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*The American Economic Review*, Vol. 91, No. 5 (Dec., 2001), 1580-1593.

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# International Coordination of Trade and Domestic Policies

By JOSH EDERINGTON\*

The past half century has seen a dramatic multilateral reduction in tariff barriers under General Agreement on Tariffs and Trade (GATT) negotiations. However, as tariff barriers have fallen, attention has shifted to the use of domestic policies as secondary trade barriers. A primary concern is that, as countries sign trade agreements that constrain their ability to pursue trade goals through trade policy, there will be unilateral incentives for governments to distort their domestic policies as a secondary means of protection.<sup>1</sup> Increasingly, international trade disputes revolve around a country's use of internal regulations as a means of restricting trade. The United States has successfully challenged the system of liquor taxes in both Japan and Korea as discriminating against imported liquor, while Venezuela and Brazil have challenged American standards for reformulated and conventional gasoline as trade protection masquerading as environmentalism. GATT contains several articles concerning the international regulation of domestic policies, but the question of how to fully incorporate domestic policies within GATT negotiations (and other international trade agreements) remains contentious. Indeed, at both the Ministerial Meeting in 1994 (at the close of the Uruguay round) and the recent unsuccessful Ministerial Conference in

Seattle, many GATT delegates renewed demands for the relationship between trade and various domestic policies (e.g., environmental policy, labor standards, or competition policy) to be examined.

Despite the importance that has recently been placed on international cooperation over domestic policies, no theoretical basis exists for considering how to cooperate over *both* trade and domestic policies within an international agreement. Previous papers on negotiation over two instruments of protection (e.g., Copeland, 1989, 1990; Thomas L. Hungerford, 1991) have assumed asymmetric limitations on cooperation (i.e., they assume that one of the two instruments is either nonobservable or nonnegotiable). This paper extends such work by investigating cooperation over two negotiable instruments of protection under symmetric limitations on cooperation, and provides insight into the design of international trade agreements that incorporate cooperation over domestic policies.

I adopt the view that enforcement issues are central to the understanding of international cooperation. One of the challenges of international cooperation is the absence of a central authority to enforce the terms of an agreement. Without access to an external enforcement mechanism, international agreements are viable only as long as member countries view continued cooperation to be in their own self-interest (i.e., the benefits from cooperating outweigh the potential gains from cheating).<sup>2</sup> While the GATT/

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<sup>1</sup> For example, Brian R. Copeland (1990) examined negotiation over one trade barrier, leaving a secondary trade barrier (e.g., nontariff barriers, domestic legislation, etc.) to be set noncooperatively. He shows that trade liberalization will induce substitution toward the less efficient, nonnegotiable instrument of protection due to the unilateral incentives to maintain trade protection facing countries. Thus, within a cooperative framework, the two types of barriers serve as imperfect substitutes for each other.

<sup>2</sup> As stated by Kenneth W. Dam in his review of the GATT institution: "The best guarantee that a commitment of any kind will be kept (particularly in an international setting where courts are of limited importance and, even more important, marshals and jails are nonexistent) is that the parties continue to view adherence to their agreement in their mutual interest ... Thus, the GATT system, unlike most legal systems ... , is not designed to exclude self-help in the form of retaliation. Rather, retaliation, subjected to established procedures and kept within prescribed bounds, is made the heart of the GATT system" (Dam, 1970 pp. 80–81).

WTO dispute settlement procedures may play an important role in facilitating enforcement efforts by GATT members (see, for example, Giovanni Maggi, 1999), GATT has no independent ability to punish violations on its own and can only authorize members to retaliate against a violator. Thus, international agreements such as GATT are limited in their ability to enforce cooperation by the severity of punishment which member countries can credibly threaten against potential cheaters. Given scarce enforcement power at the international level, governments must allocate the enforcement power they possess between cooperation over trade policy and cooperation over domestic policy.

The central focus of the paper is the treatment of domestic policy within the articles of GATT. Article III (which covers domestic policies) requires that no policy that applies to either domestic production or consumption should act as a "disguised" trade restriction.<sup>3</sup> In contrast to the treatment of domestic policies, which amounts to a blanket proscription of the use of domestic policy as a form of protection, Articles I and II (which cover tariff barriers) require only that tariff protection not exceed any "binding levels" that member countries may agree to in GATT negotiations and that all tariffs conform to the principle of nondiscrimination (MFN). Such differential treatment appears to reflect a broad presumption that protection in the form of tariffs is preferable to protection in the form of internal taxes or regulations. GATT's preference for protection in the form of tariffs is commonly justified on the grounds that direct tariffs are more "transparent" and thus easier to negotiate. This paper examines whether such differential treatment is also desirable on efficiency grounds, even absent transparency issues, once enforcement constraints associated with an international agreement are taken into account.

<sup>3</sup> Paragraph 1 of Article III states: "The contracting parties recognize that internal taxes and other internal charges, and laws, regulations and requirements affecting the internal sale, purchase, transportation, distribution or use of products, and internal quantitative regulations requiring the mixture, processing or use of products in specified amounts or proportions, should not be applied to imported or domestic products so as to afford protection to domestic production."

In this paper, I argue that there is a logical basis for Article III and find the conditions under which Article III is efficient. Specifically, I argue that when limited enforcement power prevents countries from implementing a fully efficient set of trade and domestic policies, tariff barriers are the most efficient means of affording countries protection so as to maintain the viability of the agreement. This finding reflects a simple logic: it is the temptation to pursue terms-of-trade gains that creates problems with enforcing international agreements over trade and domestic policies, and, since trade policy is the most efficient means of pursuing such terms-of-trade gains, trade policy is the most efficient means of countering the temptation to defect. This finding provides support for the general treatment of domestic policies within GATT (i.e., the preference for existing trade barriers in the form of tariffs). Indeed, this paper establishes that if supply and demand functions are approximately linear in local prices, then Article III is efficient since there is essentially no gain from distorting domestic taxes. As is shown in Section II of the paper, the only economic reason for distortionary domestic taxes comes from substantial nonlinearities in the supply and demand functions.

In the following analysis, Section I lays out the general-equilibrium model of trade and solves for Nash and Pareto-efficient policies. Section II explores the setting of cooperative policies within a self-enforcing agreement and derives the conditions under which Article III's prohibition against the use of domestic policy as a trade barrier is justified. Finally, Section III concludes.

## I. The Model

The analysis is conducted within a simple two-good, general-equilibrium model of trade with two countries, a home and foreign country (denoted by \*), and follows James R. Markusen (1975) in the modeling of the domestic distortion and policy. Both countries produce and trade the two goods ( $X$ ,  $Y$ ), and technology in both countries is described by production possibility loci [ $Y = F(X)$  and  $Y^* = F^*(X^*)$ ] which are strictly concave to the origin. Since domestic policies (e.g., environmental policy) are commonly justified as correcting for domes-

tic distortions (e.g., pollution), I allow for the presence of a negative externality that arises from both home and foreign country production of good  $X$ . I let  $S(X)$  ( $S^*(X^*)$ ) denote the external cost to production of good  $X$  for the home (foreign) country. For ease of analysis, the externality does not affect the production functions and enters separably into the welfare functions of the countries. I assume citizens are identical within each country, and define the representative citizen's welfare as a function of the quantity of each good consumed and the external cost to production. The government in each country is assumed to maximize its own citizens' welfare, and thus takes the (aggregated) representative citizen's quasi-linear utility function as its own objective function<sup>4</sup>:

$$(1) \quad W = C_Y + U(C_X, S(X)) \text{ and}$$

$$W^* = C_Y^* + U^*(C_X^*, S^*(X^*))$$

where  $C_i$  ( $C_i^*$ ) denotes home (foreign) consumption of good  $i$ . Note also, from (1), the absence of international "spillovers" associated with the production externality (i.e., production of good  $X$  in the home country does not enter directly into the welfare function of the foreign country). The case of transboundary externalities (e.g., global pollution) will be discussed in the concluding section.

There are three price ratios of interest in this model: the "world" untaxed price of good  $X$  in terms of good  $Y$  (denoted  $p_w$ ); the local consumer price ratio ( $p_c$ ); and the local producer price ratio ( $p_s$ ). I assume that  $X$  ( $Y$ ) is the natural import good of the home (foreign) country. Each country pursues trade policy through the use of trade taxes, so that  $p_c = (1 + \tau)p_w$  and  $p_c^* = p_w/(1 + \tau^*)$  where  $\tau$  is the home country ad valorem import tariff and  $\tau^*$  is the foreign ad valorem

import tariff.<sup>5</sup> Domestic policy is carried out through the use of taxes and subsidies on the production of good  $X$ , so that  $p_s = (1 - t)p_c$  and  $p_s^* = (1 - t^*)p_c^*$  where  $t$  and  $t^*$  are the ad valorem tax rates. The important distinction between trade and domestic policies is that trade policies drive a wedge between the world price and domestic prices, while domestic policies drive a wedge between domestic producer and consumer prices.

Profit-maximizing producers choose production levels to equate the marginal rate of transformation between the two goods with the local producer price ratio. Meanwhile, utility-maximizing consumers choose consumption levels to equate the marginal rate of substitution between the two goods with the consumer price ratio. Thus, consumption will be a function of local prices ( $p_c$  and  $p_s$ , which determine the budgetary trade-off between the two goods and the level of factor income in the economy) and tax revenue ( $R(p_s, p_c, p_w)$ ) which is distributed lump sum to consumers. Finally, the home country's net exports of good  $i$  (denoted by  $T_i$ ) are given by:

$$(2) \quad T_x(p_c, p_s) = X(p_s) - C_x(p_c) \text{ and}$$

$$T_y(p_c, p_s, p_w) = F(X(p_s)) - C_y(p_c, p_s, p_w).$$

The world price,  $p_w$ , is determined by the market-clearing condition that net exports of the home country of each good are equal to foreign net exports:

$$(3) \quad T_i = -T_i^*$$

Assuming that direct lump-sum transfers (in terms of the numeraire good) are available, the balance of payments constraint requires that for any world price:

$$(4) \quad T_Y + p_w T_X + m = 0 \text{ and}$$

$$T_Y^* + p_w T_X^* - m = 0$$

<sup>4</sup> The assumption of quasi-linear utility is not central to the conclusions of the paper, but assists in simplifying the analysis by allowing me to abstract away from distributional concerns. The working paper version of this paper (Ederington, 2000) provides a case where quasi-linear utility is not assumed.

<sup>5</sup> By Lerner symmetry, this trade tax can be interpreted as applying to either exports or imports in the general-equilibrium model.

where  $m$  represents the lump-sum transfer. Thus welfare for the home and foreign country can be rewritten as:

$$(5) \quad W = F(X) + p_w T_X + m \\ + U(X - T_X, S(X)) \text{ and} \\ W^* = F^*(X^*) - p_w T_X - m \\ + U(X^* + T_X, S^*(X^*)).$$

In addition, I make two assumptions about the substitutability of trade and domestic policies:

ASSUMPTION 1:

$$\frac{\partial T_X(\tau, t, \tau^*, t^*)/\partial \tau}{\partial T_X(\tau, t, \tau^*, t^*)/\partial t} \neq \frac{\partial X(\tau, t, \tau^*, t^*)/\partial \tau}{\partial X(\tau, t, \tau^*, t^*)/\partial t}.$$

ASSUMPTION 2:

$$\frac{\partial T_X(\tau, t, \tau_0^*, t_0^*)/\partial \tau}{\partial T_X(\tau, t, \tau_0^*, t_0^*)/\partial t} = \frac{\partial T_X(\tau, t, \tau_1^*, t_1^*)/\partial \tau}{\partial T_X(\tau, t, \tau_1^*, t_1^*)/\partial t}.$$

The first assumption states that trade and domestic policy are imperfect substitutes. This is a standard assumption in the literature of the first best and (implicitly) lies behind the conclusion that trade policies are the most efficient means of countering any trade distortions and production taxes are the most efficient means of countering any production distortions (e.g., see Markusen, 1975). Assumption 1 does raise a question when a country has access to many domestic policy instruments, as it is well known that a combination production subsidy/consumption tax is a perfect substitute for a tariff. Indeed, the definition of trade policy in the model is simply the wedge between the local prices and the world price, and thus  $\tau$  can be interpreted as either a tariff or as a combination production tax/consumption subsidy. Thus, even when countries have access to both production and consumption taxes, the main result of this paper would still hold (although the interpretation would be slightly different) in the sense that an efficient agreement would result in setting the “correct” wedge between the local producer and consumer prices (given by  $t$ ),

and then reducing the wedge between the local and world prices (given by  $\tau$ ) as much as possible.

The second assumption is the key assumption. It states that the *relative* effect on trade volume of the home country’s trade and domestic policies is independent of the policy choices of the foreign country (i.e., Assumption 2 ensures that the slope of an iso-trade volume curve is independent of foreign policies or, alternatively, the world price). From (2) and (3) one can derive that a sufficient condition for Assumption 2 to be satisfied is for supply and demand to be linear in local prices [i.e.,  $X(p_s)$  to be linear in  $p_s$  and  $C_X(p_c)$  to be linear in  $p_c$ ].<sup>6</sup> I will conduct the analysis in Section III under this assumption and then discuss, at the end of Section III, the case where this assumption is not satisfied.

#### A. Noncooperative Trade and Domestic Policies

In the absence of an international agreement, each country sets trade taxes and production taxes to maximize national welfare, taking the policy choices of its trading partner as given. Taking derivatives of (5), the unilaterally optimal trade and domestic policies for the home country satisfy the following first-order conditions:<sup>7</sup>

$$(6) \quad \left[ \frac{1}{\varepsilon} - \tau \right] p_w \frac{\partial T_X}{\partial \tau} + [t \cdot p_c - \lambda_d] \frac{\partial X}{\partial \tau} = 0$$

$$(7) \quad \left[ \frac{1}{\varepsilon} - \tau \right] p_w \frac{\partial T_X}{\partial t} + [t \cdot p_c - \lambda_d] \frac{\partial X}{\partial t} = 0$$

<sup>6</sup> To see this, differentiate the market-clearing condition (3) to show that  $(\partial T_X(p_w, \tau, t)/\partial t)/(\partial T_X(p_w, \tau, t)/\partial \tau)$  must be independent of  $p_w$ . Then, from (2), we have  $T_X(p_w, \tau, t) = X(p_w(1 + \tau)(1 - t)) - C(p_w(1 + \tau))$ . Differentiating and simplifying, one finds that  $(\partial T_X(p_w, \tau, t)/\partial t)/(\partial T_X(p_w, \tau, t)/\partial \tau)$  equals an expression that depends on  $p_w$  only through  $\partial X/\partial p_s$  and  $\partial C_X/\partial p_c$ . Therefore, a sufficient condition for Assumption 2 to be satisfied is for supply and demand to be linear in local prices. For example,  $U(\cdot)$  being quadratic would satisfy Assumption 2.

<sup>7</sup> First-order conditions for the foreign country are defined analogously. The derivation of these first-order conditions can be found in Appendix A.

where

$$\varepsilon = \frac{p_w(\partial T_x^*/\partial \tau)}{T_x^*(\partial p_w/\partial \tau)}, \lambda_d = -\frac{\partial W}{\partial S} \left( \frac{\partial S}{\partial X} \right).$$

When viewed from a single country's perspective, there are two basic distortions in this model: a production distortion (the presence of a domestic externality that drives a wedge between the private and social costs of domestic import-competing production) and an international trade distortion (the policy choices of each country affect the international terms of trade). Note that the reduction in world price that accompanies a slight increase in tariffs redistributes income to the importing country. Thus, countries will impose import tariffs to restrict trade in pursuit of terms-of-trade gains. In the first term of (6),  $1/\varepsilon$  is the reciprocal of the elasticity of the foreign country's supply of net exports and reflects the usual optimal tariff formula. Similarly, in the final term of (7),  $\lambda_d$  reflects the (purely local) external cost of production in the home country. If the government imposes a production tax such that  $t = \lambda_d/p_c$  (the Pigouvian tax), then producers successfully internalize all external costs of production (i.e., the price producers receive is simply the sum of the social value of production:  $p_s = p_c - \lambda_d$ ).

If  $\tau$  is set equal to  $1/\varepsilon$ , then trade policy is fully handling the trade distortion, and (7) implies that  $t$  should be set to handle the production distortion. However, if a country were not fully pursuing terms-of-trade advantages with its trade policy ( $1/\varepsilon \neq \tau$ ), there would exist a secondary role for domestic policy to play in restricting trade. For example, if the home country were to set its tariff below the unilaterally optimal level ( $1/\varepsilon > \tau$ ), then (7) implies that the home country would be tempted to lower domestic production taxes on that good below the "nondistortionary" level ( $t < \lambda_d/p_c$ ). The rationale for this effect lies in the effect of domestic policy on the world price. Since production taxes raise the world price of the good (by lowering domestic production), the terms of trade for importing countries are diminished and therefore the home government faces more than the full costs of domestic taxation when regulating import industries. As a result, a government whose tariff was set below

the unilaterally optimal level would have an incentive to undertax the domestic distortion associated with import production. Similarly, if  $t$  is set equal to  $\lambda_d/p_c$ , then the domestic distortion has been fully internalized, and (6) implies that  $\tau$  will be set to handle the international trade distortion. However, if  $t \neq \lambda_d/p_c$ , then (6) implies that, since producers do not internalize the full costs of production in their decision-making, trade policy could play a second-best role in handling the local production distortion.

Equations (6) and (7) define reaction functions for home country policies ( $\tau$ ,  $t$ ) to any choice of foreign policies ( $\tau^*$ ,  $t^*$ ). Solving (6) and (7) for these best-response functions yields the standard result of welfare analysis: the first-best policy choice is to pursue international (world price) distortions with trade policies (set  $\tau = 1/\varepsilon$ ) and counter local production distortions with domestic policies (set  $t = \lambda_d/p_c$ ). This is because trade policy is the most efficient means of affecting the world price and domestic policy is the most efficient means of affecting local prices. Similarly, there will be a set of foreign reaction functions, and the intersection of the reaction functions defines the Nash equilibrium.<sup>8</sup> This Nash equilibrium is characterized by a set of unilaterally optimal trade taxes ( $\tau^N = 1/\varepsilon$  and  $\tau^{N^*}/(1 + \tau^{N^*}) = 1/\varepsilon^*$ ) and a set of nondistortionary production taxes ( $t^N = \lambda_d/p_c$  and  $t^{N^*} = \lambda_d^*/p_c^*$ ) to counter the local externality.

### B. Globally Optimal Trade and Domestic Policies

As the previous section shows, when setting policy unilaterally, countries will have an incentive to place restrictions on trade since the resulting change in the world price shifts some of the distortionary cost of the policy to the country's trading partners. However, while it is rational for each country to erect trade barriers unilaterally, these cost-shifting incentives lead countries to place greater restrictions on trade

<sup>8</sup> I ignore issues of existence and uniqueness of this equilibrium. In this section, I am focusing on statements that will be true of any Nash equilibrium. The Nash equilibrium policies are a set of domestic and foreign policies ( $\tau^N$ ,  $t^N$ ,  $\tau^{N^*}$ ,  $t^{N^*}$ ) which simultaneously satisfy (6), (7), and their foreign analogues.

than is efficient for world welfare. Throughout this paper, I will be concentrating on Pareto-efficient agreements that maximize the sum of joint welfare ( $W + W^*$ ). As is shown in this section, in the presence of two policy instruments, an efficient agreement entails (i) eliminating the terms-of-trade motivations from each country's trade policy decisions and (ii) preventing each country from distorting its domestic policy as a secondary means of protection.<sup>9</sup>

Globally efficient trade ( $\bar{\tau}^c, \bar{\tau}^{c*}$ ) and domestic policies ( $\bar{t}^c, \bar{t}^{c*}$ ) satisfy the following first-order conditions<sup>10</sup>:

$$(8) \quad - \left[ \tau + \frac{\tau^*}{1 + \tau^*} \right] p_w \frac{\partial T_X}{\partial \tau} + [t \cdot p_c - \lambda_d] \frac{\partial X}{\partial \tau} + [t^* \cdot p_c^* - \lambda_d^*] \frac{\partial X^*}{\partial \tau} = 0$$

$$(9) \quad - \left[ \tau + \frac{\tau^*}{1 + \tau^*} \right] p_w \frac{\partial T_X}{\partial t} + [t \cdot p_c - \lambda_d] \frac{\partial X}{\partial t} + [t^* \cdot p_c^* - \lambda_d^*] \frac{\partial X^*}{\partial t} = 0$$

$$(10) \quad - \left[ \tau + \frac{\tau^*}{1 + \tau^*} \right] p_w \frac{\partial T_X}{\partial t^*} + [t \cdot p_c - \lambda_d] \frac{\partial X}{\partial t^*} + [t^* \cdot p_c^* - \lambda_d^*] \frac{\partial X^*}{\partial t^*} = 0.$$

A comparison of (6) and (7) with (8), (9), and (10) reveals that the Nash policies are not globally optimal, and that the difference between

<sup>9</sup> For an early analysis of the terms-of-trade justification for international cooperation, see Harry G. Johnson (1953–1954). In more recent papers, Kyle Bagwell and Robert W. Staiger (1999) provide a terms-of-trade interpretation of international agreements and GATT principles. In a similar vein, Alan Deardorff (1997) argues that a possible reason for environmental agreements is to save countries from a terms-of-trade prisoner's dilemma by restraining countries from distorting their environmental policies for terms-of-trade reasons.

<sup>10</sup> I present three of the first-order conditions; the derivation is in Appendix B. There is an equivalent first-order condition for  $\tau^*$  that is linearly dependent on (8).

the Nash and joint-welfare-maximizing policies is the elimination of the terms-of-trade incentive ( $1/\varepsilon$ ) from the first-order conditions. Intuitively, there is no reason for policy intervention driven by “beggar-thy-neighbor” trade-restricting motivations in an efficient cooperative arrangement. In the first term of (8), (9), and (10),  $\tau + \tau^*/(1 + \tau^*)$  represents the net trade barrier (the wedge between the relative [consumer] price of good  $X$  in each country caused by the imposition of trade taxes).<sup>11</sup> It is well known (see Wolfgang Mayer, 1981) that an entire locus of efficient (Pareto-optimal) trade tax combinations can be obtained by imposing import tariffs and symmetric export subsidies. Altering the level of these symmetric policies keeps local prices equalized (ensuring efficiency) while changing the world price (thus redistributing income between the two countries). As can be seen from (8), in the absence of the domestic policy terms, the optimal choice is to lower the net trade barrier to zero ( $\tau + \tau^*/(1 + \tau^*) = 0$ ) so as to equalize local (consumer) prices across both countries. Thus, the first role of cooperation is the elimination of terms-of-trade motivated trade restrictions.

Solving (8), (9), and (10) for the joint-welfare-maximizing policies yields the result that countries will cooperate to set the net trade barrier at zero ( $\bar{\tau}^c + \bar{\tau}^{c*}/(1 + \bar{\tau}^{c*}) = 0$ ) so as not to distort trade flows while retaining production taxes at their nondistortionary level ( $\bar{t}^c = \lambda_d/p_c, \bar{t}^{c*} = \lambda_d^*/p_c^*$ ) in order to counter the domestic distortion.

The results of this section can be summarized by Proposition 1.

**PROPOSITION 1:** *Under Assumption 1, the Nash equilibrium policies are a combination of standard optimal tariffs ( $\tau^N = 1/\varepsilon$  and  $\tau^{N*}/(1 + \tau^{N*}) = 1/\varepsilon^*$ ) and nondistortionary domestic taxes ( $t^N = \lambda_d/p_c$  and  $t^{N*} = \lambda_d^*/p_c^*$ ). Globally efficient policies are a combination of free trade ( $\bar{\tau}^c + \bar{\tau}^{c*}/(1 + \bar{\tau}^{c*}) = 0$ ) and nondistortionary domestic taxes.*

<sup>11</sup> Note that  $\tau = -\tau^*/(1 + \tau^*)$  implies that the relative (consumer) price of  $X$  is equal in the two countries (i.e.,  $p_c = p_c^*$ ).

Finally, note that even though the terms for the joint-welfare-maximizing and the Nash policies are the same ( $t^N = \lambda_d/p_c$  and  $\bar{t}^c = \lambda_d/p_c$ ), achieving the globally optimal policies will require cooperation over both trade and domestic policy, as with  $\bar{\tau}^c < \tau^N$  countries will face a unilateral incentive to use their domestic policies as a secondary trade barrier as in (7).

## II. Dynamic Model of Cooperation

The preceding section established that countries will have unilateral incentives to erect barriers to trade, but, since such barriers are globally suboptimal, would benefit from cooperating towards free trade while retaining their nondistortionary domestic policies. Unfortunately, the desire to erect trade barriers does not disappear once an agreement is in place, and a critical problem faced by any international agreement is the lack of an external enforcement mechanism to ensure that the signatories to an agreement uphold their obligations. In the absence of external enforcement mechanisms, an agreement will only be viable if it is self-enforcing (i.e., member countries must view their continued cooperation to be in their own best interest).

Moreover, as suggested by Copeland (1990), trade negotiations that constrain the ability of countries to pursue terms-of-trade advantages through trade policies induce substitution towards nonnegotiable secondary trade barriers (such as domestic policy). As can be seen from (7), once tariff barriers are lowered below their Nash levels, countries will also face a temptation to deviate from nondistortionary domestic policies. While both policies are negotiable in this paper, limitations on the ability of countries to cooperate will force a trade-off between further liberalization of tariff barriers and the ability of countries to maintain domestic taxes at their optimal levels. This raises the issue of commitments on *both* trade and domestic policies.

Avinash K. Dixit (1987), Bagwell and Staiger (1990), and Raymond Riezman (1991) show how countries can support low tariffs within a repeated relationship by configuring the tariff agreement so that each country fears that a decision to cheat on the agreement would trigger a costly retaliatory episode in the future.

I follow these papers in modeling the enforcement mechanism of an international agreement as a trigger strategy.<sup>12</sup> Consider, then, an agreement in which countries cooperate over trade and domestic taxes and credibly threaten infinite reversion to the noncooperative (Nash) equilibrium (in both policies), if cooperation is ever violated.<sup>13</sup> In each period, each country plays the cooperative trade and domestic policy pair  $(\tau^c, t^c$  and  $\tau^{c*}, t^{c*})$  provided that cooperative policies have been played by both countries in all previous periods. However, if either country ever cheats on the agreement (in either trade or domestic policy), then both countries revert to the noncooperative policies  $(\tau^N, t^N$  and  $\tau^{N*}, t^{N*})$  in all future periods.

Within this agreement, countries jointly choose cooperative trade and domestic taxes so as to maximize welfare. The cooperative level of welfare in each period is defined by:

$$(11) \quad W^C = W(\tau = \tau^c, t = t^c, \\ \tau^* = \tau^{c*}, t^* = t^{c*})$$

$$W^{C*} = W^*(\tau = \tau^c, t = t^c, \tau^* = \tau^{c*}, t^* = t^{c*})$$

where  $W$  is defined as in (5).

Since deviation in either trade or domestic policy will be punished by reversion to the Nash in both policies, if a country chooses to deviate from the agreement, it will do so in both trade and domestic policy (see B. Douglas Bernheim

<sup>12</sup> A novel feature of the current setting is that there are two instruments (trade and domestic policies) over which countries can cooperate, and this raises a question of "issue linkage": that is, should the agreement be configured so that cheating on any part of it would trigger a costly retaliatory episode covering *all* parts of the agreement, or should retaliation be confined to the provisions where the cheating took place? In this paper I assume that any deviation in either trade or domestic policy triggers retaliation in both trade and domestic policy.

<sup>13</sup> I focus on infinite reversion to the Nash equilibrium as the subgame-perfect threat that is used to support cooperation. One can consider alternative subgame-perfect punishment schemes (as in Dilip Abreu, 1986, 1988) which generate a more severe welfare level  $\bar{W}$  in the punishment phase. However, the severity of the punishment will not affect the basic result of this paper, although it will affect the range of cooperative trade policies that can be supported by the agreement.

and Michael D. Whinston, 1990). Note that a deviating country will select a trade and domestic tax pair  $(\tau^D, t^D)$  along its best-response curves [defined by equations (6) and (7)]. The level of welfare achieved by deviating from the agreement is given by:

$$(12) \quad W^D(\tau^{c*}, t^{c*}) \equiv W(\tau = \tau^D, t = t^D, \\ \tau^* = \tau^{c*}, t^* = t^{c*}) \\ W^{D*}(\tau^c, t^c) \equiv W(\tau = \tau^c, t = t^c, \\ \tau^* = \tau^{D*}, t^* = t^{D*}).$$

Once a country defects from the agreement, both countries abandon the agreement and revert to their Nash tariffs and domestic taxes (the non-cooperative equilibrium) in all subsequent periods. Nash welfare for the home country is then given by  $W(\tau = \tau^N, t = t^N, \tau^* = \tau^{N*}, t^* = t^{N*}) \equiv W^N$ , with Nash welfare for the foreign country symmetrically defined and denoted by  $W^{N*}$ . Thus, defining  $\delta$  as the discount factor between periods, the discounted value of avoiding a (permanent) breakdown in cooperation for the home country is given by  $[\delta/(1 - \delta)](W^C - W^N)$ .

An optimal agreement is characterized by maximization of joint welfare in the cooperative stage of the agreement  $(W^C + W^{C*})$ , subject to the self-enforcement constraints that neither country has an incentive to deviate from the agreement:

$$(13) \quad g(\tau^c, t^c, \tau^{c*}, t^{c*}) \\ \equiv [W^D(\tau^{c*}, t^{c*}) - W^C] \\ - \frac{\delta}{1 - \delta} (W^C - W^N) \leq 0$$

$$(14) \quad g^*(\tau^c, t^c, \tau^{c*}, t^{c*}) \\ \equiv [W^{D*}(\tau^c, t^c) - W^{C*}] \\ - \frac{\delta}{1 - \delta} (W^{C*} - W^{N*}) \leq 0.$$

The self-enforcement constraints (13) and (14) are satisfied if, for each country, the discounted value of future cooperation is greater than the

one-period gain from deviation for that country. If this condition is not satisfied, then that country would have an incentive to cheat on the agreement. Since trade and domestic policies are substitutes, this self-enforcement constraint requires countries to allocate their limited enforcement ability over the two policies. Note that when countries place great value on the future (high  $\delta$ ), the self-enforcement constraint will not bind (since each country will value highly the future gains to cooperation). Thus, any sufficiently high discount factor will support the globally efficient trade and domestic policy pairs as a self-enforcing agreement. However, when countries place less importance on the future (and thus the future gains to cooperation), an international agreement will be unable to support the efficient outcome.

I focus on the situation where self-enforcement is a binding constraint on the ability of countries to cooperate. The “most-cooperative” trade and domestic policy pair  $(\hat{\tau}^c, \hat{t}^c)$  is defined as the policy pair for the home country that, given a foreign policy pair  $(\tau^{c*}, t^{c*})$ , maximizes the joint cooperative welfare of the two countries from among the set of enforceable policy pairs [i.e.,  $(\tau^c, t^c)$  such that both (13) and (14) are satisfied]. As is shown in Appendix C, in Lemma 1, most-cooperative policies are characterized, for any  $\delta$ , by a tangency point between an iso-deviation curve ( $\tau^c$  and  $t^c$  pairs along which foreign welfare from deviating from the agreement is held constant) and an iso-global-welfare curve ( $\tau^c$  and  $t^c$  pairs along which joint [cooperative] welfare levels are held constant). Intuitively, if this tangency condition is not satisfied then there exists an alternate policy pair  $(\tilde{\tau}^c, \tilde{t}^c)$  consistent with an equivalent deviating level of welfare [i.e.,  $W^{D*}(\tilde{\tau}^c, \tilde{t}^c) = W^{D*}(\hat{\tau}^c, \hat{t}^c)$ ] and a higher cooperative level of welfare [i.e.,  $W^C(\tilde{\tau}^c, \tilde{t}^c) + W^{C*}(\tilde{\tau}^c, \tilde{t}^c) > W^C(\hat{\tau}^c, \hat{t}^c) + W^{C*}(\hat{\tau}^c, \hat{t}^c)$ ]. Thus, the alternate policy pair  $(\tilde{\tau}^c, \tilde{t}^c)$  is both enforceable and welfare superior to  $(\hat{\tau}^c, \hat{t}^c)$ , contradicting the definition of “most-cooperative” policies. Therefore, to find the most-cooperative equilibrium, one must look for the locus of such tangency points.

Iso-deviation loci reflect cooperative trade and domestic policy pairs  $(t^c, \tau^c)$  along which welfare levels from cheating on the agreement are held constant. The welfare level to be achieved by deviating from the agreement is a

function of the trade volume in the deviating stage, since a higher trade volume implies a greater incentive to deviate from the agreement as the terms-of-trade gains are applied to a larger volume of trade.<sup>14</sup> Indeed, it can be shown that the relative effect of each policy on the deviating level of welfare will be equal to each policy's relative effect on the deviating level of trade (i.e., an iso-deviation curve is simply an iso-trade curve). In addition, note that when  $t^c = \lambda_d/p_c$  and  $t^{c*} = \lambda_d^*/p_c^*$ , the production distortions have been completely internalized, and the only remaining distortion, from a global standpoint, is a policy-induced trade distortion (i.e., an inefficiently low trade volume brought on by the imposition of barriers to trade). Consequently, when  $t^c = \lambda_d/p_c$  and  $t^{c*} = \lambda_d^*/p_c^*$ , substituting between  $\tau^c$  and  $t^c$  so that trade volume is held constant, will hold global welfare constant (i.e., when countries set nondistortionary domestic taxes, the slope of the iso-global welfare curve is equal to the slope of an iso-trade curve). Thus, when countries set nondistortionary taxes ( $t^c = \lambda_d/p_c$  and  $t^{c*} = \lambda_d^*/p_c^*$ ), both the iso-deviation loci and the iso-global-welfare loci share a common slope of an iso-trade volume line. Hence, regardless of the discount factor  $\delta$ , within a self-enforcing agreement countries will always set taxes equal to the full external cost of production, since the locus of tangency points occurs at the nondistortionary domestic tax. This intuition is confirmed in the following proposition.

**PROPOSITION 2:** *Within a self-enforcing international agreement covering both trade and domestic policies, countries cooperate to set nondistortionary domestic taxes ( $t^c = \lambda_d/p_c$ ,  $t^{c*} = \lambda_d^*/p_c^*$ ) and then lower trade taxes as far as the self-enforcement constraint allows.*

**PROOF:**

See Appendix C.

Proposition 2 establishes that nondistortionary taxes will satisfy the necessary condition for an optimum within a self-enforcing agreement. Since countries cooperate to set the nondistor-

tionary domestic policy, the analysis reduces to choosing enforceable cooperative trade policies to maximize global welfare [analyzed by Dixit (1987) and Bagwell and Staiger (1990)]. Given nondistortionary taxes, joint (cooperative) welfare is monotonically increasing as countries lower the net trade barrier towards zero. Accordingly, most-cooperative trade policies ( $\hat{\tau}^c$ ,  $\hat{\tau}^{c*}$ ) can be determined by finding the lowest net trade barrier that satisfies the self-enforcement constraint, given that domestic policies are being set efficiently. Thus, within a cooperative agreement, the only means of trade protection will be in the form of trade taxes. Intuitively, since the underlying reason for defecting from the agreement is trade related, relaxing cooperation in trade policy will be the most efficient means of satisfying the self-enforcement constraint and thereby maintaining the viability of the agreement. Accordingly, this result provides support for the current treatment of domestic policies in GATT, and for the preference for existing trade barriers to be in the form of tariffs.

However, as should be apparent from the Proof of Proposition 2 in Appendix C, the strict efficiency of Article III is contingent on Assumption 2: that the slope of the iso-trade line is equal across different levels of foreign policies. If supply and demand curves are approximately linear in local prices, then Assumption 2 is satisfied and there is essentially no gain from distorting domestic policies. However, if there are substantial nonlinearities in the supply and demand functions, then Assumption 2 may not be satisfied and it may be possible to substitute away from nondistortionary taxes to achieve a more cooperative outcome. For example, assume that the home country tariff has a greater effect on trade volume (relative to the home country production tax) when the foreign country is cooperating ( $\tau^{c*}$ ,  $t^{c*}$ ) than when the foreign country is deviating ( $\tau^{D*}$ ,  $t^{D*}$ ):

$$\frac{\partial T_X(\tau^c, t^c, \tau^{c*}, t^{c*})/\partial \tau^c}{\partial T_X(\tau^c, t^c, \tau^{c*}, t^{c*})/\partial t^c} > \frac{\partial T_X(\tau^c, t^c, \tau^{D*}, t^{D*})/\partial \tau^c}{\partial T_X(\tau^c, t^c, \tau^{D*}, t^{D*})/\partial t^c}.$$

<sup>14</sup> This observation is also what drives the results of Bagwell and Staiger (1990): periods of high trade volume correspond to periods where the incentive to defect is high, and so require episodes of temporary protection to maintain the agreement.

In the above case, it is possible to substitute between the home country's tariff and production tax in such a way that the volume of trade in the deviating stage of the agreement is held constant, while the volume of trade in the cooperative stage of the agreement increases. Holding the deviating volume of trade constant holds the welfare to be achieved by deviating from the agreement constant. In addition, when a country's domestic policy is infinitesimally close to the nondistortionary tax, an increase in the cooperative trade volume will increase the cooperative level of welfare (since the only distortion in the cooperative stage of the agreement is the inefficiently low volume of trade brought on by the imposition of trade barriers). Thus, when Assumption 2 is not satisfied, it may be possible to substitute between trade and domestic policy (and away from the nondistortionary optimum) to find a "less trade-restrictive," and thereby more efficient, equilibrium.

### III. Conclusion

The analysis in this paper is motivated by two basic ideas. The first is that trade and domestic policies are substitutes, so as countries form trade agreements to lower their respective trade barriers, they encounter incentives to distort their domestic policies as a secondary trade barrier. The second is that these policies are not perfect substitutes, implying that a ranking of policies is possible. Jagdish Bhagwati and V. K. Ramaswami (1963) formalized these ideas and spawned a voluminous literature in the 1960's and 1970's on the optimal unilateral setting of trade and domestic policies in open economies in the presence of market failures. The major proposition of this research was that the first-best policy to address a single distortion is the policy that offsets the source of the distortion directly. For example, in a noncooperative framework, a large country with monopoly power in trade and a domestic distortion would introduce a domestic tax/subsidy scheme to tackle the domestic distortion, while enacting a suitable tariff for the trade distortion. My research extends these ideas to a cooperative environment, and demonstrates that they have important implications for the structure of international agreements.

The primary result of this paper is that when limited enforcement power prevents countries from implementing a fully efficient set of trade and domestic policies, countries should cooperate fully over domestic policy (set the domestic policy to fully counter any domestic distortion), and then adjust trade policies to maintain the viability of the agreement. This result is an application of the fact that trade and domestic policies are imperfect substitutes. The self-enforcement constraint requires countries to relax cooperation on at least one of the policies, so as to mitigate the incentive to defect from the agreement. Since the sole international externality in this framework is the terms-of-trade effects of a government's policy decisions, the sole reason for defection is to pursue terms-of-trade gains. Therefore, the most efficient means of countering the incentive to deviate from the agreement is to relax only trade policy (while maintaining nondistortionary domestic taxes). Such a result serves to support the current treatment of trade and domestic taxes in GATT.

A secondary application of this result regards the design and inclusion of flexibility in a joint agreement covering both trade and domestic policies. Various escape clauses and other exceptions have been built into the GATT framework, and one interpretation of these provisions is that they serve to facilitate voluntary cooperation by member countries. Bagwell and Staiger (1990) provide a model in which episodes of "special protection" can be explained as attempts to maintain the incentive to cooperate in the face of changes in the underlying trade volume (which affect the incentive countries may have to defect from the agreement). They argue that GATT's escape clauses can be interpreted as an attempt to provide member countries with the needed flexibility to maintain the integrity of a self-enforcing agreement in a volatile world, and that the recent proliferation of Voluntary Export Restraints and other "gray area" measures can be viewed as attempts to augment GATT's escape clauses with additional flexibility. In my working paper, Ederington (2000), I show that a separate implication of Proposition 2 is that, since any change in the temptation to deviate is most efficiently handled by adjusting trade policy, any joint agreement will allocate much of its

flexibility to the trade policy provisions of the agreement. Hence, the model suggests a rationale for incorporating escape valves with respect to trade policy obligations, but not domestic policy obligations, into an international agreement.

There are two caveats to the above results that bear mentioning. The first was addressed in the paper and is an application of the theory of the second best or the proposition that, in the presence of an unaddressed distortion, it is possible that the proper policy instruments cannot be uniquely ranked vis-à-vis one another. An implication of this proposition is a theorem first introduced by Jan Tinbergen (1956) that for achieving several policy goals optimally one would, in general, need as many policy instruments as goals. An international agreement has two policy instruments (cooperative trade and domestic policies), but is faced with three potential distortions (the production distortion and trade distortions in both the cooperative and deviating stages of the agreement). When the relative effect of trade and domestic policy on trade volume in both stages of the agreement is equal, then only trade policy (as the most efficient means of affecting trade volume) will be used to target both trade distortions simultaneously. However, when this relative effect differs across the two stages of the agreement, then it will be possible to substitute between trade and domestic policy so as to increase the cooperative level of world welfare while holding the incentive to deviate in check. Thus, the paper provides a condition under which full cooperation in domestic policy (the setting of nondistortionary domestic taxes) may not be desirable, and thus an exception to Article III should be made.

The second caveat is that the paper assumed that the only international externalities in the model are terms-of-trade externalities (which will only be the case when the production distortions are purely local in nature). Obviously, some environmental externalities are international in nature (i.e., transboundary or global pollution) and are of great concern in the international arena. Indeed, the presence of such nonpecuniary international externalities will cause countries to set noncooperative domestic policies which are suboptimal from a global standpoint, and it is hardly clear that trade pol-

icy is still the more efficient means of handling enforcement issues in the presence of these externalities. A potentially rewarding future line of inquiry is to explore the optimal design of international institutions (covering both trade and domestic policy) in the presence of nonpecuniary international externalities.

#### APPENDIX A: DERIVATION OF NONCOOPERATIVE FIRST-ORDER CONDITIONS

To derive the best-response function for the optimal unilateral trade policy, take the derivative of the welfare function (5) with respect to trade policy to find the first-order condition:

$$\frac{\partial W}{\partial \tau} = 0 = \left[ F_1 \frac{\partial X}{\partial \tau} + p_w \frac{\partial T_x}{\partial \tau} + T_x \frac{\partial p_w}{\partial \tau} \right] + U_1 \left[ \frac{\partial X}{\partial \tau} - \frac{\partial T_x}{\partial \tau} \right] + U_2 \left[ \frac{\partial S}{\partial X} \frac{\partial X}{\partial \tau} \right]$$

where  $U_i$  represents the partial derivative of welfare ( $U$ ) with respect to the  $i$ th argument. By collecting terms, this first-order condition can be rewritten as:

$$0 = \frac{\partial X}{\partial \tau} \left[ F_1 + U_1 + U_2 \frac{\partial S}{\partial X} \right] + \frac{\partial T_x}{\partial \tau} [p_w - U_1] + T_x \frac{\partial p_w}{\partial \tau}.$$

Using the definition of  $\lambda_d$  and the fact that profit-maximizing producers act to set the marginal rate of transformation equal to the producer price ratio ( $F_1 = -p_s$ ) while utility-maximizing consumers act to set the marginal rate of substitution equal to the consumer price ratio ( $U_1 = p_c$ ) one derives:

$$0 = \frac{\partial X}{\partial \tau} [-\lambda_d + p_c - p_s] + \frac{\partial T_x}{\partial \tau} [p_w - p_c] + T_x \frac{\partial p_w}{\partial \tau}.$$

Using the definitions of trade policy and domestic policy, I derive the first-order condition:

$$0 = [t \cdot p_c - \lambda_d] \frac{\partial X}{\partial \tau} - \tau \cdot p_w \frac{\partial T_x}{\partial \tau} + T_x \frac{\partial p_w}{\partial \tau}.$$

The derivation of the best-response function for domestic policy and the derivations for foreign best-response functions are found similarly.

APPENDIX B: DERIVATION OF GLOBALLY OPTIMAL FIRST-ORDER CONDITIONS

To derive the first-order condition for maximizing joint welfare over trade policy, take the derivative of  $(W + W^*)$  with respect to trade policy  $(\tau)$ :

$$\begin{aligned} 0 &= \frac{\partial X}{\partial \tau} \left[ F_1 + U_1 + U_2 \frac{\partial S}{\partial X} \right] \\ &+ \frac{\partial T_x}{\partial \tau} [p_w - U_1] \\ &+ \frac{\partial X^*}{\partial \tau} \left[ F_1^* + U_1^* + U_2^* \frac{\partial S^*}{\partial X^*} \right] \\ &+ \frac{\partial T_x}{\partial \tau} [U_1^* - p_w]. \end{aligned}$$

Substituting in for local producer and consumer prices, this first-order condition can be rewritten as:

$$\begin{aligned} 0 &= \frac{\partial X}{\partial \tau} [-\lambda_d + p_c - p_s] + \frac{\partial T_x}{\partial \tau} [p_w - p_c] \\ &+ \frac{\partial X^*}{\partial \tau} [-\lambda_d^* + p_c^* - p_s^*] \\ &+ \frac{\partial T_x}{\partial \tau} [p_c^* - p_w]. \end{aligned}$$

Finally, I use my definitions of trade and domestic policy (for both countries) to derive the first-order condition:

$$\begin{aligned} 0 &= (t \cdot p_c - \lambda_d) \frac{\partial X}{\partial \tau} - \tau \cdot p_w \frac{\partial T_x}{\partial \tau} \\ &+ (t^* \cdot p_c^* - \lambda_d^*) \frac{\partial X^*}{\partial \tau} \\ &- \frac{\tau^*}{1 + \tau^*} p_w \frac{\partial T_x}{\partial \tau}. \end{aligned}$$

The derivation of first-order condition for maximizing joint welfare with respect to domestic policy and foreign policy choices is exactly analogous to the above.

APPENDIX C: PROOF OF PROPOSITION 2

Most-cooperative policies  $(\hat{\tau}^c, \hat{t}^c)$  are chosen to maximize joint welfare  $(W^C + W^{C*})$  subject to the combined self-enforcement constraint:

$$\begin{aligned} (C1) \quad & [W^D(\tau^{c*}, t^{c*}) - W^C] \\ & + [W^{D*}(\tau^c, t^c) - W^C] \\ & - \frac{\delta}{1 - \delta} [(W^C + W^{C*}) - (W^N + W^{N*})] \leq 0. \end{aligned}$$

If (C1) is satisfied, then the gains to cooperation can be distributed so that both (13) and (14) are individually satisfied. In Lemma 1, I establish a necessary condition that must be satisfied by  $(\hat{\tau}^c, \hat{t}^c)$ .

LEMMA 1: For a given foreign policy pair  $(\tau^{c*}, t^{c*})$ , the “most-cooperative” policy pair for the home country  $(\hat{\tau}^c, \hat{t}^c)$  must satisfy the following tangency condition:

$$(C2) \quad \left. \frac{\partial \tau^c}{\partial t^c} \right|_{dW^{D*}=0} = \left. \frac{\partial \tau^c}{\partial t^c} \right|_{d(W^C + W^{C*})=0}.$$

PROOF:

Taking the derivatives of the Lagrangian of the constrained maximization, one derives first-order conditions with respect to the cooperative trade and domestic policies  $(\tau^c, t^c)$ . Combining these first-order conditions to eliminate the Lagrange multiplier, one derives that:

$$\frac{\partial W^{D*}/\partial \tau}{\partial W^{D*}/\partial t} = \frac{(\partial W^C/\partial \tau) + (\partial W^{C*}/\partial \tau)}{(\partial W^C/\partial t) + (\partial W^{C*}/\partial t)}$$

which is equivalent to (C2) in Lemma 1.

In Lemma 2, I characterize this locus of tangency points.

LEMMA 2: Under Assumption 2, the locus of tangency points between the iso-trade and iso-global-welfare curves are given by the nondis-

tortionary domestic tax:  $t^c = \lambda_d/p_c$  and  $t^{c*} = \lambda_d^*/p_c^*$ .

PROOF:

Taking derivatives of ( $W^{D*}$ ) with respect to  $\tau^c$  and  $t^c$ , the slope of the iso-deviation curve is given by:

$$(C3) \quad \left. \frac{\partial \tau^c}{\partial t^c} \right|_{d(W^{D*})=0} = \frac{-\left(\frac{\tau^{D*}}{1 + \tau^{D*}}\right)(p_w) \frac{\partial T_x}{\partial t^c} + T_x \left(\frac{\partial p_w}{\partial t^c}\right)}{-\left(\frac{\tau^{D*}}{1 + \tau^{D*}}\right)(p_w) \frac{\partial T_x}{\partial \tau^c} + T_x \left(\frac{\partial p_w}{\partial \tau^c}\right)}$$

As in Markusen (1975), it will be the case that, if a unique foreign offer curve is associated with every world price, one can express the

world price as a function of domestic excess supply of a single commodity (i.e.,  $p_w = H(T_x)$ ). From this equation, it is direct to show that:

$$(C4) \quad \frac{\partial T_x / \partial t^c}{\partial T_x / \partial \tau^c} = \frac{\partial p_w / \partial t^c}{\partial p_w / \partial \tau^c}$$

Using (C4), one can rewrite (C3) and derive that:

$$(C5) \quad \left. \frac{\partial \tau^c}{\partial t^c} \right|_{dW^{D*}=0} = \frac{\partial T_x / \partial t^c}{\partial T_x / \partial \tau^c}$$

Taking derivatives of [ $W^C + W^{C*}$ ] with respect to  $\tau^c$  and  $t^c$ , the slope of these indifference curves (for a given  $\tau^{c*}$  and  $t^{c*}$ ) are given by:

$$(C6) \quad \left. \frac{\partial \tau^c}{\partial t^c} \right|_{d(W^C + W^{C*})=0} = \frac{(t^c \cdot p_c - \lambda_d) \frac{\partial X}{\partial t^c} + (t^{c*} \cdot p_c^* - \lambda_d^*) \frac{\partial X^*}{\partial t^c} - \left(\tau^c + \frac{\tau^{c*}}{1 + \tau^{c*}}\right)(p_w) \frac{\partial T_x}{\partial t^c}}{(t^c \cdot p_c - \lambda_d) \frac{\partial X}{\partial \tau^c} + (t^{c*} \cdot p_c^* - \lambda_d^*) \frac{\partial X^*}{\partial \tau^c} - \left(\tau^c + \frac{\tau^{c*}}{1 + \tau^{c*}}\right)(p_w) \frac{\partial T_x}{\partial \tau^c}}$$

From (C6) and (C5) and employing Assumption 2 one can derive that the tangency condition (C2) reduces to the condition that<sup>15</sup>:

$$(C7) \quad (t \cdot p^c - \lambda_d) \frac{\partial X}{\partial t} \left[ \frac{\partial T / \partial \tau}{\partial T / \partial t} - \frac{\partial X / \partial \tau}{\partial X / \partial t} \right] = (t^* \cdot p^{c*} - \lambda_d^*) \frac{\partial X^*}{\partial t} \left[ \frac{\partial X^* / \partial \tau}{\partial X^* / \partial t} - \frac{\partial T / \partial \tau}{\partial T / \partial t} \right]$$

It is direct to verify that the right-hand side of this equation is equal to zero since:

$$\frac{\partial T_x / \partial t^c}{\partial T_x / \partial \tau^c} = \frac{\partial p_w / \partial t^c}{\partial p_w / \partial \tau^c} = \frac{\partial X^* / \partial t^c}{\partial X^* / \partial \tau^c}$$

<sup>15</sup> Assumption 2 is necessary since the equality requires that the relative effect of trade and domestic policy on the cooperative volume of trade (evaluated at  $t^{c*}$ ,  $\tau^{c*}$ ) is equal to their relative effect on the deviating volume of trade (evaluated at  $t^{D*}$ ,  $\tau^{D*}$ ).

Therefore,  $t = \lambda_d/p_c$  is a solution to (C2) and, given Assumption 1,  $t = \lambda_d/p_c$  is a unique solution. By similar calculations, one can verify that  $t^* = \lambda_d^*/p_c^*$  is a unique solution to the foreign country's tangency condition.

REFERENCES

Abreu, Dilip. "Extremal Equilibria of Oligopolistic Supergames." *Journal of Economic Theory*, June 1986, 39(1), pp. 191-225.

\_\_\_\_\_. "On the Theory of Infinitely Repeated Games with Discounting." *Econometrica*, March 1988, 56(2), pp. 383-96.

Bagwell, Kyle and Staiger, Robert W. "A Theory of Managed Trade." *American Economic Review*, September 1990, 80(4), pp. 779-95.

\_\_\_\_\_. "An Economic Theory of GATT." *American Economic Review*, March 1999, 89(1), pp. 215-48.

Bernheim, B. Douglas and Whinston, Michael D. "Multimarket Contact and Collusive Behav-

- ior." *Rand Journal of Economics*, Spring 1990, 21(1), pp. 1–26.
- Bhagwati, Jagdish and Ramaswami, V. K.** "Domestic Distortions, Tariffs, and the Theory of Optimum Subsidy." *Journal of Political Economy*, February 1963, 71(1), pp. 44–50.
- Copeland, Brian R.** "Tariffs and Quotas: Retaliation and Negotiation with Two Instruments of Protection." *Journal of International Economics*, February 1989, 26(1–2), pp. 179–88.
- \_\_\_\_\_. "Strategic Interaction among Nations: Negotiable and Non-negotiable Trade Barriers." *Canadian Journal of Economics*, February 1990, 23(1), pp. 84–108.
- Dam, Kenneth W.** *The GATT: Law and international economic organization*. Chicago: University of Chicago Press, 1970.
- Deardorff, Alan.** "International Conflict and Coordination in Environmental Policies," in Jagdeep S. Bhandari and Alan O. Sykes, eds., *Economic dimensions in international law: Comparative and empirical perspectives*. New York: Cambridge University Press, 1997, pp. 248–74.
- Dixit, Avinash K.** "Strategic Aspects of Trade Policy," in Truman F. Bewley, ed., *Advances in economic theory: Fifth World Congress*. Cambridge, MA: Cambridge University Press, 1987, pp. 329–62.
- Ederington, Josh.** "International Coordination of Trade and Domestic Policies." Mimeo, University of Miami, 2000.
- Hungerford, Thomas L.** "GATT: A Cooperative Equilibrium in a Noncooperative Trading Regime?" *Journal of International Economics*, November 1991, 31(3–4), pp. 357–69.
- Johnson, Harry G.** "Optimum Tariffs and Retaliation." *Review of Economic Studies*, 1953–1954, 21(2), pp. 142–53.
- Maggi, Giovanni.** "The Role of Multilateral Institutions in International Trade Cooperation." *American Economic Review*, March 1999, 89(1), pp. 190–214.
- Markusen, James R.** "International Externalities and Optimal Tax Structures." *Journal of International Economics*, February 1975, 5(1), pp. 15–29.
- Mayer, Wolfgang.** "Theoretical Considerations on Negotiated Tariff Adjustments." *Oxford Economic Papers*, March 1981, 33(1), pp. 135–53.
- Riezman, Raymond.** "Dynamic Tariffs with Asymmetric Information." *Journal of International Economics*, May 1991, 30(3–4), pp. 267–83.
- Tinbergen, Jan.** *Economic policy: Principles and design*. Amsterdam: North-Holland, 1956.