Paths of Efficient Self Enforcing Trade Agreements

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I. Introduction

An extensive literature has developed on whether preferential trade agreements are stumbling blocks or building blocks toward a multilateral trade agreement. The idea that preferential agreements are obstacles to global agreements is primarily focused on examples in which the members of preferential agreement earn higher welfare than they would at free trade, and therefore would not choose to become members of a free trade agreement. These examples include models where the formation of a preferential agreement confers market power on the member countries that they exercise by erecting trade barriers against non-members (eg. Bond and Syropoulos (1996)), as well as in models where the preferential agreement confers benefits to politically powerful members that would be eroded by membership in a multilateral agreement (eg. Levy (1997), Krishna (1998)).

Much of the negative impact of a preferential agreement can be eliminated if countries can use transfers to bribe the members to participate in the global agreement. If the global agreement yields higher world welfare than the preferential agreements, then the gains to the non-member from joining should be sufficiently large that a transfer can be made that will bribe the members of the preferential agreement to join the global agreement. In this view, a bilateral agreement will be at worst a temporary detour on the road to a global agreement. This temporary detour is made to improve the strategic position of the member countries, in order to receive a favorable transfer to join the global agreement.

The literature on building blocks and stumbling blocks has generally ignored the issue of enforceability of trade agreements and promises to make lump sum transfers. The transfers that are made as part of trade agreements do not typically take the form of cash, but are instead involve promises to make concessions on other issues that are of value to the countries (eg. intellectual property, labor standards, and foreign investment measures). However, countries can renege on transfers just as they can renege on promises to reduce tariffs. This limitation on transfers may prevent the non-member countries from being able to bribe the members of a preferential agreement to accept a global trade agreement.

The purpose of this paper is to formalize these constraints on transfers by characterizing the payoff frontier for a 3 country model in which agreements between countries (which include the level of transfers to be made) must satisfy a no deviation constraint. This approach can be thought of as being an exercise in which a central planner is assigning countries to trade agreement, subject to the constraint that the agreements must be self-enforcing. The question examined is which of these agreement/transfer combinations will not be Pareto dominated. Although this approach does not propose a specific bargaining game for selecting a trade agreement, it can be thought of as identifying the potential candidate agreements that could be chosen if the bargaining procedure was one that generated an outcome that was not Pareto dominated. For example, one might imagine applying the generalized Nash bargaining solution to the constrained efficient payoff frontier as a means of selecting an agreement. Which particular agreement would be selected by the bargaining process would depend on the weights applied to the respective countries.

The analysis here proceeds under the assumption that the global agreement is efficient in the absence of the requirement that agreements be self-enforcing. The question then is whether these constrained efficient agreements might either be paths in which the global agreement never is achieved, or paths in which the global agreement is only formed after some delay following a bilateral agreement. It is shown that delay in the formation of the global agreement can arise for two reasons. The first occurs in situations where a bilateral agreement provides sufficient benefit to member countries that the transfer required to induce them into a global agreement is not self-enforcing. In this case, the member countries might agree to join the global agreement, but only after some delay. The delay allows the member countries to reap the higher benefits under the preferential agreement before accepting the largest self-enforcing transfer that can be made by the non-members to join the global agreement. Such an agreement would not be Pareto dominated either by a permanent global agreement or a permanent bilateral agreement.

A second case arises where there are costs of forming an agreement to the countries involved.

Accession to multilateral and preferential trade agreements is often a lengthy process in which entrants must adjust domestic laws to make them compatible with the trade agreement. In addition, adjustment costs may be incurred from moving resources out of sectors that will face greater import competition following entry into the agreement. The self-enforcing constraints are most severe in the early stages of an agreement with agreement costs of this type. An example is provided in which countries are symmetric, and adjustment costs are such that simultaneous formation of an agreement is not self-enforcing. However, an agreement in which two of the countries form a bilateral agreement and then bring in the third with some delay may be self-enforcing. Once some of the costs of forming the agreement have been incurred by the initial entrants, these "anchor" countries of the agreement can provide transfers that make entry by the third country self-enforcing as well.

Section II presents the basic 3 country model, and uses it to provide a brief review of the literature on the effects of formation of preferential trade agreements on the adoption of multilateral agreements. The basic results are then provided for the case in which there are no costs of forming agreements. Section III introduces agreement costs, and presents the no deviation cases for permanent agreements (either bilateral and global) and expanding agreements that move from bilateral to global. Some conditions under which gradual expansion is likely to be preferred to immediate expansion are provided for the case of symmetric countries.

II. A Three Country Model of Trade Agreements

We examine a three country trade model, with the countries denoted as 1,2, and 3. The set of possible trading bloc arrangements between the countries will be denoted by A, with $a \in A$ denoting a list of the trading blocs and their members. There will be 6 possible (mutually exclusive) bloc structures: a 3 country "global" trade bloc (denoted by G = {1,2,3}), 3 different "bilateral" trade blocs (B_{ij} = {i,j}, {k}) and a case with no trade blocs (N = {1}, {2}, {3}). The payoff to country i when the bloc structure is a is $w_i(a)$. The analysis here is simplified by abstracting from transition periods during which the tariffs are adjusted from previous levels to the values negotiated under the agreement, so that the payoffs under an agreement will be the same in any period.

Minimal restrictions will be put on the country payoffs under the various agreements in order to allow for a variety of different cases that have been considered in the literature. For example, Syropoulos (1999) examines a three country symmetric endowment model with Cobb Douglas preferences and shows that the equilibrium with the customs union may satisfy either $w_1(B_{12}) > w_1(G) > w_1(N) > W_3(B_{12})$ or $w(G) > w_1(B_{12}) > w_1(N) > w_3(B_{12})$. These possibilities arise both when the customs union is setting its external tariff optimally and when its external tariff is constrained by a Article XXIV constraint. The case of customs union welfare exceeding the free trade level arises when there are moderate degrees of comparative advantage, which lead to the greatest ratio of tariffs of member countries to non-member countries. On the other hand, Bond, Riezman and Syropoulos (2004) show that if the blocs formed are FTAs, the member countries tend to reduce their external tariffs more substantially following formation of an FTA. This reduction in the external tariffs benefits the non-member country and can result in either $w_3(G) > w_3(B_{12}) > w_3(N)$ or $w_3(B_{12}) > w_3(G) > w_3(N)$. The latter case, where the excluded member is better off than under free trade, arises in the case where the bloc members are relatively small.

Similarly, a variety of outcomes can arise in models that allow for political considerations. Levy (1997) analyzes a Heckscher-Ohlin model in which the decisions are determined by the preferences of the median voter. He shows that a multilateral agreement will be preferred to a bilateral agreement when industries are perfectly competitive, but bilateral agreements could be preferred to the multilateral agreement if the products are differentiated. Krishna (1998) obtains a similar result in an oligopoly model where the objective function of the government is the profits of the home oligopolists.

A. Modeling Trade Bloc Formation

There are a number of ways to approach the issue of trading bloc formation, and whether preferential trading arrangements are obstacles to multilateral free trade agreements. One is to take an exogenously given path of potential agreements, and to ask whether the countries involved at each stage would choose to form an agreement. Under this approach, countries 1 and 2 would form a bilateral agreement if $w_i(B_{12}) \geq w_i(N)$ holds for $i = 1,2$. The multilateral agreement would then be adopted in the second round if $w_i(G) > w_i(B_{12})$ for i = 1,2,3. Bilateral agreements are stumbling blocks if the bilateral agreement passes but the multilateral agreement fails. A simple way in which bilateral agreements can become stumbling blocs is if countries are national welfare maximizers and the market power effect of a customs union is sufficiently large that the customs union is better off than it would be at free trade. The political economy models of Levy (1997) and Krishna (1998) generate similar results for some parameter values as noted above.

Note that the inability of governments to provide transfers is an important component of these results suggesting that bilateral agreements may be obstacles to multilateral agreements. If lump sum transfers can be made between governments, then the non-member can potentially bribe the member countries of a bilateral agreement to accept the multilateral agreement. The transfer that non-member country k must pay the members get them to accept a global agreement is $s_k = \sum_{u=i,j} \left(w_u(B_{ij}) - w_u(G)\right)$. Letting $\Omega(a) = \sum_i w_i(a)$ denote world welfare under agreement a, we will focus on the case in which

$$\Omega(G) > \Omega(a) \quad for \ a \neq G \tag{1}$$

In this case there is a transfer that will result in formation of the global agreement from any initial bilateral agreement than has been formed. Although case transfers are rarely observed in trade agreements, side agreements on a variety of issues are frequently considered as part of trade agreements. These side agreements will be interpreted here as representing the lump sum transfers between countries.

With lump sum transfers, the set of feasible net payoffs to the countries under the global agreement is the set of values $v_i = w_i(G) - s_i$ satisfying $\sum_{i=1}^{3} s_i \geq 0$. Assuming that (1) holds, the Pareto frontier of net payoffs to the countries from the set of potential agreements A will thus be $\sum_{i=1}^{3} v_i - \Omega(G) = 0$. Aghion, Antras, and Helpman (2006) show that the global agreement will be reached under a wide variety of bargaining protocols when (1) is satisfied. In particular, they compare multilateral and sequential bargaining procedures in situations where there is a 'leader' country that makes take it or leave it offers to the other countries. The payoff to multilateral and sequential bargaining may differ depending on the spillover effects of the formation of a bilateral agreement on the non-member country, but in either case the global agreement will be formed. Seidmann (2006) also considers a bargaining model with transfers between countries, but assumes that the initial proposer is chosen randomly and that a country rejecting a proposal gets to propose in the following period. In this environment, a bilateral agreement may be used as "strategic positioning" prior to the eventual formation of a global agreement. This occurs in cases when the formation of the bilateral agreement imposes sufficient harm on the non-member, so that the bilateral agreement can be used to improve the member country payoff when the global agreement is eventually formed.

B. Self-Enforcing Permanent Trade Agreements

The models of the formation of trade agreements discussed in the previous section were based on the assumption that countries are able to commit to make the required transfers under an agreement once it has been formed. They thus abstract from the enforcement issues that arise in agreements between sovereign countries where an external enforcement authority is lacking. In this section we examine formation of trade agreements under the assumption that an agreement must satisfy a no deviation constraint. The objective is to characterize the efficient payoff frontier of the set of agreements that satisfy the no deviation constraint. It will be assumed that transfers between agreement members are possible, although the no deviation constraint will require that the member countries be willing to pay the transfer as well as satisfy the conditions on tariffs negotiated as part of the agreement.

We first examine the sustainability of trade agreements in the absence of transfers. A trade agreement will specify a punishment payoff $w_i^P(a)$ for a country that deviates from the agreement. Letting δ be the discount factor and $w_i^D(a)$ the payoff if country i deviates from the agreement, we can express the average payoff by a country deviating from an agreement as $v_i^D(a,\delta) \equiv (1-\delta)\, w_i^D(a) + \delta w_i^P(a)$. An agreement a will be self-enforcing in the absence of transfers if $\Gamma_i(a, \delta) \equiv w_i(a) - v_i^D(a, \delta) \geq 0$. The literature on repeated games has considered a variety of restrictions to be imposed on the type of punishment allowed, including the requirements that they be subgame perfect or renegotiation proof. Since the concern here is with the relative sustainability of agreements, the important factor is how the overall deviation payoffs differ across agreements. Therefore, we will treat the average deviation payoff as a parameter in the analysis and will not focus on the particular punishment chosen. The only restriction that will be imposed on the deviation and punishment payoffs is that $w_i^D(a) > w_i(a) > w_i^P(a)$. This assumption ensures that Γ_i is increasing in δ for all member countries of an agreement and that $\Gamma_i(a, 1) > 0$. This reflects the usual result from a repeated prisoner's dilemma that the cooperative outcome can be supported as an equilibrium of the repeated game if sufficient weight is placed on future payoffs. Specifically, there will exist a critical discount factor $\delta_i^C(a) \in (0,1)$ such that agreement a will be sustainable for country i if $\delta \geq \delta_i^C(a)$.

An agreement a' will be more sustainable than agreement a for country $i \in I(a), I(a')$ if $\Gamma_i(a', \delta) > \Gamma_i(a,\delta)$. Although the global agreement is assumed to be most efficient here, we will allow for the possibility that it is either more or less sustainable than bilateral agreements. Maggi (1999) points out that one of the benefits of multilateral agreements is the ability to coordinate enforcement power, which would suggest that $w_i^P(G) < w_i^P(B_{ij})$. However, the benefits of deviation from a global agreement may well be larger than from a bilateral agreement. This raises the possibility that the relative sustainability of bilateral and global agreements depends on the level of the discount parameter, with the global agreement being more sustainable for high δ and the bilateral agreement being more sustainable for low δ. One might also question the degree to which multilateral agreements have been more effective at utilizing their enforcement power as compared with regional agreements. The WTO settles disputes primarily on a bilateral basis and does not allow third parties to punish deviating countries, whereas the European Union has a much deeper degree of integration that may allow for more effective enforcement against potential deviators. Thus, it seems preferable not to restrict the relative sustainability of the agreements ex ante.

When transfers are allowed, an agreement will also specify a sequence of transfers $s_i = (s_{i0}, s_{i1}, \ldots)$ of transfers to be paid by country i for $i \in I(a)$. Feasibility of the transfers requires $\sum_{i \in I(a)} s_{it} = 0$ for all t. The present value of transfers to i from t onward is denoted $S_{it} \equiv \sum_{i=0}^{\infty} s_{t+i}\delta^i$. It will be assumed that a deviating country receives any positive transfers made by the other member countries in the period it deviates, so the deviation payoff is $v_i^D(a,\delta) - s_{it}(1-\delta)$ for $s_{it} < 0$. However, a deviating country will not pay a transfer owed to the other member countries, yielding a deviation payoff of $v_i^D(a,\delta)$ for $s_{it} \geq 0$. This assumption reflects that fact that if transfers take the form of a side agreement, there will be a lag between the time when a country deviates from the promised transfer and the time when the deviation is recognized and punished by the partner country. This lag is assumed to be the same time period required to recognize that a deviation on the tariff rate has been taken. The no deviation constraint at t will then require that the average payoff from the agreement, $v_{it} \equiv w_i(a) - S_{it}(1 - \delta)$, be no greater than the average payoff received by country i under a deviation, $v_i^D(a, \delta) - min\ (0, s_{it})(1 - \delta)$. Using the definition of Γ_i this constraint can be expressed as

$$\Gamma_i(a,\delta) \geq (1 - \delta)\left(S_{it} - min(0,s_{it})\right) = (1-\delta)\left(max(s_{it},0) + \delta S_{i\,t+1}\right) \quad \textbf{(2)}$$

In order for a feasible agreement to be sustainable, (2) must be satisfied for all member countries at all t.

Equation (2) implies that the no deviation constraint will be most restrictive at the point where S_{it} - $min\ (0, s_{it})$ is highest. This would suggest that the most efficient means of paying a transfer with net present value S_{i0} is to have the transfers be constant over time. The following result shows that in examining sustainable agreements, there is no loss of generality in restricting attention to agreements that require an initial transfer of s_{i0} in period 0 and a constant payment of s_{i1} thereafter.

Lemma 1: Suppose an agreement requires country $i \in I(a)$ to pay a net transfer of s_{i0} at $t = 0$ and s_{i1} for all $t \geq 0$, where $\sum_{i \in I(a)} s_i = \sum_{i \in I(a)} s_{i0} = 0$.

(a) This agreement will be sustainable for country i iff $\Gamma_i \geq \max [s_{i1}, \max (0, s_{i0})(1\text{-}\delta) + \delta s_{i1}]$.

(b) Suppose that there is another sequence of transfers $s' = (s_{i0}, s_{i1}', s_{i2}', \ldots)$ satisfying $\sum_{i \in I(a)} s_{it}^{/} = 0$ for all t and $S_{i0}' = S_{i0}$ for all i. The set of Γ_i for which s_i' is sustainable is no larger than the set for which s_i is sustainable for all $i \in I(a)$.

Lemma 1 shows that agreements with constant values of transfers for $t > 0$ are the easiest to sustain. A country that receives a reduction in the amount that it must pay (or an increase in the transfer it receives for $s_i < 0$) at time *t* will face a larger obligation (or receive a smaller transfer) in the future, which tightens its no deviation constraint. Furthermore, reducing the net transfer paid by one member at t will raise the transfer (and hence tightens the no deviation constraint for some other member) at *t*. A second point to note is that there is an asymmetry between transfers at $t = 0$ and transfers for $t > 0$, which is due to the fact that a transfer paid at time 0 does not relax the incentive constraint of the recipient. To see this, note that an agreement with $s_{i0} = s_i = b < 0$ has the same no deviation constraints as an agreement with $s_{i0} = 0$ and $s_i = b$. Thus, it is desirable to "backload" the payments to a country with $\Gamma_i < 0$ to satisfy the no deviation constraint at minimum cost. In contrast, the no deviation constraint will be the same for all $t > 0$ for a country paying a positive transfer a constant transfer of $b > 0$. Thus, an agreement between two countries for which $\Gamma_1 = -\Gamma_2 > 0$ will not be sustainable because of the requirement to backload the transfer to country 2.

Lemma 1 can be used to establish the conditions under which an agreement will be sustainable, and to derive the range of sustainable payoffs for a member country for a given δ. Since we can restrict attention to agreements with $s_{it} = s_{i1}$ for $t \geq 1$, we can use (2) to obtain the the maximum sustainable value of s_i,

$$s_{i1}^{max}(a,\delta) = min\left[\Gamma_i(a,\delta),\ \Gamma_i(a,\delta)/\delta \right] \tag{3}$$

Using the restriction imposed on the deviation and punishment payoffs, $s_{i1}^{max}(a,\delta)$ will be increasing in δ with $\lim_{\delta \to 1} s_{i1}^{max}(a,\delta) > 0$. Using Lemma 1 and (3), we obtain the following result characterizing the minimum discount factor required to support an agreement and the range of feasible payoffs under a sustainable agreement.

Proposition 1: An agreement a will be sustainable iff $\sum_{i \in I(a)} s_{i1}^{max}(a,\delta) \geq 0$, *and there will exist a critical discount factor* $\delta^C(a) \in (0, 1)$ *such that the agreement is sustainable for all* $\delta \geq \delta^C(a)$. *The set of sustainable payoffs under the agreement a is a convex set and is denoted*

$$\Pi(a,\delta) = \left\{ (v_1, v_2, v_3) \mid \sum_{i \in I(a)} (v_i - w_i(a)) = 0,\ v_i \geq v_i^D(a,\delta)\ for\ i \in I(a),\ v_j = w_j(a)\ for\ j \notin I(a) \right\}.$$

Proposition 1 shows that it is possible to construct transfer schemes that hold each member country to its deviation payoff. For a transfer receiving country, the minimum payoff agreement will be one for which $s_{i0} = 0$ and $s_{it} = s_{i1}^{max}(a, \delta)$ for all t > 0. For a transfer paying country, the minimum sustainable payoff is one with $s_{it} = s_{i1}^{max}(a, \delta)$ for all t. The maximum payoff that can be achieved by country i arises when the other countries in the agreement are held to their deviation payoff, and so depends on the degree of slack in the no deviation constraints.

If countries are heterogeneous in the sense that the $\delta_i^C(a)$ differ, transfers can be used to reduce the minimum discount factor required to support an agreement because $\delta^C(a) < maxi\ \delta_i^C(a)$. If the countries are homogeneous, the only role for transfers is to allow for the redistribution among the members of the agreement. Since our primary interest is in how the no deviation constraint restricts the ability of countries to make transfers to induce other members to form a trade agreement, we will focus the remaining discussion in this section on the case in which the countries are symmetric. Symmetry is taken to mean that $w_i(B)$ and $\Gamma_i(G,\delta)$ are the same for all i and $w_i(B_{ij})$ and $v_i^D(B_{ij}, \delta)$ are the same for all $\{i,j\}$ and $k \neq i,j$.

With this symmetry assumption, we can limit discussion to three cases: a global agreement, a representative bilateral agreement between two of the countries (denoted $a = B$), and no agreement. The set of sustainable payoffs for the global and bilateral agreements can be illustrated using Figures 1. Figure 1a shows the simplex with vertices representing the payoffs to respective countries when they obtain all of the surplus from a global trade agreement, $\Omega(G) = 3w(G)$. The set of sustainable payoffs is non-empty for $w(G) \geq v^D(G, \delta)$, which is equivalent to $\delta > \delta^C(G)$. The set $\Pi(G, \delta)$ is illustrated by the triangular region **ABC** in Figure 1a, which generates payoffs in the interval $[v^D(G, \delta), \Omega(G) - 2\, v^D(G, \delta)]$ for each country. Country 1 attains its maximum payoff at point **A** and its minimum payoff on the edge **BC**. Similarly, Figure 1b shows the simplex with vertices representing the payoffs to respective countries when they obtain all the surplus from a bilateral agreement. The aggregate payoff is $\Omega(B) = 2w_m(B) + w_n(B)$, where an m (n) subscript denotes the payoff to a member (non-member) country under a bilateral agreement. The line **DE** in Figure 1b denote the sustainable payoffs to a bilateral agreement between 1 and 2 under the assumption that $w_m(B) > w_n(B)$. For $\delta > \delta^C(B)$, the sustainable payoffs from an agreement between countries 1 and 2 will be contained in the interval $[v^D(B,\delta), 2w_m(B) - v^D(B,\delta)]$. The payoff to country 3 is constant at $w_n(B)$ along this locus. The line **D'E'** illustrates the sustainable payoffs to a bilateral agreement between 1 and 2 when $w_m(B) < w_n(B)$. The latter case arises if the formation of an agreement between 1 and 2 has favorable spillovers to the non-member country, as in the case of an FTA analyzed by Bond, Riezman, and Syropoulos.

C. Pareto Undominated Agreements in the Symmetric Case

Under symmetry and (A.1), a sustainable global agreement must Pareto dominate N, which is the state with no agreement. The global agreement will Pareto dominate all bilateral agreements if for any bilateral agreement between *i* and *j* and $v \in \Pi(B_{ij}, \delta)$, there exists a $v' \in \Pi(G, \delta)$ such that $v' \geq v$. This will be trivially satisfied in the case where $\Pi(B_{ij}, \delta)$ is an empty set and $\Pi(G, \delta)$ is non-empty, so one set of conditions generating this result will be $\delta^C(B) > \delta^C(G)$ and $\delta \in [\delta^C(G), \delta^C(B))$.

If $\Pi(B_{ij}, \delta)$ is non-empty, let $v_i^{max}(B_{ij})$ denote the there country payoff vector achieved when country i receives its maximum payoff under the bilateral agreement between i and j. The set of sustainable payoffs can then be expresses as $\Pi(B_{ij}, \delta) = \left\{ v \mid v = \lambda v_i^{max}(B_{ij}) + (1-\lambda) v_j^{max}(B_{ij}), \lambda \in [0,1] \right\}$ Under the assumptions of symmetry made here, the global agreement will Pareto dominate all bilateral agreements if there exists $v' \in \Pi(G, \delta)$ such that $v' \geq v_1^{max}(B_{12})$. If such a v' exists, then the symmetry conditions ensure that there exists a $v'' \geq v_2^{max}(B_{12})$, and hence the set $\{v \mid v = \lambda v' + (1 - \lambda) v''\} \subset \Pi(G, \delta)$ Pareto dominates $\Pi(B_{12})$. Symmetry will also guarantee that this result applies for all possible bilateral agreements. Combining these arguments, we obtain conditions under which the sustainable global agreements will Pareto dominate all other sustainable agreements.

Proposition 2: The sustainable global agreements will Pareto dominate any other sustainable agreements when countries are symmetric if either of the following conditions hold:

(i) $w(G) - v^D(G, \delta) \geq 0 \geq w_m(B) - v^D(B, \delta)$

(ii) $\min [w(G) - v^D(G, \delta), w_m(B) - v^D(B, \delta)] \geq 0$ *and*

$$\Omega(G) - \Omega(B) \geq \max[0, v^D(G,\delta) - w_n(B)] + \max [0, v^D(G,\delta) - v^D(B,\delta)]$$

Condition (i) refers to the case where the only sustainable agreements are G and N. The condition in (ii) applies where there are sustainable bilateral agreements, and requires that there be sufficient slack in the no deviation constraints for the global agreement that countries can be compensated for their payoff in the best bilateral agreements.

As noted above, the set of sustainable bilateral and global agreements will both be increasing in δ.

A natural question to ask is whether this will automatically lead to a preference for global agreements as δ → 1. Since $\lim_{\delta \to 1} v^D(a,\delta) = w^P(a)$, the limit of the right hand side of (ii) is $max[0, w^P(G) - w_n(B)] + max [0, w^P(G) - w^P(B)]$. Thus, a sufficient condition for the global agreement to Pareto dominate bilateral agreements for δ sufficiently close to 1 is that $w^P(G) < min [w^P(B), w_n(B)]$.

If the sustainable payoffs under the global agreement do not Pareto dominate those under the bilateral agreements, then there will be points on the constrained Pareto frontier which will call for a bilateral agreement. In the symmetric case, these can only arise in cases where the bilateral agreement gives the member countries such extreme payoffs that they cannot be compensated by self-enforcing transfers in a global agreement. One might interpret this as a case in which a bilateral agreement is an obstacle to a global agreement, since the global agreement would form if the bilateral agreement were ruled out. While such a restriction would prevent outcomes in which the members of the bilateral agreement receive extremely large payoffs, these agreements are not "inefficient" in the traditional sense because they are Pareto undominated agreements when the no deviation constraints are taken into account.

D. Transfers to Non-Members and Bilateral Agreements as 'Building Blocs'

The analysis above considers the case in which the only alternatives are permanent bilateral agreements and a permanent global agreement, with transfers allowed only between the member countries. In the case where some payoffs of a sustainable bilateral agreement are not Pareto dominated by payoffs of a global agreement, then the set of efficient payoffs from sustainable agreements will not be a convex set. For example, consider the efficient frontier for sustainable agreements in which countries 1 and 2 receive the same payoff. This is illustrated in Figure 2, which plots the payoff $v^1 = v^2$ on the horizontal axis and v^3 on the vertical axis. The segment AB contains the sustainable payoffs under a global agreement, which gives $v_3 \in [v^D(G, \delta), \Omega(G) - v^D(G, \delta)]$ and $v^1 = v^2 \in [v^D(G, \delta), (\Omega(G) - v^D(G, \delta))/2]$. The point C is the payoff attainable in the (sustainable) bilateral agreement between 1 and 2, in which $v_1 = v_2 = w_m(B)$ *and* v_3

$= w_n(B)$. The case illustrated is one in which $2w_m(B) > 3w(G) - v^D(G, \delta)$, so that the conditions of Proposition 2 are violated. This creates a non-convexity in the efficient frontier between points B and C, as shown by the segment BDC of the constrained efficient frontier in Figure 2, where there is a switch form the global agreement to the bilateral agreement.

There are two ways in which the bilateral and global agreements considered above could be generalized to yield payoffs that dominate those on the segment BCD. One is to allow the members of the bilateral agreement to make transfers to the non-member country. Applying Lemma 1a, a transfer of amount $s_{i0} = s_{i1} \in [0, \Gamma_i(B, \delta)]$ would be incentive compatible for countries i = 1,2. The maximum attainable payoff for the non-member in this case would be $w_n(B) + 2\,\Gamma(B, \delta)$. This transfer process would allow higher payoffs to country 3 than attainable without transfers to non-members, but would still be inefficient in the sense that world welfare is still below that attainable if there is a global agreement.

A second method for transferring income to the non-member country would be to allow it to become a member of the agreement with some delay. For example, consider a bilateral agreement between countries 1 and 2 under which they agree to admit country 3 to the agreement at some future date T. Since we are focusing here on agreements that treat countries 1 and 2 symmetrically, this agreement will have an average payoff vector of $(w_m(B), w_m(B), w_n(B))$ for $t < T$ and an average payoff of $v = (v_1, v_1, v_3) \in \Pi(G, \delta)$ for $t \geq T$. The fact that $v \in \Pi(G, \delta)$ ensures that the agreement will satisfy the no deviation constraint from T onward for all countries. The average payoff for country 3 will be $(1 - \delta^T)w_n(B) + \delta^T v_3 > w_n(B)$ and the average payoff for country 1 will be $(1 - \delta^T)w_m(B) + \delta^T v_1 < w_m(B)$.

In order for the delayed formation of a global agreement to be incentive compatible, it must satisfy a no deviation constraint for the members of the bilateral agreement for periods t < T. The average payment to country 1 from period t < T onward is $(1 - \delta^{(T-t)})w_m(B) + \delta^t v_1$. It will be assumed that during the bilateral stage of the agreement, only the current members of the agreement can participate in the punishment of a deviating country so the deviation payoff will be $v^D(B, \delta)$. The no deviation constraint during the bilateral phase of the agreement can then be expressed as

$$\Gamma(B,\delta) \geq \delta^{T-t}(w_m(B) - v_1) \qquad \textbf{(4)}$$

Since $w_m(B) > v_1$ in this case, the no deviation constraint will be more severe than that for a permanent bilateral agreement and will be most severe at time T-1. It is most likely to be satisfied if countries 1 and 2 are given their most favorable payoff under the global agreement, which is the payoff of $(\Omega(G) - v^D(G, \delta))/2$ The condition for a delayed entry of country 3 to be sustainable is

$$\Gamma(B,\delta) \geq \frac{\delta}{2}(2w_m(B) + v^D(G,\delta) - 3w(G)) \qquad \textbf{(5)}$$

Consider a dynamic path in which countries 1 and 2 form a bilateral agreement at t = 0 and a global agreement with 3 at t = 1. A numerical example will illustrate the existence of parameter values for which the payoffs under this agreement are not Pareto dominated by any permanent agreement (bilateral or global). Let $w(G)$ = 110, $w_m(B)$ = 120, $w_n(B)$ = 80 and $w(N)$ = 100, which satisfies $\Omega(G) > \Omega(B) > \Omega(N)$. The deviation payoffs are assumed to be given by $w^D(G)$ = 130 and $w^D(B)$ = 125, and the punishment payoffs by $w^P(G)$ = 90 and $w^P(B)$ = 100. Assuming that punishment for a deviation from either agreement results in a reversion to the equilibrium with no agreement, we obtain $\delta^C(B)$ = 1/5 and $\delta^C(G)$ = 1/2. For δ = .9, the minimum incentive compatible payoff for 3 under a global agreement is 94 and the payoff to 1 and 2 is 118. An agreement under which there is a bilateral agreement for one period followed by a global agreement is incentive compatible for 1 and 2 with a payoff of 118.2, and gives 3 an average payoff of 92.6. Average world welfare under the gradual agreement is 329, which is substantially larger than under the bilateral agreement (320).

II. The Model with Costs of Forming an Agreement

We now introduce costs of forming an agreement. Both multilateral trading agreements and preferential trading arrangements involve substantially more than the simple elimination of trade barriers. Membership in the WTO also requires that countries adopt national laws that are compatible with the WTO agreements. For example, antidumping laws must satisfy WTO guidelines in order to be enforceable, national laws on the protection of intellectual property must satisfy the TRIPs agreement, and domestic tax and competition policy must often be adjusted to be compatible the WTO rules. In addition, tariffs must be negotiated with members as part of the accession process. As a result, the accession process for a country entering the WTO can be quite lengthy. Similarly, membership in the European Union requires the adoption of a number of policies and institutions compatible with the EU.

In addition to the costs of negotiating tariffs and harmonizing policies with those of member countries, there are also likely to be sectoral adjustment costs associated with tariff reductions. Resources will be moving out of import-competing industries where trade barriers have been reduced and into sectors producing non-traded goods and exportables. In the most general case we can express the adjustment costs as $c_i(a', a)$, where a' is the agreement that is to be formed in the current period and a is the current period's agreement. Note that we will allow for the possibility that adjustment costs from a bilateral agreement can be imposed on non-member countries, as might occur if sectoral adjustment costs are occurred as the result of diversion of trade away from non-member countries when a bilateral agreement is formed.

In the case where trade agreements are fully enforceable and there are no constraints on the level of transfers between countries, the chosen agreement will be the one that maximizes the aggregate payoff net of adjustment costs. Condition (1) will no longer be sufficient to ensure that an immediate formation of the global agreement is optimal, because conditions on the level of adjustment costs will also be required. The following conditions will also be assumed:

$$\Omega(G) - \Omega(a) > \sum_i \left(c_i(G,N) - c_i(a,N) \right)(1 - \delta) \qquad for\ a \neq G$$

(6)

$$\Omega(G) - \Omega(a) > \sum_i \left[c_i(G,N) - \left(c_i(a,N) + \delta c_i(G,a) \right) \right]$$

The first condition in (5) ensures that the permanent adoption of the global agreement will yield higher world welfare than either maintaining the situation without any agreements or permanently adopting a bilateral agreement. The second inequality ensures that the permanent adoption of a global agreement yields higher world welfare than a path which forms an interim bilateral agreement before forming a global agreement. The right hand side of the inequality in (4) is the reduction in agreement costs that results by adopting a gradual path to the global agreement. If this term is positive, this condition guarantees that the reduction in agreement costs from a gradual path to a global agreement is smaller than the loss in current trade benefits along the path.

A. Sustainable Permanent Agreements

We now turn to the restrictions on agreements imposed by the no deviation constraints. We first consider the no deviation constraint formation of an agreement a′ in period 0 and remains in the agreement thereafter. Since the adjustment costs are incurred at the formation of the agreement at t = 0, the no deviation constraint for t = 0 is

$$\Gamma_i(a', \delta) \geq (1-\delta)\left(S_{i0} - min(0, s_{i0}) + c_i(a'a)\right) \quad for\ t\ =\ 0 \tag{7}$$

For t > 0, the constraint is given by (2) as in the case without adjustment costs. The existence of these one time costs tightens the no deviation constraint at t = 0, and in the case without transfers the minimum discount factor for country i will be the solution to $\Gamma_i(a', \delta) - c_i(a', a)(1 - \delta) = 0$. Agreement costs raise the minimum discount factor required to sustain an agreement.

An argument similar to that used for Lemma 1 establishes that there is no loss of generality in assuming that $s_{it} = s_{i1}$ for $t \geq 1$. The agreement for country i can then be described by the pair (s_{i0}, s_{i1}), and (6) can be rewritten as

$$s_i \leq s_{i1}^{max}(a',a,\delta) \equiv min\left[\Gamma_i(a',\delta), \frac{\Gamma_i(a',\delta) - (1-\delta)c_i(a',a)}{\delta}\right] \qquad (a)$$

$$(1-\delta)\, max(s_{i0}, 0) + \delta s_i \leq \Gamma_i(a',\delta) - (1-\delta)c_i(a',a) \qquad (b) \qquad \textbf{(8)}$$

An agreement a' is sustainable if there exist transfers (s_{i0}, s_i) for $i \in I(a')$ such that (7) is satisfied, with $\sum_{i \in I(a')} s_{i0} = 0$, and $\sum_{i \in I(a')} s_i = 0$.

It is straightforward to establish a result similar to Proposition 1 for permanent agreements in the present of adjustment costs.

Proposition 3: The formation of an agreement a' , given an initial agreement a, will be sustainable iff

$$\sum_{i \in I(a')} s_i^{max}(a',a,\delta) \geq 0.$$

(a) The maximum feasible transfers, $s_i^{max}(a',a,\delta)$*, are increasing in* δ*. There will exist a minimum discount factor* $\delta^C(a',a) \in (0, 1)$ *such that the agreement is sustainable for all* $\delta \geq \delta^C(a',a)$*.*

(b) Let $v_i \equiv w_i(a') - (1-\delta)(S_{i0} + c(a',a))$ *denote the net payoff to country i. The set of sustainable payoffs under the agreement a', given an initial agreement a, is a convex set and is denoted*

$$\Pi(a',a,,\delta) = \{ (v_1,v_2,v_3) \mid \sum_{i \in I(a)} (v_i - w_i(a') - (1-\delta)c_i(a',a)) = 0, v_i \geq v_i^D(a',\delta) \text{ for } i \in I(a'),$$

$$v_j = w_j(a') - (1-\delta)c_j(a',a) \text{ for } j \notin I(a,) \}$$

In order for an agreement to be sustainable, the slack in the no deviation constraints must be sufficiently large that it covers the adjustment costs incurred in forming the agreement. The fact that adjustment costs become insignificant to the average agreement payoff as $\delta \to 1$, combined with the previously obtained result that $\Gamma_i(a', 1) > 0$ ensures the existence of a minimum discount factor. The resulting range of average payoffs to member countries is similar to that obtained in Proposition 1.

Proposition 3 can be used to characterize the minimum discount factor and efficient set of payoffs that can be attained from permanent agreements starting from state N at t = 0. As in the previous section we focus on the case of symmetric countries. The symmetry assumptions for transactions costs will be that all countries face the same costs from an immediate global agreement, $c_i(G,N) = c(G,N)$. Also, members of a bilateral agreement B_{ij} face identical costs when they form an agreement, $c_k(B_{ij}, N) = c_M(B,N)$ for $k \in \{i,j\}$, or when they add a new member to a bilateral agreement, $c_k(G, B_{ij}) = c_M(G, B)$ for $k \in \{i,j\}$. However, the adjustment costs for the non-member are allowed to differ and are denoted $c_k(G, B_{ij}) = c_N(G, B)$ and $c_k(B_{ij}, N) = c_N(B, N)$ for $k \neq i,j$. With these assumptions, the minimum discount factor associated with sustaining a global (bilateral) agreement from an initial state with no agreement will be the solution to $\Gamma(G, \delta) - (1 - \delta)c(G, N)$ $(\Gamma(B, \delta) - (1 - \delta)c_M(B, N))$. Whether a global or bilateral agreement is easier to sustain will depend on both the deviation payoff and the level of adjustment costs associated with the agreement.

The fact that the conditions for sustainability depend on the initial state of the agreement with adjustment costs leads to a second potential role for bilateral agreements as building blocks. Consider the minimum discount factor that is required to sustain a global agreement, once a bilateral agreement has been put in place. The condition for sustainability is $J(G,B,\delta) = \sum_{i=1}^{3} s_i^{max}(G,B,\delta) = \{min\ [\ \Gamma(G, \delta) - (1\text{-}\delta)\ c_N(G, B), \delta\Gamma(G, \delta) + 2\ min\ [\Gamma(G, \delta) - (1\text{-}\delta)\ c_M(G, B), \delta\Gamma(G, \delta)]\ \}/\delta = 0$. Since $J(G, B, \delta)$ is increasing in δ, it follows that $\delta^c(G, B) < \delta^c(G, N)$ if $J(G, B, \delta^c(G, N)) = (1\text{-}\ \delta)\{min\ [\ c(G,N) - c_N(G, B), \delta c(G,N)] + 2\ min\ [c(G, N) - c_M(G, B), \delta c(G, N)]\ \}/\delta > 0$. It would be expected that $c_M(G, B) > c(G, N)$, which means that members of the bilateral agreement incur smaller adjustment costs from adding the third country than they would by forming a global agreement from scratch in period 0. A sufficient condition for $\delta^c(G, B) < \delta^c(G, N)$ is then $c_M(G, B) \leq c(G, B)$. The lower level of agreement costs incurred by the members of the bilateral agreement can even be used to relax the no deviation constraint when $c_M(G, B) > c(G, B)$, as long as $c_M(G,$

$B) - c(G, B) < 2 \min [c(G,N) - c_M(G, B), \delta c(G,N)]$. Note that $2\, c_M(G, B) + c_N(G, B) < 3c(G,N)$ is necessary, but not sufficient, to ensure $\delta^c(G, B) < \delta^c(G, N)$. The distribution of adjustment costs across countries also matters, because the no deviation constraint will put a limit on the magnitude of transfers between countries that are sustainable.

B. Gradual Formation of Agreements in the Symmetric Country Case

The previous section established conditions under which the minimum discount factor for forming a global agreement is lower when starting from an existing bilateral agreement. This raises the of whether a global agreement is sustainable for $\delta \in [\delta^c(G, B) < \delta^c(G, N))$ if it preceded by a bilateral agreement between two of the countries. We examine this by deriving the minimum discount factor necessary to sustain a bilateral agreement between countries 1 and 2 at $t = 0$, followed by the addition of country 3 at some time $t = 1$.

An agreement at time 0 will specify a transfer to be made between 1 and 2, s_{i0}, as well as a promised payoffs when country 3 is added to the agreement. In order for the global agreement to be sustainable for $t \geq 1$, the vector of average payoffs promised to the countries as part of the global agreement must be contained in $\Pi(G, B, \delta)$. Thus, sustainability requires that $\Pi(G, B, \delta)$ be non-empty, which is the condition for $\delta \geq \delta^C(G, B)$ discussed above. It is assumed that the deviation payoff to the members from deviating from the initial bilateral agreement is given by $v^D(B, \delta)$, so that the punishment path following a deviation from this agreement is the same as would result from the deviation from a bilateral agreement. Since the concern here is on identifying the minimum discount factor associated with an agreement that eventually reaches the global agreement, we will focus on the case in which there are no transfers between countries 1 and 2 during the bilateral phase and each country is promised the same payoff during the global phase of the agreement. This type of agreement will be the one that has the lowest minimum discount factor with symmetric countries.

The no deviation constraint for a representative member country at t = 0 will be

$$w_M(B)\,(1-\delta) + \delta v_M - (1-\delta)c_M(B,N) \geq v^D(B,\delta) \qquad \textbf{(9)}$$

where v_M is the average payoff promised to each member country under the global agreement. The left hand side of (9) is the average value of the bilateral agreement at time t, given the anticipation of conversion to a global agreement at time T. The right hand side is the deviation payoff from the bilateral agreement. If $v_M > (<)\ w_M(B)$, then it can be seen from (9) that the promise of a global agreement in the future will actually relax (tighten) the no deviation constraint relative to that of a permanent bilateral agreement.

Equation (9) is most likely to be satisfied in the case where the non-member country is held to its lowest sustainable payoff in the global agreement, $v_M = \left(\Omega(G) - (1-\delta)\left(2c_M(G,B) + c_N(G,B)\right) - v^D(G,\delta) \right)/2$, as derived in Proposition 3. Substituting this value in (9) yields the requirement that

$$\frac{\Gamma(B,\delta) - (1-\delta)c_M(B,N)}{\delta} + \frac{1}{2}\left[3w(G) - (1-\delta)\left(2c_M(B,N) + c_N(G,B)\right) - v^D(G,\delta) - 2w_M(B)\right] \geq 0 \qquad \textbf{(10)}$$

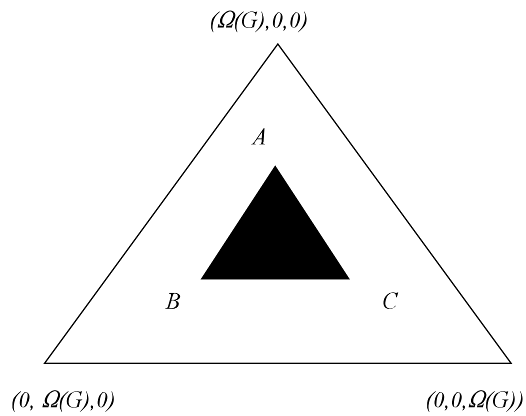
The term in (10) is increasing in δ, and will be negative (positive) as $\delta \rightarrow 0$ (1). Therefore, there will be a unique value $\hat{\delta}$ such that the gradual formation of a global agreement is sustainable for $\delta \geq \hat{\delta}$.

The gradual formation of a global agreement will be easier to sustain than an immediate jump to a global agreement if $\hat{\delta} < \delta^c(G,\ N)$. Since the expression in (10) is increasing in δ, $< \delta^c(G,\ N)$ if (10) is positive when evaluated at $\delta^c(G,\ N)$. Evaluating (10) at $\delta^c(G,\ N)$ yields

$$\frac{\left[\Gamma(B,\delta^c) - (1-\delta^c)c_M(B,N)\right]}{\delta} + \frac{(1-\delta)}{2}\left[3c(G,N) - \left(2c_M(G,B) + c_N(G,B)\right)\right]$$

$$+ (w(G) - (1-\delta)\, c(G,N) - w_M(B)) > 0 \tag{11}$$

The first term in (11) will be positive if $\delta^c(B, N) < \delta^c(G, N)$. If this condition holds, the fact that the bilateral agreement is easier to sustain than the global agreement can be used to sustain the gradual transition to the global agreement. The second term will be positive as long as the costs of forming the global agreement in the absence of any existing agreements are greater than the cost of forming the global agreement from the bilateral agreement. The final term in (11) is the difference between the average payoff to a country under the global agreement (net of the cost of forming the global agreement) and the payoff to a member under the bilateral agreement. Thus, (11) is more likely to be positive the greater is the payoff to a country under the global agreement compared to that of a member in a bilateral agreement. Taken together, these terms identify the factors that will make it more likely that a bilateral agreement can be a building block to a global agreement in the presence of agreement costs.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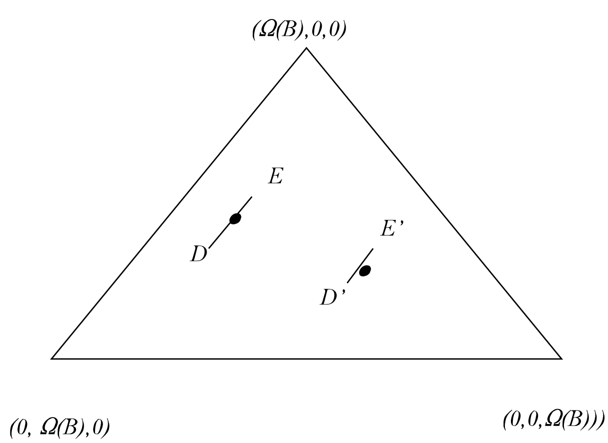
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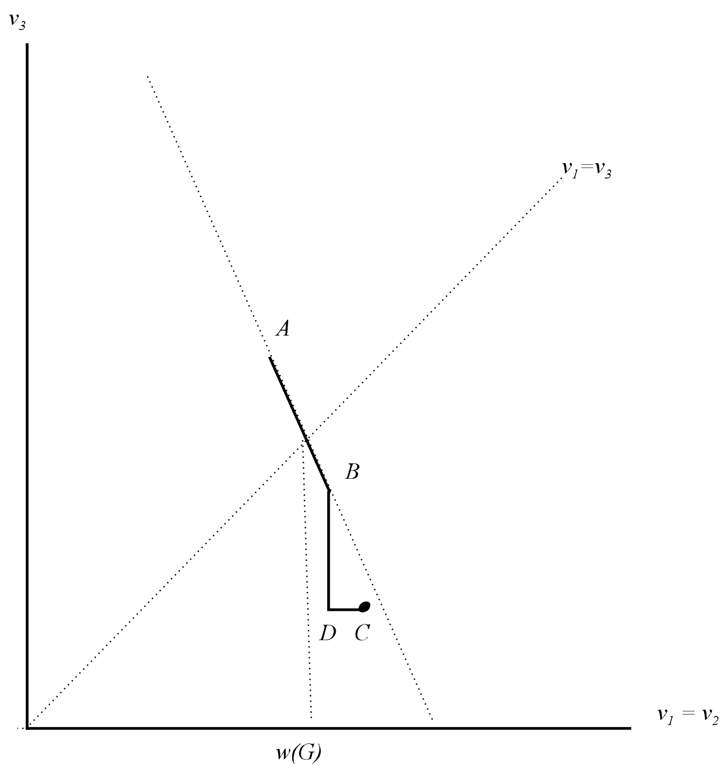

Figure 2

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Appendix

Proof of Lemma 1: (a) The sequence $s_{it} = s_{i1}$ will generate present values of transfers $S_{it} = s_{i1}/(1\text{-}\delta)$ for all i and $t > 0$. For $t = 0$, (2) will require $\Gamma_i \geq (1\text{-}\delta) \max (s_{i0},0) + \delta s_{i1}$ For $t > 0$, (2) requires $\Gamma_i \geq s_i$ ($\Gamma_i \geq \delta s_i > s_i$) for $s_i \geq 0$ ($s_i < 0$) at $t > 0$.

(b) Let t' be the smallest value of t such that $s'_{it'} \neq s_i$ for some i. Since $S'_{it'} = s_i/(1-\delta)$ for $t \leq t'$, the no deviation constraint at time zero is $\Gamma_i \geq (1\text{-}\delta) \max (s_{i0},0) + \delta s_i$ for all $i \in I(a)$ which is the same as for the transfer scheme s_i. There will exist a $j \in I(a)$ such that $s'_{jt'} < s_j$, which implies $S'_{jt'+1} > S'_{jt'} = s_j/(1-\delta)$. If $s_j \geq 0$, then (2) requires $\Gamma_i \geq (1-\delta)\left(S'_{jt'+1} - \min(0, s'_{jt'+1})\right) > s_j$ at $t'+1$ which tightens the constraint (3). If $s_j < 0$, then (2) requires $\Gamma_i \geq \delta(1-\delta)S'_{jt'+1} > \delta s_j$ at time t'. This establishes that the set of Γ_j for which the agreement s_j' is sustainable can be no larger than the set for which s_j is sustainable, and will be strictly smaller if $s_{j0} \in [\min (0, s_j), \max (0, s_j)]$.

There must also exist some $i \in I(a)$ and $i \neq j$ such that $s_{it'}' \geq s_i$. To establish the result, it remains to show that the set of Γ_i for which s_i' is sustainable can be no larger than the set for which s_i is sustainable. If $s_i \geq 0$, then (2) requires $\Gamma_i \geq s_i$ at t = 1. If $s_i < 0$, we have $\Gamma_i \geq (1\text{-}\delta) \max (s_{i0},0) + \delta s_i > s_i$ at t = 0. Therefore, the that (2) requires $\Gamma_i \geq \delta s_i$ at time 0. ||

Proof of Proposition 1: It is clear from the definition that $s_{i1} \leq s_{i1}^{max}$ is necessary for an agreement to be sustainable for country i, since this must hold for the no deviation constraint to be satisfied for t $\geq$ 1. The condition $\sum_{i \in I(a)} s_{i1}^{max}(a,\delta) \geq 0$ must then hold for there to be a sustainable scheme satisfying $\sum_{i \in I(a)} s_i = 0$. This condition will also be sufficient, since the agreement with $s_{i0} = 0$ and $s_i = s_i^{max}(a, \delta)$ will satisfy the no deviation constraint at t = 0 for all i. The existence and uniqueness of $\delta^C(a)$ follows from the fact that $J(a,\delta) \equiv \sum_{i \in I(a)} s_{i1}^{max}(a,\delta)$ is continuous and increasing in δ, with $J(a,0) < 0$ and $J(a,1) > 0$.

The minimum and maximum payoffs are derived as discussed in the text. To show the convexity of the set of payoffs, we first establish that the set of transfers satisfying is convex. Let $s_i^j = (s_{i0}^j, s_{i1}^j)$ be feasible transfers for country i for $j = a, b$. The set of feasible transfers for i is convex if $s_i^\lambda = \lambda s_i^a + (1-\lambda)s_i^b$ satisfies $\Gamma_i \geq max\ [s_i^\lambda, max\ (0, s_{i0}^\lambda)(1-\delta) + \delta s_{i1}^\lambda]$ for $\lambda \in (0,1)$. The feasibility of s_i^a and s_i^b implies $s_{i1}^\lambda = \lambda s_{i1}^a + (1-\lambda)s_{i1}^b \leq \Gamma_i$ and $max\ (0, s_{i0}^\lambda)(1-\delta) + \delta s_{i1}^\lambda \leq \lambda[max\ (0, s_{i0}^a)(1-\delta) + \delta s_{i1}^a] + (1-\lambda)[max\ (0, s_{i0}^b)(1-\delta) + \delta s_{i1}^b] \leq \Gamma_i$, which establishes the result. Suppose $v^j \in \Pi(a, \delta)$ for j = a, b where $v_i^j \equiv w_i(a) - (1-\delta)s_{i0}^j - \delta s_{i1}^j$. It follows from the convexity of the set of feasible transfers that $v^\lambda = \lambda v^a + (1-\lambda)v^b \in \Pi(a, \delta)$.‖

Proof of Proposition 2: In the case of symmetric countries, the global agreement will Pareto dominate no agreement if it is sustainable, which requires $\delta \geq \delta^C(G)$. To establish that the global agreement Pareto dominates any bilateral agreement, we must show that there exists a $v' \in \Pi(G, \delta)$ such that $v' \geq (w(B) - v^D(B, \delta), v^D(B, \delta), w_n(B))$. In order for this condition to be met, it must be the case that the maximum payoff to country 1 under G must be at least as large as under B, which requires $\Omega(G) - \Omega(B) \geq 2v^D(G, \delta) - v^D(B, \delta) - w_n(B)$. If this condition is satisfied, then it must also be the case that the payoff to 3 exceeds its minimum sustainable value when 1 and 2 receive payoffs of $w(B) - v^D(B, \delta)$ and $v^D(B, \delta)$, respectively, which requires $\Omega(G) - \Omega(B) \geq v^D(G, \delta) - w_n(B)$. Finally, it must also be the case that the payoff to 2 exceeds its minimum sustainable value when 1 receives $w(B) - v^D(B, \delta)$ and 3 receives $w_n(B)$, which requires $\Omega(G) - \Omega(B) \geq v^D(G, \delta) - v^D(B, \delta)$. Combining these results yields the condition in part (ii).