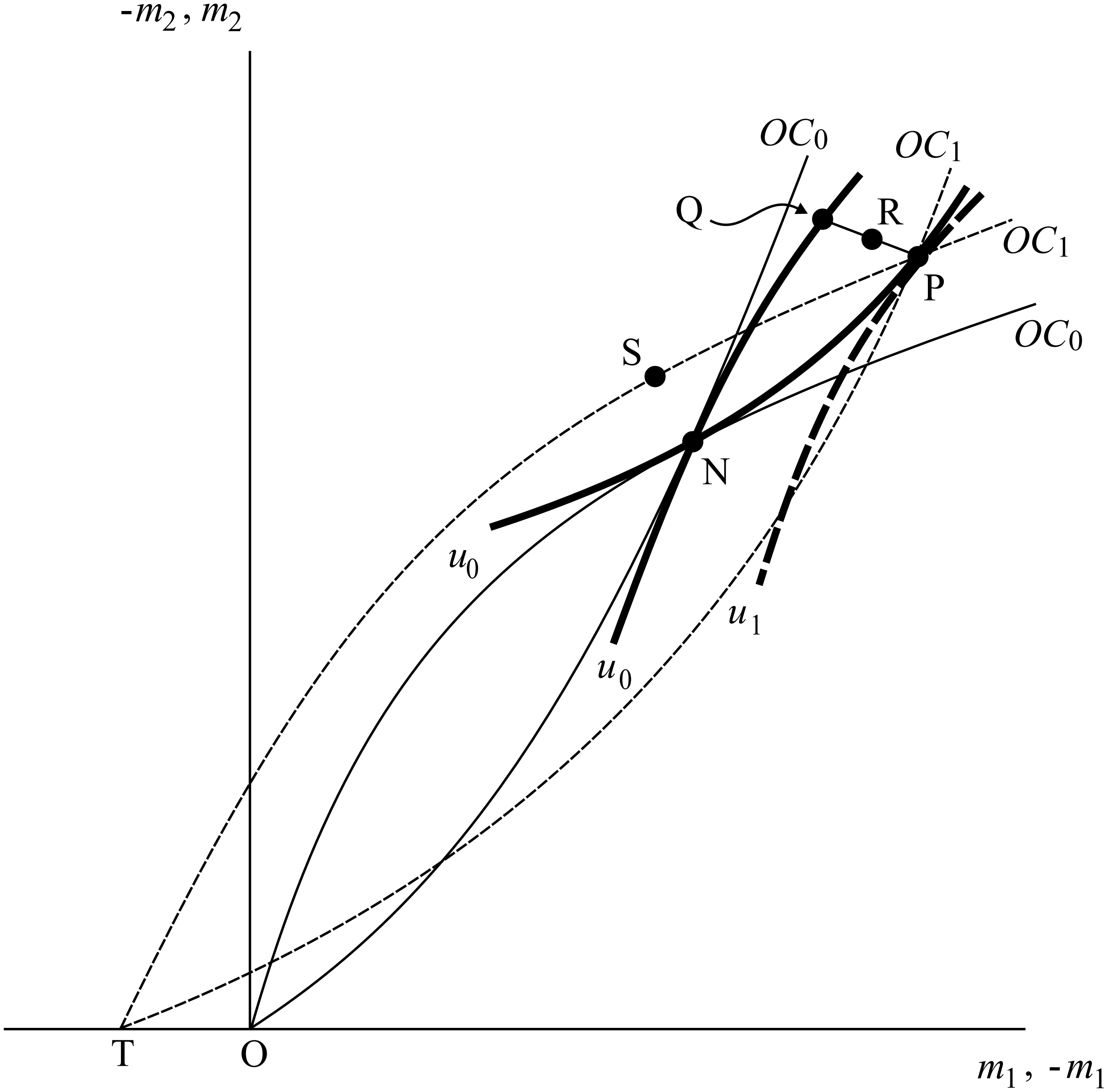

Figure 2:

Optimal Tied Transfer

References

Bhagwati, J.N., R. Brecher and T. Hatta, 1983, The generalized theory of transfers and welfare: bilateral transfers in a multilateral world, *American Economic Review* 73, 57-76.

Bhagwati, J.N., R. Brecher and T. Hatta, 1984, The paradoxes of immiserizing growth and donor-enriching 'recipient-immiserizing' transfers: a tale of two literatures, *Weltwirtschaftliches Archiv* 110, 228-243.

Bhagwati, J.N., R. Brecher and T. Hatta, 1985, The generalized theory of transfers and welfare: exogenous (policy-imposed) and endogenous (transfer-induced) distortions, *Quarterly Journal of Economics* 160, 3, 697-714.

Brecher, R., and J.N. Bhagwati, 1982, Immiserizing transfers from abroad, *Journal of International Economics* 13, 353-364.

Dixit, A. and V. Norman, 1980, *The theory of international trade*, Cambridge: Cambridge University Press.

Djajić, S., S. Lahiri, and P. Raimondos-Møller, 1999, Foreign aid, domestic investment and welfare, *Economic Journal 109,* 698-707.

Gale, D., 1974, Exchange equilibrium and coalitions: an example, *Journal of Mathematical Economics* 1, 63-66.

Gallor, O. and H. Polemarchakis, 1987, Intertemporal Equilibrium and the Transfer Paradox, *Review of Economic Studies*, 54(1), 147-56.

Hatta, T., 1977, A recommendation for a better tariff structure, *Econometrica* 45, 1859-1869.

Hatzipanayotou, P., and M. S. Michael, 1995, Foreign aid and public goods, *Journal of Development Economics*, 47, 455-467.

Johnson, H. G., 1953, Optimum tariffs and retaliation, *Review of Economic Studies* 21, 142-153.

Kemp, M. C., 1992, The static welfare economics of foreign aid: A consolidation, chapter 13 in D. Savoie and I. Brecher (eds.), *Equity and efficiency in economic development: essays in honor of Benjamin Higgins*, McGill-Queens University Press, Montreal, 289-314.

Kemp, M. C., and S. Kojima, 1985, Tied aid and the paradoxes of donor-enrichment and recipient-impoverishment, *International Economic Review*, 26, 3, 721-729.

Kemp, M. C., and K.-Y. Wong, 1993, Paradoxes Associated with the Administration of Foreign Aid, *Journal of Development Economics*, 42, 197-204.

Kowalczyk,C. and T. Sjöström, 1994, Bringing GATT into the core, *Economica* 61, 301-317.

Kowalczyk,C. and T. Sjöström, 1998, Trade, Income Transfers, Developing Countries, and the Core, mimeo.

Lahiri, S. and P. Raimondos, 1995, The welfare effect of aid under quantitative trade restrictions, *Journal of International Economics* 39, 297-315.

Lahiri, S. and P. Raimondos-Møller, 1997a, On the tying of aid to tariff reform, *Journal of Development Economics* 54, 479-491.

Lahiri, S. and P. Raimondos-Møller, 1997b, Competition for aid and trade policy, *Journal of International Economics* 43, 369-385.

Ohyama, M., 1974, Tariffs and the transfer problem, *Keio Economic Studies* 11, 29-45.

Samuelson, P. A., The transfer problem and transport costs II: analysis of effects of trade impediments, *Economic Journal* 64, 264-289.

Schweinberger, A. G., 1990, On the welfare effects of tied aid, *International Economic Review*, 31, 2, 457-462.

Staiger, R., 1996, International rules and institutions for cooperative trade policy, in (eds.) Grossman, G. and K. Rogoff, *Handbook of International Economics vol. III*, North-Holland, 1495-1552.

Turunen-Red, A. H. and A. D. Woodland, 1988, On the multilateral transfer problem: existence of Pareto improving international transfers, *Journal of International Economics* 22, 57-64.

Turunen-Red, A. H. and A. D. Woodland, 1991, Strict Pareto improving reforms of tariffs, *Econometrica* 59, 1127-1152.

United States General Accounting Office, 1995, *Foreign assistance: selected donor's approaches for managing Aid program* (USGAO, Washington D.C.).

Wong, K.-Y., 1995, *International trade in goods and factor mobility*, MIT Press.

Woodland, A. D., 1982, *International trade and resource allocation*, North-Holland.