On the different geographic characteristics of Free Trade Agreements and Customs Unions

James Lake*
Southern Methodist University

Halis M. Yildiz†
Ryerson University

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Abstract

Casual observation reveals a striking phenomenon of Preferential Trade Agreements (PTAs): while Customs Unions (CUs) are only intra–regional, Free Trade Agreements (FTAs) are inter and intra–regional. Using a farsighted dynamic model, we endogenize the equilibrium path of PTAs among two close countries and one far country. Rising transport costs mitigate the cost of discrimination faced by the far country as a CU non-member and diminish the value of preferential access as a CU member. Thus, sufficiently large transport costs imply an FTA is the only type of PTA that can induce the far country's participation in PTA formation. Unlike CU formation, FTA formation can induce participation because FTAs provide a flexibility benefit: an FTA member can form further PTAs with non-members but a CU member must do so jointly with all existing members. Hence, in equilibrium, CUs are intra-regional while FTAs are intra- and inter-regional.

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*Southern Methodist University, Economics Department, 3300 Dyer Street, Dallas, TX 75275, USA. E-mail: jlake@smu.edu

†Ryerson University, 350 Victoria Street, Toronto, ON M4K 1Y3, Canada. E-mail: hyildiz@economics.ryerson.ca

1 Introduction

Many authors have documented the unabated proliferation of Preferential Trade Agreements (PTAs) beginning in the early 1990s. Indeed, because of the inherently discriminatory nature of PTAs, this proliferation often motivates authors' interest in the role PTAs play in facilitating or hindering multilateral free trade. However, casual empiricism of PTA characteristics reveals a striking but overlooked observation: unlike Free Trade Agreements (FTAs) which are both inter and intra–regional, Customs Unions (CUs) are only intra–regional.

To be clear, the role of geography has always been intimately associated with PTAs. Indeed, "The terms "regional trade agreements" (RTAs) and "preferential trade agreements" (PTAs) are often used interchangeably in the literature" (WTO (2011, p.58)). Moreover, empirical evidence suggests distance between countries plays a role in determining whether they have a PTA (e.g. Baier and Bergstrand (2004), Egger and Larch (2008), Chen and Joshi (2010)). However, as one of the five stylized facts about PTAs, the WTO (2011, p.6) state "PTA activity has transcended regional boundaries" and they go on to state only 50% of all PTAs are regional. Thus, despite the intuitive appeal of "regionalism", surprisingly few papers have attempted to establish theoretical mechanisms underlying regionalism.

More importantly, to the best of our knowledge, no paper has endogenously determined the choice of PTA type (i.e. CU or FTA) when geographic asymmetry plays a role (by geographic asymmetry, we mean some countries are closer than others). In part, this stems from few papers having explored the endogenous choice between CUs and FTAs. Our main goal in this paper is to address why FTAs and CUs differ in their geographical characteristics.

Our baseline analysis adds market size and geographic asymmetry to the popular competing exporters trade model of Bagwell and Staiger (1999). Here, we assume costless trade between two "close" countries whereas trade between either of the close countries and the third "far" country is subject to iceberg transport costs. Higher iceberg transport costs represent higher degrees of geographic asymmetry. When the degree of geographic asymmetry is low enough, there is no meaningful distinction between intra and inter–regional agreements. However, with sufficient geographic asymmetry, we interpret an agreement involving the far country as inter-regional.

In addition to geographic asymmetry, market size asymmetry is also very important. Chen and Joshi (2010, p.244) find empirical evidence that, conditional on an FTA between a larger and a smaller country, the large country is more likely to form an FTA with an outsider country and become the hub. To focus on the role of market size asymmetry, we assume a large country and two smaller countries. In our baseline model, the large country is the "far" country and the small countries are the "close" countries. Naturally there are contrary examples, but examples in line with Chen and Joshi (2010) and the context of our model are the sequences of FTAs involving the US, EU and EFTA as the large country and countries in the regions of North Africa, the Middle-East or the Asia-Pacific as smaller countries who are close to each other but far from the large country.[1]

Our main result is that with sufficient geographic asymmetry, and hence a meaningful distinction between inter and intra-regional agreements, CUs are intra-regional yet FTAs are inter and intra-regional. Underlying this result is that, faced with the threat of being discriminated against as a CU non-member, the *only* type of PTA attractive enough to induce the large country's participation in liberalization is an FTA. The intuition is twofold.

First, rising geographic asymmetry influences whether the large far country participates in PTA formation. Due to the benefit of coordinating tariff policy, the small close countries form a CU if the large far country refuses participation in liberalization. Indeed, by reducing inter-regional trade flows, rising geographic asymmetry reduces the attractiveness to the large far country of being a CU member relative to being a CU non-member. Not only does the benefit of preferential market access as a CU member become less valuable, but the discrimination faced as a CU non-member becomes less costly. Thus, sufficient geographic asymmetry implies the large far country prefers being a CU non-member rather than a CU member. In turn, an equilibrium CU must be intra-regional and such a CU arises when the large far country refuses participation in liberalization.

Second, a dynamic trade-off underlies whether the large far country prefers FTA or CU formation and this creates the possibility that FTA formation can induce the large country's participation in liberalization even when CU formation cannot do so. Conditional on a single FTA between the large and a small country, the large country has the *flexibility* to form a second FTA with the other small country and become the "hub" with sole preferential access to each of the "spoke" countries. Indeed, due to its market size, the large country is the ideal FTA partner for the small non-member. A CU does not possess the flexibility benefit of an FTA because CU expansion must involve all members jointly.

On the other hand, a CU provides coordination benefits. Unlike FTA members, CU members coordinate external tariffs which generates a direct "myopic" CU coordination benefit. Moreover, when CU members want to exclude the non-member from expansion to global free trade, a CU also affords a "forward looking" coordination benefit: CU formation

[1]The EU, as the large country, signed sequential FTAs with the small North African countries of (i) Tunisia (1995) and Morocco (1996) prior to Tunisia and Morocco becoming FTA partners (1997), and the small Middle-Eastern countries of (ii) Palestine (1997) and Lebanon (2002), and (iii) Syria (1977) and Palestine (1997) prior to Palestine, Lebanon and Syria becoming FTA partners (2005). Similarly, as the large country, EFTA signed FTAs with the small countries of Palestine (1998) and Lebanon (2004). Similarly, as the large country, the US signed FTAs with the small Asia-Pacific countries Australia (2004) and Korea (2007) prior to the Australia-Korea FTA (2014).

prevents the FTA expansion to global free trade that takes place via the large country becoming the "hub" and the small "spoke" countries then forming their own FTA. When the discount factor is too low or too high, the myopic or forward looking components of the CU coordination benefit dominate the FTA flexibility benefit and not even FTA formation can induce the large country's participation in liberalization. However, when the discount factor lies in an intermediate range, the FTA flexibility benefit dominates the myopic and forward looking CU coordination benefits and *also* dominates the cost of being discriminated against as a CU non-member. In this case, FTA formation induces the large country's participation in liberalization and a path of inter- and intra-regional FTAs emerges with the large country being the hub on the path to global free trade.

Section 6 shows our main result, i.e. CUs are intra-regional while FTAs are inter and intra-regional, is robust to various extensions of our baseline model. Sections 6.1-6.3 explore extensions with (i) specific transport costs and a measure of size that allows the large country to simultaneously vary from demand and supply perspectives, (ii) a model of imperfect competition and intra-industry trade, and (iii) alternative structures of geographic asymmetry that vary who is the far country and allow costly trade between all country pairs.

Our paper clearly relates to the empirical determinants of PTA literature cited above, but it also bridges a gap between two distinct strands of the theoretical literature on PTAs: (i) models where countries endogenously choose between FTAs and CUs but geography plays no role, and (ii) models where geography plays a role but countries do not endogenously choose between FTAs and CUs.[2] In our model, geographically asymmetric countries endogenously choose between FTAs and CUs.

In the former strand of the literature, Riezman (1999) shows (in a setting with two small countries and one large country) that the threat of a CU between the small countries is necessary to induce the large country's participation in global free trade. In a similar setting, Melatos and Woodland (2007) show consumer preference asymmetries reduce the myopic CU coordination benefit to the extent that members may prefer FTAs over CUs. However, in these settings, but unlike our paper, FTAs never emerge in a unique equilibrium. Appelbaum and Melatos (2013) show how uncertainty over demand and marginal cost can affect the attractiveness of CUs relative to FTAs by affecting the benefit of external tariff coordination. Facchini et al. (2012) show how PTAs emerge in equilibrium when income inequality is low with FTAs rather than CUs emerging when cross country production structures are sufficiently different. Unlike these static models, Lake (2015) develops a dynamic model and

[2] In addition, some papers have compared an "FTA formation game" with a "CU formation game" rather than endogenized the choice between FTAs and CUs. Examples here include Furusawa and Konishi (2007) and Missios et al. (2016).

shows a necessary and sufficient condition for multiple FTAs to emerge in equilibrium is that the FTA flexibility benefit dominates the CU coordination benefits.

Seidmann (2009) also develops a dynamic model. In a three country dynamic bargaining model with transfers, he shows PTAs can be valuable because of a "strategic positioning" motive: PTA members affect their share of the global free trade pie by changing the outside option of the PTA non-member. Because exploiting the strategic positioning motive requires direct expansion of the bilateral PTA to global free trade, CUs may be preferable to FTAs because CU expansion immediately results in global free trade whereas FTA expansion can produce overlapping FTAs. Thus, while the flexibility of FTAs mitigates the strategic positioning motive for PTA formation in Seidmann (2009), it is a benefit in our framework. Moreover, the absence of transfers in our model implies that, unlike in Seidmann (2009), global free trade may not emerge even though global free trade maximizes world welfare.[3,4]

Similar to the role of the FTA flexibility benefit in our model, Melatos and Dunn (2013) build a two period model illustrating that FTA formation between two non–autarkic countries may be more attractive than CU formation when they anticipate an autarkic third country will subsequently integrate themselves into world trade. In contrast, our setting is one where all countries participate in global trade in all periods.[5]

In the strand of the literature not considering the endogenous choice between FTAs and CUs, Ludema (2002) builds a three country economic geography model. Global free trade is not attainable once any country is sufficiently far from the others. When there are two sufficiently close countries and one far country (similar to our geographic structure), an FTA between the close countries emerges as the unique equilibrium. In a model of coalition formation with multiple equilibria, Zissimos (2011) argues that regionalism, via larger trade volumes arising from lower transport costs, could stem from countries using proximity to coordinate on a unique equilibrium. Soegaard (2013) shows how greater product variety diminishes the incentive for regionalism and increases the scope for global free trade. Our

[3]Bagwell and Staiger (2010, p.50) argue reality lies somewhere between the extreme cases of transfers and no transfers. Papers allowing transfers include Aghion et al. (2007), Ornelas (2008), and Bagwell and Staiger (2010). Papers assuming away transfers include Riezman (1999), Furusawa and Konishi (2007), Melatos and Woodland (2007), Saggi and Yildiz (2010), Facchini et al. (2012) and Saggi et al. (2013).

[4]Despite the similarities between our paper and Seidmann (2009), two important differences imply that neither paper is a special case of the other. First, unlike our paper, Seidmann (2009) allows transfers. Thus, even though global free trade maximizes world welfare in both papers, global free trade always emerges in Seidmann (2009) but often does not in our paper. Second, Seidmann (2009) uses a stochastic bargaining protocol whereas ours is deterministic (see Section 3.1). Section 6.4 explains one important way these protocols fundamentally differ.

[5]While the setting in Melatos and Dunn (2013) has the spirit of WTO ascension after the 1995 inception of the WTO (e.g. Russia, China, Jordan or Vietnam) it should be noted that non–WTO members are generally not autarkic prior to WTO ascension and even form PTAs notified to the WTO under GATT Article XXIV (e.g. Russia).

paper differs from these papers because we endogenize the choice between FTAs and CUs in addition to the role played by geography.

The paper proceeds as follows. Section 2 presents our baseline trade model. Section 3 presents the dynamic game. Section 4 describes important background forces that drive the equilibrium path of agreements characterized in Section 5. Section 6 explores numerous extensions, showing our main results are quite robust. Section 7 concludes.

2 Baseline trade model

Our baseline analysis in Section 5 is a modified version of the popular Bagwell and Staiger (1999) competing exporters model. There are three countries $z = i, j, k$, three non–numeraire goods $Z = I, J, K$ and a numeraire good y. Each country z has zero endowment of good Z, $e_z > 0$ units of the other two goods.[6] Thus, e.g., countries j and k have comparative advantage in good I and compete when exporting good I to country i.

To this standard endowment structure, we add market size and geographic asymmetry. Demand for any good Z in country i is $q(p_i^Z) = \alpha_i - p_i^Z$.[7] The intercept α_i on the inverse demand curve captures market size and we model market size asymmetry via two small countries s_1 and s_2 and one large country l. Absent a need to distinguish between s_1 and s_2, we merely denote a small country by s.

Geographic asymmetry enters via traditional iceberg transport costs: a fraction τ_{ij} of a unit shipped from country i arrives in country j. Thus, a lower τ_{ij} indicates higher transport costs and a greater degree of geographic asymmetry. To focus on the role of geography, we assume costless trade between the small countries: $\tau_{s_1 s_2} = \tau_{s_2 s_1} = 1$. Thus, the small countries are "close". Conversely, trade is costly between either close country s and the "far" country l: $\tau_{sl} = \tau_{ls} = \tau \leq 1$. Later, we interpret a bilateral PTA involving the large far country as "inter–regional" and a bilateral PTA involving the small close countries as "intra–regional". But, when geographic asymmetry is low enough (i.e. τ large enough) we interpret all bilateral PTAs as intra–regional despite *some* degree of geographic asymmetry.

No arbitrage conditions link cross-country prices of any good I. Ruling out prohibitive tariffs and letting t_{ij} be the tariff imposed by country i on country j: $p_i^I = \frac{p_j^I}{\tau_{ij}} + t_{ij} = \frac{p_k^I}{\tau_{ik}} + t_{ik}$. Combining these no-arbitrage conditions with international market clearing conditions yields

[6] All countries have large enough endowments of the numeraire good y to ensure balanced trade.

[7] As is well known, these demand functions can be derived from a utility function of the form $U(q^Z) = \sum_Z u(q^z) + y$ where $u(\cdot)$ is quadratic and q^Z denotes consumption of good Z.

equilibrium prices. Given country i's zero endowment of good I, its imports of good I are

$$m_i^I = q(p_i^I) = \alpha_i - p_i^I. \tag{1}$$

The exports from country j that arrive in country i are

$$x_j^I = \tau_{ij}[e_j - q\left(p_j^I\right)] = \tau_{ij}[e_j - (\alpha_j - p_j^I)]. \tag{2}$$

Naturally, international market clearing for good I requires $m_i^I = x^I \equiv \sum_{z \neq i} x_z^I$. Thus, the equilibrium price of good I in country i is

$$p_i^I = \left[\alpha_i + \sum_{z \neq i} \{\tau_{zi}(t_{iz}\tau_{zi} + \alpha_z - e_z)\}\right]\left[1 + \sum_{z \neq i} \tau_{zi}^2\right]^{-1}. \tag{3}$$

Equation (3) shows that the price of good I in country i rises with transport costs (supply side effect), market size (demand side effect) and its own tariffs.[8]

Given the effective partial equilibrium nature of the model, national welfare only depends on non-numeraire goods. Thus, country i's welfare is the sum of consumer surplus (CS), producer surplus (PS), and tariff revenue (TR) over such goods:

$$W_i = \sum_Z CS_i^Z + \sum_Z PS_i^Z + TR_i. \tag{4}$$

Using equilibrium prices yields a closed form expression for country i's welfare that depends on tariffs and the model's parameters. Hereafter, we normalize the endowments of each country z to $e_z = 1$. We also set the market size of small countries to $\alpha_s = 1$ and let $\alpha_l > 1$.

2.1 Optimal Tariffs

Before describing optimal tariffs, Figure 1 illustrates and introduces notation describing the different networks of trade agreements.

2.1.1 Empty network

At the empty network $\varnothing$, each country i chooses a non-discriminatory tariff (in accordance with GATT Article I) $t_i = t_{ij} = t_{ik}$ to maximize its welfare. As is well known (e.g. Feenstra

[8] Equation (3) also shows the effect of a country's tariff on its terms of trade: only a fraction of a tariff increase, $\tau_{zi}^2/(1 + \sum_{z \neq i} \tau_{zi}^2)$, passes on to domestic consumers.

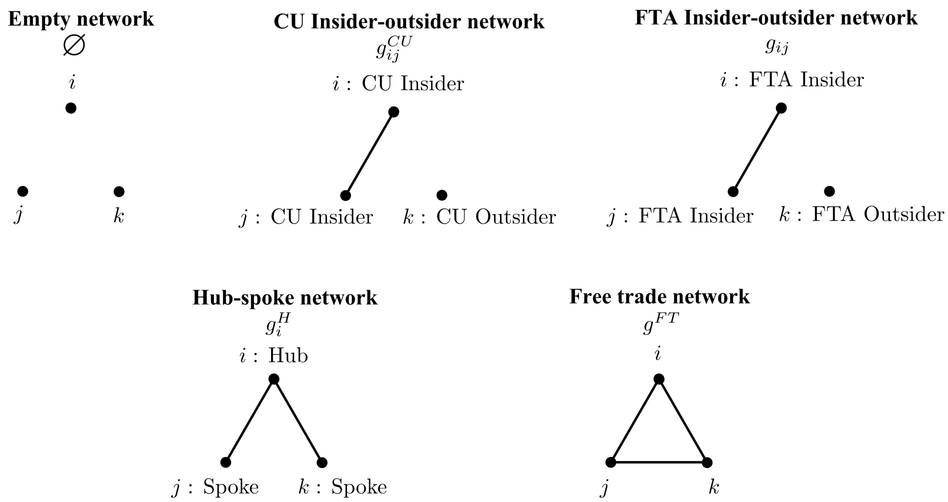

Figure 1: Networks and network positions

(2004)), country i's optimal tariff can be represented generally as:

$$
\begin{aligned}
t_i(\varnothing) &= x^I \frac{\partial p_w^I}{\partial x^I} && (5)\\
&= \left[\varepsilon_x^I\right]^{-1} p_w^I && (6)
\end{aligned}
$$

where p_w^I is the world price of good I and ε_x^I is elasticity of export supply faced by the importing country i. Note, in addition to linear export supply curves, the export supply curve faced by country i goes through the origin if $\alpha_z = 1$ for both its trading partners. In this case, country i faces a unit elastic export supply curve with (6) implying $t_i(\varnothing) = p_w^I$.

In our model, (5) or (6) yield

$$
t_s(\varnothing) = \frac{1 - \tau(\alpha_l - 1) + \tau^2}{(1+\tau^2)(3+\tau^2)} \text{ and } t_l(\varnothing) = \frac{\alpha_l}{2(1+\tau^2)}. \quad (7)
$$

These optimal tariffs increase as transport costs rise (i.e. as τ falls). To see this, consider the symmetric market size case with $\alpha_z = 1$ for all z. Then, (6) implies $t_i(\varnothing) = p_w^I$. Moreover, rising transport costs make the export supply curve steeper (see (2)), increasing p_w^I and, hence, tariffs. In contrast, rising market size asymmetry has asymmetric effects: $\frac{\partial t_l(\varnothing)}{\partial \alpha_l} > 0$ but $\frac{\partial t_s(\varnothing)}{\partial \alpha_l} < 0$. As α_l rises, the large country's import demand curve shifts parallel right (see (1)). As a larger importer, (5) implies $t_l(\varnothing)$ rises. Conversely, the large country's export supply curve shifts parallel left as α_l rises (see (2)) and it becomes a smaller exporter. As a smaller importer, (5) implies $t_s(\varnothing)$ falls.[9]

[9] For sufficiently small τ and sufficiently large α_l, exports from country l can be negative. To exclude this possibility, we assume $\alpha_l \leq \bar{\alpha}_l^x(\tau) \equiv 1 + \frac{\tau(\tau^2+1)}{2\tau^2+3}$. However, this will not bind once we impose non-negative

2.1.2 Free Trade Agreements

Upon FTA formation, members remove tariffs on each other and impose their individually optimal external tariff on the non-member. Under a single FTA between l and s_1:[10]

$$t_{s_1s_2}(g_{s_1l}) = \frac{\tau(3+\tau^2)(\alpha_l - 1) + 1}{(1+2\tau^2)(2+\tau^2) + (1+\tau^2)} \text{ and } t_{ls_2}(g_{s_1l}) = \frac{\alpha_l}{(1+2\tau^2)^2 + (1+\tau^2)}. \tag{8}$$

Optimal tariffs now rise both with transport costs and market size asymmetry. For l's external tariff, the logic follows the empty network case. For s_1's external tariff, the logic differs from the empty network case. Higher transport costs bias the geographic composition of s_1's imports away from l and towards the non-member s_2 and, hence, raise $t_{s_1s_2}(g_{s_1l})$. Since l becomes a smaller exporter as market size asymmetry rises (see (2)), rising market size asymmetry also biases the geographic composition of s_1's imports away from l and towards the non-member s_2 and, hence, raises $t_{s_1s_2}(g_{s_1l})$. Finally, the optimal external tariffs imply FTA members practice tariff complementarity (i.e. $t_{is_2}(g_{s_1l}) < t_i(\varnothing)$ for $i = s_1, l$).[11]

Under a single FTA between two small countries,

$$t_{s_1l}(g_{s_1s_2}) = t_{s_2l}(g_{s_1s_2}) = \frac{(4+\tau^2)(1-\alpha_l) + \tau}{\tau(3\tau^2+8)}. \tag{9}$$

While tariffs again increase as transport costs rise, they now fall as market size asymmetry rises. Rising market size asymmetry makes l a smaller exporter (see (2)). By reducing the small countries' imports from l, their tariffs on l fall. While the small countries practice tariff complementarity (i.e. $t_{sl}(g_{s_1s_2}) < t_s(\varnothing)$ for $s = s_1, s_2$), we hereafter assume $\alpha_l \leq \bar{\alpha}_l^t(\tau)$ to guarantee non-negative external tariffs:

$$t_{sl}(g_{s_1s_2}) > 0 \;\Leftrightarrow\; \alpha_l < \bar{\alpha}_l^t(\tau) \equiv 1 + \frac{\tau}{4+\tau^2}. \tag{10}$$

tariffs under the FTA between the small countries. Specifically, $\bar{\alpha}_l^x(\tau) > \bar{\alpha}_l^t(\tau)$ (see (10)).

[10] Since the non-member country is the sole importer of the good exported by the member countries, we have $t_k(\varnothing) = t_k(g_{ij})$. In a hub-spoke network where i is the hub (see Figure 1) we have $t_{kj}(g_i^H) = t_{jk}(g_i^H) = t_{jk}(g_{ij})$ for spoke countries j and k. In contrast, since the hub has an FTA with both spokes, it practices free trade.

[11] See Richardson (1993), Bagwell and Staiger (1999), and Saggi and Yildiz (2009) for a detailed discussion of tariff complementarity and Estevadeordal et al. (2008) for empirical evidence in its support. Tariff complementarity also arises in general equilibrium models of trade agreements (e.g. Bond et al. (2004)).

2.1.3 Customs Unions

Upon CU formation, members remove tariffs on each other and impose their jointly optimal external tariffs.[12] CU members benefit from tariff coordination because they internalize the negative externality caused by tariff complementarity reducing each other's export surplus.[13] Under the respective CUs between s_1 and l and between s_1 and s_2:[14]

$$t_{s_1 s_2}(g^{CU}_{s_1 l}) = \frac{\tau(\alpha_l - 1) + 1}{(2\tau^2 + 3)},\ t_{l s_2}(g^{CU}_{s_1 l}) = \frac{\alpha_l}{(2 + 3\tau^2)} \text{ and } t_{sl}(g^{CU}_{s_1 s_2}) = \frac{2(1-\alpha_l) + \tau}{\tau(4+\tau^2)}. \tag{11}$$

Naturally, the qualitative response of jointly optimal CU tariffs to rising geographic and market size asymmetry mirrors that of individually optimal FTA tariffs. Moreover, given a CU internalizes the negative effects of tariff complementarity, CU tariffs exceed FTA tariffs:

$$t_{s_1 l}(g^{CU}_{s_1 s_2}) > t_{s_1 l}(g_{s_1 s_2}),\ t_{s_1 s_2}(g^{CU}_{s_1 l}) > t_{s_1 s_2}(g_{s_1 l}) \text{ and } t_{l s_1}(g^{CU}_{s_1 l}) > t_{l s_1}(g_{s_1 l}). \tag{12}$$

3 Dynamic game

3.1 Network dynamics

Our dynamic model closely resembles Seidmann (2009). Indeed, the set of trade agreement networks and the possible transitions between such networks are identical. Thus, we assume that at most one agreement can be formed in any given period and agreements formed in previous periods are binding.[15,16] Given a network at the end of the previous period g_{t-1},

[12] Our simple formulation of a CU's tariff choice is intuitively appealing and consistent with much of existing literature, even with asymmetric countries and transfers excluded (e.g. Saggi et al. (2013)). Moreover, our results merely rely on the one period CU payoff possibly exceeding the one period FTA payoff. For issues regarding delegation of tariff-setting authority, the choice of weights in the social welfare function, and tariff sharing rules, see Gatsios and Karp (1991), Melatos and Woodland (2007) and Syropoulos (2003). Importantly, Syropoulos shows CU members have an incentive to influence their common tariffs for external terms-of-trade reasons and for *internal* distributional purposes. However, given the focus of our paper, we abstract from such considerations.

[13] In Bagwell and Staiger (1997), CU members compete for imports rather than compete for exports. There, a CU is only beneficial because of a "market power" effect: CU members pool their market power and extract a larger terms of trade gain from non-members.

[14] When $t_{s_1 l}(g^{CU}_{s_1 s_2}) > t_{s_1 l}(\varnothing)$, tariff complementarity fails to hold based on the jointly optimal CU tariff. In this case, we exogenously impose $t_{s_1 l}(g^{CU}_{s_1 s_2}) = t_{s_1 l}(\varnothing)$ to ensure compliance with GATT Article XXIV.

[15] Many authors (e.g. Ornelas (2008) and Ornelas and Liu (2012)) argue the binding nature of trade agreements is entirely realistic and pervasive in the literature. They argue realism in terms of real world observation and as a reduced form shorthand for a more structural model. See McLaren (2002) for a sunk costs structural justification and Freund and McLaren (1999) for empirical support.

[16] Essentially, we interpret a period as the length of time taken to negotiate an agreement. Trade agreement negotiations typically take many years to complete; for example, NAFTA negotiations date back to 1986

Network at end of previous period	Possible networks at end of current period
$\varnothing$	$\varnothing, g_{ij}, g_{ik}, g_{jk}, g_{ij}^{CU}, g_{ik}^{CU}, g_{jk}^{CU}, g^{FT}$
g_{ij}^{CU}	g_{ij}^{CU}, g^{FT}
g_{ij}	$g_{ij}, g_i^H, g_j^H, g^{FT}$
g_i^H	g_i^H, g^{FT}
g^{FT}	g^{FT}

Table 1: Networks and possible transitions within a period

we follow Seidmann (2009) and refer to the current period t as the subgame at g_{t-1}. We let $V_i(g_{t-1})$ denote country i's *continuation* payoff in the subgame at g_{t-1} with Table 1 describing the feasible transitions in a given subgame. Henceforth, $g_{t-1} \rightarrow g_t$ denotes the (feasible) transition from g_{t-1} to g_t.

Seidmann (2009) assumes a stochastic protocol regarding which country, called the "proposer", can propose an agreement in a given period. However, we assume a deterministic protocol. The basic idea of our protocol is twofold. First, similar to Aghion et al. (2007), the large country is the "leader country" who has the first opportunity in a given period to propose agreements. However, unlike Aghion et al. (2007), we allow the small countries to take the proposer role if (i) they reject agreements proposed by the large country or (ii) the large country chooses to make no proposal.

Our protocol consists of stages 1(a)-1(c) below. In period t, regardless of the stage of the protocol, a proposer can only propose an agreement in which they are a member (e.g. the proposer cannot propose that the other two countries form an FTA) and which represents a feasible transition (see Table 1). To be clear, a proposer can choose to propose no agreement. In general, the protocol proceeds as follows in each period:

- Stage 1(a): l has the opportunity to propose an agreement. If all members of the proposed agreement accept, the agreement forms and the period ends. If l proposes a bilateral PTA and it is rejected, the game moves to stage 1(b). If l proposes g^{FT} and only one small country rejects, the game moves to stage 1(b). If l proposes g^{FT} and both s_1 and s_2 reject, or if l proposes no agreement, the game moves to stage 1(c).

- Stage 1(b): l has the opportunity to propose a bilateral PTA to the small country who did not reject the proposal in stage 1(a). If an agreement forms, the period ends. If no agreement forms, the game moves to stage 1(c).

- Stage 1(c): A small country s has the opportunity to propose a bilateral PTA to the other small country s'. No matter what happens here, the period ends.

despite being signed in 1992 and implemented in 1994 (Odell (2006, p.193)).

Given the assumption that agreements are binding, the protocol implies no further agreements form once the free trade network is obtained or no pair of countries want to form a subsequent agreement.[17] This happens in at most three periods.

Section 6.4 discusses reasons motivating this protocol and how our main results are robust to various alternative protocols including a small country being the "leader country" or a small country being able to propose agreements involving the large country in stage 1(c).

3.2 Equilibrium concept

We follow Seidmann (2009) and solve for a type of pure strategy Markov perfect equilibrium. Specifically, we use backward induction to solve for a pure strategy subgame perfect equilibrium where the proposal by the proposer and the response(s) by the respondent(s) in period t only depend on history via the network in place at the end of the previous period g_{t-1}. Like Seidmann (2009), we focus on the equilibrium outcome rather than the equilibrium strategy profile itself. This equilibrium outcome is a sequence of equilibrium transitions that we refer to as the equilibrium path of networks.

4 Background forces

As a prelude to our formal analysis in Sections 5-6, we first introduce the intuition behind key concepts underlying later results. In particular, we outline three different scenarios with each scenario comparing two paths of PTA formation from the perspective of the large country. Our objective is to provide the key intuition that underlies these comparisons.

The first scenario compares the path where the large country is an FTA insider and then the hub on the path to global free trade with the path where the large country is a permanent CU insider. In our model, this comparison drives whether the large country prefers to engage in FTA or CU formation. Indeed, in our model, the CU between s and l does not expand because l benefits from excluding the CU outsider and thus blocks CU expansion. That is, as discussed further below, l holds a CU exclusion incentive: $W_l\left(g_{sl}^{CU}\right) - W_l\left(g^{FT}\right) > 0$. Thus, the large country prefers to engage in FTA formation when

$$V_l\left(g_{sl}\right) = W_l\left(g_{sl}\right) + \beta W_l\left(g_l^H\right) + \frac{\beta^2}{1-\beta} W_l\left(g^{FT}\right) > V_l\left(g_{s_1 s_2}^{CU}\right) = \frac{1}{1-\beta} W_l\left(g_{sl}^{CU}\right). \qquad (13)$$

[17] Note that, given agreements are binding, some stages are redundant depending on the network at the beginning of the period. For example, stage 1(c) is redundant in period t if s_1 and s_2 have a PTA at the end of period $t-1$ (e.g. $g_{t-1} = g_{s_1 s_2}$).

Rearranging, we obtain the following decomposition:

$$\beta \underbrace{\left[W_l\left(g_l^H\right) - W_l\left(g^{FT}\right)\right]}_{\text{FTA flexibility benefit } \equiv \Delta_{flex}} > \underbrace{W_l\left(g_{sl}^{CU}\right) - W_l\left(g_{sl}\right)}_{\text{myopic CU coordination benefit } \equiv \Delta_{coord}} + \frac{\beta}{1-\beta} \underbrace{\left[W_l\left(g_{sl}^{CU}\right) - W_l\left(g^{FT}\right)\right]}_{\text{CU exclusion incentive } \equiv \Delta_{excl}^{CU}} \tag{14}$$

The benefit of CU formation stems from the coordination of tariff policy by CU members. Section 2.1 explained that CU tariffs exceed FTA tariffs because CU members internalize the negative externality of tariff complementarity that plagues FTA tariffs. This has offsetting effects on the myopic CU coordination benefit Δ_{coord}: the higher CU tariff provides greater preferential access to l when exporting to its CU partner market but, by exceeding the individually optimal FTA tariff, the higher CU tariff also reduces l's domestic surplus. Thus, $\Delta_{coord} > 0$ unless l is sufficiently large given that, as highlighted in Section 2.1, l becomes a smaller exporter (mitigating the value of preferential access) and a larger importer (exaggerating the loss of domestic surplus) as α_l rises.

Coordination of tariff policy by CU members entails a forward looking aspect that reinforces the myopic aspect. When l has a CU exclusion incentive, $\Delta_{excl}^{CU} > 0$, CU formation is attractive because a CU insider can block expansion to global free trade. Underlying Δ_{excl}^{CU} are offsetting effects. Excluding the outsider gives l (i) preferential access to its CU partner, increasing its export surplus, and (ii) the ability to impose a tariff on the CU outsider, increasing its domestic surplus. But, l faces tariffs when exporting to the CU outsider, decreasing its export surplus. $\Delta_{excl}^{CU} > 0$ with sufficient market size asymmetry or sufficient geographic asymmetry. In either case, l is a large enough importer and small enough exporter that the benefit of excluding the CU outsider outweighs the cost, noting that geographic asymmetry depresses the large far country's exports because small close country imports are biased towards each other. In the relevant range of the parameter space in Sections 5-6, $\Delta_{excl}^{CU} > 0$.

While CU formation offers coordination benefits, FTA formation offers a flexibility benefit. Specifically, FTA formation affords an FTA insider the flexibility to form a second FTA with the FTA outsider and thereby become the hub with sole preferential access to each of the spoke countries. CU formation does not afford this flexibility because, by construction, CU expansion leads directly to global free trade. Indeed, $\Delta_{flex} > 0$ because of the preferential access associated with the spokes discriminating against each other.

Because the various forces underlying the trade-off between FTA and CU formation are distributed over time, the discount factor mediates these forces. Specifically,

$$\beta \Delta_{flex} > \Delta_{coord} + \frac{\beta}{1-\beta} \Delta_{excl}^{CU} \Leftrightarrow \beta \in \left(\underline{\beta}_{In-In}^{Flex}\left(\alpha_l, \tau\right), \bar{\beta}_{In-In}^{Flex}\left(\alpha_l, \tau\right)\right). \tag{15}$$

When β lies in this intermediate range, there is sufficient weight on the FTA flexibility benefit relative to the myopic attractiveness of the myopic CU coordination benefit and the future attractiveness afforded by the CU exclusion incentive.[18] That is, the FTA flexibility benefit drives the possibility that a country may prefer FTA formation over CU formation.

While the discount factor mediates the relative attractiveness of FTA versus CU formation, geographic asymmetry crucially affects whether the large country is even prepared to participate in liberalization. In our model, refusal of the large country to engage in PTA formation leads the small countries to form a CU and exploit the myopic CU coordination benefit. Thus, our second scenario is a comparison of being a permanent CU insider versus a permanent CU outsider:

$$V_l\left(g_{s_1 l}^{CU}\right) = \frac{1}{1-\beta} W_l\left(g_{s_1 l}^{CU}\right) > V_l\left(g_{s_1 s_2}^{CU}\right) = \frac{1}{1-\beta} W_l\left(g_{s_1 s_2}^{CU}\right). \tag{16}$$

Rewriting, we obtain the following decomposition:

$$\underbrace{W_l\left(g_{s_1 l}^{CU}\right) - W_l\left(g^{FT}\right)}_{\text{CU exclusion incentive } \equiv \Delta_{excl}^{CU}} > \underbrace{W_l\left(g_{s_1 s_2}^{CU}\right) - W_l\left(g^{FT}\right)}_{\text{CU free riding incentive } \equiv \Delta_{fr}^{CU}} \tag{17}$$

That is, a comparison of the CU exclusion incentive and a CU free riding incentive, Δ_{fr}^{CU}, determines whether the large country prefers CU formation over being discriminated against as a permanent CU outsider.

A trade-off underlies the CU free riding incentive. On one hand, l faces discrimination in both small countries as the CU outsider, hurting its export surplus. On the other hand, (i) the small countries practice tariff complementarity, mitigating this discrimination, and (ii) l maintains the ability to impose tariffs on both small countries. That is, the cost underlying the CU free riding incentive is a smaller export surplus via the discrimination faced in export markets while the benefit is a larger domestic surplus via the ability to impose tariffs. Hence, $\Delta_{fr}^{CU} > 0$ when the large country is a large enough importer and small enough exporter.

Geographic asymmetry crucially affects the large country's incentive to participate in CU formation, i.e. $\Delta_{excl}^{CU} \gtrless \Delta_{fr}^{CU}$. Favoring the CU exclusion incentive via a higher export surplus is that l has preferential access, rather than facing discrimination, in its CU partner market. However, favoring the CU free riding incentive via a higher domestic surplus is l's ability to impose a tariff on the imports from both, rather than just one, of the small countries. As transport costs rise, trade flows shrink between the large far and the small close

[18] Note, as discussed above, $\Delta_{coord} < 0$ with sufficient market size asymmetry which implies $\underline{\beta}_{In-In}^{Flex}(\alpha_l, \tau) < 0$ and that FTA formation is more attractive than CU formation when $\beta < \bar{\beta}_{In-In}^{Flex}(\alpha_l, \tau)$.

countries. Importantly, this makes l's preferential access to its CU partner's export market less attractive and the discrimination faced in export markets as a CU outsider less costly. Moreover, these effects are magnified by transport costs biasing the geographic composition of small close country imports away from the large far country. Thus, absent such a bias in large country imports, sufficiently large transport costs imply the large country prefers being a permanent CU outsider over a permanent CU insider:

$$0 < \Delta_{excl}^{CU} < \Delta_{fr}^{CU} \text{ if and only if } \tau < \bar{\tau}_2 \left(\alpha_l\right). \tag{18}$$

Once $\tau < \bar{\tau}_2 \left(\alpha_l\right)$, an FTA is the only type of PTA that can induce the large country's participation in liberalization. Thus, what drives whether l prefers FTA formation over being a permanent CU outsider? The third scenario undertakes this comparison:

$$V_l \left(g_{s_1 l}\right) = W_l \left(g_{s_1 l}\right) + \beta W_l \left(g_l^H\right) + \frac{\beta^2}{1-\beta} W_l \left(g^{FT}\right) > V_l \left(g_{s_1 s_2}^{CU}\right) = \frac{1}{1-\beta} W_l \left(g_{s_1 s_2}^{CU}\right). \tag{19}$$

Rearranging, we obtain the following decomposition:

$$\underbrace{\left[W_l \left(g_{s_1 l}\right) - W_l \left(g^{FT}\right)\right]}_{\text{FTA exclusion incentive } \equiv \Delta_{excl}^{FTA}} + \beta \underbrace{\left[W_l \left(g_l^H\right) - W_l \left(g^{FT}\right)\right]}_{\text{FTA flexibility benefit } \equiv \Delta_{flex}} > \frac{1}{1-\beta} \underbrace{\left[W_l \left(g_{s_1 s_2}^{CU}\right) - W_l \left(g^{FT}\right)\right]}_{\text{CU free riding incentive } \equiv \Delta_{fr}^{CU}}. \tag{20}$$

Thus, the large country prefers FTA formation over being a permanent CU outsider if the FTA exclusion incentive and the FTA flexibility benefit outweigh the CU free riding incentive. The FTA exclusion incentive entails the same qualitative trade-off underlying the CU exclusion incentive. Thus, $\Delta_{excl}^{FTA} > 0$ in the relevant area of the parameter space in Sections 5-6: the large country is a large enough importer and a small enough exporter that the domestic surplus benefits of imposing a tariff on the FTA outsider outweigh any gains in export surplus from having tariff free access to the FTA outsider.

Like the scenario involving a comparison of FTA and CU formation, the forces driving the large country's preference over FTA formation relative to being a permanent CU outsider are distributed over time. Thus, the discount factor again mediates these forces:

$$\Delta_{excl}^{FTA} + \beta \Delta_{flex} > \frac{1}{1-\beta} \Delta_{fr}^{CU} \Leftrightarrow \beta \in \left(\underline{\beta}_{In-Out}^{Flex} \left(\alpha_l, \tau\right), \bar{\beta}_{In-Out}^{Flex} \left(\alpha_l, \tau\right)\right). \tag{21}$$

When β lies in this intermediate range, there is sufficient weight on the FTA flexibility benefit relative to the CU free riding incentive. That is, the FTA flexibility benefit drives the possibility that a country may prefer FTA formation over being a permanent CU outsider. Whether $\underline{\beta}_{In-Out}^{Flex} \left(\alpha_l, \tau\right) \gtrless 0$ depends on the whether $\Delta_{excl}^{FTA} \gtrless \Delta_{fr}^{CU}$ or, equivalently,

$W_l\left(g_{s_1l}\right) \gtrless W_l\left(g^{CU}_{s_1l}\right)$. When the FTA exclusion incentive dominates the CU free riding incentive then $\underline{\beta}^{Flex}_{In-Out}\left(\alpha_l,\tau\right) < 0$ and, hence, (21) reduces to $\beta < \bar{\beta}^{Flex}_{In-Out}\left(\alpha_l,\tau\right)$. That is, in this case, the FTA exclusion incentive reinforces the FTA flexibility effect in making FTA formation more attractive relative to being a permanent CU outsider.

5 Equilibrium path of networks

5.1 Equilibrium with intra and inter-regional agreements

To solve the equilibrium path of networks, we use backward induction (Appendix A contains the proofs). Section 4 explained how rising transport costs affect the large far country's incentive to form PTAs. By shrinking trade flows between the large far and the small close countries, rising transport costs not only reduce the attractiveness of having preferential access to a small close country via a CU but also reduce the cost of being discriminated against a CU outsider. Thus, once τ falls below a threshold $\bar{\tau}_2\left(\alpha_l\right)$, transport costs are sufficiently high that the large far country prefers remaining a permanent CU outsider over becoming a permanent CU insider: $W_l\left(g^{CU}_{s_1s_2}\right) > W_l\left(g^{CU}_{sl}\right)$ if and only if $\tau < \bar{\tau}_2\left(\alpha\right)$ (see (18)). Focusing on this range of transport costs, Lemma 1 shows the equilibrium transitions conditional on the formation of an initial PTA are quite straightforward.

Lemma 1 *When $\tau < \bar{\tau}_2\left(\alpha_l\right)$, no subsequent agreements form after an initial PTA unless the initial PTA is an FTA between s and l. Conditional on an FTA between s_1 and l, there exist critical values $\bar{\beta}^{FT-K}_{l}\left(\alpha_l,\tau\right)$ and $\bar{\beta}^{FT-K}_{s_2}\left(\alpha_l,\tau\right)$ such that the equilibrium transitions are (i) $g_{s_1l} \to g^H_l \to g^{FT}$ when $\beta \in \left(\bar{\beta}^{FT-K}_{s_2}\left(\alpha_l,\tau\right), \bar{\beta}^{FT-K}_{l}\left(\alpha_l,\tau\right)\right)$ but (ii) $g_{s_1l} \to g^H_{s_1}$ otherwise.*

The degree of transport costs incurred when $\tau < \bar{\tau}_2\left(\alpha_l\right)$ severely restricts the incentives of the large far country to engage in PTA formation. Indeed, the large far country refuses participation in any subsequent agreements either as a CU outsider or an FTA outsider. That is, the large country has a CU free riding incentive and, given CU tariff coordination mitigates tariff complementarity, an even stronger FTA free riding incentive. Thus, no subsequent agreements form after the small countries form a PTA. Moreover, the large country holds a CU exclusion incentive (see (14)) and blocks expansion of a CU involving itself to global free trade. Thus, the only way multiple agreements can form is if the large country and a small country form an FTA.

Two dynamic trade-offs determine the agreements that follow an FTA between the large far country l and a small close country s_1. Following the theme of the previous paragraph, l refuses FTA formation as a spoke. Thus, the small FTA insider s_1 becomes the permanent hub upon an FTA between itself and the small FTA outsider s_2. Moreover, this FTA is mutually attractive given (i) the strong trade flows between the small close countries in the absence of transport costs and (ii) the discrimination faced by the FTA outsider. Conversely, l can only be the hub temporarily as the strong trade flows between the small countries imply they will form a subsequent FTA that takes the world to global free trade. These alternative paths present a dynamic trade-off to l and also, potentially, to the small FTA outsider s_2.

Although becoming the hub is myopically attractive for the large country, it is also poses a future cost. The cost arises because, as discussed at the start of the previous paragraph, l prefers being a spoke over global free trade. Thus, l wants to become the hub when

$$W_l\left(g_l^H\right)+\frac{\beta}{1-\beta}W_l\left(g^{FT}\right)>\frac{1}{1-\beta}W_l\left(g_{s_1}^H\right)\Leftrightarrow\beta<\frac{W_l\left(g_l^H\right)-W_l\left(g_{s_1}^H\right)}{W_l\left(g_l^H\right)-W_l\left(g^{FT}\right)}\equiv\bar{\beta}_l^{FT-K}\left(\alpha_l,\tau\right).$$

That is, the myopic attractiveness of becoming the hub and having sole preferential access to both spokes motivates l's desire to become the hub when β falls below $\bar{\beta}_l^{FT-K}\left(\alpha_l,\tau\right)$.

The small FTA outsider s_2 faces a dynamic trade-off when it myopically prefers an FTA with the small FTA insider s_1 rather than l. Despite its myopic appeal, an FTA with s_1 brings the future cost of permanent discrimination as a spoke given FTA formation with l eventually yields global free trade. Thus, the FTA outsider s_2 prefers an FTA with l when

$$W_{s_2}\left(g_l^H\right)+\frac{\beta}{1-\beta}W_{s_2}\left(g^{FT}\right)>\frac{1}{1-\beta}W_{s_2}\left(g_{s_1}^H\right)\Leftrightarrow\beta>\frac{W_{s_2}\left(g_{s_1}^H\right)-W_{s_2}\left(g_l^H\right)}{W_{s_2}\left(g^{FT}\right)-W_{s_2}\left(g_l^H\right)}\equiv\bar{\beta}_{s_2}^{FT-K}\left(\alpha_l,\tau\right).$$

That is, the future attractiveness of no discrimination under global free trade motivates s_2's decision to form an FTA with l when β exceeds $\bar{\beta}_{s_2}^{FT-K}\left(\alpha_l,\tau\right)$. Combining the two dynamic trade-offs, the large country becomes the hub on the path to global free trade when $\beta\in\left(\bar{\beta}_{s_2}^{FT-K}\left(\alpha_l,\tau\right),\bar{\beta}_l^{FT-K}\left(\alpha_l,\tau\right)\right)$ but, otherwise, the small FTA insider s_1 becomes the permanent hub. Naturally, $\bar{\beta}_{s_2}^{FT-K}\left(\alpha_l,\tau\right)>0$ hinges on the FTA outsider's myopic preference for an FTA with the other small country. This requires sufficiently high transport costs so that an FTA with the large far country loses substantial appeal. Indeed, in our baseline model, it requires such extreme transport costs that the threshold $\bar{\beta}_{s_2}^{FT-K}\left(\alpha_l,\tau\right)$ plays no role in the equilibrium characterization of Proposition 1.

Given the equilibrium transitions established in Lemma 1 conditional on formation of an initial PTA, we now roll back to the empty network to solve the equilibrium path of networks. The following proposition characterizes this path (the critical values in the proposition will be explained below) which is illustrated in Figure 2.

Proposition 1 *For any α_l, there exists a threshold level of geographic asymmetry $\bar{\tau}_2\left(\alpha_l\right)$*

such that any equilibrium CU is between the small close countries when $\tau < \bar{\tau}_2(\alpha_l)$. *When* $\tau < \bar{\tau}_2(\alpha_l)$, *the equilibrium path of networks is:*

(i) $\varnothing \to g_{sl} \to g_l^H \to g^{FT}$ *when* $\beta \in \left(\underline{\beta}_{In-Out}^{Flex}(\alpha_l,\tau), \min\left\{\bar{\beta}_l^{FT-K}(\alpha_l,\tau), \bar{\beta}_{In-Out}^{Flex}(\alpha_l,\tau)\right\}\right)$

(ii) $\varnothing \to g_{sl} \to g_s^H$ *when* $\beta \in \left(\bar{\beta}_l^{FT-K}(\alpha_l,\tau), \bar{\beta}_{K-Out}^{Flex}(\alpha_l,\tau)\right)$

(iii) $\varnothing \to g_{s_1 s_2}^{CU}$ *otherwise.*

Proposition 1 says any equilibrium CU must be formed by the two small close countries when transport costs are sufficiently high. Given the sufficiently high transport costs involved, we interpret this result as saying any equilibrium CU is intra-regional. As discussed above, the key intuition behind the threshold $\bar{\tau}_2(\alpha_l)$ is simple: the large far country prefers being a CU outsider rather than a CU insider because shrinking trade flows with the small close countries reduce the benefit of having preferential access via a CU and reduce the cost of being discriminated against as a CU outsider.

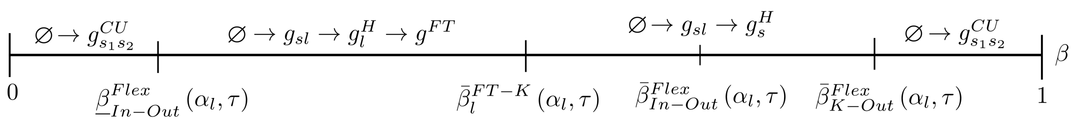

Figure 2: Equilibrium path of networks when $\tau < \bar{\tau}_2(\alpha_l)$

In addition to saying any equilibrium CU is intra-regional, Proposition 1 says equilibrium FTA formation involves inter and intra-regional FTAs with the discount factor driving the equilibrium type of PTA. If given the opportunity, the small countries form a CU rather than an FTA to exploit the myopic CU coordination benefit. Given $\tau < \bar{\tau}_2(\alpha_l)$ implies the only type of PTA attractive enough to induce the large country's participation is an FTA, equilibrium FTA formation requires the FTA flexibility benefit outweigh the CU coordination benefits. Section 4, see (15), explained that this happens when $\beta \in \left(\underline{\beta}_{In-In}^{Flex}(\alpha_l,\tau), \bar{\beta}_{In-In}^{Flex}(\alpha_l,\tau)\right)$. But, for the large country to actually propose FTA formation, FTA formation must be more attractive than becoming a permanent CU outsider.

The condition describing whether the large country proposes FTA formation depends on the subsequent agreements that form following such an FTA. Noting that $\bar{\beta}_{s_2}^{FT-K}(\alpha_l,\tau) < 0$ in the relevant area of the parameter space (i.e. $\tau > \bar{\tau}_1(\alpha_l)$ in Figure 3 below), the large country subsequently becomes the hub when $\beta < \bar{\beta}_l^{FT-K}(\alpha_l,\tau)$. Here, it proposes an initial FTA at the empty network when it prefers being the insider-turned-hub on the path to global free trade over being a permanent CU outsider. Section 4 explained, see (19)-(21), that this reduces to $\beta \in \left(\underline{\beta}_{In-Out}^{Flex}(\alpha_l,\tau), \bar{\beta}_{In-Out}^{Flex}(\alpha_l,\tau)\right)$. That is, the large country prefers FTA formation when sufficient weight is placed on (i) having sole preferential access to both small countries as the hub and (ii) if $W_l(g_{sl}) > W_l\left(g_{s_1 s_2}^{CU}\right)$, exchanging preferential access with a small country as an FTA insider.

Similarly, when the large country becomes a spoke, i.e. $\beta > \bar{\beta}_l^{FT-K}(\alpha_l, \tau)$, it proposes an initial FTA at the empty network when

$$W_l(g_{sl}) + \frac{\beta}{1-\beta} W_l\left(g_s^H\right) > \frac{1}{1-\beta} W_l\left(g_{s_1 s_2}^{CU}\right) \Leftrightarrow \beta < \frac{W_l(g_{sl}) - W_l\left(g_{s_1 s_2}^{CU}\right)}{W_l(g_{sl}) - W_l\left(g_s^H\right)} \equiv \bar{\beta}_{K-Out}^{Flex}(\alpha_l, \tau). \tag{22}$$

That is, the large country prefers FTA formation when sufficient weight is placed on exchanging preferential access with a small country as an FTA insider. Given the attractiveness of access to the large country's market implies a small country will indeed accept an FTA proposal from the large country, the large country's preferences, as contained in (19)-(21) and (22), govern the situations where FTA formation arises in equilibrium.

Figure 3 illustrates how the equilibrium structure changes with geographic asymmetry for a specifically chosen value of α_l.[19] When τ lies slightly below $\bar{\tau}_2(\alpha_l)$, FTA formation arises for any β. Here, as discussed in Section 4, $\underline{\beta}_{In-Out}^{Flex}(\alpha_l, \tau) < 0$ because $W_l(g_{sl}) > W_l\left(g_{s_1 s_2}^{CU}\right)$. In turn, the equilibrium path of networks is $\varnothing \to g_{sl} \to g_l^H \to g^{FT}$ for $\beta < \bar{\beta}_l^{FT-K}(\alpha_l, \tau)$. Also, $\bar{\beta}_{K-Out}^{Flex}(\alpha_l, \tau) > 1$ because $W_l(g_{sl}) > W_l\left(g_s^H\right) > W_l\left(g_{s_1 s_2}^{CU}\right)$. In turn, the equilibrium path of networks is $\varnothing \to g_{sl} \to g_s^H$ for $\beta > \bar{\beta}_l^{FT-K}(\alpha_l, \tau)$. As transport costs rise, i.e. τ falls, the large country's incentive to participate in agreements shrinks which then shrinks the range of the discount factor that induces the large country's participation in PTAs. In turn, the equilibrium path of networks is $\varnothing \to g_{s_1 s_2}^{CU}$ when the large country refuses participation. Once $\tau < \bar{\tau}_1(\alpha_l)$, rising transports costs shrink trade flows so far that the large country refuses to participate in any type of PTA and the equilibrium path of networks is $\varnothing \to g_{s_1 s_2}^{CU}$ for any β.

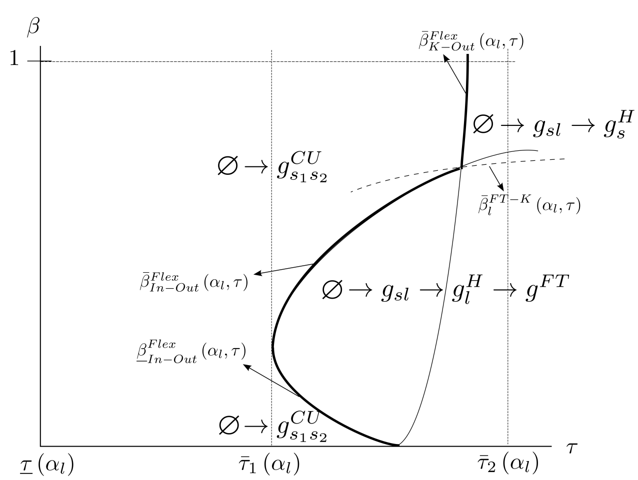

Figure 3: Equilibrium path of networks and geographic asymmetry when $\tau < \bar{\tau}_2(\alpha_l)$

[19] In Figure 3, $\underline{\tau}(\alpha_l)$ is the threshold τ associated with the non-negative external tariff constraint in (10).

As illustrated by Figure 3, the equilibrium type of PTA depends on the discount factor when $\tau \in (\bar{\tau}_1(\alpha_l), \bar{\tau}_2(\alpha_l))$. How does this interval depend on market size asymmetry? To begin, the interval is non-empty only once α_l exceeds a threshold $\underline{\alpha}_l$. When $\alpha_l < \underline{\alpha}_l$, the myopic CU coordination benefit is too large and there is no range of transport costs where an FTA is the only type of PTA that will induce the large country's participation in liberalization. But, a rising α_l permits the alternative possibility by reducing the myopic CU coordination benefit: l becomes a larger importer, thus increasing the domestic surplus cost of the CU tariff exceeding the individually optimal FTA tariff, and a smaller exporter, thus reducing the export surplus gain from the CU tariff internalizing tariff complementarity. When $\alpha_l < \underline{\alpha}_l$, the intra-regional CU emerges for all $\tau < \bar{\tau}_2(\alpha_l)$. But, the interval $(\bar{\tau}_1(\alpha_l), \bar{\tau}_2(\alpha_l))$ is non-empty once $\alpha > \underline{\alpha}_l$ and increases in α_l shift the bold bullet rightward, increasing the thresholds $\bar{\tau}_1(\alpha_l)$ and $\bar{\tau}_2(\alpha_l)$. Indeed, a sufficiently high α_l generates $\bar{\tau}_1(\alpha_l), \bar{\tau}_2(\alpha_l) > 1$: the large country again refuses PTA participation with an intra-regional CU emerging in equilibrium regardless of transport costs.

5.2 Equilibrium when all agreements are intra-regional

We now focus on the range of transport costs $\tau > \bar{\tau}_2(\alpha_l)$. Given this represents sufficiently small degrees of geographic asymmetry, we now interpret all agreements as intra-regional. To streamline the analysis, we impose three restrictions on the area of the parameter space analyzed: (i) s and l hold a CU exclusion incentive having formed their own CU, (ii) as an FTA outsider, a small country myopically benefits from FTA formation with the small FTA insider (it always myopically benefits from an FTA with the larger FTA insider), and (iii) $\beta < \bar{\beta}_l^{FT-K}(\alpha_l, \tau)$. These restrictions streamline the characterization of equilibrium without altering its essential flavor. Nevertheless, after characterizing the equilibrium, we explain the implications of relaxing these restrictions.

Two issues drive the equilibrium structure. First, the trade-off between the FTA flexibility and CU coordination benefits actually binds. By definition, $\tau > \bar{\tau}_2(\alpha_l)$ implies l now prefers being a permanent CU insider rather than a permanent CU outsider. Thus, unlike earlier, *either* type of PTA can potentially induce the large country's participation in liberalization when faced with the prospect of being discriminated against as a CU outsider.

Second, a small country s can face a dynamic trade-off between accepting an FTA offer from l and forming a CU with the other small country. When τ exceeds a threshold $\bar{\tau}_3(\alpha_l)$, l no longer holds a CU free riding incentive: $W_l(g^{FT}) > W_l(g^{CU}_{s_1 s_2})$ because low transport costs imply strong trade flows, making the discrimination faced as a CU outsider very costly. Hence, unlike Lemma 1, l participates in expansion of $g^{CU}_{s_1 s_2}$ to g^{FT}. On one hand, this delivers

s tariff free access to l's market without the discrimination faced as a spoke after being an FTA insider with l. On the other hand, given l's market size, s myopically prefers the sole preferential access gained via an FTA with l over that gained via a CU with the other small country. Thus, when $\tau > \bar{\tau}_3(\alpha_l)$, $g^{CU}_{s_1 s_2}$ expands to g^{FT} and a small country prefers an FTA with l over a CU with the other small country when β falls below a threshold $\bar{\beta}^s(\alpha_l, \tau)$.

This dynamic trade-off faced by s matters because s and l may have different preferences over the type of PTA they should form. While the FTA flexibility benefit can motivate l's preference for an FTA, s cannot benefit from this flexibility (i.e. $\beta < \bar{\beta}^{FT-K}_l(\alpha_l, \tau)$) and hence prefers a CU with l. In this case, l's proposal depends on whether s can credibly threaten to reject an FTA offer. Proposition 2 characterizes the equilibrium.

Proposition 2 *Let $\tau > \bar{\tau}_2(\alpha_l)$. Additionally, let (i) $W_i\left(g^{CU}_{sl}\right) > W_i\left(g^{FT}\right)$ for $i = s, l$, (ii) $W_{s_2}\left(g^H_{s_1}\right) > W_{s_2}\left(g_{s_1 l}\right)$ and (iii) $\beta < \bar{\beta}^{FT-K}_l(\alpha_l, \tau)$. Then, the equilibrium path of networks is*

(i) $\varnothing \rightarrow g_{sl} \rightarrow g^H_l \rightarrow g^{FT}$ when (a) $\beta \in \left(\underline{\beta}^{Flex}_{In-In}(\alpha_l, \tau), \bar{\beta}^{Flex}_{In-In}(\alpha_l, \tau)\right)$ and $\tau < \bar{\tau}_3(\alpha_l)$ or (b) $\beta \in \left(\underline{\beta}^{Flex}_{In-In}(\alpha_l, \tau), \min\left\{\bar{\beta}^{Flex}_{In-In}(\alpha_l, \tau), \bar{\beta}^s(\alpha_l, \tau)\right\}\right)$ and $\tau > \bar{\tau}_3(\alpha_l)$

(ii) $\varnothing \rightarrow g^{CU}_{sl}$ otherwise.

Figure 4 depicts the equilibrium. First, suppose the FTA flexibility benefit outweighs the CU coordination benefit for l, i.e. $\beta \in \left(\underline{\beta}^{Flex}_{In-In}(\alpha_l, \tau), \bar{\beta}^{Flex}_{In-In}(\alpha_l, \tau)\right)$. Unlike l's FTA preference, s prefers a CU with l given it cannot exploit the FTA flexibility benefit and become the hub. Thus, ideally, s would threaten to form a CU with the other small country to induce l's participation in a CU. However, given the above discussion, s can credibly do so only when $\tau > \bar{\tau}_3(\alpha_l)$ and, in addition, $\beta > \bar{\beta}^s(\alpha_l, \tau)$. In this case, l offers s a CU and, given their CU exclusion incentive, this remains forever. Otherwise, s accepts an FTA offer from l which then expands to global free trade via the hub-spoke network g^H_l.

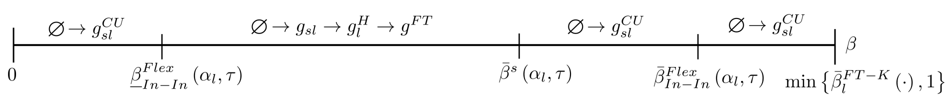

Figure 4: Equilibrium path of networks when $\tau > \bar{\tau}_2(\alpha_l)$

Second, suppose the CU coordination benefits outweigh the FTA flexibility benefit for l, i.e. $\beta \notin \left(\underline{\beta}^{Flex}(\alpha_l, \tau), \bar{\beta}^{Flex}(\alpha_l, \tau)\right)$. Unsurprisingly, a permanent CU emerges between s and l. For s, its ideal PTA is a CU with l. And, while l ideally wants to free ride on an FTA between the small countries, the prospect of being discriminated against as a CU outsider induces l's participation in a CU.

What are the essential implications of relaxing the three restrictions in Proposition 2? The primary role of imposing the CU exclusion incentives is the implication that even if $g^{CU}_{s_1 s_2}$

expands to g^{FT}, which requires $\tau > \bar{\tau}_3(\alpha_l)$, the small country still prefers a CU with l rather than the other small country. Absent the CU exclusion incentives, a sufficiently patient small country prefers a CU with the other small country that expands to global free trade so it can enjoy eventual tariff free access to all markets. The implication for Proposition 2 is that the equilibrium CU between s and l could be displaced by either the path of FTAs described therein or even a CU between the small countries that expands to global free trade.

The primary role of imposing that a small FTA outsider myopically benefits from an FTA with the small FTA insider is to ensure the small-large FTA expands to global free trade. Given the large country holds an FTA exclusion incentive (i.e. $\Delta_{excl}^{FTA} \equiv W_l(g_{sl}) - W_l\left(g^{FT}\right) > 0$), it wants to remain a permanent FTA insider rather than become the hub on the path to global free trade when β exceeds a threshold $\bar{\beta}^{NE}(\alpha_l, \tau)$.[20] In Proposition 2, this cannot happen because the small FTA outsider's willingness to form an FTA with the small FTA insider induces the large country to form an FTA with the FTA outsider merely to avoid becoming a spoke. But, relaxing the restriction $W_{s_2}\left(g_{s_1}^H\right) > W_{s_2}(g_{s_1 l})$ implies a small-large FTA would remain forever once $\beta > \bar{\beta}^{NE}(\alpha_l, \tau)$. The main implication for Proposition 2 is that the permanent small-large CU could be replaced by a permanent small-large FTA.

Finally, the restriction $\beta < \bar{\beta}_l^{FT-K}(\alpha_l, \tau)$ streamlines Proposition 2 by excluding one possible equilibrium outcome. When $\beta > \bar{\beta}_l^{FT-K}(\alpha_l, \tau)$, s becomes the hub after an FTA between s and l. In turn, as in Proposition 1, the equilibrium path of networks is $\varnothing \to g_{sl} \to g_s^H$ when $\beta \in \left(\bar{\beta}_l^{FT-K}(\alpha_l, \tau), \bar{\beta}_{K-Out}^{Flex}(\alpha_l, \tau)\right)$ but is $\varnothing \to g_{sl}^{CU}$ when $\beta > \bar{\beta}_{K-Out}^{Flex}(\alpha_l, \tau)$.

6 Extensions

While our baseline model has many features common to standard models used in the literature, we now explore various extensions to assess the robustness of our key findings. Appendix B contains all relevant proofs and expressions for welfare and optimal tariffs.

First, our modeling of size and geographic asymmetry implies these two forms of asymmetry interact in a very particular way. On one hand, our measure of geographic asymmetry, iceberg transport costs, varies the slope of export supply curves between the large far country and the small close countries. On the other hand, our measure of size asymmetry, the intercept on the demand curve for non-numeraire goods, is a parallel shifter of import demand and export supply curves. Moreover, this measure of size asymmetry does not capture that a large country may be large from both a demand and supply perspective. To address these particular features of the model, our first extension models geographic asymmetry via specific transport costs and size asymmetry via countries having different amounts of consumers

[20] $\bar{\beta}^{NE}(\alpha_l, \tau)$ plays a meaningful role in the equilibrium analysis of Section 6.1 (see (23)).

who are endowed with non-numeraire goods. The former implies geographic asymmetry is a parallel shifter of the export supply curves while the latter implies that size asymmetry affects the slope of the import demand and export supply curves. Moreover, the latter also implies a large country is large from both a demand and supply perspective.

Second, do our baseline results rely on the inter-industry competing exporter structure? In addition to being a particular model of trade, the inter-industry nature of the model, i.e. each country imports a distinct good, limits the impact of the CU common external tariff requirement. Thus, our second extension is an intra-industry oligopolistic model of trade.

Third, do our baseline results rely on the particular structure of geographic asymmetry? What if the large country is a close country and one of the small countries is the far country? What if trade between the small countries is costly? To address the former concern, our third extension models the large country as a close country and one of the small countries as the far country. To address the latter concern, our fourth extension models countries as located on a line with a small country located in the middle of the line and each of the other countries located at opposite ends of the line.

Finally, one may wonder if our results are robust to variations of the protocol used to govern FTA formation. Thus, we discuss the implications of alternative protocols.

6.1 Alternative measures of size and geographic asymmetry

For geographic asymmetry, shipping goods between the large far and the small close countries incurs a specific transport cost T (trade remains costless between the small close countries). Thus, transport costs are a parallel shifter of export supply curves. For size asymmetry, each consumer in country i (i) is endowed with 1 unit of the two non-numeraire goods $Z \neq I$ and (ii) has demand for non-numeraire goods given by $q\left(p_i^Z\right) = 1 - p_i^Z$. We assume a mass of $\alpha_l > 1$ consumers in country l and $\alpha_s = 1$ in country s. Thus, the aggregate demand curve for good Z in country i is $p\left(q_i^Z\right) = 1 - \frac{1}{\alpha_i} q_i^Z$. In turn, α_l now varies the slope of the large country's import demand and export supply curves. Moreover, country i's endowment of goods $Z \neq I$ is α_i. Thus, α_l now simultaneously alters demand and supply side asymmetry.

In Section 5, our main result revolved around the area of the parameter space where the large country preferred being a permanent CU insider over a permanent CU outsider. In the current model, this reduces to specific transport costs exceeding a threshold $\bar{T}_2\left(\alpha_l\right)$. Again, rising transport costs shrink trade flows between the large far and small close countries, reducing the attractiveness of having preferential access to a small close country via a CU and also reducing the cost of being discriminated against as a CU outsider.

To solve the equilibrium path of networks, we first show that the equilibrium transitions conditional on the formation of an initial PTA are nearly identical to those in our baseline model. The only difference relates to the transitions conditional on an FTA involving the large country and, to this end, we define $\tilde{T}_2(\alpha_l)$ such that $W_s(g_s^H) < W_s(g_{sl})$ if and only if $T > \tilde{T}_2(\alpha_l)$. Moreover, the threshold $\bar{\beta}^{NE}(\alpha_l, \tau)$ will be discussed further below.

Lemma 2 *When $T > \bar{T}_2(\alpha_l)$, no subsequent agreements form after an initial PTA unless the initial PTA is an FTA between s and l. Conditional on an FTA between s and l and $T > \underline{T}(\alpha_l) \equiv \max\left\{\tilde{T}_2(\alpha_l), \bar{T}_2(\alpha_l)\right\}$, the equilibrium transitions are (i) $g_{sl} \to g_l^H \to g^{FT}$ when $\beta < \bar{\beta}^{NE}(\alpha_l, \tau)$ but (ii) $g_{sl} \to g_{sl}$ when $\beta > \bar{\beta}^{NE}(\alpha_l, \tau)$.*

Except for an FTA between the large country and a small country, equilibrium transitions from an initial PTA are identical to our baseline model. The intuition is also identical: CU and FTA free riding incentives imply the large country refuses participation in PTA formation either as a CU or an FTA outsider and a CU exclusion incentive implies the large country blocks CU expansion as a CU insider.

However, the intuition behind the equilibrium transitions conditional on an FTA between the large and a small country differs from the baseline model. Unlike the baseline model, where the large country's export supply was decreasing in its size, the large country's export supply is now increasing in its size. This significantly alters the FTA formation incentives faced by a small country. When the large country reorients its exports to its FTA partner, say s_1, the composition of s_1's imports shifts substantially towards imports from the large country. Indeed, this happens to the extent that it can eliminate s_1's incentive to become the hub by forming a subsequent FTA with the small FTA outsider: $W_{s_1}(g_{s_1}^H) < W_{s_1}(g_{s_1 l})$ when $T > \tilde{T}_2(\alpha_l)$. However, when the large country becomes the hub and rebalances its exports across the two small countries, it restores the FTA formation incentive between the small countries: $W_{s_1}(g^{FT}) > W_{s_1}(g_l^H)$.

Ultimately, the incentives faced by the small countries creates a dynamic trade-off for the large country as an FTA insider. If it does not become the hub, the large country remains an FTA insider forever. But, becoming the hub is only temporary because global free trade will then follow after the small spokes form their own FTA. This is costly for the large country because it holds an FTA exclusion incentive: $\Delta_{excl}^{FTA} \equiv W_l(g_{sl}) - W_l(g^{FT}) > 0$. Thus, given the small FTA outsider wants to form an FTA with the large FTA insider, the large country becomes the hub if and only if

$$W_l(g_l^H) + \frac{\beta}{1-\beta} W_l(g^{FT}) > \frac{1}{1-\beta} W_l(g_{sl}) \Leftrightarrow \beta < \bar{\beta}^{NE}(\alpha_l, \tau) \equiv 1 - \frac{\Delta_{excl}^{FTA}}{\Delta_{flex}^{FTA}}. \quad (23)$$

That is, the large country exploits the myopic incentive to become the hub when the discount factor is sufficiently small but the FTA exclusion incentive implies $\bar{\beta}^{NE}(\alpha_l,\tau) < 1$ and, hence, the large country opts against becoming the hub when the discount factor is sufficiently high.

Given the equilibrium transitions in Lemma 2 are very similar to our baseline model, so too is the equilibrium path of networks described in Proposition 3. Most importantly, we again find CUs are only intra-regional yet FTAs are both intra and inter-regional.

Proposition 3 *For any α_l, there exists a threshold level of transport costs $\bar{T}_2(\alpha_l)$ such that any equilibrium CU is between the small close countries when $T > \bar{T}_2(\alpha_l)$. When $T > \underline{T}(\alpha_l) \equiv \max\left\{\tilde{T}_2(\alpha_l), \bar{T}_2(\alpha_l)\right\}$, the equilibrium path of networks is*

(i) $\varnothing \to g_{sl} \to g_l^H \to g^{FT}$ when $\beta \in \left(\underline{\beta}^{Flex}_{In-Out}(\alpha_l,\tau), \min\left\{\bar{\beta}^{NE}(\alpha_l,\tau), \bar{\beta}^{Flex}_{In-Out}(\alpha_l,\tau)\right\}\right)$

(ii) $\varnothing \to g_{sl}$ when $\beta > \bar{\beta}^{NE}(\alpha_l,\tau)$ and $W_l(g_{sl}) > W_l\left(g^{CU}_{s_1s_2}\right)$

(iii) $\varnothing \to g^{CU}_{s_1s_2}$ otherwise.

Figure 5 depicts Proposition 3 with $\bar{T}_1(\alpha_l)$ defined such that $W_l(g_{sl}) > W_l\left(g^{CU}_{s_1s_2}\right)$ when $T < \bar{T}_1(\alpha_l)$.[21] When $T \in \left(\underline{T}(\alpha_l), \bar{T}_1(\alpha_l)\right)$, FTA formation arises for any β. Here, as discussed in Section 4, $\underline{\beta}^{Flex}_{In-Out}(\alpha_l,\tau) < 0$ because $W_l(g_{sl}) > W_l\left(g^{CU}_{s_1s_2}\right)$. Thus, the equilibrium path of networks is $\varnothing \to g_{sl} \to g_l^H \to g^{FT}$ for $\beta < \bar{\beta}^{NE}(\alpha_l,\tau)$ but $\varnothing \to g_{sl}$ for $\beta > \bar{\beta}^{NE}(\alpha_l,\tau)$. As transport costs rise past $\bar{T}_1(\alpha_l)$, the large country's incentive to participate in agreements shrinks and so does the range of the discount factor that induces the large country's participation in PTAs. In turn, $\varnothing \to g^{CU}_{s_1s_2}$ is the equilibrium path of networks when the large country refuses participation (i.e. $\beta \notin \left(\bar{\beta}^{Flex}_{In-Out}(\alpha_l,\tau), \bar{\beta}^{Flex}_{In-Out}(\alpha_l,\tau)\right)$). Eventually, transport costs are sufficiently high that the large country refuses participation regardless of β, and $\varnothing \to g^{CU}_{s_1s_2}$ is the equilibrium path of networks regardless of β. Finally, as size asymmetry rises via a rising α_l, the large country's incentive to participate in PTAs shrinks with the "bullet" shifting left and the intra-regional CU becoming more prevalent in equilibrium.

6.2 Alternative model of trade

We now examine whether our main baseline results extend from an inter-industry trade structure where countries import distinct goods to an intra-industry oligopolistic trade structure where countries import a common good. To this end, we model market size and geographic asymmetry as in the baseline model. Given a symmetric and constant marginal cost c, trade barriers via tariffs or transport costs provide a cost advantage to the single domestic firm in

[21] In Figure 5, $T < \bar{T}(\alpha_l)$ ensures non-negative exports (see Appendix B.1).

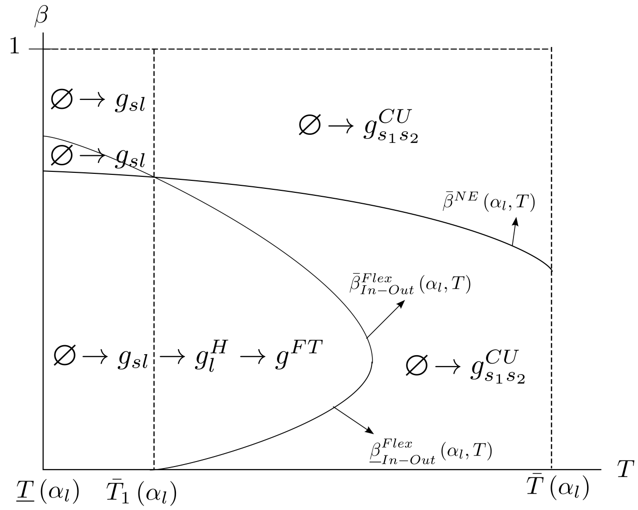

Figure 5: Alternative measures of size and geographic asymmetry: equilibrium path of networks and geographic asymmetry

the local market of country i by increasing the effective unit cost c_{ji} of the foreign firm from country j when serving the local market: $c_{ji} = \frac{c}{\tau_{ji}} + t_{ij}$.[22]

Like in our baseline model, the large far country prefers remaining a permanent CU outsider over becoming a permanent CU insider when transport costs exceed the threshold $\bar{\tau}_2(\alpha_l, c)$. Again, rising transport costs shrink trade flows with the small countries which not only reduces the attractiveness of having preferential access to a small close country via a CU but also reduces the cost of being discriminated against as a CU outsider.

As in Lemma 1, $\tau < \bar{\tau}_2(\alpha_l, c)$ implies the large country holds CU and FTA free riding incentives and a CU exclusion incentive. Thus, no subsequent agreements form after an initial PTA unless this PTA is an FTA between s and l. Moreover, the equilibrium transitions conditional on an initial FTA between s_1 and l essentially mirror Lemma 1: (i) $g_{s_1 l} \to g^H_l \to g^{FT}$ if $\beta \in \left(\bar{\beta}^{FT-K}_{s_2}(\alpha_l, \tau, c), \bar{\beta}^{FT-K}_{l}(\alpha_l, \tau, c)\right)$ but (ii) $g_{s_1 l} \to g^H_{s_1}$ otherwise.[23]

However, the equilibrium characterization differs in two ways from the baseline model. First, $\bar{\beta}^{FT-K}_{l}(\cdot)$ no longer affects the equilibrium characterization. In terms of Figure 3, the $\bar{\beta}^{FT-K}_{l}(\cdot)$, $\bar{\beta}^{Flex}_{In-Out}(\cdot)$ and $\bar{\beta}^{Flex}_{K-Out}(\cdot)$ curves now intersect when $\tau > \bar{\tau}_2(\alpha_l, c)$. Second, unlike the baseline model, $\bar{\beta}^{FT-K}_{s_2}(\cdot)$ affects the equilibrium characterization. The dynamic trade-off underlying $\bar{\beta}^{FT-K}_{s_2}(\cdot)$ weighed the myopic preference of the FTA outsider s_2 for an FTA with the small FTA insider against the cost of permanent discrimination as a spoke. Like

[22]Naturally, as in our baseline model, we continue to make the standard assumptions regarding the existence of a numeraire good and preferences that imply (i) the market for the numeraire good absorbs all general equilibrium effects and (ii) a linear inverse demand curve.

[23]Note, we say "essentially" because there is a range of the parameter space where Lemma 1 does not apply. But this does not affect the interpretation of Proposition 4, which still applies in this particular range, and so we omit such discussion from the main text.

the baseline model, this myopic preference only holds when transport costs are sufficiently high and market size is sufficiently low since both of these factors reduce the appeal of an FTA with the large far country.[24] But, this myopic preference strengthens in the presence of imperfect competition, allowing $\bar{\beta}_{s_2}^{FT-K}(\cdot)$ to play a role, because the stronger trade flows underlying an FTA between the small countries increases the welfare gains from an FTA moderating firm-level market power. Proposition 4 now characterizes the equilibrium.

Proposition 4 *Let $\tau < \bar{\tau}_2(\alpha_l, c)$. Then, any equilibrium CU is intra-regional and the equilibrium path of networks is*

(i) $\varnothing \to g_{s_1 l} \to g_l^H \to g^{FT}$ when $\beta \in \left(\max\left\{\bar{\beta}_{s_2}^{FT-K}(\alpha_l, c, \tau), \underline{\beta}_{In-Out}^{Flex}(\alpha_l, c, \tau)\right\}, \bar{\beta}_{In-Out}^{Flex}(\alpha_l, c, \tau)\right)$

(ii) $\varnothing \to g_{s_1 s_2}^{CU}$ otherwise.

Importantly, while our main findings initially arose in a perfectly competitive inter-industry trade model where countries import distinct goods, Proposition 4 shows they extend to an oligopolistic intra-industry trade model where countries import a common good. That is, CUs are only intra-regional yet FTAs are inter and intra-regional.

Figure 6 depicts Proposition 4 and illustrates the two differences, discussed above, relative to Proposition 1 and Figure 3.[25] First, $\bar{\beta}_l^{FT-K}(\cdot)$ no longer plays a role with $\varnothing \to g_{s_1 s_2}^{CU}$ now emerging when $\beta > \bar{\beta}_{In-Out}^{Flex}(\cdot)$. Second, the small FTA outsider prefers FTA formation with the small FTA insider when $\beta < \bar{\beta}_{s_2}^{FT-K}(\cdot)$ (noting that $\bar{\beta}_{s_2}^{FT-K}(\cdot) > 0$ only holds for low values of both τ and α_l). In this case, given its inability to become the hub, the large country refuses participation in PTA formation and $\varnothing \to g_{s_1 s_2}^{CU}$ emerges.

The broad intuition underlying Proposition 4 mirrors that of Proposition 1. Faced with the threat of being discriminated against as a CU outsider, the *only* type of PTA attractive enough to induce the large country's participation in liberalization is an FTA. While the coordination benefits of a CU cannot induce the large country's participation, the flexibility benefit of an FTA can induce participation. When $\beta \in \left(\max\left\{\bar{\beta}_{s_2}^{FT-K}(\cdot), \underline{\beta}_{In-Out}^{Flex}(\cdot)\right\}, \bar{\beta}_{In-Out}^{Flex}(\cdot)\right)$, this FTA flexibility benefit is sufficiently strong that the large country prefers FTA formation over the discrimination faced as a CU outsider.

6.3 Alternative structures of geographic asymmetry

6.3.1 The large country is a close country

Thus far, the large country was the far country. But, we now assume that a small country s_1 is the far country while the large country l and the small country s_2 are the close countries.

[24] That is, $W_{s_2}(g_l^H) > W_{s_2}(g_{s_1}^H)$ and hence $\bar{\beta}_{s_2}^{FT-K}(\cdot) < 0$ unless both τ and α_l are sufficiently small.

[25] In Figure 6, $\tau > \underline{\tau}(\alpha_l, c)$ ensures non-negative exports (see Appendix B.2).

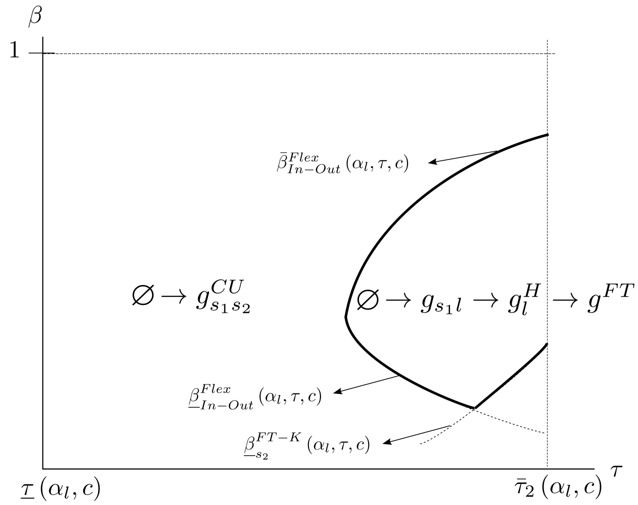

Figure 6: Oligopoly model: equilibrium path of networks and geographic asymmetry

That is, $\tau_{s_2 l} = \tau_{l s_2} = 0$ but $\tau_{s_1 i} = \tau_{i s_1} = \tau$ for $i = s_2, l$.

Our main result that CUs are intra-regional remains under this alternative pattern of geographic asymmetry.

Proposition 5 *Suppose the large country is a close country and the small country s_1 is the far country, i.e. $\tau_{s_2 l} = \tau_{l s_2} = 0$ but $\tau_{s_1 i} = \tau_{i s_1} = \tau$ for $i = s_2, l$. Then, for any α_l, there exists a threshold level of geographic asymmetry $\bar{\tau}(\alpha_l)$ such that any equilibrium CU is between countries l and s_2 when $\tau < \bar{\tau}(\alpha_l)$: any equilibrium CU is intra-regional.*

To see that any equilibrium CU must be intra-regional, first consider the small-small CU. Here, transport costs exceeding that implied by $\bar{\tau}(\alpha_l)$ depress trade flows between the small countries to the extent that, if the opportunity arises, the small far country s_1 refuses participation in a CU with the other small country s_2.

Conversely, the large close country's preferences drive failure of an equilibrium CU between itself and the small far country. While high values of α_l can make country l an attractive CU partner for the small far country, l's size makes it an unwilling participant. For low values of α_l, sufficiently high transport costs depress trade flows between the close countries and the small far country to the extent that the close countries prefer to form an intra-regional PTA rather than an inter-regional CU. Hence, when $\tau < \bar{\tau}(\alpha_l)$, an inter-regional CU does not emerge in equilibrium.

6.3.2 Countries are located on a line

Thus far, we assumed costless trade between the small countries. Relaxing this assumption, the small country s_2 is now located in the middle of a line with the large country and the other small country s_1 located at opposite ends of the line: $\tau_{s_1 l} = \tau_{l s_1} = \tau^2 \leq \tau_{s_2 s_1} = \tau_{s_1 s_2} = \tau_{s_2 l} = \tau_{l s_2} = \tau \leq 1$. We interpret the bilateral PTAs between s_1 and s_2 and between s_2 and l as intra–regional but the bilateral PTA between s_1 and l as potentially inter–regional.

Despite the introduction of costly trade between the small countries and the asymmetric distances between the large country and each of the small countries, rising transport costs crucially impact the large country's incentive to participate in PTA formation. By shrinking trade flows, rising transport costs not only reduce the attractiveness of preferential access to its CU partner market but also reduce the cost of discrimination as a CU outsider. Specifically, once τ falls below a threshold $\bar{\tau}_2(\alpha_l)$, transport costs are sufficiently high that the large country prefers becoming a permanent CU outsider rather than a permanent CU insider with either of the small countries.

Indeed, the equilibrium transitions from an initial PTA qualitatively mirror our baseline model. Except for the initial FTA between the large and a small country, the intuition is also identical: CU and FTA free riding incentives imply the large country refuses participation in PTA formation either as a CU or an FTA outsider and a CU exclusion incentive implies the large country blocks CU expansion as a CU insider with either small country.

However, two slight differences emerge conditional on an FTA between the large and a small country. First, as an FTA outsider, a small country s never has a myopic preference for an FTA with the other small country: $\bar{\beta}_s^{FT-K}(\alpha_l, \tau) < 0$ and, hence, plays no role. Second, given the small countries are now asymmetric, distinct thresholds $\bar{\beta}_{l,s_1}^{FT-K}(\alpha_l, \tau)$ and $\bar{\beta}_{l,s_2}^{FT-K}(\alpha_l, \tau)$ govern expansion of the FTAs between (i) l and s_1 and (ii) l and s_2. As earlier, the large country becomes the hub on the path to global free trade when β falls below the relevant threshold. Otherwise, the small FTA insider becomes the permanent hub.

We now roll back to the empty network to solve the equilibrium path of networks. Like in the baseline model, each small country prefers FTA formation with the large country over forming a small-small CU. Thus, given the only type of PTA that can induce the large country's participation in liberalization is an FTA, the thresholds $\underline{\beta}_{In-Out}^{Flex}(\alpha_l, \tau)$, $\bar{\beta}_{In-Out}^{Flex}(\alpha_l, \tau)$ and $\bar{\beta}_{K-Out}^{Flex}(\alpha_l, \tau)$ again drive the equilibrium. However, the path of FTAs underlying these thresholds depends on whether the large country prefers FTA formation with the small close country s_2 or the small far country s_1.

The logic driving this preference is twofold, revolving around the MFN constraint of non-discrimination. First, if the large country l could set optimal *discriminatory* tariffs then it would set a lower tariff on the small far country s_1 due to the lower import volume. But, the MFN principle constrains l to set a non-discriminatory tariff, which will lie between the optimal discriminatory tariffs. Thus, the loss of domestic surplus associated with granting a zero tariff is smaller when l forms an FTA with the small far country s_1. Second, by similar logic, the asymmetric distance of the small far country's trade partners implies it practices less tariff complementarity than the small close country s_2 when forming an FTA with l. Thus, to mitigate the negative effects of tariff complementarity on export market access, l again has a stronger incentive to form an FTA with the small far country s_1.

Proposition 6 now characterizes the equilibrium and is illustrated in Figure 7.[26]

Proposition 6 *For any α_l, there exists a threshold level of geographic asymmetry $\bar{\tau}_2(\alpha_l)$ such that any equilibrium CU is between the small countries when $\tau < \bar{\tau}_2(\alpha_l)$. When $\tau < \bar{\tau}_2(\alpha_l)$, the equilibrium path of networks is*

(i) $\varnothing \to g_{s_1 l} \to g_l^H \to g^{FT}$ when $\beta \in \left(\underline{\beta}^{Flex}_{In-Out}(\alpha_l, \tau), \min\left\{\bar{\beta}^{FT-K}_{l,s_1}(\alpha_l, \tau), \bar{\beta}^{Flex}_{In-Out}(\alpha_l, \tau)\right\}\right)$

(ii) $\varnothing \to g_{s_1 l} \to g_{s_1}^H$ when $\beta \in \left(\bar{\beta}^{FT-K}_{l,s_1}(\alpha_l, \tau)(\alpha_l, \tau), \bar{\beta}^{Flex}_{K-Out}(\alpha_l, \tau)\right)$

(iii) $\varnothing \to g^{CU}_{s_1 s_2}$ when the conditions in (i) and (ii) fail and $\tau > \bar{\tau}_0(\alpha_l)$

(iv) $\varnothing \to g^{CU}_{s_1 s_2}$ ($\varnothing \to g_{s_1 s_2}$) when $\tau < \bar{\tau}_0(\alpha_l)$ and s_1 (s_2) proposes in stage 1(c).

Proposition 6 says our main result holds in an alternative geographic structure where trade is costly between all country pairs: any equilibrium CU is intra-regional, yet FTAs are both intra and inter-regional. Moreover, the key intuition mirrors the baseline model. The only subtle difference with Proposition 1 from the baseline model is that the asymmetry between the small countries can generate disagreement over the type of PTA they should form between themselves. In this case, the small proposer country in stage 1(c) dictates the type of PTA when the large country refuses to participate in liberalization.

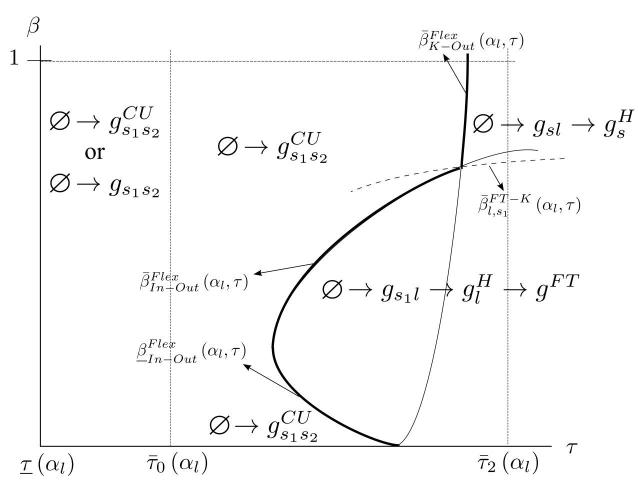

Figure 7: Line transportation costs: equilibrium path of networks and geographic asymmetry

Why does sufficiently high transport costs lead the small close country s_2 to reverse its preferences over the type of PTA to form with the other small country? When $\tau > \bar{\tau}_0(\alpha_l)$,

[26] In Figure 7, $\tau > \underline{\tau}(\alpha_l)$ ensures non-negative exports (see Appendix B.4).

transport costs are low enough that the myopic CU coordination benefit drives the small countries to prefer CU rather than FTA formation. However, rising transport costs alters the distribution of export market access gains under a small-small CU. The symmetric distance of s_2's trade partners maintains the value for s_1 of preferential access to s_2's market under a CU. However, the asymmetric distance of s_1's trade partners implies rising transport costs act as an effective form of preferential access for s_2 to s_1's market which reduces the value of additional preferential access under a CU. This asymmetry weakens s_2's desire for a CU as transport costs rise. Indeed, s_2 prefers an FTA once $\tau < \bar{\tau}_0(\alpha_l)$.

6.4 Alternative protocols

Before discussing alternative protocols, we begin by discussing the reasons motivating our baseline protocol. First, the protocol is very similar in spirit to that used by Aghion et al. (2007) in their extensive form game. However, unlike Aghion et al. (2007), we allow (i) the possibility of small countries being the proposer and hence forming their own PTA, and (ii) the possibility of PTA formation after a small country rejects the large country's proposal.

Second, Baier et al. (2014) find that, empirically, the order in which pairs of countries form agreements over time tends to be determined by the magnitude of gains associated with the agreement. Put simply, countries with larger joint gains form an agreement form agreements before countries with lower joint gains from an agreement. Whenever multiple agreements form in the equilibrium of our baseline model, agreements involving the large far country yield higher joint member gains than agreements involving both small close countries. This suggests modeling the large country as the leader country.

Third, equilibria can be quite sensitive to exogenous protocols (whether deterministic or stochastic; e.g. Ludema (1991), Ray and Vohra (1997) and Jackson (2008)). Indeed, previous versions of this paper endogenized what agreement emerges in a given period by allowing each country to freely announce the agreement it wants to form in each period. Having defined a simultaneous move equilibrium concept to solve this "announcement" game in each period, we used backward induction to determine the "subgame perfect" path of agreements. However, to avoid existence issues, we needed rather complex equilibrium concepts to solve the simultaneous move game within a period. This complexity magnified when embedding the simultaneous move game in a dynamic game. But, the equilibrium outcomes we obtain under our exogenous protocol are nearly identical to our earlier results where who formed what agreement in a given period was completely endogenous.

Our final reason relates to issues regarding a natural alternative protocol where a *single* proposer country is randomly chosen each period (Seidmann (2009) uses a protocol very similar to this). Stochastic protocols like this can introduce complications due to the "possibility of waiting". To illustrate, suppose s_1 is the chosen proposer and its ideal outcome is a CU with l but l's ideal outcome is an FTA with s_1. Then l faces a dynamic trade-off when s_1 proposes a CU: CU formation could be better than the status quo, but waiting allows the possibility of being the proposer next period and forming an FTA. Of course, this dynamic trade-off is irrelevant when focusing on either $\beta \approx 0$ (only myopic considerations matter) or $\beta \approx 1$ (only the final outcome matters) like Seidmann (2009). But, our central results emerge for intermediate values of β and so we want to avoid the issue of waiting driving or complicating the interpretation of our results.

Despite these reasons, we now explore alternative protocols. Our main result is that CUs are intra-regional yet FTAs are inter and intra-regional. This result arises because (i) the small countries can form a CU, (ii) an FTA is the only type of PTA attractive enough to induce the large country's participation in liberalization when faced with the threat of being a CU outsider, and (iii) s prefers FTA formation with l over a permanent CU with the other small country. Thus, the features of the protocol facilitating our result are (i) the small countries have an opportunity to form a CU and (ii) s and l have an opportunity to form an FTA. Therefore, our main result is robust to various protocols incorporating these features.

It is trivial to verify each of the following alternative protocols can only, potentially, affect the subgame at the empty network and so we focus our discussion of alternative protocols on this subgame. First, suppose s_1 is the proposer in stage 1(c) and can propose agreements involving l. This alternative protocol addresses concerns that l may have a "last mover advantage" or "ultimatum power" in that s_1 is unable to propose agreements involving l in stage 1(c). But, being discriminated against as a CU outsider is costly for l (relative to the status quo of no agreements) and only FTA formation can induce its participation in liberalization when faced with the prospect of this discrimination. Thus, the outcome in stage 1(c) is simple: if l prefers FTA formation over the status quo of no agreements then s_1 will propose an FTA with l, and otherwise it will propose the intra-regional CU. In turn, the large country's preferences still drive the equilibrium outcome which is either an intra-regional CU or a path of intra and inter-regional FTAs.

Second, suppose s_1 is the leader in stage 1(a) and l is the proposer in stage 1(c). This alternative protocol addresses concerns that l may have a "first mover advantage". In stage 1(c), l will either propose its preferred PTA with s_2, which is an FTA, or no agreement. Moreover, l's preferences again drive the equilibrium outcome given that each small country prefers FTA formation with l over an intra-regional CU: (i) s_1 proposes an FTA with l in stage 1(a) when l is willing to participate in FTA formation in stage 1(c), but (ii) otherwise, s_1 proposes a CU with s_2. Thus, the equilibrium outcome is either an intra-regional CU or a path of intra and inter-regional FTAs.

Third, suppose s_1 is the leader in stage 1(a) and l is the proposer in stage 1(c) and l can propose agreements including either, or both, of the small countries. Given the symmetry between s_1 and s_2, the logic from the second alternative protocol applies again: the equilibrium outcome is either an intra-regional CU or a path of intra and inter-regional FTAs.

7 Conclusion

We began by describing the striking, but often overlooked, geographic characteristics of PTAs: unlike FTAs which are both inter and intra–regional, CUs are only intra–regional. Indeed, this observation is more than casual empiricism. Motivated by our model, Facchini et al. (2015, p.30) find distance is systematically related to the type of PTA countries form.

Our model provides mechanisms that help explain the empirically observed geographic characteristics of PTAs and these mechanisms fundamentally rely on the model's dynamic nature. Transport costs crucially impact the large far country's incentive to participate in PTA formation. By reducing trade flows between the large far country and the small close countries, rising transport costs not only reduce the attractiveness to the large far country of having preferential access to a small country but also reduce the cost of being discriminated against as a CU outsider. Thus, sufficiently high transport costs imply the only type of PTA that can induce the large country's participation is an FTA. Even though the benefits of trade policy coordination under a CU are too weak to induce the large country's participation, FTA formation affords a flexibility benefit: unlike a CU, an FTA allows the large country to form overlapping FTAs and have sole preferential access to both small countries on the path to global free trade. When the discount factor lies in an intermediate range, this FTA flexibility benefit is strong enough to induce the large country's participation in PTA formation. Thus, the equilibrium outcome is either an intra-regional CU between the small close countries or a path of intra and inter-regional FTAs.

Importantly, this result and its intuition is quite robust. Our extensions demonstrate that this result is not crucially dependent on our particular modeling choices in the baseline model. Specifically, our main result holds under (i) alternative measures of transport costs and market size asymmetry, (ii) alternative trade structures that depart from perfect competition and inter-industry trade, (iii) alternative patterns of geography including the large country being a close country or trade being costly between all country pairs, and (iv) alternative protocols governing the order that countries can propose agreements.

Appendix

A Baseline Model

We report welfare levels for country i under a network g as a function of an arbitrary tariff vector $\mathbf{t}^g$ where $\mathbf{t}^g = (t^g_{ij}, t^g_{ik})$ and, slightly abusing notation, $t^g_{ij} \equiv t_{ij}(g)$:

$$W_i(g) = \sum_Z CS^Z_i(g) + \sum_Z PS^Z_i(g) + TR_i(g)$$

where

$$\begin{aligned}
\sum_Z CS^Z_{s_1}(g) &= \frac{1}{2}[1-\tau(\frac{\tau^2(t^g_{ls_1}+t^g_{ls_2})+\alpha_l}{(1+2\tau^2)} - t^g_{ls_1})]^2 \\
&+\frac{1}{2}[1-\frac{\tau^2 t^g_{s_1 l}+1+t^g_{s_1 s_2}+\tau(\alpha_l-1)}{(2+\tau^2)}]^2 \\
&+\frac{1}{2}[1-\frac{\tau^2 t^g_{s_2 l}+1+t^g_{s_1 s_2}+\tau(\alpha_l-1)}{(2+\tau^2)}+t^g_{s_2 s_1}]^2
\end{aligned}$$

$$\begin{aligned}
\sum_Z CS^Z_{l}(g) &= \frac{1}{2}[\alpha_l-\frac{\tau^2(t^g_{ls_1}+t^g_{ls_2})+\alpha_l}{(1+2\tau^2)}]^2 \\
&+\frac{1}{2}[\alpha_l-\tau(\frac{\tau^2 t^g_{s_1 l}+\tau(\alpha_l-1)+1+t^g_{s_1 s_2}}{(2+\tau^2)} - t^g_{s_1 l})]^2 \\
&+\frac{1}{2}[\alpha_l-\tau(\frac{\tau^2 t^g_{s_2 l}+\tau(\alpha_l-1)+1+t^g_{s_2 s_1}}{(2+\tau^2)} - t^g_{s_2 l})]^2
\end{aligned}$$

$$\sum_Z PS^Z_{s_1}(g) = \frac{1+\tau(\alpha_l-1)-t^g_{s_2 s_1}+\tau^2(t^g_{s_2 l}-t^g_{s_2 s_1})}{(2+\tau^2)} + \tau\frac{\alpha_l - t^g_{ls_1}+\tau^2(t^g_{ls_2}-t^g_{ls_1})}{(1+2\tau^2)}$$

$$\sum_Z PS^Z_{l}(g) = \tau[\frac{1+\tau(\alpha_l-1)+t^g_{s_1 s_2}-2t^g_{s_1 l}}{(2+\tau^2)} + \frac{1+\tau(\alpha_l-1)+t^g_{s_2 s_1}-2t^g_{s_2 l}}{(2+\tau^2)}]$$

$$\begin{aligned}
TR_{s_1}(g) &= t^g_{s_1 s_2}(\frac{\tau^2 t^g_{s_1 l}+\tau(\alpha_l-1)+1+t^g_{s_1 s_2}}{(2+\tau^2)} - t^g_{s_1 s_2}) \\
&+\tau t^g_{s_1 l}[1-\alpha_l+\tau(\frac{\tau^2 t^g_{s_1 l}+\tau(\alpha_l-1)+1+t^g_{s_1 s_2}}{(2+\tau^2)} - t^g_{s_1 l})]
\end{aligned}$$

$$TR_l(g) = \tau^2 t^g_{ls_1}(\frac{\tau^2(t^g_{ls_1} + t^g_{ls_2}) + \alpha_l}{(1+2\tau^2)} - t^g_{ls_1}) + \tau^2 t^g_{ls_2}(\frac{\tau^2(t^g_{ls_1} + t^g_{ls_2}) + \alpha_l}{(1+2\tau^2)} - t^g_{ls_2}).$$

Proof of Lemma 1

Let $\tau < \bar{\tau}_2(\alpha_l)$. One can easily verify (i) $W_l(g_{s_1s_2}) > \max\{W_l(g^{FT}), W_l(g^H_s)\}$, (ii) $W_l(g^{CU}_{s_1s_2}) > W_l(g^{FT})$, and and (iii) $W_l(g^{CU}_{sl}) > W_l(g^{FT})$. Thus, for any subgame at $g = g_{s_1s_2}, g^{CU}_{s_1s_2}, g^{CU}_{sl}$ it is optimal for l to make no proposal in stages 1(a)-(b). In turn, since any subsequent PTA in these subgames requires l's acceptance, the respective equilibrium transitions are $g_{s_1s_2} \to g_{s_1s_2}$, $g^{CU}_{s_1s_2} \to g^{CU}_{s_1s_2}$ and $g^{CU}_{sl} \to g^{CU}_{sl}$.

Now consider the subgame at g_{s_1l}. One can easily verify (i) $W_s(g^{FT}) > W_s(g^H_l)$, (ii) $W_l(g^H_s) > W_l(g^{FT})$, (iii) $W_i(g^H_{s_1}) > W_i(g_{s_1l})$ for $i = s_1, s_2$, (iv) $W_{s_2}(g^H_l) > W_{s_2}(g_{s_1l})$ and (v) $W_{s_2}(g^H_l) > W_{s_2}(g^H_{s_1})$ if and only if $\tau > \bar{\tau}_0(\alpha_l)$. (i) and (ii) imply $g^H_l \to g^{FT}$ but $g^H_s \to g^H_s$ in subgames at g^H_l and g^H_s. Given (iii), $g_{s_1l} \to g^H_{s_1}$ obtains if stage 1(c) is reached. Thus, l benefits from forming an FTA in stages 1(a)-(b) if $W_l(g^H_l) + \frac{\beta}{1-\beta}W_l(g^{FT}) > \frac{1}{1-\beta}W_l(g^H_s)$ which reduces to $\beta < \bar{\beta}^{FT-K}_l(\cdot)$. It is optimal for s_2 to accept an FTA proposal from l in stages 1(a)-(b) if $W_{s_2}(g^H_l) + \frac{\beta}{1-\beta}W_{s_2}(g^{FT}) > \frac{1}{1-\beta}W_{s_2}(g^H_{s_1})$ which reduces to $\beta > \bar{\beta}^{FT-K}_{s_2}(\cdot)$ noting that $\bar{\beta}^{FT-K}_{s_2}(\cdot) > 0$ if and only if $\tau < \bar{\tau}_0(\alpha_l)$. Thus, $g_{s_1l} \to g^H_l$ obtains in stages 1(a)-(b) when $\beta \in \left(\bar{\beta}^{FT-K}_{s_2}(\cdot), \bar{\beta}^{FT-K}_l(\cdot)\right)$ but $g_{s_1l} \to g^H_s$ obtains in stage 1(c) otherwise. □

Proof of Proposition 1

Lemma 1 establishes the equilibrium transitions conditional on formation of any initial PTA. Thus, consider the subgame at $\varnothing$. One can easily verify $W_{s_1}(g^{CU}_{s_1s_2}) > \max\{W_{s_1}(g_{s_1s_2}), W_{s_1}(\varnothing)\}$, implying $\varnothing \to g^{CU}_{s_1s_2}$ if stage 1(c) is reached. For now, let $\bar{\beta}^{FT-K}_{s_2}(\cdot) < 0$ and define $\bar{\tau}_1(\alpha_l)$ such that $V_l(g_{s_1l}) = W_l(g_{sl}) + \beta W_l(g^H_l) + \frac{\beta^2}{1-\beta}W_l(g^{FT}) > V_l(g^{CU}_{s_1s_2}) = \frac{1}{1-\beta}W_l(g^{CU}_{s_1s_2})$ if and only if $\tau > \bar{\tau}_1(\alpha_l)$. Then, given $\tau < \bar{\tau}_2(\alpha_l)$, it is optimal for l to either propose an FTA with s or make no proposal and it is optimal to make no proposal when $\tau < \bar{\tau}_1(\alpha_l)$. Given one can verify $V_{s_1}(g_{s_1l}) = W_{s_1}(g_{s_1l}) + \frac{\beta}{1-\beta}W_{s_1}(g^H_{s_1}) > V_{s_1}(g_{s_1l}) = W_{s_1}(g_{s_1l}) + \beta W_{s_1}(g^H_l) + \frac{\beta^2}{1-\beta}W_{s_1}(g^{FT}) > V_{s_1}(g^{CU}_{s_1s_2}) = \frac{1}{1-\beta}W_{s_1}(g^{CU}_{s_1s_2})$, s_1 accepts an FTA proposal from l in stages 1(a)-(b) whenever l benefits from this proposal. l benefits from this proposal if and only if $V_l(g_{s_1l}) > V_{s_1}(g^{CU}_{s_1s_2}) = \frac{1}{1-\beta}W_{s_1}(g^{CU}_{s_1s_2})$, otherwise l makes no proposal in stages 1(a)-(b) and stage 1(c) is reached.

$V_l(g_{s_1l})$ can take two values. $\beta < \bar{\beta}^{FT-K}_l(\cdot)$ implies $V_l(g_{s_1l}) = W_l(g_{sl}) + \beta W_l(g^H_l) + \frac{\beta^2}{1-\beta}W_l(g^{FT})$ and, in turn, $V_l(g_{s_1l}) > V_l(g^{CU}_{s_1s_2})$ reduces to $\beta \in \left(\underline{\beta}^{Flex}_{In-Out}(\cdot), \bar{\beta}^{Flex}_{In-Out}(\cdot)\right)$. Thus, the equilibrium path of networks is $\varnothing \to g_{sl} \to g^H_l \to g^{FT}$ if $\beta \in \left(\underline{\beta}^{Flex}_{In-Out}(\cdot), \bar{\beta}^{Flex}_{In-Out}(\cdot)\right)$ but $\varnothing \to g^{CU}_{s_1s_2}$ otherwise. Conversely, $\beta > \bar{\beta}^{FT-K}_l(\cdot)$ implies $V_l(g_{s_1l}) = W_l(g_{sl}) + \frac{\beta}{1-\beta}W_l(g^H_s)$ and, in turn, $V_l(g_{s_1l}) > V_l(g^{CU}_{s_1s_2})$ reduces to $\beta < \bar{\beta}^{Flex}_{K-Out}(\cdot)$. Thus, the equilibrium path of networks is $\varnothing \to g_{sl} \to g_s^H$ if $\beta < \bar{\beta}^{Flex}_{K-Out}(\cdot)$ but $\varnothing \to g^{CU}_{s_1 s_2}$ otherwise. Combining the cases $\beta \gtrless \bar{\beta}^{FT-K}_{l}(\cdot)$ yields parts (i)-(iii) of Proposition 1.

Finally, let $\bar{\beta}^{FT-K}_{s_2}(\cdot) > 0$. Then, per the proof of Lemma 1, $\tau < \bar{\tau}_0(\alpha_l)$ and one can easily verify $V_l\left(g^{CU}_{s_1 s_2}\right) > V_l(g_{s_1 l}) = W_l(g_{sl}) + \frac{\beta}{1-\beta} W_l\left(g_s^H\right)$. Thus, it is optimal for l to make no proposal in stages 1(a)-(b). One can verify $\bar{\tau}_0(\alpha_l) < \bar{\tau}_1(\alpha_l)$, completing the proof. $\square$

Proof of Proposition 2

When $\tau < \bar{\tau}_3(\alpha_l)$, one can easily verify Lemma 1 applies directly. When $\tau > \bar{\tau}_3(\alpha_l)$, two modifications arise. First, by definition, $W_l\left(g^{FT}\right) > W_l\left(g^{CU}_{s_1 s_2}\right)$ and hence, given $W_s\left(g^{FT}\right) > W_s\left(g^{CU}_{s_1 s_2}\right)$, it is optimal for l to make and s to accept a CU proposal in the subgame at $g^{CU}_{s_1 s_2}$. Thus, $g^{CU}_{s_1 s_2} \to g^{FT}$. Second, $W_l\left(g^{FT}\right) > W_l\left(g_s^H\right)$ is now possible and, in this case, $g_s^H \to g^{FT}$ in the subgame at g_s^H. Given one can verify $W_{s_1}\left(g^H_{s_1}\right) > W_{s_1}\left(g^{FT}\right) > W_{s_1}(g_{s_1 l})$, it is optimal for, say, s_1 to make and for s_2 to accept an FTA proposal in stage 1(c) of the subgame at $g_{s_1 l}$. In turn, given $W_l\left(g_l^H\right) > W_l\left(g^{FT}\right) > W_l\left(g_s^H\right)$ and $W_{s_2}\left(g_l^H\right) > W_{s_2}\left(g^H_{s_1}\right)$, it is optimal for l to make and s_2 to accept an FTA proposal in stage 1(a) or 1(b). Thus, given $\bar{\beta}^{FT-K}_{l}(\cdot) > 1$ by construction when $W_l\left(g^{FT}\right) > W_l\left(g_s^H\right)$, the equilibrium transitions from g_{sl} ultimately remain as specified in Lemma 1.

Now consider the subgame at $\varnothing$. First, let $\beta \in \left(\underline{\beta}^{Flex}_{In-In}(\cdot), \bar{\beta}^{Flex}_{In-In}(\cdot)\right)$. Like the proof of Proposition 1, $\varnothing \to g^{CU}_{s_1 s_2}$ in stage 1(c). Given one can verify $W_{s_1}\left(g^{CU}_{s_1 l}\right) > W_{s_1}\left(g^{FT}\right) > W_{s_1}\left(g^{CU}_{s_1 s_2}\right)$ and $W_{s_1}\left(g^{CU}_{s_1 l}\right) > W_{s_1}(g_{s_1 l}) > W_{s_1}(g_{s_2 l}) > W_{s_1}\left(g^{CU}_{s_2 l}\right)$, it is optimal in stages 1(a)-(b) for s to accept an FTA or a CU from l if $\beta < \bar{\beta}^s(\cdot)$ but optimal to only accept a CU if $\beta > \bar{\beta}^s(\cdot)$. In turn, it is optimal for l to propose an FTA in stages 1(a)-(b) when $\beta < \bar{\beta}^s(\cdot)$ but to propose a CU when $\beta > \bar{\beta}^s(\cdot)$. Thus, the equilibrium path of networks is $\varnothing \to g_{sl} \to g_l^H \to g^{FT}$ when $\beta < \bar{\beta}^s(\cdot)$ but $\varnothing \to g^{CU}_{sl}$ when $\beta > \bar{\beta}^s(\cdot)$.

Second, let $\beta \notin \left(\underline{\beta}^{Flex}_{In-In}(\cdot), \bar{\beta}^{Flex}_{In-In}(\cdot)\right)$. Like the proof of Proposition 1, $\varnothing \to g^{CU}_{s_1 s_2}$ in stage 1(c). Given one can verify $W_{s_1}\left(g^{CU}_{s_1 l}\right) > W_{s_1}\left(g^{CU}_{s_2 l}\right)$, it is optimal in stages 1(a)-(b) for s to accept a CU offer from l. In turn, it is optimal for l to propose a CU with s in stages 1(a)-(b). Hence, the equilibrium path of networks is $\varnothing \to g^{CU}_{sl}$. $\square$

B Extensions

B.1 Alternative measures of size and transport costs

We report welfare levels for country i under a network g as a function of an arbitrary tariff vector $\mathbf{t}^g$ where $\mathbf{t}^g = (t^g_{ij}, t^g_{ik})$ and, slightly abusing notation, $t^g_{ij} \equiv t_{ij}(g)$:

$$\sum_Z CS^Z_{s_1}(g) = = \frac{1}{2}\left(1-\frac{1+\left(T+t^g_{s_1 l}\right)\alpha_l+t^g_{s_1 s_2}}{2+\alpha_l}\right)^2 + \frac{1}{2}\left(1+t^g_{s_2 s_1}-\frac{1+\left(T+t^g_{s_2 l}\right)\alpha_l+t^g_{s_2 s_1}}{2+\alpha_l}\right)^2 + \frac{1}{2}\left(1+t^g_{l s_1}+T-\frac{\alpha_l+2T+t^g_{l s_1}+t^g_{l s_2}}{2+\alpha_l}\right)^2$$

$$\sum_Z CS^Z_{l}(g) = = \frac{\alpha_l}{2}\left(1+t^g_{s_1 l}+T-\frac{1+\left(T+t^g_{s_1 l}\right)\alpha_l+t^g_{s_1 s_2}}{2+\alpha_l}\right)^2 + \frac{\alpha_l}{2}\left(1+t^g_{s_2 l}+T-\frac{1+\left(T+t^g_{s_2 l}\right)\alpha_l+t^g_{s_2 s_1}}{2+\alpha_l}\right)^2 + \frac{\alpha_l}{2}\left(1-\frac{\alpha_l+2T+t^g_{l s_1}+t^g_{l s_2}}{2+\alpha_l}\right)^2$$

$$\sum_Z PS^Z_{s_1}(g) = \frac{\left(T+t^g_{s_2 l}-t^g_{s_2 s_1}\right)\alpha_l+\left(1-t^g_{s_2 s_1}\right)+\left(1-T-t^g_{l s_1}\right)\alpha_l+t^g_{l s_2}-t^g_{l s_1}}{2+\alpha_l}$$

$$\sum_Z PS^Z_{l}(g) = \frac{\alpha_l[\left(1-2T+t^g_{s_1 s_2}-2t^g_{s_1 l}\right)+\left(1-2T+t^g_{s_2 s_1}-2t^g_{s_2 l}\right)}{2+\alpha_l}$$

$$TR_{s_1}(g) = \frac{\left(1+\left(T+t^g_{s_1 l}-t^g_{s_1 s_2}\right)\alpha_l-t^g_{s_1 s_2}\right)t^g_{s_1 s_2}+\alpha_l t^g_{s_1 l}\left(1-2T+t^g_{s_1 s_2}-2t^g_{s_1 l}\right)}{2+\alpha_l}$$

$$TR_l\left(g\right) = \frac{(1-T-t^g_{l s_1})\alpha_l+t^g_{l s_2}-t^g_{l s_1}+(1-T-t^g_{l s_2})\alpha_l+t^g_{l s_1}-t^g_{l s_2}}{2+\alpha_l}.$$

The network dependent optimal tariffs are:

$$t_s\left(\varnothing\right) = \frac{1+\alpha_l\left(1-T\right)}{\alpha_l^2+4\alpha_l+3};\ t_l\left(\varnothing\right) = \frac{\alpha_l\left(1-T\right)}{2\left(1+\alpha_l\right)}$$

$$t_{s_1}\left(g_{s_1 s_2}\right) = \frac{1-T\left(4+\alpha_l\right)}{3\alpha_l+8};\ t_l\left(g_{s_1 s_2}\right) = t_l\left(\varnothing\right)$$

$$t_{s_1}(g_{s_1l}) = \frac{1+T\alpha_l(3+\alpha_l)}{2\alpha_l^2+6\alpha_l+3};\ t_l(g_{s_1l}) = \frac{\alpha_l^2(1-T)}{2\alpha_l^2+5\alpha_l+4};\ t_{s_2}(g_{s_1l}) = t_{s_2}(\varnothing)$$

$$t_i\left(g_j^H\right) = t_{ij}(g_{ij}) \text{ for any } i,j$$

$$t_{s_1}\left(g_{s_1s_2}^{CU}\right) = \frac{1-2T}{\alpha_l+4};\ t_l\left(g_{s_1s_2}^{CU}\right) = t_l(\varnothing)$$

$$t_{s_1}\left(g_{s_1l}^{CU}\right) = \frac{1+T\alpha_l}{2\alpha_l+3};\ t_l\left(g_{s_1l}^{CU}\right) = \frac{\alpha_l(1-T)}{2\alpha_l+3};\ t_{s_2}\left(g_{s_1l}^{CU}\right) = t_{s_2}(\varnothing).$$

Three important points deserve attention. First, when the non-negative tariff constraint is violated, we impose a zero tariff. Second, when tariff complementarity fails to hold we impose the empty network tariff to ensure compliance with GATT Article XXIV. Third, to ensure non-negative exports, we impose l's exports to s under $\varnothing$ are $x_{ls}(\varnothing) = \frac{\alpha_l(1+\alpha_l(1-2T)-3T)}{(\alpha_l+1)(\alpha_l+3)} \geq 0$ which requires $T < \bar{T}(\alpha_l) \equiv \frac{\alpha_l+1}{2\alpha_l+3}$.

Proof of Lemma 2

Let $T > \bar{T}_2(\alpha_l)$. One can easily verify the proof follows that of Lemma 1 for subgames at $g = g_{s_1s_2}, g_{s_1s_2}^{CU}, g_{sl}^{CU}$. Now consider the subgame at g_{sl}. Let $T > \underline{T}(\alpha_l) \equiv \max\left\{\bar{T}_2(\alpha_l), \tilde{T}_2(\alpha_l)\right\}$. Note, one can easily verify (i) $W_s\left(g^{FT}\right) > W_s\left(g_l^H\right)$ and (ii) $W_l\left(g_s^H\right) > W_l\left(g^{FT}\right)$ and, in turn, $g_l^H \to g^{FT}$ but $g_s^H \to g_s^H$ in subgames at hub-spoke networks. Given $T > \tilde{T}_2(\alpha_l)$ implies $W_s(g_{sl}) > W_s\left(g_s^H\right)$, $g_{sl} \to g_{sl}$ obtains if stage 1(c) is reached. Thus, given one can easily verify $W_{s_2}\left(g_l^H\right) > W_{s_2}(g_{s_1l})$, $g_{s_1l} \to g_l^H$ obtains in stage 1(a) or 1(b) if and only if $V_l\left(g_l^H\right) = W_l\left(g_l^H\right) + \frac{\beta}{1-\beta}W_l\left(g^{FT}\right) > V_l(g_{s_1l}) = \frac{1}{1-\beta}W_l(g_{s_1l})$ which reduces to $\beta < \bar{\beta}^{NE}(\cdot)$; otherwise, stage 1(c) is reached. □

Proof of Proposition 3

Lemma 2 establishes the equilibrium transitions conditional on formation of any initial PTA. Thus, consider the subgame at $\varnothing$. One can easily verify $W_{s_1}\left(g_{s_1s_2}^{CU}\right) > \{W_{s_1}(g_{s_1s_2}), W_{s_1}(\varnothing)\}$, implying $\varnothing \to g_{s_1s_2}^{CU}$ if stage 1(c) is reached. Given one can easily verify $W_{s_1}(g_{s_1l}) > W_{s_1}(g_{s_2l})$ and $\frac{1}{1-\beta}W_{s_1}(g_{s_1l}) > W_{s_1}(g_{s_1l}) + \beta W_{s_1}\left(g_l^H\right) + \frac{\beta^2}{1-\beta}W_{s_1}\left(g^{FT}\right) > V_{s_1}\left(g_{s_1s_2}^{CU}\right) = \frac{1}{1-\beta}W_{s_1}\left(g_{s_1s_2}^{CU}\right)$, s_1 accepts an FTA offer from l in stages 1(a)-(b). Moreover, given $T > \bar{T}_2(\alpha_l)$, l makes this offer if and only if $V_l(g_{s_1l}) > V_{s_1}\left(g_{s_1s_2}^{CU}\right) = \frac{1}{1-\beta}W_{s_1}\left(g_{s_1s_2}^{CU}\right)$; otherwise, it makes no proposal.

First, let $\beta < \bar{\beta}^{NE}(\cdot)$. Then $V_l(g_{s_1l}) = W_l(g_{sl}) + \beta W_l\left(g_l^H\right) + \frac{\beta^2}{1-\beta}W_l\left(g^{FT}\right)$ and $V_l(g_{s_1l}) > V_{s_1}\left(g_{s_1s_2}^{CU}\right)$ reduces to $\beta \in \left(\underline{\beta}_{In-Out}^{Flex}(\cdot), \bar{\beta}_{In-Out}^{Flex}(\cdot)\right)$. Thus, the equilibrium path of networks is $\varnothing \to g_{sl} \to g_l^H \to g^{FT}$ if $\beta \in \left(\underline{\beta}_{In-Out}^{Flex}(\cdot), \bar{\beta}_{In-Out}^{Flex}(\cdot)\right)$ but $\varnothing \to g_{s_1s_2}^{CU}$ otherwise. Second, let $\beta > \bar{\beta}^{NE}(\cdot)$. Then, $V_l(g_{s_1l}) > V_{s_1}\left(g_{s_1s_2}^{CU}\right)$ reduces to $W_l(g_{s_1l}) > W_l\left(g_{s_1s_2}^{CU}\right)$. Thus, the equilibrium path of networks is $\varnothing \rightarrow g_{sl}$ if $W_l\left(g_{s_1 l}\right) > W_l\left(g^{CU}_{s_1 s_2}\right)$ but $\varnothing \rightarrow g^{CU}_{s_1 s_2}$ if $W_l\left(g^{CU}_{s_1 s_2}\right) > W_l\left(g_{s_1 l}\right)$. Noting that, by definition, $\overline{\beta}^{NE}(\cdot) < \underline{\beta}^{Flex}_{In-Out}(\cdot)$ if and only if $W_l\left(g_{s_1 l}\right) > W_l\left(g^{CU}_{s_1 s_2}\right)$, parts (i)-(iii) of Proposition 3 follow immediately. $\square$

B.2 Alternative model of trade

We report welfare levels for country i under a network g as a function of an arbitrary tariff vector $\mathbf{t}^g$ where $\mathbf{t}^g = (t^g_{ij}, t^g_{ik})$ and, slightly abusing notation, $t^g_{ij} \equiv t_{ij}(g)$:

$$CS_{s_1}(g) = \frac{1}{2}\left[\frac{3\tau - c(2\tau+1) - \tau(t^g_{s_1 s_2} + t^g_{s_1 l})}{4\tau}\right]^2$$

$$CS_l(g) = \frac{1}{2}\left[\frac{3\tau\alpha_l - c(\tau+2) - \tau(t^g_{ls_1} + t^g_{ls_2})}{4\tau}\right]^2$$

$$\begin{aligned} PS_{s_1}(g) \;=\; & \left[\frac{\tau + c(1-2\tau) + \tau(t^g_{s_1 s_2} + t^g_{s_1 l})}{4\tau}\right]^2 + \left[\frac{\tau + c(1-2\tau) + \tau(t^g_{s_2 l} - 3t^g_{s_2 s_1})}{4\tau}\right]^2 + \\ & \left[\frac{\tau(\alpha_l + c) - 2c + \tau(t^g_{ls_2} - 3t^g_{ls_1})}{4\tau}\right]^2 \end{aligned}$$

$$\begin{aligned} PS_l(g) \;=\; & \left[\frac{\tau\alpha_l + c(2-3\tau) + \tau(t^g_{ls_1} + t^g_{ls_2})}{4\tau}\right]^2 + \left[\frac{\tau + c(2\tau-3) + \tau(t^g_{s_1 s_2} - 3t^g_{s_1 l})}{4\tau}\right]^2 + \\ & \left[\frac{\tau + c(2\tau-3) + \tau(t^g_{s_2 s_1} - 3t^g_{s_2 l})}{4\tau}\right]^2 \end{aligned}$$

$$TR_{s_1}(g) = \frac{t^g_{s_1 s_2}[\tau + c(1-2\tau) + \tau(t^g_{s_1 l} - 3t^g_{s_1 s_2})] + t^g_{s_1 l}[\tau + c(2\tau-3) + \tau(t^g_{s_1 s_2} - 3t^g_{s_1 l})]}{4\tau}$$

$$TR_l(g) = \frac{t^g_{ls_1}[\tau\alpha_l + c(\tau-2) + \tau(t^g_{ls_2} - 3t^g_{ls_1})] + t^g_{ls_1}[\tau\alpha_l + c(\tau-2) + \tau(t^g_{ls_1} - 3t^g_{ls_2})]}{4\tau}.$$

The network dependent optimal tariffs are:

$$t_s(\varnothing) = \frac{3\tau - c(2\tau+1)}{10\tau};\; t_l(\varnothing) = \frac{3\alpha_l\tau - c(\tau+2)}{10\tau}$$

$$t_{s_1 l}(g_{s_1 s_2}) = t_{s_2 l}(g_{s_1 s_2}) = \frac{\tau + c(2\tau-3)}{7\tau} = t_{s_1 l}(g^H_{s_2}) = t_{s_2 l}(g^H_{s_1})$$

$$t_{s_1s_2}(g_{s_1l}) = \frac{3\tau + c(7-10\tau)}{21\tau} = t_{s_1s_2}(g_l^H) = t_{s_2s_1}(g_l^H)$$

$$t_{ls_2}(g_{s_1l}) = \frac{3\alpha_l\tau - c(\tau+2)}{21\tau} = t_{ls_1}(g_{s_2l}) = t_{ls_1}(g_{s_2}^H) = t_{ls_2}(g_{s_1}^H)$$

$$t_{s_1l}(g_{s_1s_2}^{CU}) = t_{s_2l}(g_{s_1s_2}^{CU}) = \frac{5\tau + c(2\tau-7)}{19\tau}$$

$$t_{s_1s_2}(g_{s_1l}^{CU}) = t_{ls_2}(g_{s_1l}^{CU}) = \frac{5\tau(\alpha_l+1) - 5c(\tau+1)}{38\tau}.$$

Three important points deserve attention. First, $t_{s_1s_2}(g_{s_1l}^{CU}) > t_s(\varnothing)$, and thus Article XXIV is violated, when $\alpha_l > \widetilde{\alpha}(c,\tau) = \frac{32\tau + c(6-13\tau)}{25\tau}$. In this case, we impose $t_{s_1s_2}(g_{s_1l}^{CU}) = t_s(\varnothing)$. Second, to ensure non-negative exports, we impose l's exports to s_1 under $g_{s_1s_2}^{CU}$ are $x_{ls_1}(g_{s_1s_2}^{CU}) = \frac{\tau + c(8\tau-9)}{19\tau} \geq 0$ which requires $\tau > \underline{\tau}(\alpha_l) \equiv \frac{9c}{8c+1}$. Third, there exists a threshold $\underline{\alpha}_l$ such that $\tau < \bar{\tau}_2(\alpha_l, c)$ cannot hold when $\alpha_l < \underline{\alpha}_l$.

Proof of Proposition 4

Consider the equilibrium transitions conditional on an initial PTA. One can easily verify Lemma 1 applies for subgames at $g \neq g_{sl}$. For the subgame at g_{s_1l}, there are multiple possible cases. To this end, define the following thresholds: (i) $W_l(g^{FT}) > W_l(g_{s_1}^H)$ if and only if $\tau < \bar{\tau}_4(\alpha_l, c)$ and (ii) $W_{s_2}(g_{s_1l}) > W_{s_2}(g_{s_1}^H)$ if and only if $\tau > \bar{\tau}_5(\alpha_l, c)$. Note, $\bar{\tau}_4(\alpha_l, c) < \bar{\tau}_5(\alpha_l, c)$. To characterize the equilibrium, as shown below, the relevant case is $\tau \in (\bar{\tau}_4(\alpha_l, c), \bar{\tau}_5(\alpha_l, c))$. In this range, one can verify Lemma 1 applies in the subgame at g_{sl}. Moreover, only the welfare rankings underlying the thresholds $\bar{\tau}_4(\alpha_l, c)$ and $\bar{\tau}_5(\alpha_l, c)$ are reversed when $\tau \notin (\bar{\tau}_4(\alpha_l, c), \bar{\tau}_5(\alpha_l, c))$.

Now consider the subgame at the empty network $g = \varnothing$. One can easily verify $W_{s_1}(g_{s_1s_2}^{CU}) > \{W_{s_1}(g_{s_1s_2}), W_{s_1}(\varnothing)\}$, implying $\varnothing \to g_{s_1s_2}^{CU}$ if stage 1(c) is reached. In stages 1(a)-(b), $\tau < \bar{\tau}_2(\alpha_l, c)$ implies it is optimal for l to either propose an FTA, which requires $V_l(g_{sl}) > V_l(g_{s_1s_2}^{CU})$, or make no proposal. For now, assume $\tau \in (\bar{\tau}_4(\alpha_l, c), \bar{\tau}_5(\alpha_l, c))$. Then, the proof of Proposition 1 applies with two slight modifications. First, unlike Proposition 1, $\bar{\beta}_{s_2}^{FT-K}(\cdot) > \underline{\beta}_{In-Out}^{Flex}(\cdot)$ can happen. In this case, one can verify $W_l(g_{s_1s_2}^{CU}) > W_l(g_{sl}) > W_l(g_s^H)$ which implies $\bar{\beta}_{K-Out}^{Flex}(\cdot) < 0$. Thus, $\beta \in \left(\bar{\beta}_{s_2}^{FT-K}(\cdot), \underline{\beta}_{In-Out}^{Flex}(\cdot)\right)$ implies $\beta > \bar{\beta}_{K-Out}^{Flex}(\cdot)$ and, in turn, the equilibrium path of networks is $\varnothing \to g_{s_1s_2}^{CU}$. Second, one can verify $\bar{\beta}_l^{FT-K}(\cdot) > \bar{\beta}_{In-Out}^{Flex}(\cdot)$ for $\tau < \bar{\tau}_2(\alpha_l, c)$. Thus, the equilibrium path of networks is $\varnothing \to g_{sl} \to g_l^H \to g^{FT}$ when $\beta \in \left(\min\left\{\bar{\beta}_{s_2}^{FT-K}(\cdot), \underline{\beta}_{In-Out}^{Flex}(\cdot)\right\}, \bar{\beta}_{In-Out}^{Flex}(\cdot)\right)$ but $\varnothing \to g_{s_1s_2}^{CU}$ when $\beta > \bar{\beta}_{In-Out}^{Flex}(\cdot)$.

Finally, assume $\tau \notin (\bar{\tau}_4(\alpha_l, c), \bar{\tau}_5(\alpha_l, c))$. If (i) $\tau < \bar{\tau}_4(\alpha_l, c)$ or (ii) $\tau > \bar{\tau}_5(\alpha_l, c)$, the possible equilibrium transitions conditional on reaching the subgame at g_{sl} are respectively (i)

$g_{sl} \to g_l^H \to g^{FT}$, $g_{sl} \to g_s^H \to g^{FT}$ or $g_{sl} \to g_{sl}$ or (ii) $g_{sl} \to g_l^H \to g^{FT}$ or $g_{sl} \to g_{sl}$. Regardless, one can verify $V_l\left(g_{s_1s_2}^{CU}\right) > V_l\left(g_{sl}\right)$. This implies the interval $\left(\underline{\beta}_{In-Out}^{Flex}(\cdot), \bar{\beta}_{In-Out}^{Flex}(\cdot)\right)$ is empty and the equilibrium path of networks is $\varnothing \to g_{s_1s_2}^{CU}$. $\square$

B.3 Large country is a close country

We report welfare levels for country i under a network g as a function of an arbitrary tariff vector $\mathbf{t}^g$ where $\mathbf{t}^g = (t_{ij}^g, t_{ik}^g)$ and, slightly abusing notation, $t_{ij}^g \equiv t_{ij}(g)$:

$$\begin{aligned}\sum_Z CS_{s_1}^Z(g) &= \frac{1}{2}[1-\tau\frac{\tau^2 t_{ls_1}^g + t_{ls_2}^g + \alpha_l}{(2+\tau^2)} - t_{ls_1}^g)]^2 + \frac{1}{2}[1-\tau\frac{\tau^2 t_{s_2s_1}^g + t_{s_2l}^g + \alpha_l}{(2+\tau^2)}) - t_{s_2s_1}^g]^2 \\ &+ \frac{1}{2}[1-\frac{\tau^2(t_{s_1l}^g + t_{s_1s_2}^g) + \tau(\alpha_l - 1) + 1}{(1+2\tau^2)}]^2\end{aligned}$$

$$\begin{aligned}\sum_Z CS_{s_2}^Z(g) &= \frac{1}{2}[1-\frac{\tau^2 t_{ls_1}^g + t_{ls_2}^g + \alpha_l}{(2+\tau^2)} + t_{ls_2}^g]^2 + \frac{1}{2}[1-\frac{\tau^2 t_{s_2s_1}^g + t_{s_2l}^g + \alpha_l}{(2+\tau^2)})]^2 \\ &+ \frac{1}{2}[1-\tau(\frac{\tau^2(t_{s_1l}^g + t_{s_1s_2}^g) + \tau(\alpha_l - 1) + 1}{(1+2\tau^2)} - t_{s_1s_2}^g)]^2\end{aligned}$$

$$\begin{aligned}\sum_Z CS_l^Z(g) &= \frac{1}{2}[\alpha_l-\frac{\tau^2 t_{ls_1}^g + t_{ls_2}^g + \alpha_l}{(2+\tau^2)}]^2 + \frac{1}{2}[\alpha_l-\frac{\tau^2 t_{s_2s_1}^g + t_{s_2l}^g + \alpha_l}{(2+\tau^2)} + t_{s_2l}^g)]^2 \\ &+ \frac{1}{2}[\alpha_l-\tau(\frac{\tau^2(t_{s_1l}^g + t_{s_1s_2}^g) + \tau(\alpha_l - 1) + 1}{(1+2\tau^2)} - t_{s_1l}^g)]^2\end{aligned}$$

$$\sum_Z PS_{s_1}^Z(g) = \frac{\tau(2\alpha_l + t_{s_2l}^g + t_{ls_2}^g - 2t_{s_1s_2}^g - 2t_{ls_1}^g))}{(2+\tau^2)}$$

$$\sum_Z PS_{s_2}^Z(g) = \frac{\alpha_l + \tau^2(t_{ls_1}^g - t_{ls_2}^g) - t_{ls_2}^g}{(2+\tau^2)} + \tau(\frac{\tau^2(t_{s_1l}^g - t_{s_1s_2}^g) + \tau(\alpha_l - 1) + 1 - t_{s_1s_2}^g}{(1+2\tau^2)})$$

$$\sum_Z PS_l^Z(g) = \frac{\alpha_l + \tau^2(t_{s_2s_1}^g - t_{s_2l}^g) - t_{s_2l}^g}{(2+\tau^2)} + \tau(\frac{\tau^2(t_{s_1s_2}^g - t_{s_1l}^g) + \tau(\alpha_l - 1) + 1 - t_{s_1l}^g}{(1+2\tau^2)})$$

$$
\begin{aligned}
TR_{s_1}(g) &= \tau t^g_{s_1l}[1-\alpha_l+\tau\frac{\tau^2(t^g_{s_1l}+t^g_{s_1s_2})+\tau(\alpha_l-1)+1}{(2+\tau^2)}-t^g_{s_1l}] \\
&\quad +\tau^2 t^g_{s_1s_2}[\frac{\tau^2(t^g_{s_1l}+t^g_{s_1s_2})+\tau(\alpha_l-1)+1}{(1+2\tau^2)}-t^g_{s_1s_2}]
\end{aligned}
$$

$$
\begin{aligned}
TR_{s_2}(g) &= t^g_{s_2l}[1-\alpha_l+\frac{\tau^2 t^g_{s_2s_1}+t^g_{s_2l}+\alpha_l}{(2+\tau^2)}-t^g_{s_2l}] \\
&\quad +\tau^2 t^g_{s_2s_1}[\frac{\tau^2 t^g_{s_2s_1}+t^g_{s_2l}+\alpha_l}{(2+\tau^2)}-t^g_{s_2s_1}]
\end{aligned}
$$

$$
\begin{aligned}
TR_{l}(g) &= t^g_{ls_2}[1-\alpha_l+\frac{\tau^2 t^g_{ls_2}+t^g_{ls_1}+\alpha_l}{(2+\tau^2)}-t^g_{ls_2}] \\
&\quad +\tau^2 t^g_{ls_1}[\frac{\tau^2 t^g_{ls_1}+t^g_{ls_2}+\alpha_l}{(2+\tau^2)}-t^g_{ls_1}]
\end{aligned}
$$

The network dependent optimal tariffs are:

$$
\begin{aligned}
t_{s_1}(\varnothing) &= \frac{2\tau-\alpha_l+1}{4\tau(\tau^2+1)};\ t_{s_2}(\varnothing)=\frac{\tau^2-\alpha_l+2}{(\tau^2+3)(\tau^2+1)} \text{ and } t_l(\varnothing)=\frac{\alpha_l}{(\tau^2+3)} \\
t_{s_1l}(g_{s_1s_2}) &= \frac{(1-\alpha_l)(2\tau^4+2\tau^2+1)-\tau}{\tau(4\tau^4+5\tau^2+2)} = t_{s_1l}(g^H_{s_2}) \\
t_{s_2l}(g_{s_1s_2}) &= \frac{(1-\alpha_l)(\tau^4+3\tau^2+1)+1}{(2\tau^4+6\tau^2+3)} = t_{s_2l}(g^H_{s_1}) \\
t_{s_1s_2}(g_{s_1l}) &= \frac{(2\tau^3+2\tau)(\alpha_l-1)+1}{(4\tau^4+5\tau^2+2)} = t_{s_1s_2}(g^H_l) \\
t_{ls_2}(g_{s_1l}) &= \frac{\alpha_l}{(2\tau^4+6\tau^2+3)} = t_{ls_2}(g^H_{s_1}) \\
t_{s_2s_1}(g_{s_2l}) &= \frac{\tau^2(\alpha_l-1)+3\alpha_l-2}{(3\tau^2+8)} = t_{s_2s_1}(g^H_l);\ t_{ls_1}(g_{s_2l})=\frac{\alpha_l}{(3\tau^2+8)}=t_{ls_1}(g^H_{s_2}) \\
t_{s_1l}(g^{CU}_{s_1s_2}) &= \frac{(1-\alpha_l)(1+\tau^2)+1}{(2\tau^2+3)};\ t_{s_2l}(g^{CU}_{s_1s_2})=\frac{(1-\alpha_l)(1+\tau^2)+\tau}{\tau(3\tau^2+2)} \\
t_{s_1s_2}(g^{CU}_{s_1l}) &= \frac{\tau(\alpha_l-1)+1}{(3\tau^2+2)};\ t_{ls_2}(g^{CU}_{s_1l})=\frac{\alpha_l}{(2\tau^2+3)} \\
t_{s_2s_1}(g^{CU}_{s_2l}) &= \frac{\alpha_l}{(\tau^2+4)} = t_{ls_1}(g^{CU}_{s_2l})
\end{aligned}
$$

Three important points deserve attention. First, imposing non-negative exports places a lower bound on τ, $\underline{\tau}(\alpha_l)$. Second, imposing non-negative tariffs in the absence of transport costs places an upper bound on α_l, $\bar{\alpha}_l$. Third, to ensure compliance with GATT Article XXIV, we impose $t_{s_1}(\varnothing)$ as s_1's external tariff under $g = g_{s_1 l}$ or $g = g_{s_1 l}^{CU}$ if $t_{s_1}(g) > t_{s_1}(\varnothing)$.

PROOF OF PROPOSITION 5

Throughout the proof, let $W_{s_1}(\varnothing) > W_{s_1}(g)$ for $g = g_{s_1 s_2}, g_{s_1 s_2}^{CU}$. This reduces to $\tau < \bar{\tau}_1(\alpha_l)$ and has two important implications: (i) a PTA can emerge in stage 1(c) of the subgame at $\varnothing$ only if the PTA subsequently expands and (ii) $W_{s_1}\left(g_{s_1 l}^{CU}\right) > W_{s_1}\left(g^{FT}\right)$ which implies $g_{s_1 l}^{CU} \rightarrow g_{s_1 l}^{CU}$ in the subgame at $g_{s_1 l}^{CU}$. Imposing non-negative exports places a lower bound on τ, $\tau > \underline{\tau}(\alpha_l)$. Two cases establish the proof.

First, let $W_i\left(g_{s_2 l}^{CU}\right) > W_i\left(g_{s_1 l}^{CU}\right)$ for $i = s_2, l$. This reduces to $\tau < \bar{\tau}_2(\alpha_l)$ where $\bar{\tau}_2(\alpha_l) < \bar{\tau}_1(\alpha_l)$. In this range, $W_{s_1}\left(g_{s_1 s_2}^{CU}\right) > W_{s_1}\left(g^{FT}\right)$ so $g_{s_1 s_2}^{CU} \rightarrow g_{s_1 s_2}^{CU}$ in the subgame at $g_{s_1 s_2}^{CU}$. Now consider the subgame at $\varnothing$. $g_{s_1 s_2}^{CU}$ cannot emerge in stage 1(c) given $g_{s_1 s_2}^{CU} \rightarrow g_{s_1 s_2}^{CU}$ and $W_{s_1}(\varnothing) > W_{s_1}(g)$ for $g = g_{s_1 s_2}, g_{s_1 s_2}^{CU}$. Four subcases complete the first case. First, suppose $g_{s_1 l}^{CU}$ emerges in stage 1(b). Then, l must propose some PTA with s_2 in stage 1(a) because $g_{s_1 l}^{CU} \rightarrow g_{s_1 l}^{CU}$ implies $V_i\left(g_{s_2 l}^{CU}\right) > V_i\left(g_{s_1 l}^{CU}\right)$ for $i = s_2, l$. Second, suppose $g_{s_1 l}$ emerges in stage 1(b). Then, $g_{s_1 l}^{CU}$ cannot emerge because the protocol implies l proposes to s_2 in stage 1(a). Third, suppose $g_{s_2 l}^{CU}$ emerges in stage 1(b). Then, $V_l\left(g_{s_2 l}^{CU}\right) > V_l\left(g_{s_1 l}^{CU}\right)$ implies l will not propose a CU with s_1 in stage 1(a). Finally, suppose $g_{s_2 l}$ emerges in stage 1(b). The emergence of $g_{s_1 l}^{CU}$ in stage 1(a) would require $V_l\left(g_{s_1 l}^{CU}\right) > V_l\left(g_{s_2 l}\right)$ and, in turn, $V_l\left(g_{s_2 l}^{CU}\right) > V_l\left(g_{s_2 l}\right)$. However, $\tau < \bar{\tau}_2$ implies $V_{s_2}\left(g_{s_2 l}^{CU}\right) > V_{s_2}\left(g_{s_2 l}\right)$ because (i) either $g_{s_2 l} \rightarrow g_{s_2 l}$ or $g_{s_2 l} \rightarrow g_l^H$ and (ii) $W_{s_2}\left(g_{s_2 l}^{CU}\right) > W_{s_2}\left(g_{s_2 l}\right) > W_{s_2}\left(g_l^H\right)$. A contradiction now emerges: $V_i\left(g_{s_2 l}^{CU}\right) > V_i\left(g_{s_2 l}\right)$ for $i = s_2, l$ implies $g_{s_2 l}$ cannot emerge in stage 1(b). Thus, $g_{s_1 l}^{CU}$ does not emerge in equilibrium when $\tau < \bar{\tau}_2(\alpha_l)$.

Second, consider the range of α_l such that $\tau < \bar{\tau}_2(\alpha_l)$ fails because $\bar{\tau}_2(\alpha_l) < \underline{\tau}(\alpha_l)$. This happens once α_l exceeds a threshold $\bar{\alpha}_{l,1}$. Note that $\alpha_l > \bar{\alpha}_{l,1}$ implies (i) $W_l\left(g_{s_1 s_2}\right) > \max\left\{W_l\left(g_{s_1}^H\right), W_l\left(g_{s_2}^H\right), W_l\left(g^{FT}\right)\right\}$ and, thus, $g_{s_1 s_2} \rightarrow g_{s_1 s_2}$ in the subgame at $g_{s_1 s_2}$ and (ii) $W_l(\varnothing) > W_l\left(g_{s_1 l}^{CU}\right)$ and thus, given $g_{s_1 l}^{CU} \rightarrow g_{s_1 l}^{CU}$ in the subgame at $g_{s_1 l}^{CU}$, $g_{s_1 l}^{CU}$ cannot emerge in stages 1(a)-(b) of the subgame at $\varnothing$ if $\varnothing$ is the outcome in stage 1(c) of the subgame at $\varnothing$. Two subcases complete the second case, each by establishing $\varnothing$ is the outcome in stage 1(c). Consider the subgame at $\varnothing$ and define $\bar{\tau}_3(\alpha_l)$ such that $W_{s_1}(\varnothing) > W_{s_1}\left(g^{FT}\right)$ if and only if $\tau < \bar{\tau}_3(\alpha_l)$, noting that $\bar{\tau}_3(\alpha_l) < \bar{\tau}_1(\alpha_l)$. If $\tau < \bar{\tau}_3(\alpha_l)$, no agreement forms in stage 1(c) because $W_{s_1}(\varnothing) > W_{s_1}(g)$ for $g = g_{s_1 s_2}, g_{s_1 s_2}^{CU}, g^{FT}$. If $\bar{\tau}_3(\alpha_l)$ is undefined, which happens once α_l exceeds a threshold $\bar{\alpha}_{l,2}$ where $\bar{\alpha}_{l,2} > \bar{\alpha}_{l,1}$, then $W_l\left(g_{s_1 s_2}^{CU}\right) > W_l\left(g^{FT}\right)$ which implies $g_{s_1 s_2}^{CU} \rightarrow g_{s_1 s_2}^{CU}$ in the subgame at $g_{s_1 s_2}^{CU}$. Thus, given $\tau < \bar{\tau}_1(\alpha_l)$, no agreement forms in stage 1(c) because $W_{s_1}(\varnothing) > W_{s_1}(g)$ for $g = g_{s_1 s_2}, g_{s_1 s_2}^{CU}$. $\square$

B.4 Countries located along on a line

We report welfare levels for country i under a network g as a function of an arbitrary tariff vector $\mathbf{t}^g$ where $\mathbf{t}^g = (t^g_{ij}, t^g_{ik})$ and, slightly abusing notation, $t^g_{ij} \equiv t_{ij}(g)$:

$$\begin{aligned}\sum_Z CS^Z_{s_1}(g) &= \frac{1}{2}[1 - \frac{\tau^2(\alpha_l + t^g_{s_1s_2} - 1 + \tau^2 t^g_{s_1l}) + 1}{1+\tau^2+\tau^4}]^2 + \frac{1}{2}[1 - \tau[\frac{\tau^2(t^g_{s_2s_1} + t^g_{s_2l}) + \tau(\alpha_l - 1) + 1}{2\tau^2+1} - t^g_{s_2s_1}]]^2 \\ &+ \frac{1}{2}[1 - \tau^2[\frac{\tau^4 t^g_{ls_1} + \tau^2 t^g_{ls_2} + \alpha_l}{1+\tau^2+\tau^4} - t^g_{ls_1}]]^2\end{aligned}$$

$$\begin{aligned}\sum_Z CS^Z_{s_2}(g) &= \frac{1}{2}[1 - \tau\frac{\tau^2(\alpha_l + t^g_{s_1s_2} - 1 + \tau^2 t^g_{s_1l}) + 1}{1+\tau^2+\tau^4} - t^g_{s_1s_2}]^2 + \frac{1}{2}[1 - \frac{\tau^2(t^g_{s_2s_1} + t^g_{s_2l}) + \tau(\alpha_l - 1) + 1}{2\tau^2+1}]^2 \\ &+ \frac{1}{2}[1 - \tau[\frac{\tau^4 t^g_{ls_1} + \tau^2 t^g_{ls_2} + \alpha_l}{1+\tau^2+\tau^4} - t^g_{ls_2}]]^2\end{aligned}$$

$$\begin{aligned}\sum_Z CS^Z_{l}(g) &= \frac{1}{2}[\alpha_l - \tau^2[\frac{\tau^2(\alpha_l + t^g_{s_1s_2} - 1 + \tau^2 t^g_{s_1l}) + 1}{1+\tau^2+\tau^4} - t^g_{s_1l}]]^2 + \frac{1}{2}[\alpha_l - \frac{\tau^2(t^g_{ls_1} + t^g_{ls_2} + \alpha_l)}{1+\tau^2+\tau^4}]^2 \\ &+ \frac{1}{2}[\alpha_l - \tau[\frac{\tau^2(t^g_{s_2s_1} + t^g_{s_2l}) + \tau(\alpha_l - 1) + 1}{2\tau^2+1} - t^g_{s_2sl}]]^2\end{aligned}$$

$$\sum_Z PS^Z_{s_1}(g) = \frac{\tau[\tau^2 t^g_{s_2l} - (1+\tau^2)t^g_{s_2s_1} + \tau(\alpha_l - 1) + 1]}{2\tau^2+1} + \frac{\tau^2[\alpha_l - (1+\tau^2)t^g_{ls_1} + \tau^2 t^g_{ls_2}]}{1+\tau^2+\tau^4}$$

$$\sum_Z PS^Z_{s_2}(g) = \frac{\tau[\tau^4 t^g_{s_1l} - (1+\tau^4)t^g_{s_1s_2} + \tau^2(\alpha_l - 1) + 1]}{1+\tau^2+\tau^4} + \frac{\tau[\tau^4 t^g_{ls_1} - (1+\tau^4)t^g_{ls_2} + \alpha_l]}{1+\tau^2+\tau^4}$$

$$\sum_Z PS^Z_{l}(g) = \frac{\tau^2[\tau^2(\alpha_l - 1) - (1+\tau^2)t^g_{s_1l} + \tau^2 t^g_{s_1s_2} + 1]}{1+\tau^2+\tau^4} + \frac{\tau[\tau(\alpha_l - 1) - (1+\tau^2)t^g_{s_2l} + \tau^2 t^g_{s_2s_1} + 1]}{2\tau^2+1}$$

$$\begin{aligned}TR_{s_1}(g) &= \tau^2 t^g_{s_1s_2}[\frac{\tau^4 t^g_{s_1l} + \tau^2 t^g_{s_1s_2} + \tau^2(\alpha_l - 1) + 1}{1+\tau^2+\tau^4} - t^g_{s_1s_2}] \\ &+ \tau^2 t^g_{s_1l}[1 - \alpha_l + \tau^2[\frac{\tau^4 t^g_{s_1l} + \tau^2 t^g_{s_1s_2} + \tau^2(\alpha_l - 1) + 1}{1+\tau^2+\tau^4} - t^g_{s_1l}]]\end{aligned}$$

$$
\begin{aligned}
TR_{s_2}(g) &= \tau^2 t^g_{s_2 s_1}[\frac{\tau^2(t^g_{s_2 s_1}+t^g_{s_2 l})+\tau(\alpha_l-1)+1}{(1+2\tau^2)}-t^g_{s_2 s_1}] \\
&\quad +\tau t^g_{s_2 l}[1-\alpha_l+\tau[\frac{\tau^2(t^g_{s_2 s_1}+t^g_{s_2 l})+\tau(\alpha_l-1)+1}{(1+2\tau^2)}-t^g_{s_2 l}]]
\end{aligned}
$$

$$
TR_l(g)=\tau^4 t^g_{ls_1}[\frac{\tau^4 t^g_{ls_1}+\tau^2 t^g_{ls_2}+\alpha_l}{1+\tau^2+\tau^4}-t^g_{ls_1}]+\tau^2 t^g_{ls_2}[\frac{\tau^4 t^g_{ls_1}+\tau^2 t^g_{ls_2}+\alpha_l}{1+\tau^2+\tau^4}-t^g_{ls_2}]
$$

The network dependent optimal tariffs are:

$$
\begin{aligned}
t_{s_1}(\varnothing) &= \frac{2+\tau^2-\alpha_l}{(\tau^2+1)(\tau^4+\tau^2+2)};\ t_{s_2}(\varnothing)=\frac{1+2\tau-\alpha_l}{4\tau(\tau^2+1)};\ t_l(\varnothing)=\frac{\alpha_l}{(\tau^4+\tau^2+2)} \\
t_{s_1 l}(g_{s_1 s_2}) &= \frac{(1-\alpha_l)(\tau^6+\tau^4+\tau^2+1)+\tau^2}{\tau^2(2\tau^6+3\tau^4+4\tau^2+2)}=t_{s_1 l}(g^H_{s_2}) \\
t_{s_2 l}(g_{s_1 s_2}) &= \frac{(1-\alpha_l)(2\tau^4+2\tau^2+1)+\tau}{\tau(4\tau^4+5\tau^2+2)}=t_{s_2 l}(g^H_{s_1}) \\
t_{s_1 s_2}(g_{s_1 l}) &= \frac{(\alpha_l-1)(\tau^6+\tau^4+2\tau^2)+1}{(2\tau^8+2\tau^6+4\tau^4+\tau^2+2)}=t_{s_1 s_2}(g^H_l) \\
t_{ls_2}(g_{s_1 l}) &= \frac{\alpha_l}{(2\tau^8+2\tau^6+4\tau^4+\tau^2+2)}=t_{ls_2}(g^H_{s_1}) \\
t_{s_2 s_1}(g_{s_2 l}) &= \frac{(\alpha_l-1)(2\tau^3+2\tau)+1}{(4\tau^4+5\tau^2+2)}=t_{s_2 s_1}(g^H_l) \\
t_{ls_1}(g_{s_2 l}) &= \frac{\alpha_l}{(2\tau^6+3\tau^4+4\tau^2+2)}=t_{ls_1}(g^H_{s_2}) \\
t_{s_1 l}(g^{CU}_{s_1 s_2}) &= \frac{(1-\alpha_l)(\tau^2+1)+\tau^2}{\tau^2(\tau^4+2\tau^2+2)};\ t_{s_2 l}(g^{CU}_{s_1 s_2})=\frac{(1-\alpha_l)(\tau^2+1)+\tau}{\tau(3\tau^2+2)} \\
t_{s_1 s_2}(g^{CU}_{s_1 l}) &= \frac{\tau^2(\alpha_l-1)+1}{(2\tau^4+\tau^2+2)};\ t_{ls_2}(g^{CU}_{s_1 l})=\frac{\alpha_l}{(2\tau^4+\tau^2+2)} \\
t_{s_2 s_1}(g^{CU}_{s_2 l}) &= \frac{\tau(\alpha_l-1)+1}{(3\tau^2+2)};\ t_{ls_1}(g^{CU}_{s_2 l})=\frac{\alpha_l}{(\tau^4+2\tau^2+2)}
\end{aligned}
$$

Two important points deserve attention here. First, (i) $t_{s_1 s_2}(g_{s_1 l})=t_{s_1 s_2}(g^H_l)>t_{s_1}(\varnothing)$, (ii) $t_{s_1 s_2}(g^{CU}_{s_1 l})>t_{s_1}(\varnothing)$ and (iii) $t_{s_2 s_1}(g^{CU}_{s_2 l})>t_{s_2}(\varnothing)$ obtain, violating GATT Article XXIV, when τ is sufficiently small. In such cases, we impose $t_i(\varnothing)$ for the violating country i. Second, to ensure non-negative exports, we impose l's exports to s_1 under $\varnothing$ are positive which reduces to $\tau>\underline{\tau}=\frac{\sqrt{(4-2\alpha_l)(2\alpha_l-3+\sqrt{12\alpha_l-\alpha_l^2-7})}}{2(2-\alpha_l)}$.

Proof of Proposition 6

The equilibrium transitions conditional on an initial PTA follow Lemma 1 and the proof therein with three qualifications: (i) distinct thresholds $\bar{\beta}_{l,s}^{FT-K}(\cdot)$ for $s = s_1, s_2$ replace $\bar{\beta}_{l}^{FT-K}(\cdot)$ given the asymmetry between s_1 and s_2, (ii) $W_s\left(g_l^H\right) > W_s\left(g_{s'}^H\right)$ for $s' \neq s$ implies $\bar{\beta}_{s}^{FT-K}(\cdot) < 0$, and (iii) there is a range of the parameter space where $W_{s_1}(g_{s_2l}) > W_{s_1}\left(g_{s_2}^H\right)$ and hence the possible equilibrium transitions at g_{s_2l} are $g_{s_2l} \rightarrow g_{s_2l}$ and $g_{s_2l} \rightarrow g_l^H$.

Now consider the subgame at $\varnothing$. The proof differs from the proof of Proposition 1 in three minor ways. First, $W_l\left(g_{s_1s_2}^{CU}\right) > W_l(g_{s_2l})$ when $g_{s_2l} \rightarrow g_{s_2l}$ is a possible equilibrium transition in the subgame at g_{s_2l} as described above. Thus, it is not optimal for l to propose an FTA with s_2 in the subgame at $\varnothing$ when $g_{s_2l} \rightarrow g_{s_2l}$ in the subgame at g_{s_2l}.

Second, $V_s\left(g_{s_1s_2}^{CU}\right) > V_s(g_{s_1s_2})$ for $s = s_1, s_2$ does not hold for all $\tau < \bar{\tau}_2(\alpha_l)$. Defining $\bar{\tau}_0(\alpha_l)$ such that $V_{s_1}\left(g_{s_1s_2}^{CU}\right) > V_{s_1}(g_{s_1s_2})$ if and only if $\tau > \bar{\tau}_0(\alpha_l)$, we have $V_{s_1}\left(g_{s_1s_2}^{CU}\right) > V_{s_1}(g_{s_1s_2})$ but $V_{s_2}(g_{s_1s_2}) > V_{s_2}\left(g_{s_1s_2}^{CU}\right)$ when $\tau < \bar{\tau}_0(\alpha_l)$. Defining $\bar{\tau}_1(\alpha_l)$ such that $V_l\left(g_{s_1s_2}^{CU}\right) > V_l(g)$ for $g = g_{sl}, g_{sl}^{CU}$ and for all β when $\tau < \bar{\tau}_1(\alpha_l)$, we have $\bar{\tau}_0(\alpha_l) < \bar{\tau}_1(\alpha_l)$. Thus, the equilibrium path of networks when $\tau < \bar{\tau}_0(\alpha_l)$ is $\varnothing \rightarrow g_{s_1s_2}^{CU}$ when s_1 is the proposer in stage 1(c) but $\varnothing \rightarrow g_{s_1s_2}$ when s_2 is the proposer in stage 1(c).

Third, the thresholds $\underline{\beta}_{In-Out}^{Flex}(\cdot), \bar{\beta}_{In-Out}^{Flex}(\cdot), \bar{\beta}_{K-Out}^{Flex}(\cdot)$ and $\bar{\beta}_{l}^{FT-K}(\cdot)$ now take on distinct values depending on whether the FTA insiders are (i) l and s_1 or (ii) l and s_2. However, given $W_l(g_{s_1l}) > W_l(g_{s_2l})$ and $W_l\left(g_{s_1}^H\right) > W_l\left(g_{s_2}^H\right)$, the thresholds on equilibrium FTA formation are slacker when l and s_1 are FTA insiders than when l and s_2 are FTA insiders. Thus, in the subgame at $\varnothing$, the relevant thresholds are those when l and s_1 are FTA insiders. $\square$

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