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Preferential Trading Arrangements as Strategic Positioning*

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Abstract

We analyze a three-country model of trade negotiations in which countries can form bilateral free trade areas, customs unions or a trilateral preferential trading arrangement, and can continue negotiating after reaching an agreement. In contrast to the literature on multilateral bargaining, the set of agreements can form a (non-partitional) network; while in contrast to the network literature, players can reach multilateral agreements. We show that patient enough countries reach bilateral arrangements if and only if insiders gain more than outsiders; and we characterize conditions under which a hub and spoke pattern emerges. We also use variants on the model to explain why a US commitment not to bargain bilaterally sustained progress at GATT negotiations; and the rarity of open access preferential trading arrangements.

1. INTRODUCTION

GATT Article 24 allows two exemptions from nondiscrimination: countries which liberalize mutual trade can agree either to set the same tariffs on imports from outsiders, forming a customs union; or to set these tariffs independently, forming a free trade area. Once formed, members of such preferential trading arrangements ('PTAs') can negotiate with outsiders. Thus, the EU and NAFTA have expanded by admitting new members; while the EU has reached free trade agreements with outsiders like Mexico. In short, WTO rules restrict the form that each agreement can take, but allow a complex pattern of agreements (or 'position') to emerge. As the second wave of regionalism has gathered pace, the position has indeed become more complex, as Bhagwati (1993) warned; but it has exhibited such recurring features as hub and spoke patterns, with the EU, Mexico and Singapore as local hubs.

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The literature addressing these developments has recently contrasted equilibrium tariffs and welfare when PTAs are either all customs unions or are all free trade areas.[1] We also address these developments in a model which contrasts the two sorts of PTA; but we focus on the restrictions which WTO rules entail for the transition between positions. Each existing PTA is a legally binding agreement, which can only be abrogated with the consent of all signatories. Members of a customs union like the EU can only join another PTA if the customs union breaks up or if all current members join the other PTA. By contrast, two countries which have signed a free trade agreement can each join another free trade area without their co-signatory's consent: a possibility that the US and Mexico have each exploited. In other words, the position must be partitional if countries only form customs unions, but may be nonpartitional if countries form free trade areas.

The related literature has ignored this simple contrast because it has analyzed static models of PTA formation. By contrast, we embed this distinction in a model of trade negotiations which allows countries to form either customs unions or free trade areas, and to continue negotiations with fellow PTA members and outsiders. Our main contribution is a theory of the transitions which occur on the equilibrium path: that is, of the dynamics of PTA formation in an environment which is otherwise stationary. This theory allows us to predict such emerging positions as hub and spoke patterns.

The model is extremely simple. In each period, one of the three symmetric countries proposes a PTA which can feasibly be reached in one step from the current position, and lump sum transfers to each member of the putative PTA; and the position changes if and only if all respondents accept. A country's returns equal the sum of the utility it earns at the current position and its net transfers; and its payoff is the net present value of its returns. Global free trade is socially efficient, and is therefore always reached in equilibrium. We characterize the transition to global free trade as a function of the common discount factor and the utilities that PTA members and outsiders earn at each position.

In contrast to the literature, our most striking results arise when each bilateral customs union member earns the same utility as a member of a free trade area, and an outsider's utility is independent of the sort of PTA: conditions we call 'utility-equivalence'. If countries are patient enough then a bilateral PTA forms if and only if the outsider earns less than PTA members. The intuition is that formation of a PTA shifts the status quo, and thereby affects the distribution of the gains from global free trade; and the status quo shifts in a direction favorable to PTA members if and only if they are the relative beneficiaries of its formation.[2] We dub this new motive for forming PTAs: 'strategic positioning'.

When countries are patient enough, a hub and spoke pattern would follow a free trade area if the hub earns greater utility than each spoke. The advantages of strategic positioning are then dissipated by competition to be the hub. Utility-equivalence then implies that countries earn higher payoffs by forming a bilateral customs union than by forming a bilateral free trade area: so a hub and spoke pattern cannot form on the equilibrium path.

[1] See, for example, Syropoulos (1999) and Bond et al (2004). Panagariya (2000) surveys the earlier literature.

[2] Note that we refer to *relative* beneficiaries. Our result does not rely on whether members are better off forming the PTA: the theme addressed by the literature on trade creation and diversion.

Conversely, such a position is reached if free trade area members earn greater utility than customs union members, and the hub earns more than each spoke.

In short, our model exploits the strategic consequences of PTA formation to address the changing pattern of trade agreements. Our approach therefore complements the trade literature's focus on determinants of the utilities earned at each position: be they trade creation/diversion or political economy considerations.[3] Our results also relate to Bhagwati and Panagariya's (1996) question about the dynamic interaction between PTA and WTO negotiations, provided that we identify the latter with trilateral offers.[4] However, we address a positive question; so our results do not seem to translate naturally into the language of stepping stones and stumbling blocks.

We treat the utilities at each position as primitive; so our model also applies directly to settings other than trade negotiations. In contrast to the literature on multilateral bargaining, we allow players to reach agreements yielding nonpartitional positions.[5] In contrast to the literature on network formation, we allow players to reach multilateral agreements; and can therefore ask when bilateral links predominate? In further contrast, we adopt a dynamic approach; whereas the literature following Jackson and Wolinsky (1996) studies the stability of terminal states.[6] However, we also use our approach to address a couple of issues of particular importance in trade negotiations:

According to a literature initiated by Olson and Zeckhauser (1966), international public goods have only been provided by a hegemon which is prepared to incur an undue burden. Kindleberger (1986) and Bhagwati (1993) argue that this theory can explain why progress in post-war trade negotiations was typically achieved via GATT rounds before the mid-'80s, and via bilateral agreements thereafter: the trigger for regime change being the US's willingness to negotiate bilaterally, as of 1982. However, neither author explains why a US commitment to multilateral negotiations deterred other countries from forming PTAs. We use a variant of our model to answer this question. If all countries are prepared to negotiate bilaterally and PTA members are the relative beneficiaries then it is unprofitable to make a multilateral proposal, as every country must then be compensated for not exercising its outside option of forming a PTA. By contrast, only two countries need be compensated if one country is committed to multilateral agreements; and it is then profitable to make multilateral proposals. While this argument addresses the critique of the Kindleberger/Bhagwati thesis, it is inconsistent with the tenor of the related literature: for we show that the hegemonic role can be undertaken by any of the *symmetric* countries.

WTO rules allow countries to form closed or open access PTAs: entrants must secure the assent of existing members to join a closed access PTA, but can choose unilaterally

[3] See, for example, Grossman and Helpman (1995) and Levy (1997).

[4] Panagariya (2000) surveys the related literature.

[5] See, in particular, Seidmann and Winter (1998), Hyndman and Ray (2005) and Gomes and Jehiel (2005). Yi (1996) analyzes negotiations to form customs unions on the supposition that a country leaves the bargaining table after joining a customs union. Aghion et al. (2004) analyze a bargaining model in which a specified country is the sole proposer, and must choose ex ante whether it will make bilateral or multilateral proposals.

[6] Jackson (2004) surveys this literature. See, in particular Section 4 on solution concepts. Goyal and Joshi (forthcoming) study the pattern of free trade agreements from this perspective, while Bloch and Jackson (forthcoming) analyze network formation with transferable utility.

whether to join an open access PTA. Several papers have argued that mandating open access would promote global free trade (cf. Yi (1996) and Bergsten (1997)). By contrast, we use a variant on our model to explain why no countries have formed an open access PTA under existing rules: open access bilateral PTAs are dominated by closed access bilateral PTAs if strategic positioning is advantageous; and are otherwise dominated by a trilateral PTA.

In Section 2, we present our model of negotiating closed access PTAs, analyzing the model in Section 3. Sections 4 and 5 respectively develop variants on this model to explain the effects of a commitment to negotiate multilaterally and the rarity of open access PTAs. We conclude in Section 6, and present some longer proofs in an Appendix.

2. CLOSED ACCESS GAME: MODEL

We present our benchmark model in this section, studying a 'closed access' game in which countries can only join a PTA with the assent of existing members. We divide the section into two parts. We present our model in Section 2.1, treating the utilities which countries receive as primitive. In Section 2.2, we present a simple example which allows us to derive these utilities from primitives.

2.1. Model

Three symmetric countries, denoted $i \neq j \neq k$, negotiate the formation of preferential trading arrangements ('PTAs') over an infinite number of periods, indexed by t. We allow for two feasible sorts of PTAs: customs unions ('CUs') and free trade areas ('FTAs'). PTA members eliminate tariffs on all intra-PTA trade; and members set a common tariff on any outsider in a customs union, and choose tariffs independently in a free trade area.

Positions and transitions

The three countries can be configured in six patterns of PTAs, which we call 'positions', and detail in Table 2.1.1 below:

Positions	*PTAs*
Π_0	No PTAs
$\Pi_1^{ij}(FTA)$	A free trade area between i and j
$\Pi_1^{ij}(CU)$	A customs union between i and j
Π_2^i	A hub and spoke pattern of free trade areas, with i as the hub
Π_3	A trilateral PTA
Π_4	The complete network of 3 bilateral FTAs

Table 2.1.1 Positions

A trilateral free trade area is equivalent to a trilateral customs union; so we treat them as a single position. It is useful to distinguish between positions Π_3 and Π_4 even though global free trade prevails at both positions.

Each period $t \geq 1$ is characterized by a prevailing position. The prevailing position in period 1 is assumed to be Π_0, and otherwise depends on negotiations in previous periods. We assume that the position can be changed at most once in a period. We also assume that a PTA can only form or grow with the consent of all members: a property which we describe as 'closed access'.[7]

These assumptions differentiate our model from the multi-player bargaining literatures:

- Papers in the network literature usually assume that a bilateral link can be broken unilaterally, but can only formed by mutual consent;
- In contrast to the coalitional bargaining literature, we allow for a nonpartitional position (Π_2^i);
- In contrast to Gomes and Jehiel (2005) and Hyndman and Ray (2005), we assume that a PTA can neither break up nor change from a free trade area to a customs union or conversely. This assumption is unrestrictive in our three-country model, and simplifies exposition.[8]

Table 2.1.2 below specifies the (different) positions which can be reached from each prevailing position, and the countries whose consent is required for such a change (in brackets).

Prevailing position	Reachable positions (consenting countries)
Π_0	$\Pi_1^{ij}(FTA)$ $(\{i,j\})$, $\Pi_1^{ij}(CU)$ $(\{i,j\})$, Π_3 $(\{i,j,k\})$
$\Pi_1^{ij}(FTA)$	Π_2^i $(\{i,k\})$, Π_3 $(\{i,j,k\})$
$\Pi_1^{ij}(CU)$	Π_3 $(\{i,j,k\})$
Π_2^i	Π_3 $(\{i,j,k\})$, Π_4 $(\{j,k\})$
Π_3	None
Π_4	None

Table 2.1.2 Transition matrix

Time line

Period t starts with Nature's history-dependent selection of a proposer. If some country rejected an offer in period $t-1$ then the last country to reject is selected to propose in period t; if no country rejected in period $t-1$ then Nature selects each country as the period t proposer with equal probability.[9]

The selected country then makes a proposal to one or both of the countries, specifying both a position which can be reached in one step with the consent of the proposer and the respondents, and a lump sum transfer to be paid in every subsequent period to each of the

[7] In Section 5, we analyze a game in which countries can form open access PTAs, which can be joined without the assent of current members.

[8] More precisely, the game would not exhibit any cycles if we allowed coalitions to break up.

[9] Our results do not rely, qualitatively, on this particular protocol: for example, we obtain analogous results if the proposer is randomly chosen each period, as in Okada (2000).

chosen respondents. The latter respond in sequence by accepting or rejecting the proposal. The period ends as soon as either a respondent rejects the proposal or all respondents have accepted the proposal. In the former case, the same position prevails in periods t and $t+1$; in the latter case, the proposed new position prevails from the end of period t, and the proposed transfers are paid thereafter.

Our assumption that countries can make transfers is crucial to our results, as PTAs can only be motivated by strategic positioning if there are several possible ways of dividing the gains from global free trade; but our results would still hold if transfers were not lump sum. While trade agreements rarely incorporate direct money transfers, both bilateral and multilateral agreements typically include nontrade issues. Furthermore, trade agreements rarely eliminate all intra-PTA tariffs immediately; and the transfers in our model could be interpreted as a choice of a path to free trade.[10]

We will use the phrase 'a subgame at new position Π' to describe any subgame which starts at the beginning of a period immediately after the prevailing position has changed to Π, and before Nature has selected that period's proposer.

Payoffs

In any period t, each country receives a return which is the sum of the net transfers to which it has agreed in periods up to and including t, and a utility which depends on the position at the end of period t. All countries share a common discount factor of $d \in [0, 1)$; and each country's payoff is the net present value of its stream of returns.

We normalize utilities such that each country earns a utility of 0 absent any PTAs, and earns a utility of 1 under global free trade. We define notation for utilities at each position in Table 2.1.3 below.

Position	Country i	Country j	Country k
Π_0	0	0	0
$\Pi_1^{ij}(FTA)$	v^{FTA}	v^{FTA}	w^{FTA}
$\Pi_1^{ij}(CU)$	v^{CU}	v^{CU}	w^{CU}
Π_2^{i}	h	s	s
Π_3 and Π_4	1	1	1

Table 2.1.3 Utilities

Our assumption that countries receive the same utility under a complete network and a trilateral PTA suppresses the costs of enforcing rules of origin. This assumption simplifies exposition without losing important generality.

In contrast to Bagwell and Staiger (1997), we de-emphasize the role of enforcement in determining transitions. However, our approach is complementary in the sense that the utilities associated with each position can be interpreted as equilibrium payoffs in unmodelled tariff-setting subgames.

We will focus on games in which aggregate utility under global free trade exceeds aggregate utility at any other position. Accordingly, we adopt the following assumption:

[10] See Bond and Park (2002) for an explanation of gradual tariff adjustment.

Efficient Free Trade $\max\{2v + w, h + 2s\} < 3$

Efficient Free Trade implies that every efficient position is negative-externality-free in Gomes and Jehiel's (2005) terms. While their bargaining model has a slightly different protocol (random proposers), a simple variant on their argument establishes that every stable position is efficient (their Proposition 6).

Efficient Free Trade places upper bounds on the sum of utilities, but not on the utilities themselves. In particular, PTAs can be disadvantageous to their members (as in models of trade diversion), and can be advantageous to the outsider (as in Bond et al's (2004) model of free trade areas).

We sketch the new transitions which can occur if **Efficient Free Trade** fails in Remark 3, at the end of the next section.

Our results will turn on some simple conditions on the four parameters $\{h, s, v, w\}$. Accordingly, we will treat these parameters as primitive. However, it will prove convenient to track some conditions using a simple example, which we present in the next subsection.

Solution concept

We refer to games which satisfy the conditions above as 'closed access games'. Such multilateral bargaining games have a multiplicity of pure strategy subgame-perfect equilibria.[11] Accordingly, we follow the literature by using a version of stationary subgame perfection (aka Markov perfection) to characterize play. Specifically, we characterize those subgame perfect equilibria in which a country's proposal only depends on history via the prevailing position; and in which a country's response to any given proposal only depends on history via the proposer, the countries which have already accepted the proposal, and the prevailing position.[12] We refer to such strategy combinations as 'equilibria'.

In equilibrium, a proposer tailors its offer such that each respondent is indifferent between accepting and rejecting: in which case, the respondent would propose next period. We will solve for equilibria by repeatedly using this indifference condition.

Our results clearly generalize to games with asymmetric countries. Symmetry not only simplifies exposition, but also allows us to focus on a hegemon's strategic role in the Section 4 variant on this model.

2.2. Example

In this subsection, we use an example of a three good exchange economy to calculate values of the parameters $\{h, s, v, w\}$:

We suppose that each country is composed of a single consumer, who is endowed with the entire endowment of one good (normalized to one unit). We index the three goods, like countries, by i, j and k. Consumption of good j by consumer i denoted by x^i_j.

In each period, consumer i trades competitively, paying p^i_j for good j. If countries i and j are members of the same PTA then consumer i pays the international price of P^j for the good; otherwise, trade between countries i and j is subject to an ad valorem tariff of

[11] See, for example, the arguments in Chatterjee et al. (1993).

[12] Stationarity excludes (inter alia) strategies which punish countries for rejecting previous offers.

$\tau > -1$: where τ is fixed, and independent of i and j.[13] This assumption will imply that customs union and free trade areas are utility-equivalent, in the sense that they entail the same vector of utilities. Accordingly, we identify positions $\Pi_1^{ij}(FTA)$ and $\Pi_1^{ij}(CU)$ in this subsection, writing both as Π_1^{ij}.

In any period, a consumer's return depends on consumption of the three goods and on money (lump sum) transfers - where net transfers to i are denoted by m^i. We assume that consumer i's preferences are represented by

$$\begin{aligned} u^i(x_1^i, x_2^i, x_3^i) &= A[\sum_{j=1}^{j=3} \log x_j^i - \log(1+\tau) + 3\log(3+\tau)] + m^i \\ \text{where } A &\equiv \frac{1}{3\log(3+\tau) - \log(1+\tau) - 3\log 3} > 0. \end{aligned}$$

τ is a parameter of this model; so u^i is an increasing, linear transformation of the standard representation $\sum_{j=1}^{j=3} \log x_j^i + m^i$. We add the constant terms to normalize such that each country earns 0 absent any agreements, and 1 under free trade.

We write consumer i's income as Y^i, which is equal to P^i, the international price of good i, plus the tariffs country i collects on consumer i's purchases of goods j and k. Consumer i's demand for good j is then given by $x_j^i = Y^i/3p_j^i$. We now use this demand function to calculate each consumer's utility at every position.

At position Π_0, each country sets τ on all trade, so symmetry implies that the world price of each good is 1. Solving for incomes yields $Y^i = \frac{3(1+\tau)}{3+\tau}$; so

$$x_j^i = \begin{cases} \frac{1+\tau}{3+\tau} : j = i \\ \frac{1}{3+\tau} : j \neq i \end{cases}$$

It is easy to confirm that country i's utility is 0 at this position.

Now consider position Π_1^{ij}. In equilibrium, we must have $P^i = P^j \equiv P$, $Y^i = Y^j \equiv Y$ and $x_l^i = x_l^j \equiv x_l$ for every good l. Hence,

$$x_l = \begin{cases} \frac{Y}{3P} : l \neq k \\ \frac{Y}{3(1+\tau)P^k} : l = k \end{cases} \quad \text{and} \quad x_l^k = \begin{cases} \frac{Y^k}{3(1+\tau)P} : l \neq k \\ \frac{Y^k}{3P^k} : l = k \end{cases}$$

Substituting for incomes: $Y = \frac{3(1+\tau)}{3+2\tau}P$ and $Y^k = \frac{3(1+\tau)}{3+\tau}P^k$; and substituting back into the demand functions, we have:

$$x_l = \begin{cases} \frac{1+\tau}{3+2\tau} : l \neq k \\ \frac{1}{3+2\tau}\frac{P}{P^k} : l = k \end{cases} \quad \text{and} \quad x_l^k = \begin{cases} \frac{1}{3+\tau}\frac{P^k}{P} : l \neq k \\ \frac{1+\tau}{3+\tau} : l = k \end{cases}$$

[13] The assumption of a fixed tariff can be interpreted as equilibrium strategies in a tariff war game where countries are subject to the WTO rule that PTAs don't raise tariffs and equilibrium tariffs at Π_0 are high enough.

Relative prices are determined by the market-clearing conditions. In particular, net aggregate demand for good i equals 0:

$$\frac{2(1+\tau)}{3+2\tau}+\frac{1}{3+\tau}\frac{P^k}{P}=1,$$

which implies that $\frac{P^k}{P}=\frac{3+\tau}{3+2\tau}$. Substituting into the demand functions and then into returns yields the following expressions for v and w:

$$\begin{aligned} v &= A[\log(1+\tau)+2\log(3+\tau)-2\log(3+2\tau)] \text{ and} \\ w &= A[2\log(3+\tau)-2\log(3+2\tau)] \end{aligned}$$

It is easy to confirm that $w<0<v<1$ if $\tau>0$; and that $v<0<1<w$ if $\tau<0$. In other words, PTA members are the sole beneficiaries of a PTA which removes a positive tariff, while the outsider is the sole beneficiary of a PTA which removes a subsidy.

Now consider position Π_2^i. In equilibrium, we must have $P^j=P^k\equiv P$, $Y^j=Y^k=\frac{3(1+\tau)}{3+2\tau}P$ and $Y^i=P^i$. The market-clearing conditions therefore imply that $\frac{P}{P^i}=\frac{3+2\tau}{3(1+\tau)}$. Substituting into the demand functions and then into returns yields the following expressions for h and s:

$$\begin{aligned} h &= A[3\log(3+\tau)+\log(1+\tau)-2\log(3+2\tau)-\log 3] \\ s &= A[3\log(3+\tau)-2\log(3+2\tau)-\log 3] \end{aligned}$$

It is easy to confirm that $h>1>v>s>w$ if $\tau>0$; and that $w>s>v>h$ if $\tau<0$.

Finally, each consumer buys $\frac{1}{3}$ of a unit of each good under global free trade, and therefore earns a utility of 1 at positions Π_3 and Π_4. It is easy to confirm that $h>1$ if $\tau>0$; and that $w>1$ if $\tau<0$.

The relative magnitudes of v and w will be crucial to our results below. Bond et al's (2004) model of an exchange economy with three tariff-setting governments illustrates how v may exceed w or conversely. The outsider always gains from formation of a free trade area (Proposition 5);[14] and the members lose if endowments of each good are distributed unequally enough (Table 1): so we have $w>0>v$. By contrast, members gain and the outsider loses from formation of a bilateral customs union.

3. CLOSED ACCESS GAME: RESULTS

In this section, we characterize equilibria of the game defined in Section 2. It will prove convenient to divide the analysis into three parts. In Section 3.1, we consider a special case of the game which satisfies the following restriction: if countries i and j form a bilateral PTA then the only feasible new PTA is trilateral. This condition is, of course, satisfied if every PTA must be a customs union. In Section 3.2, we characterize equilibria of a game in which every PTA must be a free trade area: so a member of a bilateral PTA cannot prevent its partner from forming another PTA with the outsider. Finally, in Section 3.3 we use our results to describe play in a game where countries can choose whether to form a customs union or a free trade area.

[14] Kennan and Riezman (1990) Example B illustrates how this result could be reversed.

3.1. The customs union game

The distinguishing feature of this special case is the supposition that positions must be partitional: an assumption adopted throughout the literature on multilateral bargaining. Accordingly, we will refer to a bilateral PTA as a customs union. We simplify notation in this subsection by replacing $\Pi_1^{ij}(CU)$ with Π_1^{ij}, v^{CU} with v, and w^{CU} with w. The transition matrix in the customs union game is

Prevailing position	Reachable positions (consenting countries)
Π_0	Π_1^{ij} $(\{i,j\})$, Π_3 $(\{i,j,k\})$
Π_1^{ij}	Π_3 $(\{i,j,k\})$
Π_3	None

Table 3.1.1 Transition matrix (customs union game)

This model builds on the reversible action game presented in Seidmann and Winter (1998), extending their analysis by allowing for externalities.[15] The most closely related papers in the trade literature are Yi (1996) and Aghion et al. (2004). In Yi's unanimous regionalism model, transfers are unavailable, and PTA members cannot renegotiate their agreement. Aghion et al assume that a prespecified country makes all of the offers, and that the game ends when an offer is rejected or when global free trade is reached.

Our first result characterizes equilibrium play after a customs union has formed.

Lemma 3.1 *The subgame which starts at new position Π_1^{ij} possesses a unique equilibrium in which both members receive an expected transfer of $\frac{1}{3}(v-w)$.*■

The proof of Lemma 3.1 uses arguments which are conventional in the bargaining literature, and is therefore omitted. These arguments establish that the three countries *must* agree to free trade once a customs union has formed. Seidmann and Winter (1998) Example 2 demonstrate that this property does not hold for all equilibria of a game with patient countries (viz. $d = 1$).

We now use Lemma 3.1 to characterize play:

Theorem 3.1 *If*

$$(3-2d)v - dw > \frac{3(1-d)(3+4d)}{2(1+2d)}$$

then, in every equilibrium of the customs union game, a customs union forms in the first period and expands to global free trade in the second period. If

$$(3-2d)v - dw < \frac{3(1-d)(3+4d)}{2(1+2d)}$$

then the game has a unique equilibrium in which the three countries agree to global free trade in the first period.

[15] Gomes and Jehiel (2005) analyze a dynamic bargaining model with externalities, albeit with a slightly different protocol (= extensive form).

Proof

In every equilibrium, the three countries choose pure, symmetric strategies such that an agreement is reached in the first period. Accordingly, we prove the result by providing necessary and sufficient conditions for existence of an equilibrium in which a customs union forms, and of an equilibrium in which all three countries agree to global free trade immediately. We start with the former case.

We claim that this game possesses an equilibrium in which each country proposes position Π_1^{ij} and a transfer of $[\frac{d}{3(1+d)}w - \frac{3-2d}{3(1+d)}v - \frac{d}{1+d}]$ at prevailing position Π_0 if $(3-2d)v - dw > \frac{3(1-d)(3+4d)}{2(1+2d)}$. Lemma 3.1 implies that the proposer (say, country i) then earns $V^P \equiv \frac{2}{3(1-d^2)}[(3-2d)v - dw + 3d]$, while the respondent at position Π_0 earns dV^P. The transfer is calibrated such that the respondent at position Π_0 is indifferent between accepting and rejecting. If some country can profitably deviate then country i can profitably deviate to proposing position Π_3 and a transfer which makes countries j and k indifferent between accepting and rejecting. It is easy to confirm that such a deviation is indeed profitable if and only if $(1+2d)V^P < \frac{3}{1-d}$. Substituting for V^P and rearranging yields the first condition in the premise.

Now suppose that $(3-2d)v - dw < \frac{3(1-d)(3+4d)}{2(1+2d)}$. We claim that this game possesses an equilibrium in which each country proposes position Π_3 and a transfer of $-\frac{1-d}{1+2d}$ at prevailing position Π_0, which is calibrated such that both respondents are indifferent between accepting and rejecting. The proposer (say, country i) then earns $\frac{3}{(1-d)(1+2d)}$. If some country can profitably deviate then country i can profitably deviate to proposing position Π_1^{ij} and a transfer which makes country j indifferent between accepting and rejecting. It is easy to confirm that such a deviation is indeed profitable if and only if the second condition in the premise is satisfied.■

Theorem 3.1 implies that the equilibrium transition path is unique for generic customs union games.

In the special case of no externalities ($w = 0$), the set of countries and the pair $\{v, 3\}$ define a 0-normalized characteristic function game, whose core is empty if $v > 2$. The customs union game then corresponds to Example 1 in Seidmann and Winter (1998), who show that patient enough countries form a customs union.[16]

If d is close to 1 then Theorem 3.1 implies that a customs union forms in equilibrium if and only if $v > w$. We represent such transitions in Table 3.1.2. The notation $\Pi \mapsto \Pi$' means that position Π' is reached in one step from position Π:

$v < w$	$\Pi_0 \mapsto \Pi_3$
$v > w$	$\Pi_0 \mapsto \Pi_1^{ij} \mapsto \Pi_3$

Table 3.1.2 Equilibrium transitions (patient enough countries)

The intuition for Theorem 3.1 is that a customs union shifts the status quo point in a direction which is favorable for its members if and only if $v > w$. Such a shift allows

[16] Seidmann and Winter (1998) Theorem 1 states that patient enough countries cannot agree to efficient free trade immediately if the core of the underlying characteristic function game is empty.

members to gain a larger share of the gains from global free trade than they would earn if the trilateral PTA formed at the initial position. Accordingly, we refer to this motive for forming a PTA as 'strategic positioning'.

Strategic positioning requires that countries be patient enough: for if not, then the immediate opportunity cost of negotiating a customs union outweighs the gains in subsequent free trade negotiations. If d is close to 0 then Theorem 3.1 implies that a customs union forms in equilibrium if and only if $v > \frac{3}{2}$, when the two PTA members jointly earn more utility than the three countries earn under global free trade.[17] Lemma 3.1 implies that a trilateral PTA forms next period in our model. However, the motive for forming a PTA is independent of this property: a customs union would form in a model without any renegotiation if $v > \frac{3}{2}$.

Strategic positioning can only explain the formation of a customs union if trilateral negotiations cover other issues as well. (We highlight this condition in our model by assuming that countries can engage in lump sum transfers.). If transfers were impossible (as in Yi (1996)) then agreements would not be renegotiated in equilibrium, and a customs union would form if and only if $v > \frac{3}{2}$.

3.2. The free trade area game

In this subsection, we analyze a variant on the CU game in which a bilateral agreement does not prevent a PTA member from reaching a further agreement with the outsider. We dub this the 'free trade area game'. We simplify notation in this subsection by replacing $\Pi_1^{ij}(FTA)$ with Π_1^{ij}, v^{FTA} with v, and w^{FTA} with w.

The transition matrix in the free trade area game is

Prevailing position	Reachable positions (consenting countries)
Π_0	Π_1^{ij} $(\{i,j\})$, Π_3 $(\{i,j,k\})$
Π_1^{ij}	Π_2^{i} $(\{i,k\})$, Π_3 $(\{i,j,k\})$
Π_2^{i}	Π_3 $(\{i,j,k\})$, Π_4 $(\{j,k\})$
Π_3	None
Π_4	None

Table 3.2.1 Transition matrix (free trade area game)

Our main result in this subsection characterizes transitions in the free trade area game when countries are patient enough.

Theorem 3.2 *If countries are patient enough then transitions on the equilibrium path of the free trade area game are described in the table below:*

	$h < s$	$h > s$
$v < w$	$\Pi_0 \mapsto \Pi_3$	$\Pi_0 \mapsto \Pi_3$
$v > w$	$\Pi_0 \mapsto \Pi_1^{ij} \mapsto \Pi_3$ if $s - h > v - w$ $\Pi_0 \mapsto \Pi_1^{ij} \mapsto \Pi_2^{i} \mapsto \Pi_3$ if $s - h < v - w$	$\Pi_0 \mapsto \Pi_1^{ij} \mapsto \Pi_2^{i} \mapsto \Pi_3$ or Π_4

[17] $v > \frac{3}{2}$ holds in the Example if τ is small enough but positive.

We prove Theorem 3.2 in the Appendix via Proposition A3.2, which describes equilibrium transitions for every generic discount factor. We prove Proposition A3.2 via a couple of Lemmas:

Lemma A3.2.1 characterizes equilibrium play in a subgame starting at new position Π_2^i, distinguishing between two cases. If $(1+d)h > 1-d+2ds$ then the hub proposes to both spokes, and each spoke proposes to the other spoke alone; so the terminal position can either be a complete network of free trade areas or a trilateral PTA, depending on the proposer's identity. By contrast, a trilateral PTA always forms if $(1+d)h < 1-d+2ds$.

In either case, the hub acceptably proposes a trilateral PTA.in equilibrium, even if it earns more utility as a hub $(h > 1)$. It participates actively in negotiations in order to obtain some rent because the other two countries would reach an agreement next period, even if the hub's offer were rejected.[18] If $(1+d)h > 1-d+2ds$ then this rent disappears as the discount factor approaches 1 because the hub becomes essentially a dummy player.

Lemma A3.2.2 characterizes equilibrium play in a subgame starting at new position Π_1^{ij}, distinguishing between cases in which the trilateral PTA and the hub and spoke pattern are reached in the next period. In the former case, the free trade area members obviously earn the same payoff at new position Π_1^{ij} as they earn at that new position in the customs union game (cf. Lemma 3.1). In the latter case, the free trade area outsider is indifferent between proposing to country i and to country j. Consequently, the subgame which starts at new position Π_1^{ij} has a continuum of equilibrium outcomes, which are indexed by the probability with which the outsider proposes to a given free trade area member. However, there is clearly an equilibrium in which the hub and spoke pattern is reached if and only if there is an equilibrium in which the outsider is equally likely to propose to each free trade area member.

We then use the equilibrium payoffs at new positions Π_1^{ij} and Π_2^i to fully characterize equilibrium transitions. If the hub and spoke pattern is never reached then the game is strategically equivalent to the customs union game; so Theorem 3.1 describes the conditions under which a free trade area forms in equilibrium. Otherwise, a free trade area is formed if and only if members of the initial free trade area expect to earn more (after formation of a further free trade area) than by agreeing to a trilateral free trade area immediately.

The arguments which we use all involve comparisons between the joint surplus available to two countries when they form a free trade area and when they agree with the other country. The free trade game therefore possesses a unique equilibrium for generic discount factors.

Theorem 3.2 asserts that patient enough countries form a free trade area if and only if its members earn a greater utility than the outsider: the necessary and sufficient condition for a customs union to form.

If this condition $(v > w)$ is satisfied then a hub and spoke pattern may form even if the hub earns a lower utility than the spokes. If countries are patient then any relative loss that accrues when $h < s$ is transitory, and the hub expects to receive very small transfers when global free trade is achieved. The advantage to member i of proposing an additional free trade area necessarily accrues from the transfer demanded from the outsider (country

[18] This rent always compensates for any initial loss of utility because $h + 2s < 3$ by **Efficient Free Trade**.

k) to put it in a symmetric position to the other free trade area member (country j). Hub and spoke patterns may therefore be reached because formation of an initial PTA does not commit its members not to compete against each other in this game. By contrast, formation of a customs union forces its members to extend the existing PTA rather than to replicate it. We will exploit this property in the next subsection.

A complete network (Π_4) is only reached if $v > w$ and $h > s$. Arguments used in the proof of Lemma A3.2.1 then imply that formation of a complete network relies on the identity of the proposer at position Π_2^i.

Suppose that the parameters are derived from the Example of the last section. If $\tau > 0$ then $h > s$ and $v > w$; whereas $h < s$ and $v < w$ if $\tau < 0$. Our model then implies that a hub and spoke pattern must form along the transition path if countries are patient enough and $\tau > 0$; whereas a trilateral free trade area forms immediately if $\tau < 0$.

3.3. The closed access game

In this subsection, we analyze the closed access game introduced in Section 2.1, which allows countries to form either a customs union or a free trade area at the initial position.

Theorem 3.3 *If $v^{CU} - w^{CU} \geq v^{FTA} - w^{FTA}$ and countries are patient enough then a hub and spoke pattern is never reached in a closed access game.*

Proof

Position Π_2^i can be reached in an equilibrium of the closed access game if and only if it is reached in an equilibrium of the free trade area game, and the aggregate payoff of the two free trade area members exceeds their aggregate payoff after forming a customs union. If countries are patient enough then Lemma 3.1 implies that the latter condition is satisfied whenever a free trade area member's average payoff at new position $\Pi_1^{ij}(FTA)$ exceeds $\frac{1}{1-d}[1 + \frac{1}{3}(v^{CU} - w^{CU})]$. There are two cases to consider:

- If $(1 + d)h > 1 - d + 2ds$ then the average payoff at new position $\Pi_1^{ij}(FTA)$ is close to $\frac{1}{1-d}[1 + \frac{1}{4}(v^{FTA} - w^{FTA})]$. Theorem 3.2 implies that patient enough countries only form a free trade area if $v^{FTA} > w^{FTA}$; so the country which proposes position $\Pi_1^{ij}(FTA)$ could profitably deviate to proposing $\Pi_1^{ij}(CU)$ instead, thereby precluding formation of a further free trade area;

- If $(1+d)h < 1-d+2ds$ then the average payoff at new position $\Pi_1^{ij}(FTA)$ is close to $\frac{1}{12(1-d)}[12+3(v^{FTA} - w^{FTA}) + s - h]$. Furthermore, Theorem 3.2 implies that patient enough countries only form a free trade area if $v^{FTA} - w^{FTA} > s - h$. Consequently, the country which proposes position $\Pi_1^{ij}(FTA)$ could profitably deviate to proposing $\Pi_1^{ij}(CU)$ instead, thereby precluding formation of a further free trade area.■

The intuition for Theorem 3.3 is that a free trade area member which is selected to propose at new position $\Pi_1^{ij}(FTA)$ can address its offer to the outsider, thereby reducing its fellow member's payoff. By contrast, global free trade must be reached if two countries form a customs union. The identity of the proposer at new position $\Pi_1^{ij}(FTA)$ is determined randomly, so the aggregate payoff of free trade area members at this new position is less than the aggregate payoff of customs union members.

These arguments rely on the supposition that countries are patient enough. If countries were impatient ($d = 0$) then a hub and spoke pattern would be reached in the closed access game if either $h > 1$ and $v > \max\{h - s - 3, \frac{3}{2}\}$ or $h < 1$ and $v > \max\{3 - (h + s), \frac{3}{2}\}$. A hub and spoke can also, of course, form in equilibrium if $v^{CU} - w^{CU}$ sufficiently exceeds $v^{FTA} - w^{FTA}$.

Our last result in this section confirms a property which holds in both the customs union and the free trade area games:

Theorem 3.4 *If countries are patient enough then the three countries reach global free trade immediately in a closed access game unless members of some PTA earn greater utility than the outsider.*■

Theorem 3.4 follows immediately from Theorems 3.1 and 3.2.

The condition for PTA formation ($v > w$) is satisfied in the Example of Section 2.2 if and only if $\tau > 0$. Our model then implies that patient countries form a PTA if and only $\tau > 0$.

If $\tau > 0$ in the Example then we also have $v > 0$. This condition is not, in general, necessary for a bilateral PTA to form. A PTA whose members earned less than 0 could form in equilibrium, provided that the outsider lost even more: a condition consistent with Vinerian arguments about trade diversion or with terms of trade effects. By contrast, a bilateral PTA can only form in Aghion et al. (2004) if $w < 0$ because the utility earned by the other PTA member (v) is irrelevant in equilibrium when one country has a monopoly on making proposals.

In sum, our model predicts that inefficient PTAs form, ceteris paribus, when they inflict large collateral damage on outsiders.[19] This result may explain why Mexico agreed to join NAFTA even though, as Panagariya (1999) argues, it suffered static losses (via loss of tariff revenue). Mexican participation in NAFTA may have caused other Latin American countries to suffer sufficient collateral damage that Mexico was advantaged in its post-NAFTA negotiations with MERCOSUR, Chile, Caricom and the Andean Pact.

Our results in this section are related to Bhagwati's famous question: Are PTAs stumbling blocks or stepping stones to free trade?[20] Theorem 3.4 specifies conditions under which global free trade is delayed (but not prevented) by PTA formation.[21] PTAs can therefore be interpreted as possible stumbling blocks in our model; though it does not admit an obvious interpretation of PTAs as stepping stones. In contrast to the related literature, our model allows countries to choose whether to propose at a bilateral or a trilateral level, as well as to renegotiate agreements.[22] Most of the literature also precludes any transfers, so PTAs are stumbling blocks if the associated utility vector is not

[19] See Winters and Chang (2000) for empirical estimates of the (adverse) terms of trade effects on outsiders.

[20] See, in particular, Bhagwati and Panagariya (1996).

[21] However, PTAs could prevent free trade if $d = 1$: cf. the paragraph following Lemma 3.1.

[22] Panagariya (2000) surveys this literature.

Pareto-dominated by global free trade. The social desirability of a transition to global free trade is then moot. By contrast, we show that PTA formation can be unambiguously undesirable.

Remark 3 **Efficient Free Trade** might fail if smaller PTAs can adopt deeper integration than their larger counterparts (cf. Baldwin (1995)) or if fewer multilateral agreements can be enforced. Suppose that the condition fails, and that PTAs could break up with the consent of all members. If v were small and positive, w large enough and countries patient enough then the trilateral PTA would form in the first period, with one member leaving (by mutual consent) in the second period.[23]■

4. THE US COMMITMENT TO FREE TRADE

According to hegemonic stability theory, international cooperation requires a dominant country to exercise its power.[24] As Kindleberger (1986) notes, free trade has historically relied on the willingness of a hegemon to provide leadership. Britain's unilateral liberalization underpinned free trade in the later 19^{th} century, and the US commitment not to join any bilateral PTAs underwrote progress at GATT. This commitment was costly to the US, which gradually lost its dominant position in world trade. In 1982, the US announced that it would pursue a 'twin track' strategy, and then signed a free trade agreement with Canada. Multilateral negotiations have subsequently proceeded slowly (though the Uruguay Round was completed) while many bilateral PTAs have been agreed. As Bhagwati has frequently claimed (e.g. Bhagwati (1993)), the twin track strategy may have been responsible for these developments.

The Kindleberger/Bhagwati thesis is widely cited (but rarely discussed): primarily in the related literature on burden sharing in alliances, which was initiated by Olson and Zeckhauser (1966). This literature typically models alliances as voluntary contribution games;[25] whereas Kindleberger/Bhagwati address another mechanism by which a hegemon might sustain cooperation. However, on closer inspection, the claim that GATT negotiations were sustained by the American commitment seems problematic: for it is unclear why a commitment by one country not to join a PTA should deter other countries from forming PTAs.

In this section, we use a variant of the closed access game to defend the argument against this critique. In brief, we will argue that formation of PTAs is a systemic property which depends on the value of all countries' outside options, rather than on a single country's commitment.

We analyze two variants on the customs union game which satisfy

Condition *A trilateral offer can only be made in odd-numbered periods, whereas an offer to form a bilateral PTA can be made in each period.*

[23] We proved this assertion in an earlier version of this paper, which is available on request.
[24] See Keohane (1984) for an exposition and elaboration.
[25] See, in particular, Hamada (1996).

This assumption is essential to our results (for reasons explained below). While **Condition** is formally artificial, it is empirically plausible if we identify a trilateral offer with negotiations conducted under GATT/WTO auspices: for it then asserts that multilateral negotiations take longer to organize than bilateral negotiations. In light of **Condition**, we also suppose that a proposer can choose not to make any offer – in which case it retains the floor in the next period.

In one variant, which we dub the 'commitment game', a single country (labeled i) is exogenously committed neither to make nor to accept any bilateral proposal; in the other variant, which we dub the 'no-commitment game', none of the countries are so committed. The games are identical to the customs union game in all other respects.

We analyze these games by characterizing their stationary subgame-perfect equilibria; but, in light of **Condition**, we allow stationary offers to depend on the oddness of the period. Specifically, we define a state as a pair, consisting of a position and the oddness of the period, writing a state as $< \Pi, \delta >$: where $\delta \in \{odd, even\}$. We will say that a strategy combination is an 'equilibrium' if it is subgame-perfect, and is stationary at every state.

Only one bilateral PTA can feasibly form if country i is committed; so positions are necessarily partitional in the commitment game. Our assumption that countries can only form customs unions allows us to suppress the difference between partitional and nonpartitional positions, which we analyzed in Section 3.3, and to focus on the direct effect of commitment. The assumption also simplifies exposition.

Condition will turn out to be crucial to our results:

- If Π_3 could be proposed each period then stationarity would imply that every country proposes Π_3 in the initial round whenever some country proposes Π_3 in an equilibrium of the game. Hence, no countries have *valuable* outside options in an equilibrium of the game, and formation of a bilateral PTA depends on whether such an agreement strategically positions the first period proposer. These incentives are unaffected by a single country's commitment, as countries j and k can still each find a PTA partner: so they form a PTA if and only if $v > w$ in both games;

- If Π_3 could only be proposed in odd periods and proposers had to make an offer then country i's return would be driven down to 0 in any equilibrium where Π_3 was proposed.

Our main result in this section focuses on outcomes when countries are patient. It states that the outcome of the no-commitment game is close to that of the customs union game, and that a trilateral customs union always forms in equilibrium: We will use this result to explain the effects of the US commitment on PTA formation.

Theorem 4 *If countries are patient enough then*

a) *No-commitment games possess a unique equilibrium in which a bilateral customs union forms in the first period if and only if $v > w$ and a trilateral customs union otherwise forms in the first period;*

b) *Commitment games possess a unique equilibrium in which a trilateral customs union forms in the first period;*

c) *If $v > w$ then country i earns less in the commitment game than in the no-commitment game, and if $v < w$ then country i earns the same in both games.*■

We prove Theorem 4 in the Appendix.

Suppose that $v > w$. Absent an agreement to form a trilateral customs union, any two countries which are not otherwise committed would immediately form a customs union in an even-numbered period. Consequently, these countries have an outside option in an odd-numbered period at the initial position. If country i is committed then it must offer each of the other countries a transfer sufficiently high that neither has an incentive to exercise its outside option of forming a customs union when proposing in an odd-numbered period at the initial position. This reduces the payoff which country i would demand at the initial position; so the other two countries would also propose that a trilateral customs union form in odd-numbered periods.

By contrast, if no country were committed, then each first round proposer would earn less than the value of its outside option if it offered the other countries sufficient to induce acceptance of a trilateral offer. Hence, a customs union must form in the first round, even though customs unions are inefficient and countries are impatient. In sum, formation of a customs union is a systemic property, which depends on whether the sum of the values of outside options exceeds the gains from free trade, rather than simply on individual countries' commitments.

Country i's commitment hastens global free trade, but is never advantageous to that country: for if $v > w$ then country i must always compensate the other two countries for not forming a customs union; whereas it would be a customs union member whenever it proposed in the no-commitment game.

According to our model, the US commitment not to negotiate bilaterally may indeed have prevented other countries from forming bilateral PTAs, whereas a new regime was inaugurated when the US abandoned this commitment; so our argument supports Kindleberger's claim that the US commitment caused progress at multilateral talks. Our model may also be of contemporary relevance because Japan has recently abandoned its own commitment not to negotiate bilaterally by agreeing to form a free trade area with Singapore after delays in effecting APEC's objectives.[26] Our analysis suggests that the change in Japanese policy may presage the formation of PTAs within East Asia, rather than the long mooted APEC free trade area.

Our model also implies that the commitment was costly: a theme of the burden-sharing literature. On the other hand, we demonstrate that the 'hegemonic role' could be played effectively by a country which is not large. In this sense, our results run counter to the literature on hegemonic stability, which focuses on the US's relative decline.[27] We note, though, that the absence of *any* bilateral PTAs in the commitment game is an artifact of our three-country model: two uncommitted countries could otherwise form a customs union in order to strategically position themselves with respect to a third uncommitted country.[28] Accordingly, we interpret Theorem 4 as asserting that a commitment by one country to negotiate multilaterally reduces incentives for other countries to form PTAs.

[26] See Dent (2003) on the formation of bilateral and regional multilateral PTAs in East Asia.

[27] See, for example, Keohane (1984).

[28] We are grateful to Richard Cornes for raising this point.

5. ACCESS GAMES

Despite the profusion and variety of PTAs, no countries have formed an open access PTA, which allows free entry by outsiders.[29] While APEC has announced an intention to allow free entry, it froze membership for ten years in 1997 (cf. Choi (2004)). If the PTA outsider gained more than its members from entry then members would be better off forming a closed rather than an open access PTA, which would explain why the latter type of PTA is so unusual. However, this argument relies on the assumed distribution of gains from entry, and there have surely been cases where this assumption failed. For example, prior to British entry into the EC (in 1973), it was widely believed that EC members would collectively gain more than Britain from British entry.

In this section, we present a model of PTA formation in which members can decide whether to form an open or a closed access PTA. Our main result (Theorem 5) explains why open access PTAs do not form, even if members would be the main beneficiaries of entry. We then use our argument to support Bergsten's (1997) suggestion that only open access PTAs be allowed under WTO rules, demonstrating that a trilateral PTA would form immediately in such a game. We end this section by relating our model to the literature.

We explain the rarity of open access PTAs by extending the closed access customs union model to allow members of a bilateral customs union to decide whether or not to allow free entry, calling this the 'access game'.

We denote the position at which countries i and j form a closed [resp. open] customs union as Π_1^{ij} [resp. P_1^{ij}]. To simplify exposition, we suppose that a trilateral customs union (position Π_3) can alone be reached from either Π_1^{ij} or P_1^{ij}.

Each period of the access game starts with a bargaining phase in which one country proposes either a trilateral, a closed bilateral or an open bilateral customs union (in each case with some transfers), and the respondent(s) accept or reject. The position changes if and only if all respondents accept an offer.

If the bargaining phase of some period ends with the game at any position other than Π_1^{ij} then the game proceeds to the next period, as in the customs union game. If the bargaining phase of some period ends at position P_1^{ij} then the period ends with country k choosing whether to join the customs union. If country k chooses to join then a trilateral customs union automatically forms in the next period, without any transfers to or from country k; whereas the next period starts at position P_1^{ij} if the outsider chooses not to join.

Utilities at every position correspond to those introduced in Section 3.1. In particular, open and closed customs unions yield the same pattern of utilities. We analyze the access game by characterizing those subgame perfect equilibria in which

- A country's proposal only depends on the position;
- A country's response to a proposal only depends on the proposal and the position; and

[29] The phrase 'open access PTA' is sometimes used differently, e.g. to mean that a PTA offers unconditional MFN to outsiders. See Bergsten (1997).

- A country's entry decision only depends on the identity of the proposer next period.

We again abuse terminology by calling such a strategy combination an 'equilibrium'.

Theorem 5 *If countries are patient enough then the access game has no equilibrium in which an open customs union forms.*

Proof

There can be no equilibrium in which the outsider chooses to enter an open access customs union: for the rules of the game require that some offer must then have been rejected at position P_1^{ij}, delaying global free trade till the next period; so the country which proposes in that period could profitably deviate to an offer which the other two countries would accept. Consequently, position Π_3 must be reached immediately from position P_1^{ij}.

There are two cases to consider. If $v > w$ then country k earns less than $\frac{1}{1-d}$ after some country proposes at position P_1^{ij}, and can therefore profitably deviate to rejecting the offer and entering the customs union if d is close enough to 1. If $v < w$ then every equilibrium is symmetric; so each country earns about $v + \frac{d}{1-d}[1 + \frac{1}{3}(v - w)]$ if it proposes at position Π_0, and would therefore accept a transfer of less than $\frac{1}{1-d}$ to form a trilateral customs union. Consequently, the proposer at position Π_0 can profitably deviate.■

The proof of Theorem 5 implies that a generic access game possesses the same equilibrium outcomes as a customs union game with the same pattern of utilities.

The proof of Theorem 5 establishes that an open access PTA is never on the outer envelope of PTAs: if countries gain from strategic positioning ($v > w$) then the initial proposer is better off with a closed than an open access customs union, as the outsider would neutralize the strategic advantage by entering unilaterally; if countries lose from strategic positioning ($v < w$) then the outsider would not enter an open access PTA unilaterally, and it is better to propose a trilateral customs union at the initial proposition. Theorem 5 therefore explains why open access customs unions are so rare.

Bergsten (1997) has argued for a change in WTO rules which would require any PTA to be open access. We address this suggestion by analyzing a simplified version of access games in which countries are prohibited from proposing a closed access customs union at the initial position. We call this the 'open access game', and analyze it using the same solution concept as for access games. Our last result supports Bergsten's proposal in the context of our model:

Corollary 5 *If countries are patient enough then a trilateral customs union forms immediately in every equilibrium of an open access game.*■

We omit the proof of Corollary 5 as it follows the same lines as the proof of Theorem 5.

This section has analyzed a game in which countries can choose whether to adopt open access provisions in PTA agreements. Accordingly, we can explain why so few PTAs have voluntarily adopted open access provisions. By contrast, the related literatures have compared equilibria in games with mandatory provisions to equilibria in games with no such provisions.

The closest relation is Yi's (1996) open regionalism model, where an open PTA consists of the set of countries which simultaneously announce the same address. Yi proves an analog of Corollary 5 above under conditions which translate into $v > 0$ and $w < 1$ in our model.[30]

6. CONCLUSIONS

We have presented a model of trade negotiations in which countries can form either customs unions or free trade areas, and can continue to negotiate after reaching an agreement. We have also used variants on this model to explain how one country's commitment to multilateral negotiations affects other countries' equilibrium proposals; and why open access PTAs are so unusual.

Both our benchmark model and its subsequent developments rely on the notion of strategic positioning: countries form PTAs in order to achieve a more favorable division of the gains from global free trade. This motive is novel in the literature because previous papers on trade negotiations have assumed that countries leave the bargaining table after forming a PTA. Strategic positioning seems to capture an important reason for the formation of the EU and of MERCOSUR: that these larger groups would be better positioned in subsequent negotiations with the US. It also seems to correspond to 'competitive liberalization': a motive that (Trade Representative) Robert Zoellick adduced for negotiating bilateral PTAs.[31]

Our approach could be adapted to address some related questions. Bagwell and Staiger (2005) argue that MFN and reciprocity protect outsiders when a PTA forms. Countries can then form a free trade area without worrying that their partners will reach further agreements with outsiders. Such provisions may have the opposite effect in (an extension of) our model: measures which protect outsiders reduce the strategic advantage of forming exclusive PTAs, inducing countries to negotiate multilaterally rather bilaterally.

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[30] Baldwin (1995) and (1997) use similar assumptions in a domino model of the growth of open access PTAs.

[31] See, in particular, Zoellick (2004). Feinberg (2003) p.1020 interprets competitive liberalization as "establishing precedents, models or serving as catalysts for wider trade agreements".

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APPENDIX: PROOFS

Theorem 3.2 *If countries are patient enough then transitions on the equilibrium path of the free trade area game are described in the table below:*

	$h < s$	$h > s$
$v < w$	$\Pi_0 \mapsto \Pi_3$	$\Pi_0 \mapsto \Pi_3$
$v > w$	$\Pi_0 \mapsto \Pi_1^{ij} \mapsto \Pi_3$ if $s - h > v - w$ $\Pi_0 \mapsto \Pi_1^{ij} \mapsto \Pi_2^i \mapsto \Pi_3$ if $s - h < v - w$	$\Pi_0 \mapsto \Pi_1^{ij} \mapsto \Pi_2^i \mapsto \Pi_3$ or Π_4

Theorem 3.2 follows immediately from

Proposition A3.2 *For generic free trade area games:*

a) *The countries agree to a trilateral free trade area in the first period if and only if one of the following sets of conditions is satisfied:*

- $h > \frac{1-d}{1+d} + \frac{2d}{1+d}s$, $(3-2d)v - dw < \frac{3(1-d)(3+4d)}{2(1+2d)}$ *and*

$$v - dw < \frac{1-d}{3(1+d)}\{(1+2d)[3(1+d)h - (3+2d)s] - 10d^2 - 20d - 9\};$$

- $h < \frac{1-d}{1+d} + \frac{2d}{1+d}s$, $(3-2d)v - dw < \frac{3(1-d)(3+4d)}{2(1+2d)}$ *and*

$$3(v - dw) < 3(1-d)(3+4d) + (1+2d)[(4d-3)s - (3-2d)h]$$

- $h > \frac{1-d}{1+d} + \frac{2d}{1+d}s$,

$$v - dw > \frac{1-d}{3(1+d)}\{(1+2d)[3(1+d)h - (3+2d)s] - 10d^2 - 20d - 9\},\ \textit{and}$$

$$\begin{aligned}(6+d-4d^2)v - d(2+d)w \quad < \quad & (1-d)[\frac{27+108d+169d^2+121d^3+34d^4}{3(1+d)(1+2d)} \\ & +d(2+d)h + \frac{d(15+28d+14d^2)}{3(1+d)}s];\ \textit{or}\end{aligned}$$

- $h < \frac{1-d}{1+d} + \frac{2d}{1+d}s$, $3(v - dw) > 3(1-d)(3+4d) + (1+2d)[(4d-3)s - (3-2d)h]$

$$\begin{aligned}& \textit{and}\ [(6+d-4d^2)v - d(2+d)w] + [\frac{d(6-4d-5d^2)}{3}h + \frac{d(15-2d-10d^2)}{3}s] \\ < \quad & \frac{(1-d)(9+27d+29d^2+10d^3)}{1+2d}.\end{aligned}$$

b) *Two countries agree to a bilateral free trade area in the first period and a trilateral free trade area is formed in the second period if and only if either*

- $h > \frac{1-d}{1+d} + \frac{2d}{1+d}s$, $(3-2d)v - dw > \frac{3(1-d)(3+4d)}{2(1+2d)}$ *and*

$$v - dw < \frac{1-d}{3(1+d)}\{(1+2d)[3(1+d)h - (3+2d)s] - 10d^2 - 20d - 9\};\ \textit{or}$$

- $h < \frac{1-d}{1+d} + \frac{2d}{1+d}s$, $(3-2d)v - dw > \frac{3(1-d)(3+4d)}{2(1+2d)}$ *and*

$$3(v - dw) < 3(1-d)(3+4d) + (1+2d)[(4d-3)s - (3-2d)h]$$

c) *Two countries agree to a bilateral free trade area in the first period, another free trade area is formed in the second period and global free trade is reached in the third period if and only if either*

- $h > \frac{1-d}{1+d} + \frac{2d}{1+d}s$,

$$v - dw > \frac{1-d}{3(1+d)}\{(1+2d)[3(1+d)h - (3+2d)s] - 10d^2 - 20d - 9\},\ \textit{and}$$

$$\begin{aligned}(6+d-4d^2)v - d(2+d)w \quad > \quad & (1-d)[\frac{27+108d+169d^2+121d^3+34d^4}{3(1+d)(1+2d)} \\ & +d(2+d)h + \frac{d(15+28d+14d^2)}{3(1+d)}s];\ \textit{or}\end{aligned}$$

- $h < \frac{1-d}{1+d} + \frac{2d}{1+d}s$, $3(v - dw) > 3(1-d)(3+4d) + (1+2d)[(4d-3)s - (3-2d)h]$

  and $[(6+d-4d^2)v - d(2+d)w] + [\frac{d(6-4d-5d^2)}{3}h + \frac{d(15-2d-10d^2)}{3}s]$
  $$> \frac{(1-d)(9+27d+29d^2+10d^3)}{1+2d}.$$

Proof

We start the analysis by characterizing equilibrium play in every subgame which starts at new position Π_2^i.

Lemma A3.2.1

a) *If* $(1+d)h > 1-d+2ds$ *then, gross of any previously agreed transfers, each spoke earns* $\frac{2(1+2d)}{3(1-d^2)} + \frac{1}{3(1+d)}s$ *in every equilibrium of the subgame at new position* Π_2^i;

b) *If* $(1+d)h < 1-d+2ds$ *then, gross of any previously agreed transfers, each spoke earns* $\frac{1}{1-d} + \frac{1}{3(1-d)}(s-h)$ *in every equilibrium of the subgame at new position* Π_2^i.

It will prove useful to denote a spoke's equilibrium payoff at new position Π_2^i by $\frac{1}{1-d}U$. Note that

$$\frac{2(1+2d)}{3(1-d^2)} + \frac{1}{3(1+d)}s > \frac{1}{1-d} + \frac{1}{3(1-d)}(s-h) \text{ if and only if } (1+d)h > 1-d+2ds.$$

Proof

It is easy to confirm that there is no equilibrium in which exactly one of the spokes proposes Π_3. Accordingly, we prove the result by characterizing conditions under which the subgame possesses an equilibrium in which the two spokes each propose position Π_4 and an equilibrium in which all countries propose position Π_3.

We start with the first case. In any such equilibrium, the hub must make a proposal (necessarily of position Π_3). It is easy to confirm that a proposing spoke must offer a transfer of $\frac{1-d}{1+d}s - \frac{1-d}{1+d} < 0$ to the other spoke; so the hub must (acceptably) propose position Π_3. Hence, $(1+d)h > 1-d+2ds$ implies that neither spoke can profitably deviate to proposing position Π_3.

We now turn to the second case. In any such equilibrium, the hub must make a proposal (necessarily of position Π_3). It is easy to confirm that a proposing spoke must offer a transfer of $\frac{1}{1+2d}s - \frac{1-d}{1+2d} - \frac{d}{1+2d}h$ to the other spoke, and of $\frac{1+d}{1+2d}h - \frac{1-d}{1+2d} - \frac{2d}{1+2d}s$ to the hub. Hence, $(1+d)h < 1-d+2ds$ implies that neither spoke can profitably deviate to proposing position Π_4.■

Our proof implies that an agreement to global free trade is reached immediately in every equilibrium; so the hub (country i) earns $\frac{1}{1-d}(3-2U)$ in every equilibrium.

We now characterize equilibrium play in subgames in which the prevailing position is Π_1^{ij}:

Lemma A3.2.2

a) *If either* $h > \frac{1-d}{1+d} + \frac{2d}{1+d}$ *and*

$$v - dw < \frac{1-d}{3(1+d)}\{(1+2d)[3(1+d)h - (3+2d)s] - 10d^2 - 20d - 9\}$$

or $h < \frac{1-d}{1+d} + \frac{2d}{1+d}$ *and*

$$3(v - dw) < 3(1-d)(3+4d) + (1+2d)[(4d-3)s - (3-2d)h]$$

then the subgame at new position Π_1^{ij} *possesses a unique equilibrium in which all countries propose position* Π_3 *and, gross of any previously agreed transfers, each free trade area insider earns* $\frac{1}{1-d}[1 + \frac{1}{3}(v - w)]$;

b) *If* $h > \frac{1-d}{1+d} + \frac{2d}{1+d}s$ *and*

$$v - dw > \frac{1-d}{3(1+d)}\{(1+2d)[3(1+d)h - (3+2d)s] - 10d^2 - 20d - 9\}$$

then the subgame at new position Π_1^{ij} *possesses a unique equilibrium in which all countries propose some position* Π_2^l *and, gross of any previously agreed transfers, each free trade area member earns*

$$\frac{1}{1+d}[h + \frac{3+2d}{3(1+d)}s] + \frac{1}{1-d^2}(dv - w) + \frac{d(7-5d)}{3(1+d)(1-d^2)}$$

if it proposes, and

$$\frac{d}{3(1+d)^2}[3(1+d)h + (3+2d)s] + \frac{1}{1-d^2}(v - dw) + \frac{d^2(7-5d)}{3(1+d)(1-d^2)}$$

if it responds.

c) *If* $h < \frac{1-d}{1+d} + \frac{2d}{1+d}s$ *and*

$$3(v - dw) > 3(1-d)(3+4d) + (1+2d)[(4d-3)s - (3-2d)h]$$

then the subgame at new position Π_1^{ij} *possesses a unique equilibrium in which all countries propose some position* Π_2^l *and, gross of any previously agreed transfers, each free trade area member earns*

$$\frac{1}{1+d}(h+s) + \frac{1}{3(1-d^2)}[2dv - (3-d)w] + \frac{2d}{1-d^2}$$

if it proposes, and

$$\frac{d}{1+d}(h+s) + \frac{1}{3(1-d^2)}[(3-d^2)v - d(3-d)w] + \frac{2d^2}{1-d^2}$$

if it responds.

Proof

At position Π_1^{ij}, each of the free trade area members (l) can induce either position Π_2^l or position Π_3; while the outsider (country k) can induce either position Π_2^l (for some $l \neq k$) or position Π_3. It is easy to see that, for generic games, there are no equilibria in which any two countries propose different positions. We can therefore focus on the conditions under which all countries propose a position Π_2^l or all countries propose position Π_3.

We start with putative equilibria in which all countries propose position Π_3. Conventional arguments imply that the two members accept a transfer of $\frac{v-dw-1+d}{1+2d}$, whereas the outsider accepts a transfer of $\frac{(1+d)w-2dv-1+d}{1+2d}$. If some country has a profitable deviation then it can profitably deviate to proposing position Π_2^l and a transfer which, if accepted, would make its respondent as well off as in the putative equilibrium. This deviation is unprofitable if and only if the sum of the equilibrium payoffs of the outsider and a free trade area member, with one as proposer and the other as respondent, exceeds $h + s + \frac{d}{1-d}(3-U)$.[32] Hence, generic games possess an equilibrium in which all countries propose position Π_3 if and only if

$$h < \frac{3(1-2d^2)}{(1-d)(1+2d)} - \frac{1}{(1-d)(1+2d)}(v-dw) - s + \frac{d}{1-d}U:$$

where U is defined in the proof of Lemma 3.2.1.

There are two cases to consider. If $h > \frac{1-d}{1+d} + \frac{2d}{1+d}s$ then, using Lemma 3.2.1, the condition is satisfied if and only if

$$v - dw < \frac{1-d}{3(1+d)}\{(1+2d)[3(1+d)h - (3+2d)s] - 10d^2 - 20d - 9\};$$

and if $h < \frac{1-d}{1+d} + \frac{2d}{1+d}s$ then the condition is satisfied if and only if

$$3(v-dw) < 3(1-d)(3+4d) + (1+2d)[(4d-3)s - (3-2d)h]$$

Each free trade area member then earns $\frac{1}{1-d}[1 + \frac{1}{3}(v-w)]$ at new position Π_1^{ij}.

It is easy to confirm that, for generic games, no country can profitably deviate from a putative equilibrium in which all countries propose position Π_2^l (some $l \neq k$) if and only if neither condition in the premise of part **a)** holds. Parts **b)** and **c)** follow by substituting for U. A free trade area member's payoffs as proposer and respondent then follow from the equilibrium requirement that any respondent be indifferent between accepting and rejecting a proposal.■

If Π_2^i is always reached from Π_1^{ij} then country k is indifferent between proposing to country i and to country j. Consequently, the subgame which starts at new position Π_1^{ij} has a continuum of equilibrium outcomes, which are indexed by the probability with which country k proposes to country i. Clearly, there is an equilibrium in which Π_2^i is reached if and only if there is an equilibrium in which country k is equally likely to propose to each country in position Π_1^{ij}; in which case, each member earns

$$\frac{1}{6(1-d^2)}[(1-d)(2+d)h + (1-d)(5+4d)s + (1+2d)v - (2+d)w + 3d(2+d) + d(1+2d)U)].$$

[32] This sum is independent of the proposer's identity.

in the subgame at new position Π_1^{ij}.

The only positions which can be reached from Π_0 are Π_1^{ij} and Π_3 (cf. the transition matrix: Table 3.2.1). If a trilateral PTA is reached in one step in equilibrium then the proposer and the other two countries must respectively earn $\frac{1}{1-d}\frac{3}{1+2d}$ and $\frac{1}{1-d}\frac{3d}{1+2d}$. This outcome can be supported in equilibrium unless the proposer can profitably deviate to proposing position Π_1^{ij} and a transfer such that the respondent earns $\frac{1}{1-d}\frac{3d}{1+2d}$. There are three cases to consider:

- If the conditions in part **a)** of Lemma A3.2.2 are satisfied then the free trade game is then strategically equivalent to the customs union game in the sense that it possesses the same equilibrium paths. Equilibrium transitions then follow from the proof of Theorem 3.1.

- If the conditions in part **b)** of Lemma A3.2.2 are satisfied then a trilateral PTA is reached in one step if and only if

$$\begin{aligned}(6+d-4d^2)v - d(2+d)w &< (1-d)[\frac{27+108d+169d^2+121d^3+34d^4}{3(1+d)(1+2d)} \\ &\quad + d(2+d)h + \frac{d(15+28d+14d^2)}{3(1+d)}s];\end{aligned}$$

  otherwise, a free trade area is first formed, followed by a second free trade area.

- If the conditions in part **c)** of Lemma A3.2.2 are satisfied then a trilateral PTA is reached in one step if and only if

$$\begin{aligned}&[(6+d-4d^2)v - d(2+d)w] + [\frac{d(6-4d-5d^2)}{3}h + \frac{d(15-2d-10d^2)}{3}s] \\ &< \frac{(1-d)(9+27d+29d^2+10d^3)}{1+2d};\end{aligned}$$

  otherwise, a free trade area is first formed, followed by a second free trade area.■

Theorem 4 *If countries are patient enough then generically:*

a) *No-commitment games possess a unique equilibrium in which a bilateral customs union forms in the first period if and only if $v > w$ and a trilateral customs union otherwise forms in the first period;*

b) *Commitment games possess a unique equilibrium in which a trilateral customs union forms in the first period;*

c) *If $v > w$ then country i earns less in the commitment game than in the no-commitment game, and if $v < w$ then country i earns the same in both games.*

Proof

a) The proof follows from arguments which are very similar to those exploited in the proof of Theorem 3.1.

b) We start by demonstrating that a commitment game possesses an equilibrium in which a bilateral and a trilateral customs union respectively form in states $<\Pi, even>$ and $<\Pi, odd>$ if and only if $v > w$.

We start in state $<\Pi_1^{jk}, odd>$, where every country proposes a trilateral customs union, offering country i a transfer of n_1, and every other country a transfer of m_1. If a respondent rejects then it proposes in the next period, which is in state $<\Pi_1^{jk}, even>$.

No trilateral customs union can be proposed in state $<\Pi_1^{jk}, even>$, so the proposer delays its offer till the next period, which is in state $<\Pi_1^{jk}, odd>$. Country i then earns $(1+d)w + \frac{d^2}{1-d}(1-2m_1)$ by rejecting in state $<\Pi_1^{jk}, odd>$, whereas country $l \neq 1$ earns $(1+d)v + \frac{d}{1-d}(1-m_1-n_1)$ by rejecting in state $<\Pi_1^{jk}, odd>$. Country i's incentive condition requires that

$$\begin{aligned}
\frac{1}{1-d}(1+n_1) &= (1+d)w + \frac{d^2}{1-d}(1-2m_1) \text{ or} \\
\frac{1}{1-d}n_1 &= (1+d)w - (1+d) - \frac{2d^2}{1-d}m_1. \\
\text{Hence, } \frac{d^2}{1-d}(1-m_1-n_1) &= \frac{d^2(2-d^2)}{1-d} - \frac{d^2(1-2d^2)}{1-d}m_1 - d^2(1+d)w
\end{aligned}$$

The analogous condition for the other countries requires that

$$\begin{aligned}
\frac{1}{1-d}(1+m_1) &= (1+d)v + \frac{d^2}{1-d}(1-m_1-n_1) \\
&= (1+d)(v-d^2w) + \frac{d^2(2-d^2)}{1-d} - \frac{d^2(1-2d^2)}{1-d}m_1
\end{aligned}$$

Consequently,

$$\begin{aligned}
\frac{1}{1-d}m_1 &= \frac{1}{(1-d)(1+2d^2)}(v-d^2w) - \frac{1+d}{1+2d^2} \text{ and} \\
\frac{1}{1-d}n_1 &= -\frac{1}{(1-d)(1+2d^2)}[2d^2v-(1+d^2)w] - \frac{1+d}{1+2d^2} \text{ and} \\
\frac{1}{1-d}m_1 - \frac{1}{1-d}n_1 &= \frac{1}{1-d}(v-w).
\end{aligned}$$

In new state $<\Pi_1^{jk}, odd>$, country i earns

$$\frac{1}{1-d} - \frac{2}{3(1-d)}(m_1-n_1) = \frac{1}{1-d} - \frac{2}{3(1-d)}(v-w);$$

whereas the other countries earn

$$\frac{1}{1-d} + \frac{1}{3(1-d)}(m_1-n_1) = \frac{1}{1-d} + \frac{1}{3(1-d)}(v-w).$$

We now turn to position Π_0.

Every country proposes a trilateral customs union in state $< \Pi_0, odd >$, offering country i a transfer of n_0, and every other country a transfer of m_0. If a respondent (say, l) rejects then the next period is in state $< \Pi_0, even >$ with l as proposer.

If country i rejects in state $< \Pi_0, odd >$ then it must delay its offer in state $< \Pi_0, even >$, proposing again next period, which is in state $< \Pi_0, odd >$. Hence, it earns $\frac{d^2}{1-d}(1-2m_0)$ by rejecting in state $< \Pi_0, odd >$: so

$$\begin{aligned}\frac{1}{1-d}(1+n_0) &= \frac{d^2}{1-d}(1-2m_0) \text{ or} \\ \frac{1}{1-d}n_0 &= -(1+d) - \frac{2d^2}{1-d}m_0\end{aligned}$$

If some country $l \neq i$ rejected in state $< \Pi_0, odd >$ then it proposes a bilateral customs union in state $< \Pi_0, even >$, with a transfer of t to country $L \notin \{i, l\}$. If the latter rejects then it proposes next period in state $< \Pi_0, odd >$; if country L accepts then the game reaches new state $< \Pi_1^{jk}, odd >$. In the former case, country L's payoff in state $< \Pi_0, even >$ is

$$\frac{d}{1-d}(1-m_0-n_0) = \frac{d(2-d^2)}{1-d} + \frac{d(2d^2-1)}{1-d}m_0.$$

In the latter case, country L earns $v + \frac{1}{1-d}t + \frac{d}{1-d} + \frac{d}{3(1-d)}(v-w)$. Consequently, country $l \neq i$ earns

$$2dv - \frac{d^4}{1-d} + \frac{d^2(1-2d^2)}{1-d}m_0 + \frac{2d^2}{3(1-d)}(v-w)$$

in state $< \Pi_0, odd >$ if it rejects a proposal. The transfer offered to country l in that state must therefore satisfy

$$\frac{1}{1-d}m_0 = \frac{1}{1-d^2+2d^4}[2dv + \frac{d^4-1}{1-d} + \frac{2d^2}{3(1-d)}(v-w)].$$

If the proposer in state $< \Pi_0, even >$ deviated to delaying then it would earn $\frac{d}{1-d}(1-m_0-n_0)$. Cross-multiplying by $d(1-d)$, this deviation is unprofitable if and only if

$$2d(1-d)v + d^4 + \frac{2d^2}{3}(v-w) - d^2(2d^2-1)m_0 \geq d^2(2-d^2) + d^2(2d^2-1)m_0$$

Now the right-hand side of this inequality condition equals $1+m_0$; so the deviation is unprofitable if and only if

$$\begin{aligned}(1+d^2-2d^4)m_0 &= (1-d)(1+d+2d^2+2d^3)m_0 \geq -(1-d^2)^2, \text{ or} \\ (1+d+2d^2+2d^3)m_0 &\geq -(1+d)(1-d^2).\end{aligned}$$

Substituting for m_0 yields the condition

$$\frac{(1+d+2d^2+2d^3)}{1-d^2+2d^4}[2d(1-d)v + (d^4-1) + \frac{2d^2}{3}(v-w)] \geq -(1+d)(1-d^2).$$

Cross-multiplying by $1-d^2+2d^4 > 0$ and rearranging:

$$(1+d+2d^2+2d^3)[2d(1-d)+\frac{2d^2}{3}(v-w)] \geq 4d^2(1-d)(1+d)^2,$$

which is satisfied for all d close enough to 1 if $v > w$.

Suppose that some country $l \neq i$ deviates in state $< \Pi_0, odd >$ by proposing a bilateral customs union. This deviation is unprofitable if and only if countries j and k jointly earn more in the putative equilibrium than their joint payoff after the deviation. Substituting for n_0, this condition is equivalent to

$$1+d+\frac{2d^2}{1-d^2+2d^4}[2dv+\frac{d^4-1}{1-d}+\frac{2d^2}{3(1-d)}(v-w)] \geq 2(1+d)v+\frac{2d^2}{1-d}[1+\frac{1}{3}(v-w)].$$

Rearranging terms and cross-multiplying by $3(1-d^2+2d^4) > 0$:

$$2d^2(2d^3+2d^2-d-1)(v-w) \geq 6(1+d-d^2-3d^3+2d^4+2d^5)v-9(1+d-d^2-d^3+2d^4+2d^5)$$

If d is close to 1 then the left-hand and the right-hand sides are respectively close to $4(v-w)$ and $12v-36$. Efficient Free Trade implies that this inequality holds.

Analogous arguments imply that there is an equilibrium in which all countries propose a trilateral customs union in state $< \Pi_0, odd >$, and delay their proposal in state $< \Pi_0, even >$ if and only if $v < w$. Specifically, every respondent receives a transfer of $-\frac{1+d}{1+2d^2}$ in state $< \Pi_0, odd >$ in such an equilibrium.

It is easy to confirm that if d is close enough to 1 then no country can profitably deviate to proposing formation of a bilateral customs union in state $< \Pi_0, even >$ if and only if $v < w$.

If some country $l \neq i$ deviated to proposing a bilateral customs union in state $< \Pi_0, odd >$ then it would have to pay a transfer whose net present value is at least $\frac{2d^2(1+d)}{1+2d^2} - (1+d)v - \frac{d^2}{3(1-d)}(v-w)$. Hence, country l cannot profitably deviate if and only if

$$\frac{2d^2}{3(1-d)}(v-w) \leq \frac{(1+d)(3+4d^2)}{1+2d^2} - 2(1+d)v.$$

This condition is satisfied for d close enough to 1 if and only $v < w$.

Part **b)** then follows because, for generic games, no other transitions are possible in equilibrium.

c) Each country clearly earns close to $\frac{1}{1-d}$ in the (unique) equilibrium of the no-commitment game. Parts **a)** and **b)** imply that the two games possess the same outcomes if $v < w$. By contrast, if $v > w$ then country i earns about $\frac{1}{1-d}[1 - \frac{2}{3}(v-w)]$ in the commitment game, whichever country is selected to make the game's first proposal.■