Bilateralism, multilateralism, and the quest for global free trade*

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Abstract

This paper develops an equilibrium theory of trade agreements and evaluates the relative merits of bilateralism and multilateralism. We derive coalition proof (stable) Nash equilibria of a three-country game in which each country is free to negotiate a trade agreement with only one of its trade partners, or both of them (i.e. practice free trade), or none of them (i.e. opt for the status quo under which all countries impose their optimal Nash tariffs on each other). To determine whether and how bilateralism matters, we also analyze this game under the assumption that countries follow a purely multilateral approach to trade liberalization. Thus, in our model, the degree and the nature of trade liberalization are both endogenously determined. We find that: (1) under symmetry, global free trade is the only stable equilibrium regardless of whether countries can pursue bilateral agreements or not; and (2) when countries have asymmetric endowment levels, there exist circumstances under which free trade is a stable equilibrium only if countries are free to pursue bilateral trade agreements. These results hold even when governments are politically motivated (i.e. they value producer interests and tariff revenue more than consumer surplus).

Keywords: Bilateral trade agreements, multilateral trade liberalization, free trade agreements, GATT. *JEL Classifications*: F13, F12.

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1 Introduction

Global trade liberalization occurs through a variety of channels, not all of which appear to be in harmony with one another. While every major nation is now a member of the World Trade Organization (WTO) and a participant in its complex process of multilateral trade liberalization, an average WTO member also belongs to six preferential trade agreements (PTAs) (World Bank, 2005). The schizophrenic nature of today's multilateral trading system is reflected in the somewhat conflicting rules of the WTO's key multilateral trade agreement, i.e. the General Agreement for Tariffs and Trade (GATT): while Article I of GATT requires member countries to undertake trade liberalization on a most-favored-nation (MFN) or non-discriminatory basis, Article XXIV of the very same agreement permits a subset of WTO members to pursue PTAs under which they can grant tariff (and other trade policy) concessions to each other that they do *not* have to extend to others.[1] This raises the following question: would GATT serve the cause of global free trade more effectively if it did *not* include the exception to MFN provided by Article XXIV? In other words, would global free trade be easier to achieve if all WTO members were to pursue trade liberalization on *only* a multilateral basis? To address this issue, we develop an equilibrium theory of free trade agreements (FTAs) and use it to compare the pros and cons of bilateral and multilateral approaches to trade liberalization. To the best of our knowledge, our paper is the first to provide such a comparison in a model in which the number of trade agreements as well as the nature and the degree of trade liberalization are endogenously determined.

An important feature of our approach is that it allows countries to form multiple FTAs. Formally, we analyze the coalition proof (or stable) Nash equilibria of a game of trade liberalization between three countries that differ with respect to their endowment levels. The game (which we refer to as *bilateralism*) proceeds as follows. In the first stage, each country announces whether or not it wants to form an FTA with each of its trading partners. An

[1] While Article XXIV tries to limit the damage on non-member countries by requiring PTA members to not raise tariffs on outsiders, the fact remains that it contradicts the principle of non-discrimination that underlies the entire WTO system.

FTA between two countries requires them to abolish tariffs on each other and it arises iff they both announce each other's name. Similarly, global free trade emerges iff all countries call each other's names. Next, given the world trade regime, countries impose their optimally chosen tariffs. Finally, international trade and consumption take place. After analyzing equilibrium trade agreements under bilateralism, we examine the stable equilibria of this game under the restriction that countries can liberalize trade on only a multilateral basis (we call this restricted game *multilateralism*). By comparing equilibrium outcomes under bilateralism with those under multilateralism, we are able to isolate the consequences of the exception to multilateral trade liberalization that is provided to WTO members by GATT Article XXIV.[2]

Consistent with actual WTO experience, under our multilateralism game two countries are free to undertake mutual trade liberalization so long as they extend any tariff reductions that they grant to each other also to the third country.[3] We find that the degree of trade liberalization undertaken by two countries (say i and j) under such a multilateral trade agreement $\langle\{ij^m\}\rangle$ is lower relative to that under the bilateral trade agreement $\langle\{ij\}\rangle$, under which countries i and j eliminate tariffs on each other but impose their optimal external tariffs on country k. This result captures the *free-riding* problem inherent to multilateral trade liberalization when it does not involve all three countries – under the agreement $\langle\{ij^m\}\rangle$ country k benefits from the trade liberalization undertaken by countries i and j without having to offer any tariff reductions in return. An important implication of this reduced trade liberalization under $\langle\{ij^m\}\rangle$ is that the non-participating country (i.e. k) actually faces *lower* tariffs in export markets under the bilateral FTA $\langle\{ij\}\rangle$ relative to the multilateral agreement $\langle\{ij^m\}\rangle$. However, the non-member country (k) is relatively disadvantaged under $\langle\{ij\}\rangle$ since it faces discriminatory tariffs in export markets under $\langle\{ij\}\rangle$ whereas no such tariff discrimination exists under $\langle\{ij^m\}\rangle$. Even though the optimal external

[2] We do not consider unilateral trade liberalization since the presence of terms of trade considerations in our model implies that such liberalization is not in any country's interest.

[3] Note that in our model the three countries are free to sign a multilateral agreement even under bilateralism. In other words, our bilateralism game does not rule out a multilateral agreement. By contrast, the multilateralism game rules out a discriminatory bilateral agreement.

tariffs of member countries of the bilateral FTA $\langle\{ij\}\rangle$ are lower than the optimal non-discriminatory tariffs that they choose under the multilateral agreement $\langle\{ij^m\}\rangle$, the discriminatory nature of the bilateral FTA $\langle\{ij\}\rangle$ implies that the non-member country is worse off under it relative to the multilateral agreement $\langle\{ij^m\}\rangle$.[4]

Our analysis also shows that when countries are symmetric with respect to their endowment levels, global free trade is the only stable equilibrium both under bilateralism and multilateralism – i.e. under symmetry, the freedom to pursue purely bilateral agreements has no consequences at all. This irrelevance result points to the importance of allowing for heterogeneity across countries. To this end, we then consider a scenario where endowment levels are unequal across countries and show that global free trade is stable over a larger parameter space under bilateralism relative to multilateralism. This result has a powerful and surprising implication – i.e. there exist circumstances where global free trade is a stable equilibrium *only if* countries are free to form bilateral FTAs. Why? The logic is as follows. First note that, in our model, global free trade obtains iff all countries participate in the multilateral agreement. Further, a country (say k) that is considering not to participate in global free trade has to take into account its welfare under the agreement that would emerge in the *absence* of its participation. Next, as noted above, country k is worse off if the other two countries sign the bilateral FTA $\langle\{ij\}\rangle$ relative to when they sign the multilateral agreement $\langle\{ij^m\}\rangle$. As a result, a country's incentive to opt for free trade is stronger when the alternative to free trade is a bilateral FTA between the other two countries as opposed to a multilateral agreement between them. This is one reason why the freedom to pursue bilateral agreements can be a force in favor of global free trade.

Overall, our results suggest that heterogeneity across countries is an important determinant of the potential for success of multilateralism and that bilateralism has a useful role to play in the process of global trade liberaliza-

[4]See Chang and Winters (2002) for detailed evidence regarding the adverse effects of the Latin American customs union MERCOSUR on the exports of non-member countries to MERCOSUR.

tion.[5] An important implication of our analysis is that to properly account for the role of bilateralism, we need to better understand *why* countries choose to enter into bilateral agreements when multilateral trade liberalization is an option. Indeed, in this context, it is noteworthy that, in our model, such an effect can arise only when countries are asymmetric with respect to their endowment levels. This obviously raises the issue of whether international differences in technology, underlying institutions, and/or political economy forces could deliver a similar result. Indeed, in section 6 we consider a scenario where one country faces stronger political economy pressure than the other two in the sense that it puts greater emphasis on producer interests and tariff revenue (thereby making it relatively more protectionist). We find that the threat of a bilateral FTA between the other two countries can indeed be necessary to provide the relatively protectionist country a sufficient incentive to participate in global free trade.[6]

In a recent paper, Aghion et. al. (2007) provide a comparison of sequential and multilateral bargaining of FTAs. While we consider similar issues, there are important differences between their approach and ours. First, in our model, *all* countries are free to negotiate FTAs and are not required to choose between joining a single grand coalition with a leading country or staying out. Second, we allow countries to form multiple bilateral FTAs. Third, unlike them we do not allow transfers between different coalitions. This is important because when transfers are possible and global free trade maximizes aggregate welfare, it emerges as the equilibrium under both sequential and multilateral bargaining.[7] When free trade does not maximize aggregate welfare, Aghion et. al. (2007) show that FTAs facilitate the achievement of global free trade iff they create negative externalities for non-members. In our model, FTAs can have this effect even when free trade

[5] While both Krugman (1991) and Grossman and Helpman (1995) noted that asymmetries across countries can play a crucial role in determining incentives for bilateral and multilateral trade liberalization, existing literature has tended to pay little attention to this issue.

[6] Saggi and Yildiz (2006) consider cost differences across countries in an oligopolistic model of intraindustry trade and uncover similar results. See Levy (1997), Krishna (1998), and Ornelas (2005b) for analyses focusing on political economy considerations.

[7] We obtain a similar result in the absence of transfers when endowment levels are symmetric across countries.

maximizes global welfare.

Our paper shares some key elements with Goyal and Joshi (2006) and Furusawa and Konishi (2007), both of which employ the network formation game developed by Jackson and Wolinsky (1996) in examining whether or not a given trade configuration is pairwise stable.[8] Under symmetry, global free trade is also stable under their approach. Unlike, us however, they only examine whether the formation of bilateral FTAs results in global free trade as the stable outcome and do not analyze the consequences of adopting a strictly multilateral approach to trade liberalization.

The approach of this paper is also related to that of Riezman (1999) who also asks whether bilateralism facilitates or hinders the achievement of global free trade. However, while we analytically derive the stable Nash equilibria of a non-cooperative game of FTA formation, Riezman (1999) uses the cooperative solution concept of the core and illustrates his results via numerical examples. Second, our model allows us to focus on asymmetries across countries in a way that cannot be done in Riezman's (1999) framework. As noted above, endowment asymmetry across countries plays a crucial role in determining the welfare implications of bilateralism in our model.

The relationship between preferential and multilateral liberalization, to which Bhagwati (1991) first drew attention, has frequently been analyzed in the literature in models of repeated interaction between countries – see Bagwell and Staiger (1997), Bond et. al. (2001), Freund (2000), and Saggi (2006).[9] We add value to this literature by treating both bilateral and multilateral liberalization as endogenous.

[8] Relative to our approach, the concept of pairwise stability implies two constraints. First, the deviating coalition can contain at most two countries. Second, the deviation can consist of severing just one existing link or forming one additional link. In order to eliminate these constraints, we follow Bernheim et al. (1987) and use the concept of coalition proof Nash equilibrium to isolate stable equilibria.

[9] See Bhagwati et. al. (1999) for a collection of many of the important papers in the area.

2 Underlying trade model

To endogenize the formation of trade agreements among asymmetric countries, we utilize an appropriately adapted version of the partial equilibrium framework developed by Bagwell and Staiger (1997 and 1998). There are three countries: a, b, and c and three (non-numeraire) goods: A, B, and C. Each country's market is served by two competing exporters and I denotes the good that corresponds to the upper case value of i. For example, if $i = a$ then $I = A$. Country i is endowed with zero units of good I and e_i units of the other two goods where $e_a \leq e_b \leq e_c$.[10]

The demand for good z in country i is given by

$$d(p_i^z) = \alpha - p_i^z \text{ where } z = A, B, \text{ or } C \tag{1}$$

As is well known, the above demand functions can be derived from a utility function of the form $U(c^z) = u(c^z) + w$ where c^zdenotes consumption of good z; w denotes the numeraire good; and $u(c^z)$ is quadratic and additively separable in each of the three goods. Since each country possesses only two goods while it demands all three, country i must import good I in order to consume it and it can import it from either trading partner. For example, country a imports good A from both countries b and c while it exports good B to country b and good C to country c.

Let t_{ij} be the tariff imposed by country i on its imports of good I from country j. Ruling out prohibitive tariffs yields the following no-arbitrage conditions for good I:

$$p_i^I = p_j^I + t_{ij} \ = p_k^I + t_{ik} \tag{2}$$

where $i, j, k = a, b, c$, and $i \neq j \neq k$. Let m_i^I be country i's imports of good I. Since country i has no endowment of good I, we have

$$m_i^I = d(p_i^I) = \alpha - p_i^I \tag{3}$$

Each country's exports of a good must equal its endowment of that good minus its local consumption:

$$x_j^I = e_j - [\alpha - p_j^I] \tag{4}$$

[10] In addition, all countries have large enough endowments of the numeraire good w to ensure trade balance.

Market clearing for good I requires that country i's imports equal the total exports of the other two countries:

$$m_i^I = \sum_{j \neq i} x_j^I \tag{5}$$

Equations (2) through (5) imply that the equilibrium price of good I in country i equals:

$$p_i^I = \frac{1}{3}\left(3\alpha - \sum_{j \neq i} e_j + \sum_{j \neq i} t_{ij}\right) \tag{6}$$

Using these prices, the volume of trade is easily calculated. As is clear from equation (6), the price of good I in country i increases in its tariffs and decreases in the endowment levels of the other two countries. The effect of a country's tariff on its terms of trade is evident from equation (6): only a third of a given increase in either of its tariffs is passed on to domestic consumers with exactly two third of the tariff increase falling on the shoulders of foreign exporters.

By design the model examines country j's trade protection towards only good J (i.e. the only non-numeraire good that it imports). Since countries have asymmetric endowments, under free trade country a faces the largest volume of imports of protected goods (it imports $(e_b + e_c)/3$ units of good A) whereas country c faces the lowest volume of imports of such goods (it imports $(e_a + e_b)/3$ units of good C).[11] Note also that country j's imports of good J do not equal its exports of other non-numeraire goods. For example, under free trade, country a exports $(2e_a - e_b)/3$ units of good C to country c and $(2e_a - e_c)/3$ units of good B to country b and the sum of these exports is lower than its total imports of good C: $0 < 4e_a - e_b - e_c < e_b + e_c$. In order to balance trade, in addition to exporting goods B and C, country a exports the numeraire good to both countries b and c. Similarly, country c imports the numeraire good from both its trading partners.

From a welfare perspective, given the partial equilibrium nature of the model, it suffices to consider only protected goods. A country's welfare is

[11] The same ranking applies with respect to the value of imports so long as $3\alpha > e_a + e_b + 2e_c$, which is a minor condition that is assumed to hold.

defined as the sum of consumer surplus, producer surplus, and tariff revenue over all such goods:

$$w_i = \sum_z CS_i^z + \sum_z PS_i^z + TR_i \tag{7}$$

Using equations (2) through (6) one can easily obtain welfare of country i as a function of endowment levels and tariffs. Let aggregate world welfare be defined as the sum of each country's welfare

$$ww = \sum_i w_i \tag{8}$$

We proceed as follows. First, we consider a three stage game of trade liberalization under which each country is free to pursue either (a) no trade liberalization or (b) bilateral trade liberalization or (c) multilateral trade liberalization.[12] This game is meant to capture the various options regarding trade liberalization that are available to WTO members today – option (b) being made possible by GATT Article XXIV. After deriving Nash equilibria of this game and isolating those equilibria that are stable (more on this below), we next ask how equilibrium outcomes are affected if countries can choose only between options (a) and (c). The objective of this exercise to isolate the consequences of the exception to MFN that is provided under GATT Article XXIV.

3 Endogenous trade agreements

We now describe our game of trade liberalization (which we refer to as *bilateralism*).[13] In the first stage, each country simultaneously announces whether or not it wants to sign a free trade agreement (FTA) with each of its trading partners (country i's announcement is denoted by σ_i). Country i's strategy set Ω_i consists of four possible announcements:

$$\Omega_i = \{\{\phi, \phi\}, \{j, \phi\}, \{\phi, k\}, \{j, k\}\} \tag{9}$$

[12] Note that all countries have market power in the competing exporters model of Bagwell and Staiger (1997 and 1998) that we utilize. As a result, allowing for unilateral liberalization is not necessary (no country will choose to pursue it in this model).

[13] It is worth emphasizing that in the bilateralism game, countries are free to pursue both bilateral and multilateral trade agreements.

where the announcement $\{\phi, \phi\}$ by country i is in favor of the status quo (or no trade liberalization); $\{j, \phi\}$ is in favor of an FTA with only country j; $\{\phi, k\}$ is in favor of an FTA with only country k; and $\{j, k\}$ is in favor of FTAs with both of them (which is equivalent to country i announcing in favor of multilateral free trade). This stage determines the underlying policy regime. Next, given the policy regime, countries impose their optimal external tariffs. Finally, given trade agreements and tariffs, international trade and consumption take place.

The following policy regimes can emerge in the bilateralism game: (i) No agreement or the status quo $\langle\{\Phi\}\rangle$ prevails when no two announcements match or when everyone announces $\{\phi, \phi\}$; (ii) an FTA between countries i and j denoted by $\langle\{ij\}\rangle$ is formed iff countries i and j announce each other's name $j \epsilon \sigma_i$ and $i \epsilon \sigma_j$; (iii) two independent bilateral FTAs in which i is the common member denoted by $\langle\{ij, ik\}\rangle$ are formed iff (1) $j \epsilon \sigma_i$ and $i \epsilon \sigma_j$ and (2) $k \epsilon \sigma_i$ and $i \epsilon \sigma_k$; and (iv) free trade, denoted by $\langle\{F\}\rangle$, obtains iff all countries announce each others' names: i.e. $\sigma_i = \{j, k\}$ for all $i, j, k = a, b, c$.

It is worth noting here that the regime under which there exist two independent bilateral FTAs (i.e. $\langle\{ih\}\rangle$) is a 'hub and spoke' trading arrangement where the common member (i.e. country i) is the hub while each of the other two countries is a spoke. To simplify notation, we denote $\langle\{ij, ik\}\rangle$ as $\langle\{ih\}\rangle$ (i.e. country i is hub).

Before deriving equilibrium trade agreements, we clarify an expositional point: while changes in the underlying trade regime result from announcement deviations by countries, it proves more convenient to refer directly to regime changes rather than changes in announcements. For example, when the bilateral FTA $\langle\{ij\}\rangle$ is in place, the unilateral announcement deviation of country i from $\{j, \phi\}$ to $\{\phi, \phi\}$ alters the underlying trade regime from $\langle\{ij\}\rangle$ to no agreement $\langle\{\Phi\}\rangle$ and we refer to this announcement deviation of country i as simply a deviation from $\langle\{ij\}\rangle$ to $\langle\{\Phi\}\rangle$.

We next derive equilibrium trade agreements.[14]

[14] We should note that while the joint welfare of members is often considered in determining whether or not a trade agreement would arise (see, for example, Ornelas (2005a) and Krishna (1998)), much of the existing literature on free trade agreements does not derive the equilibria of a fully specified game of trade agreement formation.

3.1 Equilibrium analysis under symmetry

Throughout the remainder of this section as well as section 4, we maintain the following assumption:[15]

Assumption 1:

$$e_i = e \text{ } for \text{ } all \text{ } i = a, b, c. \qquad \text{(symmetry)}$$

Let country i's welfare as a function of trade regime r be denoted by $w_i(r)$ where $r \, \epsilon \, \{\langle\{\Phi\}\rangle, \langle\{ij\}\rangle, \langle\{jk\}\rangle, \langle\{ih\}\rangle, \langle\{jh\}\rangle$ or $\langle\{F\}\rangle\}$ and $i, j, k = a, b, c$. Also, let $\Delta w_i(r - v)$ denote the difference between country i's welfare under trade regimes r and v:

$$\Delta w_i(r - v) \equiv w_i(r) - w_i(v) \tag{10}$$

3.1.1 Optimal tariffs

Since Article I of GATT forbids tariff discrimination, we assume that under the status quo, each country imposes a non-discriminatory tariff on its trading partners: $t_{ij} = t_{ik} = t_i^{\phi}$ for all $i, j, k = a, b, c$. Country i's optimal MFN tariff is easily calculated:

$$t_i^{\phi} \equiv Arg \max w_i(\Phi) = \frac{e}{4} \tag{11}$$

If two countries form an FTA, they remove their tariffs on each other and impose their optimal external tariffs on the non-member country: under $\langle\{ij\}\rangle$ we have $t_{ij} = t_{ji} = 0$, $t_{ik} = t_i^f$ and $t_{jk} = t_j^f$. The optimal external tariff of country i on the non-member country k is given by:

$$t_i^f \equiv Arg \max w_i(ij) = \frac{e}{11} \tag{12}$$

Note that under symmetry, we have $t_i^{\phi} = t_j^{\phi} = t^{\phi}$ and that $t_i^f = t_j^f = t^f$. As in Bagwell and Staiger (1997), we find that the formation of a bilateral FTA induces each member to lower its tariff on the non-member country relative to the status quo (i.e. the model exhibits tariff complementarity): $t^f < t^{\phi}$.[16]

[15] Calculations supporting the results reported in the rest of the paper are contained in the appendix.

[16] See Bagwell and Staiger (1997) for a detailed discussion of the tariff complementarity effect and Estevadeordal et. al. (2007) for empirical evidence in its support. It is worth

We are now ready to derive equilibrium trade agreements under bilateralism.

3.1.2 Nash equilibria

It is straightforward that the status quo is a Nash equilibrium since no country has an incentive to announce another's name if the latter does not announce its name in return. Which of the other three policy regimes – i.e. a bilateral FTA $\langle\{ij\}\rangle$, global free trade $\langle\{F\}\rangle$, and a hub and spoke agreement $\langle\{ih\}\rangle$ – can emerge as Nash equilibria? Before addressing this question, we report a useful lemma that is easy to establish:

Lemma 1: *Under symmetry,* $\Delta w_j(ih - F) < 0 < \Delta w_i(ih - F)$.

In other words, the hub country (i) of the hub and spoke agreement $\langle\{ih\}\rangle$ is better off relative to free trade $\langle\{F\}\rangle$ while each spoke country is worse off. The intuition for this result is transparent. First note that the hub country i enjoys privileged access in both foreign countries under $\langle\{ih\}\rangle$ – neither spoke country imposes a tariff on the hub country whereas both impose the tariff t^f on each other. As a result of this favorable treatment, country i's export surplus under $\langle\{ih\}\rangle$ exceeds that under $\langle\{F\}\rangle$. Second, country i's domestic surplus under $\langle\{ih\}\rangle$ is the same as that under $\langle\{F\}\rangle$ since it itself practices free trade as a hub country. Thus, country i is strictly better off under $\langle\{ih\}\rangle$ relative to $\langle\{F\}\rangle$. To see why the spokes are worse off under $\langle\{ih\}\rangle$ relative to $\langle\{F\}\rangle$, first note that aggregate global welfare is strictly higher under $\langle\{F\}\rangle$ relative to $\langle\{ih\}\rangle$. Since the hub is strictly better off under $\langle\{ih\}\rangle$ relative to $\langle\{F\}\rangle$ and welfare of the two spoke countries is equal due to symmetry, both spokes must be worse off under $\langle\{ih\}\rangle$ relative to $\langle\{F\}\rangle$. In fact, it turns out that that a spoke country has an incentive to revoke its FTA with the hub and become an outsider facing an FTA between the other two countries:

$$\Delta w_j(ik - ih) > 0 \tag{13}$$

This immediately implies that a hub and spoke arrangement $\langle\{ih\}\rangle$ is not a Nash equilibrium.

noting that tariff complementarity also arises in simple general equilibrium models of free trade agreements such as Bond et. al. (2004).

Is a bilateral FTA $\langle\{ij\}\rangle$ a Nash equilibrium? It is easy to show that

$$\Delta w_i(ij - \Phi) = \Delta w_j(ij - \Phi) > 0 \tag{14}$$

i.e. a member country of a bilateral FTA has no unilateral incentive to break the agreement and this implies that a bilateral FTA is a Nash equilibrium. It is also worth noting here that the tariff complementarity effect is large enough to make the non-member country better off under a bilateral FTA relative to the status quo:

$$\Delta w_k(ij - \Phi) > 0 \tag{15}$$

The only remaining candidate for a Nash equilibrium is free trade $\langle\{F\}\rangle$. For $\langle\{F\}\rangle$ to be a Nash equilibrium, we need to rule out the following two (representative) deviations of country k:

(UF1): From $\langle\{F\}\rangle$ to $\langle\{ih\}\rangle$ (or $\langle\{jh\}\rangle$).

(UF2): From $\langle\{F\}\rangle$ to $\langle\{ij\}\rangle$.

It is obvious from Lemma 1 that UF1 cannot occur. Deviation UF2 deserves further consideration because of the tariff complementarity effect of an FTA – as noted above $\Delta w_k(ij-\Phi) > 0$. However, this effect is not strong enough for a country to prefer free riding on bilateral trade liberalization undertaken by others without liberalizing itself since it turns out that

$$\Delta w_i(F - jk) > 0 \tag{16}$$

Thus, $\langle\{F\}\rangle$ is also a Nash equilibrium. We have established the following result:

Proposition 1a: *Given symmetry, the status quo $\langle\{\Phi\}\rangle$, a bilateral FTA $\langle\{ij\}\rangle$, and free trade $\langle\{F\}\rangle$ are all Nash equilibrium trade agreements under bilateralism.*

To deal with the multiplicity of equilibria described in Proposition 1a and to capture the process of FTA formation in a more realistic fashion, we now isolate Nash equilibria that are coalition proof (i.e. Nash equilibria that are immune to self-enforcing coalitional deviations).[17] Following Dutta and Mutuswami's (1997) terminology, we refer to coalition proof Nash equilibria as *stable* equilibria.

[17] Following Bernheim et. al. (1987), a coalitional deviation is self-enforcing if a proper subset of players in the deviating coalition have no incentive to undertake a *further* devi-

3.1.3 Stable equilibria

Which, if any, of the Nash equilibrium agreements described in Proposition 1a are stable? We begin by considering the stability of free trade $\langle\{F\}\rangle$. To this end, we need to rule out three distinct joint deviations:

(JF1): Deviation of j and/or k from $\langle\{F\}\rangle$ to $\langle\{ih\}\rangle$.

(JF2): Deviation of i and j from $\langle\{F\}\rangle$ to $\langle\{ij\}\rangle$.

(JF3): Deviation of i and j from $\langle\{F\}\rangle$ to $\langle\{\Phi\}\rangle$.

It is immediate form Lemma 1 that JF1 can not occur. We also find that, under symmetry, no two countries have a joint incentive to exclude the third country from free trade:

$$\Delta w_i(F - ij) > 0 \tag{17}$$

Thus JF2 also can not occur. Finally, it is immediate from (14) and (17) that the three countries have no incentive to deviate jointly from $\langle\{F\}\rangle$ to $\langle\{\Phi\}\rangle$ so that JF3 is ruled out. In fact, this inequality also implies that $\langle\{\Phi\}\rangle$ is not a stable Nash equilibrium since the joint deviation of countries i and j from $\langle\{\Phi\}\rangle$ to $\langle\{ij\}\rangle$ is self-enforcing: both countries benefit from this deviation and it is immune to further unilateral deviations by virtue of the fact that $\langle\{ij\}\rangle$ is a Nash equilibrium. By similar logic, it is easy to see that $\langle\{ij\}\rangle$ also fails to be stable since the joint deviation of all three countries to $\langle\{F\}\rangle$ is self-enforcing. Thus, we have shown

Proposition 1b: *Given symmetry, free trade $\langle\{F\}\rangle$ is the only stable trade agreement under bilateralism.*

It is worth noting that the above result also obtains under the network formation game of Goyal and Joshi (2006) under which countries pursue only bilateral trade agreements. Interestingly, Goyal and Joshi (2006) interpret this result as establishing the compatibility of bilateralism and free trade. As we shall see below, by providing a comparison of bilateralism and multilateralism our model suggests an alternative interpretation of this result.

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ation. Note that an alternative approach would have been to use the notion of a strong Nash equilibrium (SNE). However we think that the use of CPNE is more appealing since the definition of a SNE requires that the equilibrium strategies be immune to *any* joint deviations, even those that are not self-enforcing (i.e. are susceptible to further deviations on the part of a proper subset of the deviating coalition).

We now analyze a scenario where countries follow a multilateral approach to trade liberalization. The motivating question is: What, if anything, is lost if countries can pursue only multilateral trade liberalization?

4 Endogenous agreements under multilateralism

Under a multilateral approach to trade liberalization (or simply *multilateralism*), the strategy set of country i is $\Omega_i = \{\phi, M\}$, $j \neq k \neq i$. In other words, each country can announce either in favor of or against multilateralism. If all three countries announce in favor, they choose the jointly optimal set of tariffs which, in our model, are equal to zero – i.e. all countries practice free trade. If only countries i and j announce in favor of multilateralism, they jointly choose their optimal tariffs subject to the constraint that they cannot discriminate against country k – i.e. in accordance with the MFN clause of the WTO, the tariffs that they impose on each other must be equal to their respective tariffs on country k. Formally, countries i and j sign the multilateral agreement $\langle\{ij^m\}\rangle$ when individual country announcements are as follows: $\sigma_i = M$, $\sigma_j = M$, $\sigma_k = \phi$. Finally, we should note that if two (or more) countries announce against multilateralism, the status quo $\langle\{\Phi\}\rangle$ prevails under which each country imposes its optimal MFN tariff on every other country.

4.1 Equilibrium analysis under symmetry

As in the previous section, we maintain our assumption that countries are symmetric: $e_j = e$ for all $j = a, b, c$. As noted above, if countries i and j agree to sign the multilateral agreement $\langle\{ij^m\}\rangle$ they choose the pair (t_i^m, t_j^m) to solve

$$(t_i^m, t_j^m) \equiv Arg \max [w_i(ij^m) + w_j(ij^m)] \tag{18}$$

As is clear, under symmetry, we must have $t_i^m = t_j^m = t^m$ and this jointly optimal MFN tariff is given by:

$$t^m = \frac{e}{7} < t^\phi = \frac{e}{4} \tag{19}$$

Since $t^m < t^\phi$, it is immediate that countries that sign the multilateral agreement $\langle\{ij^m\}\rangle$ lower their tariffs on each other as well as on the non-participating country (i.e. k). Furthermore, it is worth emphasizing that country k faces lower tariffs in export markets when the other two countries implement the bilateral FTA $\langle\{ij\}\rangle$ relative to when they sign the multilateral agreement $\langle\{ij^m\}\rangle$, i.e., $t^f < t^m$. The inequality $t^f < t^m$ captures the *free-riding* problem inherent to multilateral trade liberalization when it does not involve all three countries – under $\langle\{ij^m\}\rangle$ country k benefits from the multilateral trade liberalization undertaken by the other two countries without having to offer any liberalization in return since it retains its optimal Nash tariff t^ϕ on countries i and j. As a result, the *degree of trade liberalization* undertaken by two countries is lower when they sign the multilateral agreement $\langle\{ij^m\}\rangle$ than when they sign the bilateral agreement $\langle\{ij\}\rangle$: $t^\phi - t^m < t^\phi - t^f$. Despite the fact that it faces lower tariffs under $\langle\{ij\}\rangle$ relative to $\langle\{ij^m\}\rangle$, it turns out that the welfare of the non-member country (k) is actually lower under $\langle\{ij\}\rangle$ compared to $\langle\{ij^m\}\rangle$: $w_k(ij) < w_k(ij^m)$. This is because the non-member country is subject to *discriminatory treatment* in each member country's market under the bilateral FTA $\langle\{ij\}\rangle$: while countries i and j face zero tariffs in each other's market under $\langle\{ij\}\rangle$, country k faces the tariff t^f. By contrast, such discriminatory treatment is absent under $\langle\{ij^m\}\rangle$ – in each member country's market, the tariff faced by the non-member is the same as that faced by the other member (i.e. both face t^m). As we will show below, this fundamental difference between bilateral and multilateral trade liberalization plays a crucial role in our analysis.[18]

Next, we derive trade agreements that constitute the (subgame perfect) Nash equilibria of the multilateralism game.

4.1.1 Nash equilibria

As under bilateralism, it is straightforward that the status quo $\langle\{\Phi\}\rangle$ is also a Nash equilibrium under multilateralism. In order to check whether $\langle\{ij^m\}\rangle$ is also a Nash equilibrium, we need to consider two unilateral deviations:

(UM1): Deviation of i from $\langle\{ij^m\}\rangle$ to $\langle\{\Phi\}\rangle$

[18] It is also worth noting here that countries i and j are always better off under the bilateral FTA $\langle\{ij\}\rangle$ relative to the multilateral agreement $\langle\{ij^m\}\rangle$ since only under the latter agreement do they have to abide by the non-discrimination constraint.

(UM2): Deviation of k from $\langle\{ij^m\}\rangle$ to $\langle\{F\}\rangle$.

It is easy to show that while a member country has no incentive to break the multilateral agreement $\langle\{ij^m\}\rangle$:

$$\Delta w_i(ij^m - \Phi) > 0 \tag{20}$$

the outside country (k) actually benefits from joining the agreement $\langle\{ij^m\}\rangle$ thereby converting it to $\langle\{F\}\rangle$:

$$\Delta w_k(F - ij^m) > 0 \tag{21}$$

Thus, under symmetry the multilateral agreement $\langle\{ij^m\}\rangle$ fails to be a Nash equilibrium because the country that does not sign the agreement is worse-off relative to free trade and by signing the agreement it can ensure that free trade obtains.[19] This result is interesting because it says that under symmetry the free rider benefits of the multilateral trade liberalization undertaken by countries i and j under $\langle\{ij^m\}\rangle$ are *not* enough for country k to prefer $\langle\{ij^m\}\rangle$ to global free trade – while multilateral trade liberalization that occurs under $\langle\{ij^m\}\rangle$ does make country k better off relative to the status quo, the extent of such liberalization is not large enough to make country k opt out of the agreement and thereby prevent global free trade from emerging.

The only remaining question is whether free trade is a Nash equilibrium. The answer is in the affirmative: the only possible unilateral deviation that can occur from free trade is UM2 and we have already shown that this deviation does not occur under multilateralism. Thus we have shown the following:

Proposition 2a: *Given symmetry, no agreement* $\langle\{\Phi\}\rangle$ *and free trade* $\langle\{F\}\rangle$ *are both Nash equilibria under multilateralism.*

Note that, as before, multiple Nash equilibria arise in the multilateralism game – the key difference being that, by definition, a bilateral FTA is infeasible under multilateralism. We next isolate stable agreements under the two approaches to trade liberalization.

[19] We show later that such an agreement can indeed be a Nash equilibrium under asymmetry.

4.1.2 Stable agreements under multilateralism

It is clear that the status quo $\langle\{\Phi\}\rangle$ fails to be stable since all three countries benefit from deviating from it to $\langle\{F\}\rangle$ from which there exist no further unilateral or coalitional deviations – see inequalities (20) and (21). We thus have

Proposition 2b: *Given symmetry, free trade* $\langle\{F\}\rangle$ *is the only stable agreement under multilateralism.*[20]

A comparison of Propositions 2a and 2b shows that when countries are symmetric, multilateralism is sufficient to reach global free trade. This result implies that if global trade liberalization were to confer equal gains upon all countries (which is what happens when countries have symmetric endowments), nothing would be lost by forsaking the freedom to pursue bilateral FTAs since such agreements would *not* even arise in equilibrium. This suggests that, under symmetry, bilateralism is basically irrelevant for the ultimate objective of achieving global free trade.

Given this result, it is natural to ask: under what circumstances. if any, does the freedom to pursue bilateral FTAs actually matter? We show next that such a possibility arises (only) when endowments are sufficiently asymmetric across countries.

5 When, why, and how bilateralism matters

From hereon, we drop the assumption that endowment levels are symmetric across countries. In what follows, the size of a country is measured by its endowment of non-numeraire/protected goods relative to others. This is useful because the volume of a country's exports of such goods is positively related to its endowment while the volume of its imports of such goods is negatively related to it. It is worth emphasizing that in our model no country is a price taker on world markets – in fact each country is the unique importer of a single good and therefore has market power that can be exploited via a tariff. Thus, the traditional notion of a 'small' country – i.e. one that cannot influence its terms of trade – does not apply here.

[20] In fact, we can show that under symmetry global free trade is the unique strong Nash equilibrium under both bilateralism and multilateralism.

We next derive optimal tariffs under each regime under asymmetry.

5.1 Optimal tariffs under asymmetry

If a country is not a member of any trade agreement, it chooses a non-discriminatory (or MFN) tariff to maximize its own welfare and this tariff is given by:

$$t_i^{\phi} \equiv Arg \max w_i(\Phi) = \frac{e_j + e_k}{8} \tag{22}$$

Note that a country's MFN tariff increases with the endowments of its trading partners. Similar to (12), when countries i and j form a bilateral FTA $\langle\{ij\}\rangle$, they abolish tariffs on each other and choose their external tariffs independently. We have[21]

$$t_i^f \equiv Arg \max w_i(ij) = \frac{5e_k - 4e_j}{11} \text{ and } t_j^f \equiv Arg \max w_j(ij) = \frac{5e_k - 4e_i}{11} \tag{23}$$

It is easy to see that the external tariff of an FTA member increases with the endowment of the non-member whereas it decreases with that of its FTA partner.[22] Similarly, a comparison of t_i^{ϕ} and t_i^f implies that the magnitude of the tariff complementarity effect increases with the size of partner country's endowment whereas it decreases with the endowment of the non-member country. To guarantee that all tariffs are positive and non-prohibitive, given (23) we assume that $\min\{e_i, e_j, e_k\} \geq \frac{4}{5} \max\{e_i, e_j, e_k\}$.

Finally, under the multilateral agreement $\langle\{ij^m\}\rangle$ countries i and j choose the pair (t_i^m, t_j^m) to maximize $w_i(ij^m) + w_j(ij^m)$. We have

$$t_i^m = \frac{2e_k - e_j}{7} \text{ and } t_j^m = \frac{2e_k - e_i}{7} \tag{24}$$

Before proceeding with the derivation of equilibrium agreements, we examine the incentives of asymmetric countries to form a bilateral trade agreement. In this context, it is worth recalling that in the competing exporters model of Bagwell and Staiger (1997) utilized by us, each country's

[21] Note that country i's own endowment does not affect its tariff level since the tariff applies to its imports of good i, of which its endowment is zero.

[22] It is obvious that the same optimal tariff obtains for a spoke country under a hub and spoke trading regime. By contrast, since the hub has an FTA with both spokes, it practises free trade.

endowment of the (unique) good it imports is zero and that asymmetry in endowments translates directly into asymmetries of volume of exports. In other words, an increase in a country's endowment in this model increases its exports of non-numeraire/protected goods without increasing its imports of such goods (since the model is partial equilibrium in nature and lacks any income effects). Indeed, since the country with the largest endowment of non-numeraire goods faces relatively smaller suppliers, its imports of such goods are the smallest.

5.2 Incentives for bilateral trade liberalization

How do individual country incentives to form a bilateral FTA depend on the distribution of endowments across countries? We address this key question by breaking it up into parts and stating three related lemmas:[23]

Lemma 2a: *Let country j be an FTA partner of country i under regime r but not under regime v and let the status of country k be the same under both regimes (i.e. either it is a partner of country i under both regimes or not). Then, the following holds:* $\frac{\partial \Delta w_i(r-v)}{\partial e_j} \leq 0 \leq \frac{\partial \Delta w_i(r-v)}{\partial e_i}$.

The intuition underlying the $\frac{\partial \Delta w_i(r-v)}{\partial e_i} \geq 0$ is as follows. Due to the smaller volume of their exports, countries with smaller endowments benefit less from tariff reductions granted by others. Similarly, such countries have relatively more to lose from eliminating their own optimal tariffs since these tariffs apply to relatively larger import volumes (or to relatively inelastic export supply curves). Thus, a country's willingness to enter into a bilateral trade agreement with another depends positively on its own endowment.

A similar intuition underlies the other inequality (i.e. $\frac{\partial \Delta w_i(r-v)}{\partial e_j} \leq 0$). The smaller the endowment of a country's partner, the larger the increase in its export surplus from the elimination of its partner's optimal tariff and the smaller the loss due to its own trade liberalization since the tariff reduction applies to a smaller volume of imports (due to the smaller size of its partner). The two inequalities reported in Lemma 2a imply that a country prefers to

[23] Welfare levels under all possible regimes are reported in the appendix and these can be used to prove Lemma 2a through Lemma 4.

form a bilateral FTA with the smaller of its two trading partners:

$$w_i(ij) \geq w_i(ik) \text{ iff } e_k \geq e_j \tag{25}$$

How does the endowment level of a competing exporter, denoted by k, affect the incentive of country i to form a bilateral FTA with country j?

Lemma 2b*: Let country j be an FTA partner of country i under regime r but not under regime v and let the status of country k be the same under both regimes (i.e. either it is a partner of country i under both regimes or not). Then,*

(i) $\frac{\partial \Delta w_i(r-v)}{\partial e_k} \leq 0$ *if country k is an FTA partner of country j under regimes r and v; whereas*

(ii) $\frac{\partial \Delta w_i(r-v)}{\partial e_k} \geq 0$ *if country k is not an FTA partner of country j under regimes r and v.*

The first part of the above lemma captures the idea that when country k is already an FTA partner of country j, country i's welfare gain from bilateral trade liberalization with country j decreases with the endowment of country k. Why is this true? Recall that both countries i and k export the same good to country j (i.e. they are competing exporters). When country k already enjoys free access to country j's market, the larger is country k's endowment the smaller the increase in country i's export surplus that results from the trade liberalization undertaken by country j. The intuition behind part (*ii*) of the lemma is analogous – when its rival exporter (i.e. country k) is *not* an FTA partner of country j, the strategic advantage gained by country i in country j's market from signing the bilateral FTA $\langle\{ij\}\rangle$ increases in country k's size, making the FTA more valuable from its perspective.

The following lemma examines the welfare implications of being a hub country (say i under $\langle\{ih\}\rangle$) relative to other trade regimes:

Lemma 3: $w_i(ih) > \max\{w_i(ij), w_i(F), w_i(\Phi)\}$ *for all* $i, j = a, b, c$.

The above lemma informs us that a hub country prefers the hub and spoke arrangement $\langle\{ih\}\rangle$ to all other trade agreements. The fact that hub country prefers $\langle\{ih\}\rangle)$ to $\langle\{F\}\rangle$ informs us that the first part of Lemma 1 generalizes to the case of asymmetric endowments. The intuition for this result is the same as that under symmetry: relative to free trade, the hub country enjoys privileged access in both spoke countries. One implication of this lemma is worth stressing: because a country enjoys the highest possible welfare as a hub, it has no incentive to unilaterally revoke either one or both of its FTAs.

5.3 Multilateral trade liberalization under asymmetry

How do the incentives of countries to form (or join to) a multilateral agreement depend on the underlying endowment structure?

Lemma 4: *Under multilateralism, the following hold:*
(i) $\frac{\partial \Delta w_i(ij^m - \phi)}{\partial e_i} > 0$, $\frac{\partial \Delta w_i(ij^m - \phi)}{\partial e_j} < 0$ *and* $\frac{\partial \Delta w_i(ij^m - \phi)}{\partial e_k} < 0$*; and*
(ii) $\frac{\partial \Delta w_i(F - ij^m)}{\partial e_i} > 0$, $\frac{\partial \Delta w_i(F - ij^m)}{\partial e_j} < 0$ *and* $\frac{\partial \Delta w_i(F - ij^m)}{\partial e_k} < 0$.

The intuition underlying all of the inequalities reported in Lemma 4 is quite analogous to that which underlies parallel results under bilateralism with only one exception – i.e. whereas $\frac{\partial \Delta w_i(ij - \phi)}{\partial e_k} > 0$ under bilateralism when country k is a non-member country, the opposite is true under multilateralism, i.e., $\frac{\partial \Delta w_i(ij^m - \phi)}{\partial e_k} < 0$. To see why this is the case recall that under the multilateral agreement $\langle\{ij\}\rangle^m$, countries i and j lower their tariffs on not only to each other but also on country k whereas under the bilateral agreement $\langle\{ij\}\rangle$ they only lower tariffs on each other. The larger is country k's endowment, the smaller the increase in the export surplus that countries i and j obtain due to the multilateral agreement $\langle\{ij^m\}\rangle$ since their rival exporter (i.e. country k) captures a larger share of their markets.

To highlight the crucial role played by asymmetry, it proves instructive to focus the analysis on the following two cases: (i) two countries (denoted by l and l') have larger endowments than the third (denoted by s) and (ii) two countries (denoted by s and s') have smaller endowments than the third (denoted by l). We consider each in turn.

5.4 Equilibrium agreements under bilateralism: one small and two large countries

Let the pattern of endowment asymmetry be given by:

Assumption 2:

$$e_s = \frac{e}{\theta} < e_l = e_{l'} = e \textit{ and } 1 \leq \theta \leq \frac{5}{4} \tag{26}$$

To avoid redundancy, we focus directly on stable agreements under bilateralism (i.e. we skip the discussion of Nash equilibria). First consider the perspective of the two large countries. We know from Lemma 1 that spoke countries are worse off relative to free trade under symmetry. Similarly, Lemma 2a and Lemma 2b imply that $\frac{\partial \Delta w_l(F-l'h)}{\partial e_s} \leq 0$ and $\frac{\partial \Delta w_l(F-sh)}{\partial e_s} \leq 0$. Thus, a large country (say l) under free trade has no incentive to revoke one of its FTAs and become a spoke:

$$\Delta w_l(F - sh) > 0 \text{ and } \Delta w_l(F - l'h) > 0 \text{ for all } \theta \tag{27}$$

Similarly, we know from (16) that under symmetry, starting from global free trade a country has no incentive to unilaterally revoke its two FTAs. Lemma 2a and Lemma 2b reinforce this result for the large countries under asymmetry. We have:

$$\frac{\partial \Delta w_l(F - sl')}{\partial e_s} = \underbrace{\frac{\partial \Delta w_l(F - sh)}{\partial e_s}}_{\leq 0} + \underbrace{\frac{\partial \Delta w_l(sh - sl')}{\partial e_s}}_{\leq 0} \leq 0 \tag{28}$$

Therefore, a large country (say l) prefers $\langle\{F\}\rangle$ to $\langle\{sl'\}\rangle$:

$$\Delta w_l(F - sl') > 0 \text{ for all } \theta \tag{29}$$

Thus, inequalities (27) and (29) show that a large country has no unilateral incentive to defect from free trade.

Next, consider incentives of the two large countries to jointly defect from free trade. There are five possible joint defections:

(JF1): Joint deviation of l and s from $\langle\{F\}\rangle$ to $\langle\{l'h\}\rangle$.

(JF2): Joint deviation of l and l' from $\langle\{F\}\rangle$ to $\langle\{sh\}\rangle$.

(JF3): Joint deviation of l and s from $\langle\{F\}\rangle$ to $\langle\{sl\}\rangle$.

(JF4): Joint deviation of l and l' from $\langle\{F\}\rangle$ to $\langle\{ll'\}\rangle$.

(JF5): Joint deviation of l and s or l and l' or all countries from $\langle\{F\}\rangle$ to $\langle\{\Phi\}\rangle$.

It is immediate from (27) that a joint defection from free trade to any hub and spoke regime does not occur. Thus, JF1 and JF2 are ruled out. We know from inequality (17) that under symmetry ($\theta = 1$) no two countries benefit from excluding the third country from free trade. Furthermore, we show in the appendix that $\Delta w_l(F - sl)$ is monotonically decreasing in θ:

$$\frac{\partial \Delta w_l(F - sl)}{\partial \theta} < 0 \tag{30}$$

and $\Delta w_l(F - sl) > 0$ at the smallest possible endowment (when $\theta = \frac{5}{4}$) of country s. This implies that joint deviation JF3 cannot occur:

$$\Delta w_l(F - sl) > 0 \text{ for all } \theta \tag{31}$$

It is immediate from inequalities in (25) and (31) that the two large countries have no incentive to jointly deviate from $\langle\{F\}\rangle$ to $\langle\{ll'\}\rangle$:

$$\Delta w_l(F - ll') > 0 \text{ for all } \theta \tag{32}$$

Therefore, joint deviation JF4 is also ruled out. Finally, inequalities (14), (31) and Lemma 2a together imply that joint deviation JF5 also does not occur:

$$\Delta w_l(F - \Phi) > 0 \text{ for all } \theta \tag{33}$$

Thus, we have shown the following:

Lemma 5a: *Suppose Assumption 2 holds. Then, there exist no unilateral or coalitional deviations of large countries from free trade.*

Lemma 5a is noteworthy because one of the policy concerns with respect to the proliferation of preferential trade agreements has been that such agreements may serve as devices for excluding some countries from the multilateral trading system. What this result shows is that, at least in our model, the two large countries are not the source of this problem. This suggests that the stability of global free trade depends critically upon the preferences of the small country. In this regard, it is clear from our analysis that the degree of endowment asymmetry (as captured by θ) is likely to be the critical determining factor. So let $\theta_i(r - v)$ denote the critical threshold at which country i is indifferent between regimes r and v. In fact, it is straightforward to show that

$$\Delta w_s(F - ll') \geq 0 \text{ iff } \theta \leq \theta_s(F - ll') \tag{34}$$

and

$$\Delta w_s(F - lh) \geq 0 \text{ iff } \theta \leq \theta_s(F - lh) \tag{35}$$

where we show in the appendix that $\theta_s(F - ll') < \theta_s(F - lh)$. Together with (34) and (35), this implies that free trade is stable iff $\theta \leq \theta_s(F - ll')$. What happens when $\theta > \theta_s(F - ll')$? Parts (*ii*) and (*iii*) of the following proposition (proved in the appendix) addresses this question:

Proposition 3a: *Given Assumption 2, the following hold under bilateralism:*

(i) $\langle\{F\}\rangle$ *is uniquely stable when* $\theta \leq \theta_s(F - ll')$*;*

(ii) both $\langle\{sl\}\rangle$ *and* $\langle\{ll'\}\rangle$ *are stable when* $\theta_s(F - ll') \leq \theta \leq \theta_{l'}(lh - sl)$*; and*

(iii) $\langle\{ll'\}\rangle$ *is uniquely stable when* $\theta \geq \theta_s(F - ll')$*.*

– Figure 1here –

Proposition 3a relates the degree of underlying asymmetry to the nature of stable agreements. Part (*i*) simply says that if the degree of endowment asymmetry is sufficiently small, free trade is uniquely stable. This implies that Proposition 1B does not require symmetry but rather that the degree of endowment asymmetry be sufficiently small. Part (*ii*) says that if the degree of endowment asymmetry is moderate, both a bilateral trade agreement between a small and a large country and a bilateral FTA between the two large countries are stable whereas part (*iii*) says that if the degree of endowment asymmetry is sufficiently large, only the FTA between the two large countries is stable – in such a situation, the small country prefers being a non-member to participating in multilateral free trade

It is noteworthy that multiple stable equilibria obtain when the degree of endowment asymmetry is moderate – i.e. when $\theta_s(F - ll') \leq \theta \leq \theta_{l'}(lh - sl)$. Since theory offers no guidance about which of these equilibria might be observed, we examine both of these possibilities hereafter.

5.4.1 How and why bilateralism can facilitate global free trade

To see how the ability to form bilateral FTAs matters, suppose countries were to follow only a multilateral approach to trade agreements. Under such an approach, there are four possible Nash equilibria: $\langle\{\Phi\}\rangle$, $\langle\{sl^m\}\rangle$, $\left\langle\{ll'^m\}\right\rangle$ and $\langle\{F\}\rangle$. Using arguments analogous to those under symmetry, it is straightforward to establish that $\langle\{\Phi\}\rangle$ and $\langle\{sl^m\}\rangle$ are not stable multilateral agreements. To see when and why the other two agreements are stable, first note that (33) implies that no deviation can occur from $\langle\{F\}\rangle$ to $\langle\{\Phi\}\rangle$. Furthermore, Lemma 4 implies that the large country l' has no incentive to unilaterally deviate from $\langle\{F\}\rangle$ to $\langle\{sl^m\}\rangle$. This implies that $\langle\{sl^m\}\rangle$ is not stable. In fact, the only deviation from free trade that we need to consider is the unilateral deviation of the small country from $\langle\{F\}\rangle$ to $\left\langle\{ll'^m\}\right\rangle$. It turns out that this deviation does not occur if the degree of endowment asymmetry is small enough:

$$\Delta w_s(F - ll'^m) \geq 0 \text{ iff } \theta \leq \theta_s(F - ll'^m) \tag{36}$$

It immediately follows that free trade is stable under multilateralism when $\theta \leq \theta_s(F - ll'^m)$. What if $\theta > \theta_s(F - ll'^m)$? We know from the inequality in (20) that $\Delta w_l(ll'^m - \Phi) > 0$ under symmetry ($\theta = 1$). Since $\frac{\partial \Delta w_l(ll'^m - \phi)}{\partial e_s} < 0$ (Lemma 4) we have

$$\Delta w_l(ll'^m - \Phi) > 0 \text{ for all } \theta \tag{37}$$

Then using inequalities (36) and (37) we can argue that the multilateral agreement $\left\langle\{ll'^m\}\right\rangle$ is stable when $\theta > \theta_s(F - ll'^m)$.

Proposition 3b: *Given Assumption 2,* $\langle\{F\}\rangle$ *is stable when* $\theta \leq \theta_s(F - ll'^m)$. *Otherwise* $\left\langle\{ll'^m\}\right\rangle$ *is stable.*

Figure 2 shows stable agreements under multilateralism.

– Figure 2 here–

Recall that under bilateralism, global free trade is stable only when $\theta \leq \theta_s(F - ll')$ whereas it is stable under multilateralism only when $\theta \leq \theta_s(F - ll'^m)$. A straightforward comparison of these critical thresholds along with Figures 1 and 2 delivers one of our major results:

Proposition 4: *Given Assumption 2, the following hold:*

(i) $\theta_s(F - ll'^m) < \theta_s(F - ll')$; *and*

(ii) over the parameter range $\theta_s(F - ll'^m) < \theta \leq \theta_s(F - ll')$ *the unique stable agreement under bilateralism is* $\langle\{F\}\rangle$ *whereas under multilateralism it is* $\langle\{ll'^m\}\rangle$*.*

Part (i) of proposition 4 says that free trade is stable over a *larger* parameter space when countries are free to sign bilateral FTAs relative to when they cannot. Part (ii) demonstrates that there exist circumstances where the freedom to pursue bilateral FTAs is *necessary* for achieving global free trade. This happens because the small country has a greater incentive to choose global free trade under bilateralism due to the fact that it is discriminated against its rival exporter in each large member country's market under the bilateral FTA $\langle\{ll'\}\rangle$ whereas it suffers no such disadvantage under the multilateral agreement $\langle\{ll'^m\}\rangle$ – i.e. opting out of global free trade is relatively costlier for the small country under bilateralism. It is noteworthy that this result obtains even though the small country faces lower tariffs in its export markets under the bilateral FTA between the two large countries $\langle\{ll'\}\rangle$ relative to that under the multilateral agreement $\langle\{ll'^m\}\rangle$. Thus, if the degree of endowment asymmetry is not too large, the threat of a bilateral FTA between the two large countries and the discrimination that is inherent to such a trade agreement can be necessary to nudge the small country to announce in favor of global free trade. It is important to emphasize that the very fact that the multilateral agreement is non-discriminatory in nature makes it *less* effective in altering the trade-off facing the small country since it does not lose as much from opting out of global free trade.

When $\theta > \theta_s(F - ll')$, global free trade fails to obtain under both bilateralism and multilateralism. Intuitively, if the small country is sufficiently small, then even the possibility of a bilateral FTA between the two large countries is not enough to induce it to opt for global free trade. When such is the case, one possible way forward is to ask how global welfare compares under the equilibrium agreements that obtain under bilateralism and multilateralism. From Proposition 3b we know that under bilateralism both $\langle\{ll'\}\rangle$ and $\langle\{sl\}\rangle$ are stable agreements when $\theta_s(F - ll') < \theta \leq \theta_{l'}(lh - sl)$ whereas $\langle\{ll'\}\rangle$ is uniquely stable when $\theta > \theta_{l'}(lh - sl)$. Furthermore, Proposition 3b says that when global free trade does not obtain under multilateralism, $\langle\{ll'^m\}\rangle$ emerges as the unique stable equilibrium. Thus, when

$\theta > \theta_s(F - ll')$, we need to consider two possible scenarios: (1) $\langle\{ll'\}\rangle$ is stable or (2) $\langle\{sl\}\rangle$ is stable. First, consider scenario (1) and note that *lower* internal and external tariffs (thus freer trade) obtain under $\langle\{ll'\}\rangle$ relative to $\left\langle\{ll'^m\}\right\rangle$:

$$t_l^m > t_l^f \tag{38}$$

Thus, larger trade volumes and higher aggregate world welfare obtain under $\langle\{ll'\}\rangle$ relative to $\left\langle\{ll'^m\}\right\rangle$:

$$\Delta ww(ll' - ll'^m) > 0 \tag{39}$$

Now consider scenario (2) where $\langle\{sl\}\rangle$ is the stable bilateral agreement. We show the following in the appendix

$$\Delta ww(sl - ll'^m) > 0 \text{ when } \theta_s(F - ll') < \theta < \theta_{l'}(lh - sl) \tag{40}$$

i.e. over the relevant parameter range, global welfare is higher under the bilateral agreement $\langle\{sl\}\rangle$ relative to the multilateral agreement $\left\langle\{ll'^m\}\right\rangle$. Thus, when free trade is out of reach, the option to pursue bilateral FTAs can yield deeper (and welfare-improving) trade liberalization that is foregone under the multilateral approach. Figure 3 illustrates the beneficial effects of bilateralism.

– Figure 3 here–

Of course, aggregate world welfare does not necessarily speak to the fate of individual countries. In this regard, we can state the following:

Proposition 5: *Suppose Assumption 2a holds. Then, the relative welfare effects of bilateralism and multilateralism on individual countries are as follows:*

(i) when $\theta_s(F - ll'^m) < \theta \leq \theta_s(F - ll')$, the two large countries are better off under bilateralism relative to multilateralism whereas the small country's fate is the opposite.

(ii) when $\theta > \theta_s(F - ll')$ there exist $\underline{\theta}$ and $\overline{\theta}$ such that:

(a) the small country is better off under multilateralism whereas the two large countries are worse off when $\theta < \underline{\theta}$;

(b) all countries are worse off under multilateralism when $\underline{\theta} < \theta < \overline{\theta}$*; and*

(c) the two large countries are better off under multilateralism whereas the small country is worse off when $\theta > \overline{\theta}$*.*

Since world welfare is higher under free trade relative to $\langle\{ll'^m\}\rangle$, the first part of the proposition is a direct implication of inequality (36). When global free trade is infeasible (i.e. $\theta > \theta_s(F - ll')$), we only discuss the scenario (1) under which $\langle\{ll'\}\rangle$ is the stable agreement over the multiplicity region under bilateralism while relegating the discussion of the scenario (2) to the appendix in order to avoid redundancy. Proposition 5 clarifies that the degree of asymmetry (as captured by θ) plays an important role in determining the relative effects of bilateralism and multilateralism on individual countries. From (38) we know that the optimal external tariff of FTA members under $\langle\{ll'\}\rangle$ (i.e. t_l^f) decreases with the degree of endowment asymmetry (θ) both in an absolute sense as well as relative to the optimal MFN tariff of member countries under $\langle\{ll'^m\}\rangle$:

$$\frac{\partial t_l^f}{\partial \theta} < 0 \text{ and } \frac{\partial (t_l^f / t_l^m)}{\partial \theta} < 0 \tag{41}$$

Thus, as θ gets larger, the small country not only benefits from a higher degree of trade liberalization under bilateralism but also from a reduction in the degree of discrimination it faces under $\langle\{ll'\}\rangle$ relative to $\langle\{ll'^m\}\rangle$. Proposition 5 essentially argues that when θ is sufficiently small ($\theta < \underline{\theta}$), the discrimination aspect of a bilateral FTA between the two large countries dominates the tariff reduction effect so that the small country prefers $\langle\{ll'^m\}\rangle$ to $\langle\{ll'\}\rangle$:

$$\Delta w_s(ll' - ll'^m) \leq 0 \text{ iff } \theta \leq \underline{\theta} \tag{42}$$

Then it is clear from (39) that large countries prefer the ability to form bilateral FTAs to multilateralism. On the other hand, when $\theta > \underline{\theta}$, the tariff reduction effect dominates the discrimination effect and the small country prefers $\langle\{ll'\}\rangle$ to $\langle\{ll'^m\}\rangle$.

We now consider the case of one large and two small countries.

5.5 One large and two small countries

We now consider the case where two countries have smaller endowments than the third:

Assumption 2b: $e_s = e_{s'} = \frac{e}{\theta} < e_l = e$ and $\frac{5}{4} \geq \theta > 1$.

5.5.1 Stable agreements

We first derive conditions under which free trade is a stable equilibrium. Similar to the previous case, we consider the perspective of the large country first. It is immediate from Lemma 1, (16) and Lemma 2a that the large country has no incentive to unilaterally deviate from $\langle\{F\}\rangle$ to $\langle\{ss'\}\rangle$ or $\langle\{sh\}\rangle$ ($\langle\{s'h\}\rangle$):

$$\Delta w_l(F - ss) > 0 \text{ for all } \theta \tag{43}$$

and

$$\Delta w_l(F - sh) = \Delta w_l(F - s'h) \geq 0 \text{ for all } \theta \tag{44}$$

Moreover, it is easy to show that $\frac{\partial \Delta w_l(F-sl)}{\partial \theta} > 0$. Then, combining this with inequality (17), we argue that country l has no incentive to jointly deviate with one of the smaller countries (say s) from $\langle\{F\}\rangle$ to $\langle\{sl\}\rangle$:

$$\Delta w_l(F - sl) > 0 \text{ for all } \theta \tag{45}$$

Finally, since $\Delta w_l(sl - \Phi) > 0$ always holds, the above inequality implies that the large country has no incentive to deviate coalitionally from free trade to the status quo: $\Delta w_l(F - \Phi) > 0$.

We have shown the following:

Lemma 5b *Suppose Assumption 2b holds. Then, there exist no unilateral or coalitional deviation from free trade that involve the large country.*

The above lemma confirms our earlier result that the stability of global free trade depends critically upon the preferences of the small countries. To derive stable agreements, is useful to focus on the perspective of the two small countries (i.e. s and s'). First note that the small countries have no incentives to jointly deviate from free trade to no agreement:

$$\Delta w_s(F - \Phi) > 0 \text{ for all } \theta \tag{46}$$

On the other hand, if θ is sufficiently large, the small countries indeed have an incentive to jointly deviate from $\langle\{F\}\rangle$ to $\langle\{ss'\}\rangle$:

$$\Delta w_s(F - ss') \leq 0 \text{ iff } \theta \geq \theta_s(F - ss') \tag{47}$$

However, it is immediate from Lemma 3 that one of the smaller countries (say s) has an incentive to further deviate from $\langle\{ss'\}\rangle$ to $\langle\{sh\}\rangle$. Therefore,the initial joint deviation of the two small countries from $\langle\{F\}\rangle$ to $\langle\{ss'\}\rangle$ is not self-enforcing.

Further note that country s has an incentive to unilaterally deviate from $\langle\{F\}\rangle$ to $\langle\{s'l\}\rangle$ if country l's endowment is sufficiently large:

$$\Delta w_s(F - s'l) \leq 0 \text{ iff } \theta \geq \theta_s(F - s'l) \tag{48}$$

Next we consider unilateral deviation of a small country (say s) from $\langle\{F\}\rangle$ to a pair of bilateral FTAs where the other small country is a hub ($\langle\{s'h\}\rangle$. We have:

$$\Delta w_s(F - s'h) \leq 0 \text{ iff } \theta \geq \theta_s(F - s'h) \tag{49}$$

Since $\theta_s(F - s'h) > \theta \geq \theta_s(F - s'l)$, it is not a binding deviation for the stability of $\langle\{F\}\rangle$. Finally note from Lemma 2a that neither small country has an incentive to deviate from $\langle\{F\}\rangle$ to $\langle\{lh\}\rangle$ where the large country is the hub:

$$\Delta w_l(F - lh) > 0 \text{ for all } \theta \tag{50}$$

We can now state:[24]

Proposition 6: *Suppose Assumption 2b holds. Then, the following hold under bilateralism:*

(i) $\langle\{F\}\rangle$ *is stable when* $\theta \leq \theta_s(F - s'l)$*;*

(ii) $\langle\{sl\}\rangle$ *(or* $\langle\{s'l\}\rangle$*) is uniquely stable when* $\theta_s(F - s'l) \leq \theta \leq \theta_s(ss' - \Phi)$*; and*

(iii) there exists no stable equilibrium if $\theta > \theta_s(ss' - \Phi)$*.*

The above proposition shows that the multiplicity problem that existed under bilateralism for the case of two large and one small country no longer

[24]Proofs of statements (*ii*) and (*iii*) are in the appendix.

arises. However, the set of stable equilibria is now empty when the large country has a sufficiently big endowment relative to the small countries (i.e. when $\theta > \theta_s(ss' - \Phi)$).

5.5.2 Bilateralism versus multilateralism

What light does our model shed on the relative merits of bilateralism and multilateralism when two countries are small relative to the third? To avoid redundancy, we directly state our main result:

Proposition 7: *Suppose Assumption 2b holds. Then,*

(i) $\theta_s(F - s'l^m) < \theta_s(F - s'l)$

(ii) over the parameter range $\theta_s(F - s'l^m) < \theta \leq \theta_s(F - s'l)$*, bilateralism yields* $\langle\{F\}\rangle$ *as the stable equilibrium whereas multilateralism yields* $\langle\{sl^m\}\rangle$*; and*

(iii) when $\theta > \theta_s(F - s'l)$*),* $\langle\{sl^m\}\rangle$ *is stable under multilateralism if* $\theta \leq \theta_s(sl^m - \Phi)$ *while* $\langle\{sl\}\rangle$ *is stable under bilateralism if* $\theta \leq \theta_s(sl - \Phi)$*, where* $\theta_s(sl - \Phi) > \theta_s(sl^m - \Phi)$*.*[25]

– Figure 4 here –

The interpretation of Proposition 7 is quite analogous to that of Proposition 4 and there is little need to repeat it here. We next briefly examine whether and how the presence of political economy considerations affects our main results.

6 Political economy considerations

In order to determine whether the presence of political economy concerns affect our results, suppose countries put additional weight on producer surplus and tariff revenue relative to consumer surplus and that endowments are symmetric across countries. Let

[25] We obtain emptiness of stable Nash equilibria under bilateralism when $\theta > \theta_s(sl - \Phi)$ and under multilateralism when $\theta > \theta_s(sl^m - \Phi)$. In both cases, country s has an incentive to deviate from the relevant two country agreement – i.e. $\langle\{sl\}\rangle$ or $\langle\{sl^{am}\}\rangle$ – to $\langle\{\Phi\}\rangle$ when θ is sufficiently large.

$$w_i = \sum_z CS_i^z + (1+\eta_i)[\sum_z PS_i^z + TR_i] \tag{51}$$

First suppose that the degree of political economy pressure is the same across countries: $\eta_i = \eta$ for all i. It is easy to calculate optimal tariffs under each trade regime:[26]

$$t_i^{\phi} = \frac{e(3\eta+1)}{2(3\eta+2)}; t_i^f = \frac{e(3\eta+1)}{12\eta+11} \text{ and } t_i^m = \frac{e(3\eta+1)}{12\eta+7} \tag{52}$$

where, as expected, optimal tariffs rise with η.[27] Moreover, like in Ornelas (2005b), the reduction in external tariffs undertaken by member countries is deeper when governments are more politically motivated (irrespective of the nature of trade liberalization):

$$\frac{\partial(t_i^{\phi} - t_i^m)}{\partial\eta} > 0 \text{ and } \frac{\partial(t_i^{\phi} - t_i^f)}{\partial\eta} > 0 \tag{53}$$

We show the following in the appendix:

Proposition 8: *Given symmetric endowments and equal political economy pressures across countries (* $e_i = e$ and $\eta_i = \eta$ *for all* i*), global free trade is the unique stable equilibrium under both bilateralism and multilateralism.*

This is an important result since it says that proposition 2 is robust to the presence of political economy pressures: even under such pressures, global free trade arises among symmetric countries regardless of whether they follow multilateralism or bilateralism. What is important about this result is that both bilateralism and multilateralism yield the *same* outcome. In an alternative formulation of political economy, it is conceivable that this outcome does not coincide with global free trade. However, our analysis suggests that so long as countries are symmetric with respect to the political economy forces that they face, the stable outcome under both bilateralism and multilateralism is likely to be the same.

[26] Note that in the present model countries have no import competing industry. Thus, the same tariff levels would obtain if the additional weight were to apply only on tariff revenue. However, the weight on producer surplus does affect welfare levels under each regime.

[27] One can easily calculate the welfare levels under each regime by plugging these optimal tariff levels into equation (7).

Now suppose countries face unequal political pressures. To this end, we analyze a simple scenario where two countries (b and c) maximize their welfare with equal weights on consumer surplus, producer surplus and tariff revenue ($\eta_b = \eta_c = 0$) while the third country (country a) puts additional weight, denoted by η, on producer surplus and tariff revenue. Under such a scenario, country a's tariffs under each trade regime increase with the degree of political pressure η:

$$t_a^{\phi} = t_i^{\phi}; t_a^f = t_i^f; \text{ and } t_a^m = \frac{e(6\eta + 1)}{7 + 12\eta} \tag{54}$$

Analogous to the threshold parameters that we defined under endowment asymmetry, we can define threshold levels of political pressure in the protectionist country and state the following result that is proved in the appendix:

Proposition 9: *Given symmetric endowments and* $\eta_a = \eta > \eta_b = \eta^c = 0$*, the following hold:*

(i) $\eta_a(F - bc^m) < \eta_a(F - bc)$*;*

(ii) over the parameter range $\eta_a(F - bc^m) < \eta \leq \eta_a(F - bc)$*, bilateralism yields* $\langle\{F\}\rangle$ *as the stable equilibrium whereas multilateralism yields* $\langle\{bc^m\}\rangle$*; and*

(iii) when $\eta > \eta_a(F - bc))$*, multilateralism yields* $\langle\{bc^m\}\rangle$ *as the stable equilibrium whereas bilateralism yields* $\langle\{bc\}\rangle$*; and*

(iv) the country with the higher political economy pressure (i.e. country a) prefers multilateralism while the other countries prefer bilateralism.

– Figure 5 here –

Proposition 9 provides a confirmation of our key insight that a country that is reluctant to liberalize has a greater incentive to opt out of global free trade under multilateralism relative to bilateralism since the agreement that obtains between the other two countries under the former regime is less damaging to it. Thus, the nature of underlying asymmetry does not appear to be important. Instead, what is key is that the underlying asymmetry generate differing national incentives to liberalize.

7 Conclusion

One of the striking features of today's global policy landscape is the widespread prevalence of preferential trade agreements. Only a handful of countries are not involved in one and most simultaneously participate in several such agreements. Jagdish Bhagwati (1991) famously raised concern about the potential adverse effects of the pursuit of preferential trade agreements on the prospects of multilateral trade liberalization. His work led to a rich body of research that has illuminated various aspects of the multi-faceted relationship between preferential and multilateral trade liberalization. However, this literature has often tended to treat bilateral trade agreements as exogenous or only considered an endogenous trade agreement between a pair of countries while treating the third country as a silent observer. By contrast, we present a model in which all countries are free to pursue both bilateral and multilateral agreements. To determine whether bilateralism hampers or facilitates the obtainment of global free trade, we also derive stable equilibria under a purely multilateral approach to trade agreements. This analysis helps shed light on the pros and cons of bilateralism and multilateralism.

A central result of this paper is that bilateralism can actually provide an impetus to multilateral trade liberalization. The point is that a country that is choosing whether or not to participate in global free trade must consider its fate under the agreement that would emerge in the *absence* of its participation. Due to the fact that a bilateral trade agreement discriminates against the outsider whereas a multilateral agreement does not, a non participating country is worse off under the former relative to the latter. As a result, a country's incentive to opt for free trade is stronger when the alternative to free trade is a bilateral agreement between the other two countries as opposed to a multilateral one. An important implication of our analysis is that to properly account for the role of bilateralism, we need to better understand *why* countries choose to enter into bilateral agreements when multilateral trade liberalization is an option. To this end, the model suggests that the debate regarding preferential versus multilateral liberalization is moot in the absence of some type of asymmetry across countries.

This is because, in our model, whether or not countries are free to pursue bilateral trade agreements, global free trade is the only stable equilibrium under symmetry. This result demonstrates that heterogeneity across countries with respect to the benefits that they enjoy from global free trade may be a critical determinant of the success of a purely multilateral approach to trade liberalization. In our view, such heterogeneity has received insufficient attention in the literature and its role merits further research.

8 Appendix

In this Appendix we provide all supporting calculations and proofs.

8.1 Supporting calculations

We begin by reporting welfare levels under different policy regimes. Under free trade we have:

$$w_i(F) = \frac{[(\sum_j \frac{e_j}{3})^2 + \sum_j (\frac{e_j}{3})^2]}{2} + e_i(2\alpha - \frac{2e_i + \sum_{j\neq i} e_j}{3})$$

whereas the status quo yields

$$w_i(\Phi) = \frac{\sum_{j\neq i}[\frac{3(e_i+e_j)}{8}]^2}{2} + (\frac{e_j + e_k}{4})^2 + e_i(2\alpha - \frac{6e_i + \sum_{j\neq i} 3e_j}{8})$$

Under a bilateral FTA, the welfare of a member equals

$$w_i(ij) = \frac{[\frac{3(e_i+e_j)}{8}]^2 + [\frac{(2e_k+5e_i)}{11}]^2}{2} + \frac{(4e_k^2 + 3e_j^2 - 2e_je_k)}{22} + e_i[2\alpha - (\frac{73e_i}{88} + \frac{3e_j}{8} + \frac{2e_k}{11})]$$

whereas that of the non-member equals

$$w_i(jk) = \frac{\sum_{j\neq i}(\frac{7e_i+e_j}{11})^2}{2} + (\frac{e_j + e_k}{4})^2 + e_i(2\alpha - \frac{14e_i + \sum_{j\neq i} e_j}{11})$$

The welfare of a hub is given by

$$w_i(ih) = \frac{1}{2}\left[[\frac{(e_j+e_k)}{3}]^2 + \sum_{j\neq i}[\frac{(2e_j+5e_i)}{11}]^2 \right] + e_i(2\alpha - \frac{10e_i + \sum_{j\neq i} 2e_j}{11})$$

whereas that of the spoke by

$$w_i(jh) = \frac{(\frac{e_i+e_k}{3})^2 + (\frac{7e_i+e_j}{11})^2}{2} + \frac{(4e_k^2 + 3e_j^2 - 2e_je_k)}{22} + e_i(2\alpha - \frac{32e_i + 11e_k + 3e_j}{33})$$

Under the multilateral agreement the welfare of a participating country equals

$$w_i(ij^m) = 2\alpha e_i + \frac{3(e_i+e_j)(3e_j - 13e_i)}{128} + \frac{(2e_i+3e_k)(3e_k - 12e_i) + (3e_j+e_k)(e_j+5e_k)}{98}$$

while that of the non-participating country equals

$$w_i(jk^m) = 2\alpha e_i + (\frac{e_j+e_k}{4})^2 + \frac{(3e_i+2e_j)(2e_j - 11e_i) + (3e_i+2e_k)(2e_k - 11e_i)}{98}$$

Welfare levels under symmetry can be calculated by setting each country's endowment to e in the formulae above. The relevant comparisons under symmetry are as follows:

$$\Delta w_i(ij - \Phi) = \frac{47}{2}(\frac{e}{44})^2 > 0;\ \Delta w_k(ij - \Phi) = 23(\frac{e}{44})^2 > 0$$

and

$$\begin{aligned} \Delta w_i(ih - F) &= 23(\frac{e}{33})^2 > 0;\ \Delta w_j(F - ih) = \frac{29}{2}(\frac{e}{33})^2 > 0; \\ \Delta w_i(ih - ij) &= \frac{1039}{2}(\frac{e}{132})^2 > 0;\ \Delta w_j(ik - ih) = \frac{161}{2}(\frac{e}{132})^2 > 0 \end{aligned}$$

Also

$$\Delta w_i(F - jk) = \frac{13}{3}(\frac{e}{22})^2 > 0; \Delta w_i(F - ij) = \frac{101}{6}(\frac{e}{22})^2 > 0$$

Furthermore

$$\Delta w_i(ij^m - \Phi) = \frac{1}{14}(\frac{e}{4})^2 > 0;\ \Delta w_k(F - ij^m) = \frac{1}{3}(\frac{e}{14})^2 > 0$$

8.2 Proof of Lemma 3

First consider part (i). We know from Lemma 1 that $\Delta w_i(ih-F)>0$ under symmetry. One can easily show that $\frac{\partial \Delta w_i(ih-F)}{\partial e_i}=\frac{134(e_j+e_k)-320e_i}{33^2}<0$, $\frac{\partial \Delta w_i(ih-F)}{\partial e_j}=\frac{134e_i-85e_j}{33^2}>0$ and $\frac{\partial \Delta w_i(ih-F)}{\partial ek}=\frac{134e_i-85e_k}{33^2}>0$. At $e_i=\frac{4e}{5}$ and $e_j=e_k=e$, we have $\Delta w_i(ih-F)=3(\frac{e}{11})^2>0$. Using analogous arguments, we can establish parts (ii) and (iii).

8.3 Critical thresholds

Since $e_l=e_{l'}$, we must have $\theta(F-lh)=\theta(F-l'h)$. Furthermore, $\theta(F-ll')_s\cong 1.0398$ and $\theta(F-lh)_s\cong 1.1487$.

8.4 Inequalities from the text

We have

$$\Delta w_l(F-sl)\mid_{\theta=\frac{5}{4}}=\frac{7}{2}(\frac{e}{12})^2>0 \text{ and } \frac{\partial \Delta w_l(F-sl)}{\partial \theta}=-\frac{1357\theta-1211}{6336\theta^3}<0$$

8.5 Proof of Proposition 3a

Note from (14) that under symmetry two countries always benefit from forming a bilateral FTA. Also, we know from Lemma 2b that $\frac{\partial \Delta w_l(ll'-\phi)}{\partial e_s}>0$. Next, note that $\Delta w_l(ll'-\Phi)\mid_{\theta=\frac{5}{4}}=\frac{3}{10}(\frac{e}{8})^2>0$. This implies that

$$\Delta w_l(ll'-\Phi)>0 \text{ for all } \theta \tag{55}$$

This implies that $\langle\{\Phi\}\rangle$ is not stable. Furthermore, inequalities (25) and (55) together imply that

$$\Delta w_l(sl-\Phi)>0 \text{ for all } \theta \tag{56}$$

Consider now the small country's perspective under $\langle\{sl\}\rangle$. From Lemma 2a, we know that $\frac{\partial \Delta w_l(sl-\phi)}{\partial e_s}>0$. Further note that $\Delta w_s(sl-\Phi)\mid_{\theta=\frac{5}{4}}=\frac{719}{2}(\frac{e}{440})^2>0$. This implies

$$\Delta w_s(sl-\Phi)>0 \text{ for all } \theta \tag{57}$$

We next examine whether hub and spoke agreements are stable. It is immediate from (27) that two large countries always have incentives to jointly defect from $\langle\{sh\}\rangle$ to $\langle\{F\}\rangle$ and this defection is self-enforcing since a large country has no incentive to further defect (Lemma 5a). Thus, $\langle\{sh\}\rangle$ is not stable. Now consider $\langle\{lh\}\rangle$.[28] Lemma 2a and inequality (13) together imply that the small country always defects unilaterally from $\langle\{lh\}\rangle$ to $\langle\{ll'\}\rangle$ so that $\langle\{lh\}\rangle$ is never stable.

Are $\langle\{sl\}\rangle$ or $\langle\{ll'\}\rangle$ stable? We know from (56) and (57) that unilateral defection from $\langle\{sl\}\rangle$ to $\langle\{\Phi\}\rangle$ does not occur. There exist five possible coalitional deviations from $\langle\{sl\}\rangle$:

(JSL1): Deviation of l and l' from $\langle\{sl\}\rangle$ to $\langle\{ll'\}\rangle$.

(JSL2): Deviation of s and l' from $\langle\{sl\}\rangle$ to $\langle\{sh\}\rangle$.

(JSL3): Deviation of l and l' from $\langle\{sl\}\rangle$ to $\langle\{lh\}\rangle$.

(JSL4): Deviation of all countries from $\langle\{sl\}\rangle$ to $\langle\{l'h\}\rangle$.

(JSL5): Deviation of all countries from $\langle\{sl\}\rangle$ to $\langle\{F\}\rangle$.

Note from (25) that country l never defects from $\langle\{sl\}\rangle$ to $\langle\{ll'\}\rangle$. Thus, JSL1 is ruled out. Next consider JSL2 and JSL3. We know from Lemma 3 that country s (l) always has incentive to defect from $\langle\{sl\}\rangle$ to $\langle\{sh\}\rangle$ ($\langle\{lh\}\rangle$). For these deviations to occur, the choice of country $l^{'}$ is pivotal. We have

$$\Delta w_{l'}(sh - sl) \geq 0 \text{ iff } \theta \geq \theta_{l'}(sh - sl) = 1.0639 \quad (58)$$

and

$$\Delta w_{l'}(lh - sl) \geq 0 \text{ iff } \theta \geq \theta_{l'}(lh - sl) = 1.0629 \quad (59)$$

Thus, since $\theta \geq \theta_{l'}(lh - sl) \geq \theta_{l'}(sh - sl)$ JSL3 is the binding deviation.

Now consider JSL4. Since small country always has incentive to unilaterally deviate from $\langle\{l'h\}\rangle$ to $\langle\{ll'\}\rangle$, even if JSL4 occurs, it is not self-enforcing. Finally, we know from (34) and (35) that JSL5 occurs when $\theta < \theta_s(F - lh)$ and it is a self enforcing deviation only if $\theta < \theta_s(F - ll^{'})$. Thus, $\langle\{sl\}\rangle$ is stable iff $\theta_{l'}(lh - sl) \geq \theta \geq \theta_s(F - ll')$.

Is $\langle\{ll'\}\rangle$ a stable agreement? Inequality (55) implies that there is no defection from $\langle\{ll'\}\rangle$ to $\langle\{\Phi\}\rangle$. Now consider the following coalitional deviations:

[28] An analogous discussion applies to $\langle\{l'h\}\rangle$.

(JLL1): Deviation of s and l from $\langle\{ll'\}\rangle$ to $\langle\{sl\}\rangle$.
(JLL2): Deviation of s and l from $\langle\{ll'\}\rangle$ to $\langle\{lh\}\rangle$.
(JLL3): Deviation of all countries from $\langle\{ll'\}\rangle$ to $\langle\{sh\}\rangle$.
(JLL4): Deviation of all countries from $\langle\{ll'\}\rangle$ to $\langle\{F\}\rangle$.

From Lemma 3, it is immediate that JLL1 is not a self-enforcing deviation since country l has an incentive to further deviate to $\langle\{lh\}\rangle$. Moreover, it is straightforward to argue from (13) and Lemma 2a that JLL2 is also ruled out since country s never defects from $\langle\{ll'\}\rangle$ to $\langle\{lh\}\rangle$. We also know from (27) that even when JLL3 occurs, large countries have incentives to further deviate from $\langle\{sh\}\rangle$ to $\langle\{F\}\rangle$. Thus the initial deviation is not self-enforcing. Finally, (34) implies that all countries deviate from $\langle\{ll'\}\rangle$ to $\langle\{F\}\rangle$ when $\theta < \theta_s(F-ll')$ and this deviation is self-enforcing. Thus, $\langle\{ll'\}\rangle$ *is stable iff* $\theta \geq \theta_s(F-ll')$.

8.6 Other inequalities from the text

We have $\Delta w_s(F-ll'^m) \geq 0$ iff $\theta \leq \theta_s(F-ll'^m) = 1.0149$.

Furthermore,

$$\frac{\partial \Delta ww(sl'-ll'^m)}{\partial \theta} = -\frac{86605\theta + 1949}{2\theta}\left(\frac{e}{308\theta}\right)^2 < 0$$

Note that when $\theta = \theta_{l'}(lh-sl)$, $\Delta ww(sl'-ll'^m) > 0$. Thus, $\Delta ww(sl'-ll'^m) > 0$ when $\theta_{l'}(lh-sl) \geq \theta > \theta_s(F-ll')$.

8.7 Proof of Proposition 5

When global free trade is infeasible, suppose $\langle\{sl\}\rangle$ is the stable agreement over the multiplicity region under the FTA game while $\left\langle\{ll'^m\}\right\rangle$ obtains under multilateralism when $\theta \leq \theta_{l'}(lh-sl)$. First note that when $\theta = 1$, we have $\Delta w_s(sl-ll'^m) = -\frac{1327}{2}(\frac{e}{308})^2 < 0$, $\Delta w_l(sl-ll'^m) = \frac{13}{14}(\frac{e}{11})^2 > 0$ and $\Delta w_{l'}(sl-ll'^m) = \frac{201}{14}(\frac{e}{44})^2 > 0$. It is easy to verify from the proofs of lemmas 2a, 2b and 4 that $\frac{\partial \Delta w_s(sl-ll'^m)}{\partial \theta} < 0$, $\frac{\partial \Delta w_l(sl-ll'^m)}{\partial \theta} > 0$ and $\frac{\partial \Delta w_{l'}(sl-ll'^m)}{\partial \theta} < 0$. Thus, it is immediate that country s prefers multilateralism (i.e. it prefers $\left\langle\{ll'^m\}\right\rangle$ to $\langle\{sl\}\rangle$) while country l always prefers sl to ll'^m. Now consider country l': $\Delta w_{l'}(sl-ll'^m) \leq 0$ iff $\theta \geq \theta(ll'^m - sl)_{l'} \cong 1.0912 \geq \theta_{l'}(lh-sl)$.

Thus, when $\theta \leq \theta_{l'}(lh - sl)$, country l' always prefers sl to ll'^m. This completes the proof.

8.8 Other calculations

$$\Delta w_s(ll' - ll'^m) = -\frac{e^2(15\theta - 16)(29\theta - 72)}{(77\theta)^2} \leq 0 \text{ iff } \theta \leq \underline{\theta} = \frac{16}{15}$$

$$\Delta w_l(ll' - ll'^m) = -\frac{e^2(\theta^2 + 80\theta - 94)}{14(11\theta)^2} \leq 0 \text{ iff } \theta \geq \overline{\theta} = 11\sqrt{14} - 40$$

$$\Delta w_s(F - \Phi) = (\frac{e}{24\theta})^2 \frac{51 - 25\theta^2 - 2\theta}{2} > 0 \text{ for all } \theta$$

$$\Delta w_s(F - ss') \leq 0 \text{ iff } \theta \geq \theta_s(F - ss') = 1.0845$$

$$\Delta w_s(F - s'l) \leq 0 \text{ iff } \theta \geq \theta(F - s'l)_s = 1.0810$$

$$\Delta w_s(F - s'h) \leq 0 \text{ iff } \theta \geq \theta(F - s'h)_s = 1.1814$$

8.9 Proof of Proposition 6

Part (*ii-iii*): Country s has an incentive to unilaterally defect from $\langle\{sl\}\rangle$ *to* $\langle\{\Phi\}\rangle$ iff θ is sufficiently large:

$$\Delta w_s(sl - \Phi) < 0 \text{ iff } \theta > \theta(sl - \Phi)_s = 1.2409$$

Note that even if two small countries jointly deviate from $\langle\{sl\}\rangle$ *to* $\langle\{ss'\}\rangle$, Lemma 3 implies that this is not a self-enforcing deviation. Now consider the joint deviation of countries s and s' from $\langle\{sl\}\rangle$ to $\langle\{sh\}\rangle$. We have

$$\Delta w_{s'}(sh - sl) = \frac{e^2(29775\theta^2 - 70558\theta + 4007)}{(132\theta)^2} < 0 \text{ for all } \theta \qquad (60)$$

Similarly country s' has no incentive to jointly deviate with the large country from $\langle\{sl\}\rangle$ to $\langle\{lh\}\rangle$:

$$\Delta w_{s'}(lh - sl) = \frac{e^2(12870^2 - 37620\theta + 2399)}{132^2} < 0 \text{ for all } \theta \qquad (61)$$

Finally, it is immediate from (48) that all countries deviate from $\langle\{sl\}\rangle$ to $\langle\{F\}\rangle$ iff $\theta < \theta(F - s'l)_s$ and that this is a self-enforcing deviation.

It is immediate from (60) and (61) that $\langle\{sh\}\rangle$ and $\langle\{lh\}\rangle$ are not stable. Similarly, two small benefit from deviating from $\langle\{\Phi\}\rangle$ to $\langle\{ss'\}\rangle$ (which is a self enforcing deviation):

$$\Delta w_s(ss' - \Phi) = (\frac{e}{88})^2 \frac{(2094\theta - 1185\theta^2 - 721)}{2} > 0 \text{ for all } \theta \qquad (62)$$

Thus, $\langle\{\Phi\}\rangle$ is not stable. Combining these results with the first two parts, we examine the stability of $\langle\{ss'\}\rangle$ to complete our proof. Consider the following joint deviations:

(JSS1): Deviation of s and l from $\langle\{ss'\}\rangle$ to $\langle\{sh\}\rangle$.

(JSS2): Deviation of all countries from $\langle\{ss'\}\rangle$ to $\langle\{F\}\rangle$.

We know from Lemma 3 that country s has an incentive to deviate from $\langle\{ss'\}\rangle$ to $\langle\{sh\}\rangle$ while country l deviates only if $\theta > \theta(sh - ss')_l = \frac{206 - 3\sqrt{2354}}{340} \cong 1.0340$. Thus JSS1 occurs if $\theta > \theta(sh - ss')_l$ and it is a self-enforcing deviation (due to Lemma 3). Now consider JSS2. It is immediate from (47) that JSS2 happens if $\theta < \theta_s(F - ss')$ and it is a self enforcing deviation if $\theta < \theta(F - sl)_s$. Note that since $\theta(F - sl)_s > \theta(sh - ss')_l$, it is clear that $\langle\{ss'\}\rangle$ is not stable.

8.10 Proof of Proposition 7

First note that the large country has no incentive to unilaterally deviate from $\langle\{F\}\rangle$ to $\langle\{ss'^m\}\rangle$:

$$\Delta w_l(F - ss'^m) = (\frac{e}{42\theta})^2(208\theta^2 - 208\theta + 3) > 0 \text{ for all } \theta$$

Thus $\langle\{ss'^m\}\rangle$ is not stable. On the other hand, country s has an incentive to unilaterally deviate from $\langle\{F\}\rangle$ to $\langle\{s'l^m\}\rangle$ if θ is sufficiently large:

$$\Delta w_s(F - s'l^m) < 0 \text{ iff } \theta > \theta_s(F - s'l^m) = 1.0298$$

We also know that no country has an incentive to deviate from $\langle\{F\}\rangle$ to $\langle\{\Phi\}\rangle$. Thus $\langle\{F\}\rangle$ is stable iff $\theta \leq \theta_s(F - s'l^m)$ holds. Note also that the country s has an incentive to unilaterally deviate from $\langle\{sl^m\}\rangle$ to $\langle\{\Phi\}\rangle$:

$$\Delta w_s(sl^m - \Phi) < 0 \text{ iff } \theta > \theta_s(sl^m - \Phi) = 1.1477$$

Thus $\langle\{sl^m\}\rangle$ is stable iff $\theta \leq \theta_s(sl^m - \Phi)$ holds. Finally, under $\langle\{\Phi\}\rangle$, small countries always have incentives to form $\langle\{ss'^m\}\rangle$:

$$\Delta w_s(ss'^m - \Phi) = \frac{1}{14}[\frac{e(3\theta-5)}{8}]^2 > 0 \text{ for all } \theta$$

Thus $\langle\{\Phi\}\rangle$ is not stable. Combining with proposition 6, we have completed our proof.

8.11 Proof of Proposition 8

$$\begin{aligned}
\Delta w_i(F-\Phi) &= \frac{e^2(2\eta+1)(3\eta+1)^2}{12(3\eta+2)^2} > 0;\\
\Delta w_i(F-jk) &= \frac{e^2(48\eta^2+56\eta+13)(3\eta+1)^2}{6(3\eta+2)(12\eta+11)^2} > 0;\\
\Delta w_i(F-jk^m) &= \frac{e^2(2\eta+1)(3\eta+1)^2}{6(3\eta+2)(7+12\eta)^2} > 0;\\
\Delta w_i(F-ij) &= \frac{e^2(144\eta^3+408\eta^2+364\eta+101)(3\eta+1)^2}{24(3\eta+2)^2(12\eta+11)^2} > 0;\\
\Delta w_i(F-jh) &= \frac{e^2(36\eta+29)(3\eta+1)^2}{18(12\eta+11)^2} > 0
\end{aligned}$$

8.12 Proof of Proposition 9

Consider multilateralism first:

$$\begin{aligned}
\Delta w_a(F-\Phi) &= \frac{e^2(7\eta+2)}{48(3\eta+2)} > 0;\ \Delta w_b(F-\Phi) = \frac{e^2(33\eta^2+36\eta+8)}{96(3\eta+2)^2} > 0;\\
\Delta w_a(F-bc^m) &= \frac{e^2(1-63\eta^2-16\eta)}{294(3\eta+2)} < 0 \text{ iff } \eta > \eta_a(F-bc^m) = 0.0519;\\
\Delta w_b(bc^m-\Phi) &= \frac{e^2}{224} > 0;
\end{aligned}$$

In addition, both (i) $\Delta w_c(F - ab^m) < 0$ iff $\eta > 0.2695$ and (ii) $\Delta w_b(ab^m - \Phi) =< 0$ iff $\eta > 0.0643$ hold. Thus, the following obtains: (i) $\langle\{ab^m\}\rangle$ ($\langle\{ac^m\}\rangle$) is never stable; (ii) $\langle\{F\}\rangle$ is stable when $\eta \leq \eta_a(F - bc^m)$ and (iii) $\langle\{bc^m\}\rangle$ is stable $\eta \geq \eta_a(F - bc^m)$.

Turning to bilateralism, consider the stability of free trade first. The first inequality above implies that no country an incentive to deviate from

$\langle\{F\}\rangle$ to $\langle\{\Phi\}\rangle$. We have: $\Delta w_b(F-ac) = (\frac{e}{22})^2\frac{(6744\eta^2+8976\eta+1573)}{3(12\eta+11)^2} > 0$; $\Delta w_b(F-ah) = (\frac{e}{33})^2\frac{(29)}{2} > 0$ and $\Delta w_b(F-ch) = (\frac{e}{22})^2\frac{e^2(1044\eta^2+1452\eta+319)}{198(12\eta+11)^2} > 0$. This implies that countries b and c always deviate from $\langle\{ah\}\rangle$ to $\langle\{F\}\rangle$ and this deviation is self-enforcing. Thus $\langle\{ah\}\rangle$ *is never stable.* While country a has no incentive to unilaterally deviate from $\langle\{F\}\rangle$ to $\langle\{bh\}\rangle$, it does so from $\langle\{F\}\rangle$ to $\langle\{bc\}\rangle$ when $\eta > \eta_a(F-bc) \cong 0.44$. Next note that $\Delta w_b(F-bc) = (\frac{e}{22})^2\frac{(681\eta^2+666\eta+101)}{6(3\eta+2)^2} > 0$. Finally, note that country a has no incentive to jointly deviate with country b from $\langle\{F\}\rangle$ to $\langle\{bc\}\rangle$: $\Delta w_b(F-bc) = (\frac{e}{44})^2\frac{(4820\eta^2+1584\eta+1111)}{6(12\eta+11)^2} > 0$. As a result, $\langle\{F\}\rangle$ is stable when $\eta \leq \eta_a(F-bc)$.

Note that $\langle\{\Phi\}\rangle$ is never stable since $\Delta w_b(bc-\Phi) = (\frac{e}{44})^2\frac{47}{2} > 0$. Moreover, $\langle\{bh\}\rangle$ is not stable since $\Delta w_c(bh-ab) = -19(\frac{e}{66})^2 < 0$. Now consider the stability of $\langle\{ab\}\rangle$. Countries a and c have incentives to jointly deviate from $\langle\{ab\}\rangle$ to $\langle\{ah\}\rangle$ when $\eta > \eta_c(ah-ab) \cong 0.1688$ and this deviation is self-enforcing. We also know that joint deviation of all countries from $\langle\{ab\}\rangle$ to $\langle\{F\}\rangle$ is self-enforcing when $\eta \leq \eta_a(F-bc) \cong 0.44$. Therefore, $\langle\{ab\}\rangle$ is not stable. Finally consider the stability of $\langle\{bc\}\rangle$. We know that countries b and c have no incentives to deviate from $\langle\{bc\}\rangle$ to $\langle\{\Phi\}\rangle$. Even if the joint deviation from $\langle\{bc\}\rangle$ to $\langle\{ab\}\rangle$ occurs, it is not self-enforcing since country b always has an incentive to further deviate to $\langle\{bh\}\rangle$. Similarly, the joint deviation of all countries from $\langle\{bc\}\rangle$ to $\langle\{ah\}\rangle$ can be ruled out as well. Finally, country c has no incentive to deviate jointly with country b from $\langle\{bc\}\rangle$ to $\langle\{bh\}\rangle$. As a result, $\langle\{bc\}\rangle$ is stable iff $\eta \geq \eta_a(F-bc)$.

For the last part of the proposition, note that $\Delta w_a(F-bc^m) < 0$ iff $\eta > \eta_a(F-bc^m)$. To complete the proof, simply note that:

$$\begin{aligned}
\Delta w_b(F-bc^m) &= \frac{e^2(51\eta^2+54\eta+51)}{168(3\eta+2)^2} > 0;\\
\Delta w_b(bc-bc^m) &= (\frac{e}{11})^2(\frac{13}{14}) > 0 \text{ and}\\
\Delta w_a(bc-bc^m) &= -(\frac{e}{77})^2(154\eta+43) < 0
\end{aligned}$$

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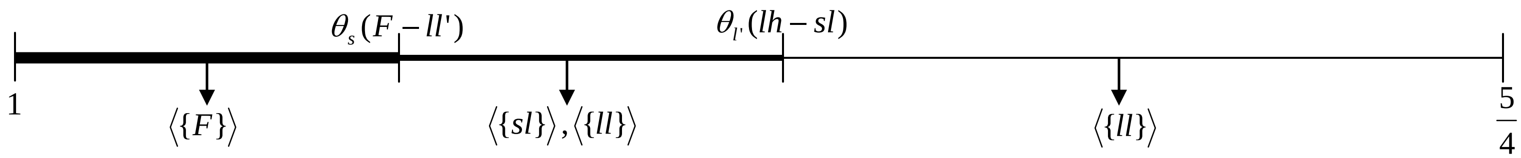

Figure 1: Stable agreements under bilateralism: two large and one small country

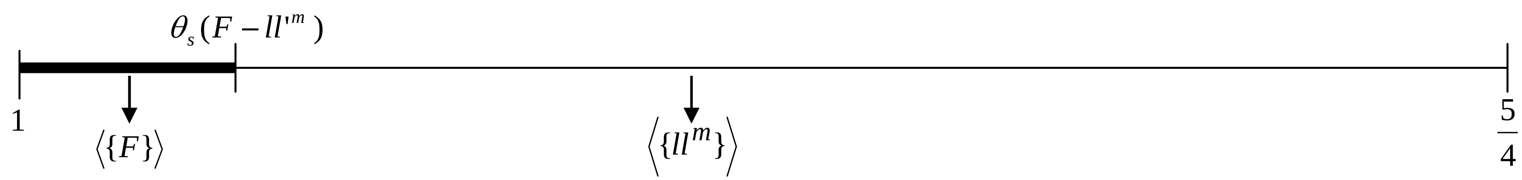

Figure 2: Stable agreements under multilateralism: two large and one small country

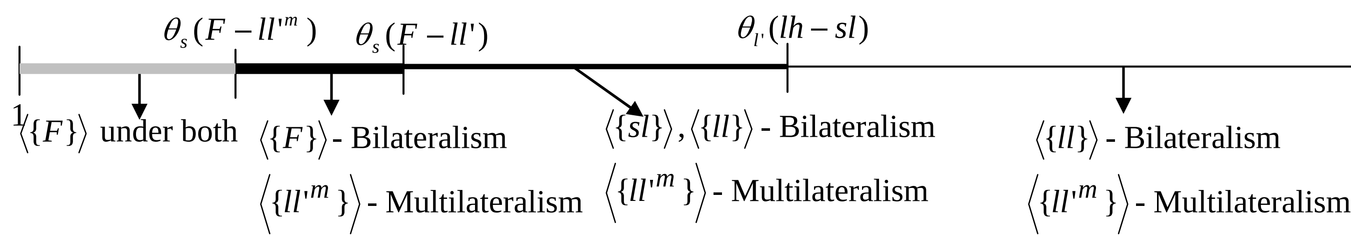

Figure 3: Bilateralism versus multilateralism: two large and one small country

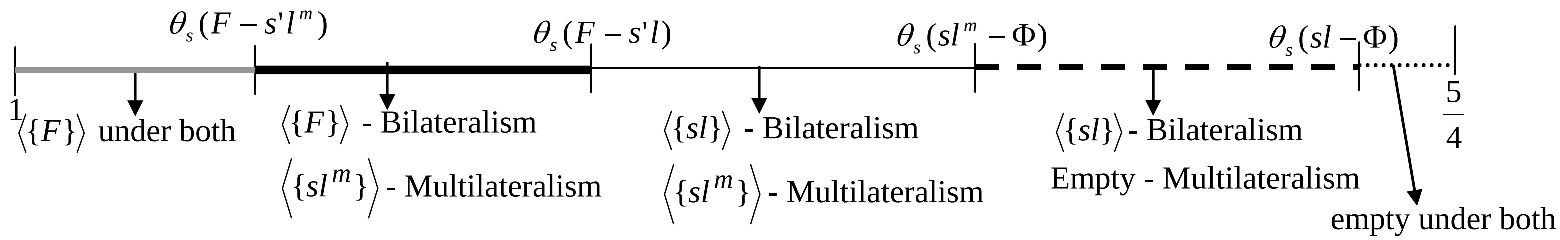

Figure 4: Bilateralism versus multilateralism: two small and one large country

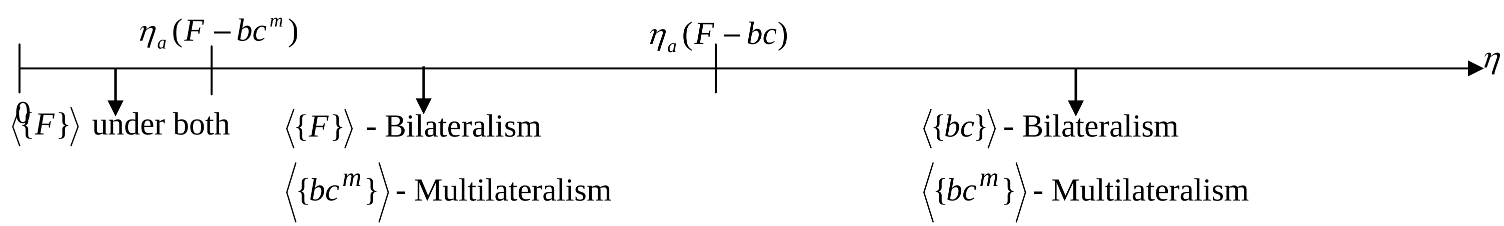

Figure 5: Bilateralism versus multilateralism under political economy pressures