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

James Lake*
Southern Methodist University

Halis M. Yildiz
Ryerson University

May 8, 2014

Abstract

A striking phenomenon emerges from casual observation of the geographical characteristics of Preferential Trade Agreements (PTAs): while Customs Unions (CUs) are only intra–regional, Free Trade Agreements (FTAs) are both inter and intra–regional. A second striking phenomenon is that FTAs dramatically outnumber CUs. We present a farsighted dynamic model that endogenizes the choice of PTA type and rationalizes the first phenomenon via an FTA flexibility benefit: FTAs are more flexible than CUs because an FTA member is free to form further PTAs with non-members whereas a CU member must engage in further PTAs jointly with all existing members. Our model also suggests that greater distance between countries increases the prevalence of FTAs relative to CUs. Finally, the model relates geography and market size to the order of PTA formation.

JEL codes: C71, F12, F13

Keywords: Free Trade Agreement, Customs Union, flexibility, coordination, geography, networks, farsighted

1 Introduction

Many authors have documented the unabated proliferation of Preferential Trade Agreements (PTAs) that began in the early 1990s. Indeed, because of the inherently discriminatory nature of PTAs, this proliferation often motivates authors interest in the role that PTAs play in facilitating or hindering multilateral free trade. However, casual empiricism of PTA

*Corresponding author e-mail: jlake@smu.edu.

characteristics reveal two other striking observations that are often overlooked: i) unlike Free Trade Agreements (FTAs) which are both inter and intra–regional, Customs Unions (CUs) are only intra–regional and ii) FTAs are far more prevalent than CUs.

To be clear, the role of geography has always been intimately associated with PTA formation to the extent that "The term "regional trade agreements" (RTAs) and "preferential trade agreements" (PTAs) are often used interchangeably in the literature" (WTO, 2011 p.58). Indeed, empirical evidence suggests that 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 five stylized facts about PTAs, the WTO (2011, p.6) state that "PTA activity has transcended regional boundaries" and they go on to state that 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.[1]

More importantly, as far as we aware, no paper has attempted to endogenously determine the choice of PTA type (i.e. CU or FTA) in a model where geographic asymmetry plays a role (by geographic asymmetry, we mean some countries are closer than others). In part, this open question stems from the fact that few papers explore the endogenous choice between CUs and FTAs.[2] Our goal in this paper is to simultaneously address the issues of why FTAs and CUs differ in their geographical characteristics, whether geographic asymmetries can shed light on the prevalence of FTAs relative to CUs and the how the interaction between market size and geographic asymmetry affect the order in which FTAs form.[3]

We explore these issues in a three country dynamic model. In each period, at most one agreement can form. Which agreement forms, if any, is determined by a simultaneous move "announcement game" where each country can announce the country with whom it wants to form an agreement (if any) and what type of agreement (i.e. CU or FTA) it wants to form. Countries are farsighted because they make these announcements based on continuation payoffs rather than one period payoffs. Because we use a simultaneous move announcement game to endogenously determine which agreement forms in any given period, we do not impose arbitrary or ad hoc assumptions on the order in which countries have the opportunity to form agreements.[4] Moreover, the dynamic nature of the model brings out an important

[1] One notable exception is Zissimos (2011). Another exception is a recent working paper by Soegaard (2013).

[2] The few exceptions include Riezman (1999), Melatos and Woodland (2007), Seidmann (2009), Facchini et al. (2012) Appelbaum and Melatos (2013), and Lake (2013a).

[3] According to the WTO's RTA-IS database, `http://rtais.wto.org/UI/PublicMaintainRTAHome.aspx`, accessed December 23 2013, 208 of the 225 PTAs in force and notified to the WTO under GATT Article XXIV are FTAs while the remaining 17 are CUs.

[4] This contrasts with the exogenous order of negotiations in the extensive form model of Aghion et al.

flexibility benefit that FTAs provide. Specifically, unlike CU formation where subsequent liberalization must involve all CU members, FTA formation allows a member country to form its own subsequent agreements. This FTA flexibility benefit plays an important role in much of our analysis and builds on Lake (2013a) who develops this FTA flexibility benefit in a framework without geographic asymmetry.[5]

For the underlying trade model, we add market size and geographic asymmetry to the popular competing exporters model of Bagwell and Staiger (1999). To focus on the role of geography, we assume trade between two "close" countries is not subject to transport costs while 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, we believe market size asymmetry is 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. 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 Israel, Jordan, Lebanon, Morocco, Australia and South Korea as small countries.[6]

Given our structure of market size and geographic asymmetry, we have a simple result when market size asymmetry is sufficiently large: the unique equilibrium is a CU between the small close countries regardless of the degree of geographic asymmetry. The intuition is straight forward. Here, the large far country refuses to participate in any liberalization despite the threat of being discriminated against under a small–small CU because the market access gained via a PTA with a small country does not justify giving up preferential domestic market access. Thus, the small close countries form an intra–regional CU to exploit the CU coordination benefit gained via external tariff coordination.

A richer equilibrium structure emerges when we consider a "moderate degree" of market

(2007) and the dynamic model of Mukunoki and Tachi (2006).

[5]Later in the introduction, we disucss other papers that endoegnize the choice between CUs and FTAs. In contrast, some papers (e.g. Missios et al. (2013) and Soegaard (2013)) compare an FTA formation game with a CU formation game.

[6]The EU, EFTA and US (the large far country) formed sequential FTAs with Isreal and then Jordan (smaller close countries) before Jordan and Isreal concluded their own FTA. The same is true for the EU and EFTA with Lebanon and Morocco. Additionally, the US (large far country) formed sequential FTAs with Australia and Korea (smaller close countries) while negotiations are ongoing between Australia and Korea.

size asymmetry. Indeed, this equilibrium structure addresses the two key empirical observations of why CUs are intra-regional yet FTAs are inter and intra–regional and why FTAs are so prevalent relative to CUs. We can address the latter observation both when there is sufficient geographic asymmetry which gives rise to a meaningful distinction between intra and inter–regional PTAs and when geographic asymmetry is low enough that all PTAs are intra–regional. That is, even in the case where all PTAs are intra–regional, rising geographic asymmetry still helps explain the prevalence of FTAs relative to CUs.

When all PTAs are intra–regional, two important necessary conditions underlie the equilibrium emergence of FTAs. First, the large far country prefers engaging in FTA rather than CU formation. On one hand, the large country forgoes the CU coordination benefit by doing so. Nevertheless, the degree of market size asymmetry and the divergent tariff preferences between a large and small country dilute this benefit. On the other hand, FTA formation provides the flexibility for the large country to become the hub which is valuable given the sole preferential access enjoyed by the hub in each spoke market. Thus, the large country will prefer FTA rather than CU formation if this FTA flexibility benefit outweighs the CU coordination benefit. The second necessary condition is that a small country chooses to forego a CU with the other small country, and the associated CU coordination benefit, for an FTA with the large country.

Importantly, a small country's preference regarding a small–small CU versus a small–large FTA depends on the degree of geographic asymmetry. Rising geographic asymmetry reduces the large country's incentive to participate in expansion of a small–small CU to global free trade. From the small country's view, this increases the attractiveness of an FTA with the large far country relative to a CU with the other small close country. Once rising geographic asymmetry prevents the small–small CU expanding to global free trade, FTAs rather than CUs emerge in equilibrium. Indeed, rising market size asymmetry acts along similar lines, providing another mechanism underlying the prevalence of FTAs.

With sufficient geographic asymmetry, a different mechanism links geographic asymmetry and the equilibrium emergence of FTAs. Indeed, given the meaningful distinction between intra and inter–regional PTAs, this equilibrium structure also matches the empirical observation that all CUs are intra–regional yet FTAs are intra and inter–regional. Here, the only type of PTA formation attractive enough to induce the large country's participation in liberalization is an FTA. That is, despite the threat of being discriminated against under a small–small CU, the large country will not form a CU but may form an FTA.

Sufficient geographic asymmetry and the moderate degree of market size asymmetry both work to make CU formation unattractive for the large country relative to being discriminated against under a small–small CU. Moreover, these same factors dilute the CU coordination benefit relative to the FTA flexibility benefit meaning FTA formation can be more attractive than CU formation and attractive enough to induce the large country's participation in liberalization. Since the FTA flexibility stems from being the hub on the path to global free trade, the FTA flexibility benefit is high when the discount factor is in an intermediate range. Thus, in this intermediate range of the discount factor, the large country participates in liberalization and a path of inter followed intra–regional FTAs leads to global free trade in equilibrium. Otherwise, an intra–regional CU emerges in equilibrium.

The above results implicitly assumed the large country becomes the hub following a small–large FTA. However, the large country may forego this opportunity and, effectively, allow a smaller country to become the hub because the additional market access gained does not justify the domestic market access given up. In this case, the equilibrium emergence of FTAs hinges on whether the large country prefers CU or FTA formation with a smaller country. The large country is pivotal because it can credibly threaten to form a CU with the other small country if the (initial) small country attempts to force the large country to accept an FTA. However, the large country may prefer FTA formation because market size asymmetry dilutes the primary benefit of a CU which is external tariff coordination. While greater market size asymmetry increases the scope of FTAs in equilibrium here, greater degrees of geographic asymmetry reduce the scope of FTAs in equilibrium. Thus, rising geographic asymmetry can only explain the prevalence of FTAs relative to CUs in the case where the large country wants to exploit the FTA flexibility benefit of becoming the hub which, per Chen and Joshi (2010), is the empirically relevant case.

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 PTA formation: (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. 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 that consumer preference asymmetries reduce the CU coordination benefit to the extent that members may prefer FTAs over CUs. However, in both of these settings, and in contrast to 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 in-come inequality is low with FTAs rather than CUs emerging when cross country production structures are sufficiently different.

Unlike these static models, Seidmann (2009) develops a three country dynamic bargaining model with transfers. He shows that PTAs can be valuable because of a "strategic positioning" motive: PTA members can affect their share of the global free trade pie by affecting the outside option of the PTA outsider. 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 must immediately result 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. Additionally, there is no role for geography in Seidmann (2009).

A key modeling difference between our paper and Seidmann (2009) driving the different role of FTAs is the absence of transfers. Without transfers, countries payoffs come from the discounted value of one period payoffs along the equilibrium path. Thus, the CU coordination benefit arises because of the additional one period payoff between CU and FTA formation stemming from external tariff coordination whereas FTA formation is valuable because it allows a country to then become the hub and have sole preferential access to each spoke market. Additionally, even though global free trade maximizes world welfare (here and in Seidmann (2009)), global free trade may not arise here given the absence of transfers (as in, e.g., Saggi et al. (2013)). Bagwell and Staiger (2010, p.50) argue that reality is "... positioned somewhere in between the extremes of negotiations over tariffs only and negotiations over tariffs and [transfers]...".[7]

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.[8]

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

[7] Other papers allowing transfers between countries are Aghion et al. (2007), Ornelas (2008), and Bagwell and Staiger (2010) while other papers assuming away transfers are Riezman (1999), Furusawa and Konishi (2007), Melatos and Woodland (2007), Saggi and Yildiz (2010) and Facchini et al. (2012). Bagwell and Staiger (2010, p.50) state that "While it is not standard for GATT/WTO trade negotiations to involve explicit transfers as part of the agreement, these negotiations do often involve more than just tariff reductions." and Furusawa and Konishi (2007, p.329) state "...feasible amounts of transfer are usually limited in practice.".

[8] 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).

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 the geographic structure we consider), an FTA between the close countries emerges as the unique equilibrium. In a model of coalition formation where multiple equilibria emerge, 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 paper differs from these three 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 the underlying trade model which is a modified version of the Bagwell and Staiger (1999) competing exporters model. Section 3 presents the dynamic game and the associated equilibrium concepts. Sections 4 and 5 explore the equilibrium path of agreements in the dynamic game and Section 6 concludes. Proofs are collected in Appendix B.

2 Underlying trade model

To endogenize the choice of PTA type and employ our dynamic model (explained in Section 3) among asymmetric countries, we utilize an appropriately adapted version of the competing exporters framework developed by Bagwell and Staiger (1999). There are three countries: i, j, and k, three (non–numeraire) goods: I, J, and K and a numeraire good y. Each country's market is served by two competing exporters and country i is endowed with zero units of good I and e_i units of the other two goods.[9]

To this standard endowment structure, we add market size and geographic asymmetry. The demand for good z in country i is given by $d(p_i^z) = \alpha_i - p_i^z$ where $z = I, J$, or K. As is well known, these demand functions can be derived from a utility function of the form $U(c^z) = \sum\limits_z u(c^z) + y$ where c^z denotes consumption of good z and y denotes the numeraire good. Since each country possesses only two goods while it demands all three, country i must import good I in order to consume it and can import it from either trading partner. For example, country i imports good I from both countries j and k while it exports good J to country j and good K to country k. Given linear demand, the intercept on the inverse demand curve is interpreted as the market size parameter. As discussed in the introduction, we model market size asymmetry through two small countries and one large country.

We model geographic asymmetry via traditional iceberg transport costs. Specifically, $d > 1$ units of a good must be shipped so that 1 unit arrives. Alternatively, only a fraction

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

$\tau = \frac{1}{d}$ of a unit shipped actually arrives. Thus, a lower τ indicates higher transport costs and a greater degree of geographic asymmetry. To focus on the role of geography, we assume that trade is costless between the small countries, say i and j, so that $\tau_{ij} = \tau_{ji} = 1$. Thus, we call the small countries "close". Conversely, trade is costly between either of the close countries (say i) and the third "far" country (say k): $\tau_{ik} = \tau_{ki} = \tau \leq 1$. Later, we will interpret a bilateral PTA involving the large far country as "inter–regional" and a bilateral PTA involving the small close countries as an "intra–regional" agreement. However, when geographic asymmetry is low enough (i.e. τ large enough) we will interpret all bilateral PTAs as intra–regional even though there is some degree of geographic asymmetry.

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

$$p_i^I = \frac{p_j^I}{\tau_{ij}} + t_{ij} = \frac{p_k^I}{\tau_{ik}} + t_{ik} \tag{1}$$

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

$$m_i^I = d(p_i^I) = \alpha_i - p_i^I. \tag{2}$$

Each country ships its endowment of a good minus its local consumption to the export market and thus export supply of country j to country i is $[e_j - (\alpha_j - p_j^I)]$. However, only a fraction τ of this export actually arrives. Thus, the actual exports from country i to country j equals

$$x_j^I = \tau_{ij}[e_j - (\alpha_j - p_j^I)]. \tag{3}$$

Market clearing for good I requires that country i's imports equal the total exports of the other two countries (denoted by x^I):

$$m_i^I = x^I = \sum_{h \neq i} x_h^I. \tag{4}$$

Equations (1) through (4) imply that the equilibrium price of good I in country i equals:

$$p_i^I = \frac{\alpha_i + \sum_{h \neq i} [\tau_{hi}(t_{ih}\tau_{hi} + \alpha_h - e_h)]}{1 + \sum_{h \neq i} \tau_{hi}^2}. \tag{5}$$

As is clear from equation (5), the price of good I in country i increases in the transportation cost (supply side effect), market size of all countries (demand side effect) and its tariffs. The effect of a country's tariff on its terms of trade is evident from equation (5): only a fraction of a given increase in either of its tariffs $(\tau_{hi}^2/(1+\sum_{h\neq i}\tau_{hi}^2))$ is passed on to domestic consumers. Using these prices, the volume of trade is easily calculated:

$$x_j^I = \frac{\tau_{ji}[(e_j-\alpha_j+\tau_{ji}(\alpha_i-t_{ij}))+\tau_{ki}^2(e_j-\alpha_j)-\tau_{ji}\tau_{ki}(e_k-\alpha_k)+\tau_{ji}\tau_{ki}^2(t_{ik}-t_{ij})]}{1+\sum_{h\neq i}\tau_{hi}^2} \tag{6}$$

and thus

$$m_i^I = x^I = \frac{\sum_{h\neq i}[\tau_{hi}(e_h-\alpha_h)+\tau_{hi}^2(\alpha_i-t_{ih}))]}{1+\sum_{h\neq i}\tau_{hi}^2}.$$

By design the model examines country i's trade protection towards only good I (i.e. the only non-numeraire good that it imports). From hereon, we assume that the endowment of goods in each country is normalized to 1: $e_h = 1$, where $h = i, j, k$. To capture the market size asymmetry, we set the market size of the smallest country (country s) to $\alpha_s = 1$. Rather than setting the market size parameter of the other "small" country (country m) to 1, we set it equal to $\alpha_m = 1+\varepsilon$ for some small $\varepsilon > 0$ (m can be thought of as standing for "medium" country). This technical modification reduces the extent to which multiple equilibria arise. We denote the market size of the large country (country l) by $\alpha_l > 1+\varepsilon$.[10]

From a welfare perspective, given the partial equilibrium nature of the model, it suffices to consider only protected goods. A country's welfare is defined as the sum of consumer surplus, producer surplus, and tariff revenue over all such goods:

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

Using equations (1) through (5) one can easily obtain welfare of country i as a function of endowment levels and tariffs. We next derive optimal tariffs under each regime.[11]

2.1 Optimal Tariffs

In the absence of any trade agreement, each country i chooses non-discriminatory tariffs to maximize its welfare since Article I of GATT forbids tariff discrimination: $t_{ij} = t_{ik} = t_i$. To

[10] Since countries have asymmetric market sizes, country l faces the largest volume of imports of protected goods under global free trade whereas country s faces the lowest volume of imports. In order to balance trade, country l exports the numeraire good to both countries s and m.

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

derive optimal tariffs, we follow the approach of Feenstra (2004) and Broda et al. (2008). Let p_w^I the world price of good I. Consider country i's tariff problem. Differentiating W_i with respect to t_i, we obtain:

$$\frac{\partial W_i}{\partial t_i} = t_i \frac{\partial m_i^I}{\partial p_i^I}\frac{\partial p_i^I}{\partial t_i} - m_i^I \frac{\partial p_w^I}{\partial t_i}. \tag{8}$$

The first term of the above first order condition is the efficiency cost of the tariff (i.e. the marginal deadweight loss from the tariff) while the second term is the terms of trade effect, that is, the reduction in the price of good I that accrues to other countries (p_w^I) multiplied by the quantity of country i's imports from country j. The optimal ad-valorem tariff is computed where (8) equals zero:

$$\frac{\partial W_i}{\partial t_i} = 0 \Rightarrow \frac{t_i}{p_w^I} = \frac{\frac{\partial p_w^I}{\partial t_i}\frac{m_i^I}{p_w^I}}{\frac{\partial m_i^I}{\partial p_i^I}\frac{\partial p_i^I}{\partial t_i}} \tag{9}$$

Note that, since $m_i^I = x^I$, we must have

$$\frac{\partial m_i^I}{\partial p_w^I}\frac{\partial p_w^I}{\partial t_i} = \frac{\partial x^I}{\partial t_i}. \tag{10}$$

Substituting this into (9) shows that country i's optimal ad-valorem tariff equals the inverse of the elasticity of the export supply curve faced by country i, denoted by ε_{x^I}:

$$\frac{t_i}{p_w^I} = \frac{1}{\varepsilon_{x^I}} = \left[\frac{\partial x^I}{\partial p_w^I}\frac{p_w^I}{x_j^I}\right]^{-1}. \tag{11}$$

Since our focus is on the optimal tariffs, we can simplify (11) to the following:

$$t_i = x^I \frac{\partial p_w^I}{\partial x_j^I}. \tag{12}$$

2.1.1 No Agreements (empty network)

Consistent with the above general discussion, we assume that under no agreement, denoted $\varnothing$, each country imposes a non-discriminatory tariff on its trading partners: $t_{ij} = t_{ik} = t_i(\varnothing)$. The optimal MFN tariffs of the small (close) countries and the large (far) country can be easily calculated:

$$t_s(\varnothing) \equiv \operatorname{Arg\,max} W_s(\varnothing) = \frac{1 - \tau(\alpha_l - 1) + \tau^2}{(1+\tau^2)(3+\tau^2)} \tag{13}$$

and

$$t_l(\varnothing) \equiv \operatorname{Arg\,max} W_l(\varnothing) = \frac{\alpha_l}{2(1+\tau^2)}. \tag{14}$$

It is immediate from the above tariffs that as transportation costs rise (as τ falls), optimal tariffs rise: $\frac{\partial t_l(\varnothing)}{\partial \tau} < 0$ and $\frac{\partial t_s(\varnothing)}{\partial \tau} < 0$. To understand the intuition, suppose that countries are symmetric in market size and thus their import demands are identical. Note that the export supply is linear and goes through the origin in our model, and thus $x_j^I \frac{\partial p_w^I}{\partial x_j^I}$ reduces to p_w^I. As transportation costs rise (τ falls), the export supply curve of a good traded between far apart countries becomes steeper (higher $\frac{\partial p_w^I}{\partial x_j^I}$) leading to a higher equilibrium world price p_w^I. As a result, using (12), it is immediate to argue that higher optimal tariffs obtain as transportation costs rise.

Moreover, as the market size of the large country rises, its own tariff rises while the small countries impose lower tariffs: $\frac{\partial t_l(\varnothing)}{\partial \alpha_l} > 0$ and $\frac{\partial t_s(\varnothing)}{\partial \alpha_l} < 0$. To see this more clearly, suppose there exists no transportation cost: $\tau = 1$. As α_l rises, the import demand of the large country shifts parallel to the right, leading to a larger equilibrium export volume. Since the slope of the export supply curve stays unchanged, we can argue from (12) that the optimum tariff of the large country rises as α_l increases. On the other hand, for smaller countries, as α_l rises, the export supply of the large country shifts parallel to the left, leading to a smaller equilibrium volume of exports into small countries. Therefore, it is immediate from (12) that the optimal tariff of the small countries falls as α_l increases since the slope of the export supply curve stays the same while volume of exports decrease.

Given the large far country has a larger market size and faces transport costs when importing from *both* of its trading partners, the far country imposes higher tariffs relative to the two small close countries:

$$t_l(\varnothing) - t_s(\varnothing) = \frac{\alpha_l(\tau^2 + 2\tau + 3) - 2\left(\tau^2 + \tau + 1\right)}{2(1+\tau^2)(3+\tau^2)} > 0 \tag{15}$$

Here, one point deserves an attention: for sufficiently small τ and sufficiently large α_l, exports of the far country can be negative. In order to exclude this possibility, we assume that $\alpha_l \leq \bar{\alpha}_l^x(\tau)$ holds where[12]

$$\bar{\alpha}_l^x(\tau) \equiv 1 + \frac{\tau\left(\tau^2+1\right)}{2\tau^2+3}. \tag{16}$$

[12] Later in the tariff complementarity discussion under an FTA between two close countries, we will argue that this condition does not bind.

2.1.2 Free Trade Agreements

If countries i and j form an FTA, denoted (ij), they remove their tariffs on each other ($t_{ij}(ij) = 0$ and $t_{ji}(ij) = 0$) and impose their optimal external tariffs on the non-member country: $t_{ik}(ij) = t_i(ij)$ and $t_{jk}(ij) = t_j(ij)$. First, consider an FTA between a small and a large country, say (sl). The optimal external tariffs of the member countries (s and l) on the non-member country m are given by:[13]

$$t_{sm}(sl) \equiv \operatorname{Arg\,max} W_s(sl) = \frac{\tau(3+\tau^2)(\alpha_l - 1) + 1}{(1+2\tau^2)(2+\tau^2) + (1+\tau^2)} \tag{17}$$

$$t_{lm}(sl) \equiv \operatorname{Arg\,max} W_l(sl) = \frac{\alpha_l}{(1+2\tau^2)^2 + (1+\tau^2)} \tag{18}$$

It is immediate from the above tariffs that member countries' tariffs rise with transportation costs (as τ falls). On one hand, the large far member country faces a steeper export supply curve as τ falls and thus imposes higher tariffs as explained above in the No Agreements case. This effect on the large far country's tariff is a direct effect. On the other hand, higher transportation costs induce the small member country to reallocate imports from its FTA partner (large far country) to the non-member small country. Therefore, higher transport costs indirectly raise the small member country's tariff. Here, it is important to note that, since the former direct effect dominates the latter indirect effect, the large (far) member's tariff rises faster than the one of the small member's tariff as τ falls.

As the market size of the large country rises, both member countries impose higher tariffs. First, note that higher α_l raises the import demand of the large member country as under the No Agreement case. However, unlike the No Agreement case, most of the increased imports still come from its FTA partner which limits the increase of its tariff imposed on the non-member. From the small member country's perspective, unlike the No Agreement case, it imposes higher tariffs as the market size of its FTA partner increases. Indeed, given the absence of any limiting effect, the small member's tariff rises faster than the large member's tariff as α_l rises. To understand why the small member's tariff rises, note that export supply of the large member shrinks as its demand rises. Thus, the small country relies more on imports from the non-member country which raises its tariff.

An implication of this discussion is that the small member imposes a higher tariff than the large member under an FTA when there is no transportation cost: $t_{sm}(sl) > t_{lm}(sl)$ when $\tau = 1$. But, since the large member's tariff rises faster than the small member's as

[13] Since the non-member country is the sole importer of the good the member countries are competing for export, the external tariff of the non-member under a PTA always equals its MFN tariff under no agreement: $t_k(\varnothing) = t_k(ij)$. Moreover, it is obvious that the same optimal tariff obtains for a spoke country under a hub and spoke trading regime. By contrast, since the hub has an FTA with both spokes, it practises free trade.

τ falls, there exists a critical $\underline{\tau}(\alpha_l)$ below which the large member imposes a higher tariff relative to the small member.

It is also immediate from the comparison of the tariffs in (13), (14), (17) and (18) that the formation of a bilateral FTA induces each member to lower its tariff on the non-member country relative to no agreement (i.e. the model exhibits tariff complementarity): $\Delta t_{im}(sl) = t_i(\varnothing) - t_{im}(sl) > 0, i = s, l$.[14]

Now consider the formation of an FTA between two small countries (sm). The following external tariff is optimal for the member countries:

$$t_{sl}(sm) = t_{ml}(sm) \equiv \operatorname{Arg\,max} W_s(sm) = \frac{(4+\tau^2)(1-\alpha_l)+\tau}{\tau(3\tau^2+8)} \tag{19}$$

Note that when the far country is sufficiently large in market size and transportation cost is sufficiently high, it is optimal for small countries to an impose import subsidy:

$$t_{sl}(sm) = t_{ml}(sm) < 0 \text{ when } \alpha_l > \bar{\alpha}_l^t(\tau) \equiv 1 + \frac{\tau}{4+\tau^2} \tag{20}$$

To guarantee non-negative external tariffs, we assume we assume that $\alpha_l \leq \bar{\alpha}_l^t(\tau)$ holds hereafter. It is worth noting that $\bar{\alpha}_l^t(\tau) \leq \bar{\alpha}_l^x(\tau)$ always holds and thus the previous condition avoiding negative exports is no longer binding.

A similar tariff discussion applies here as above.[15] An important difference is that as α_l rises, small member countries have an incentive to reduce their tariffs on the large non-member country. The intuition is fairly straightforward. As the demand in the non-member large country increases, its export supply shifts to the left, reducing the volume of imports by member countries (exports of the non-member) from the non-member. Using (12), this gives member countries an incentive to lower their external tariffs.

2.1.3 Customs Unions

If two countries form a CU, they remove tariffs on each other and impose jointly optimal external tariffs (denoted by $t_{ik}(ij^{CU})$ and $t_{jk}(ij^{CU})$) on the non-member country.[16] The tariff

[14] See Bagwell and Staiger (1997a, 1997b), and Saggi and Yildiz (2009) for a detailed discussion of the tariff complementarity effect and Estevadeordal et al. (2008) for empirical evidence in its support. It is worth noting that tariff complementarity also arises in simple general equilibrium models of trade agreements such as Bond et al. (2004).

[15] It is easy to see that the tariff complementarity effect holds under (sm) as well.

[16] Our simple formulation of a CU's tariff choice problem is intuitively appealing and in line with much of existing literature (even when excluding transfers, e.g. (Saggi et al. (2013))). However, Syropoulos (2003) has shown that the nature of the sharing rule of a CU with respect to tariff revenue can affect tariff preferences as well as the trade patterns of CU members in ways that can prevent the implementation of jointly optimal tariffs. An important insight of his analysis is that CU members have an incentive to influence their common tariffs not just for external terms-of-trade reasons but also for internal distributional purposes. Given the

pair $(t_i(ij^{CU}), t_j(ij^{CU}))$ is chosen to solve the joint welfare maximization problem:[17]

$$\max_{t_i(ij^{CU}),t_j(ij^{CU})} W_i(ij) + W_j(ij) \text{ subject to } t_{ij}\left(ij^{CU}\right) = t_{ji}\left(ij^{CU}\right) = 0 \tag{21}$$

Since each country is the unique importer of a good in our competing exporters model, the "market power effect" of a CU emphasized by Bagwell and Staiger (1997b) does not arise here since that effect arises only when CU members "compete" for imports.[18] As a result, the coordination of tariffs is beneficial to CU members only because each member internalizes the effect of its tariff on the export surplus of the other member.

First consider a CU between a small and a large country $\left(sl^{CU}\right)$. The optimal joint external tariffs are given by:

$$t_{sm}(sl^{CU}) = \frac{\tau(\alpha_l - 1) + 1}{(2\tau^2 + 3)} \tag{22}$$

and

$$t_{lm}(sl^{CU}) = \frac{\alpha_l}{(2 + 3\tau^2)} \tag{23}$$

It is easy to see that both external tariffs increase with α_l. One point deserves attention: when there exists no transportation cost ($\tau = 1$), the external tariffs of CU members are the same regardless of their market sizes. This is intuitive since a CU acts as a common market so the import demand of member countries and the export supply of the non-member to the member countries cannot be differentiated due to non-existence of transportation costs. However, as τ goes down, the export supply of the non–member country (one of the close countries) to the far member country is steeper relative to that of the close member country since the non-member faces transportation costs only exporting to the far country. Therefore, the following is immediate from (22) and (23):

$$t_{lm}(sl^{CU}) > t_{sm}(sl^{CU}) \text{ when } \tau < 1 \tag{24}$$

Finally, consider a CU between two small (close) countries $\left(sm^{CU}\right)$. The optimal joint external tariff is given by

focus of our paper, we abstract from such considerations. Indeed, what our results rely upon is merely that the one period CU payoff can exceed the one period FTA payorff.

[17]The assumption that the CU maximizes the sum of national utilities is commonly employed in the literature. Issues of the delegation of tariff-setting authority and the choice of weights in the social welfare function are discussed by Gatsios and Karp (1991) and Melatos and Woodland (2007).

[18]In Bagwell and Staiger (1997a), countries forming a CU do not trade with each other at all and the CU is attractive to them only because it allows them to pool their market power and extract a larger terms of trade gain from non-members.

$$t_{sl}(sm^{CU}) = \frac{2(1-\alpha_l)+\tau}{\tau(4+\tau^2)} \tag{25}$$

A similar tariff discussion applies as under the FTA (sm). To minimize the potential harmful effects of PTAs on non-members, Article XXIV requires that member countries do not raise their external tariffs on non-members. When $\alpha_l \le \bar{\alpha}_l^t(\tau)$ holds, it is straightforward to show, using (13), (14), (22), (23) and (25), that the formation of a bilateral CU induces each member to lower its tariff on the non-member country relative to the No Agreements case (tariff complementarity holds). Thus, the restriction imposed by Article XXIV does not bind in our model.

As might be expected, since each member internalizes the effect of its tariff on the export surplus of the other member, CU external tariffs always exceed the external tariffs under an FTA:

$$t_{sl}(sm^{CU}) > t_{sl}(sm),\ t_{sm}(sl^{CU}) > t_{sm}(sl) \text{ and } t_{lm}(sl^{CU}) > t_{lm}(sl) \tag{26}$$

3 Dynamic game and equilibrium concept

3.1 Overview

Our dynamic model has two defining features. First, at most one agreement can form in each period (the game starts with no agreements in place). Essentially, we view a period as the length of time taken to negotiate an agreement.[19] The second defining feature is that trade agreements formed in previous periods are binding (see last paragraph of this subsection for discussion). Since we assume Markov behavior, this implies the status quo remains forever once no PTA forms in a given period or global free trade is attained. With one agreement per period, the status quo remains after at most three periods. Figure 1 depicts the possible trade networks; the countries are generically denoted i, j and k and an edge between two countries represents a trade agreement.

As noted by (Seidmann, 2009, p.145), each period can be viewed as a subgame characterized by the network that exists at the beginning of the period. Importantly, the payoffs resulting from an outcome in a given subgame are the continuation payoffs rather than the one period payoffs. Given the assumption of binding agreements, we simply solve the model using backward induction since global free trade is an absorbing state. To determine which

[19] The length of time between commencement of negotiations and implementation of an agreement is typically many years. For example, NAFTA was implemented in 1994 yet negotiations date back to 1986. Thus, the discount factor for a period in the model is effectively the one year discount factor raised to the power n where n is the number of years needed to negotiate an agreement.

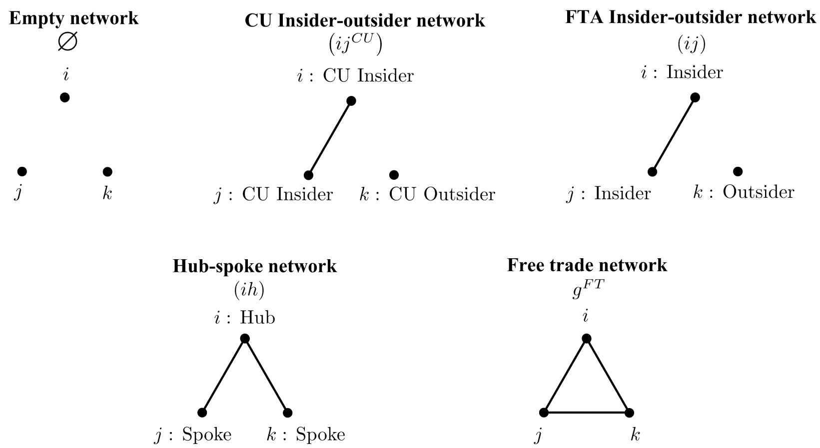

Figure 1: Networks and network positions

agreement forms in a given period, we model a subgame as a simultaneous move "announcement game" where each country announces the agreement it wants to form. We describe the announcement games in the following subsection. To solve each subgame we use the solution concept of equilibrium binding agreement (EBA; Ray and Vohra (1997); Diamantoudi (2003)) which is explained in Section 3.3. Importantly, the model does not suffer from the well known difficulty that the equilibrium of sequential move games is often sensitive to the order of negotiations (Ludema (1991), Ray and Vohra (1997), Jackson (2008)). Rather, the outcome of an announcement game depends endogenously on geographic and market size asymmetries.[20][21]

Before moving on, we make a final observation. The assumption that trade agreements formed in previous periods are binding places strong restrictions on inter–temporal coalitional formation. Conversely, the EBA solution concept assumes a coalition of countries could break up into subcoalitions costlessly while the trade agreement to be formed in the current period is still "under negotiation". We view this dichotomy as a strength rather than a weakness of our model. Many authors (e.g. Ornelas (2008) and Ornelas and Liu (2012)) have argued the binding nature of trade agreements is entirely realistic and pervasive in the trade agreements literature.[22] Additionally, Lake (2013b) describes how Colombia and

[20] This endogenous order contrasts with previous sequential and dynamic models of trade agreements such as Aghion et al. (2007), Mukunoki and Tachi (2006) and Seidmann (2009). The endogenous order also contrasts with the rest of the dynamic network theoretic literature; for example, the model of Dutta et al. (2005).

[21] Indeed, when FTAs emerge in a unique equilibrium, the order in which countries form FTAs in equilibrium will directly correspond to the magnitude of the joint welfare gain of members. This is consistent with the recent empirical evidence of Baier et al. (2014).

[22] It is realistic both in terms of real world observation and in terms of being a reduced form shorthand for a more structural modeling approach. See McLaren (2002) for sunk costs as a structural justification and

South Korea began FTA negotiations with Canada before they began negotiations with the US yet both Colombia and South Korea formed FTAs with the US before they did with Canada even though Canada and the US were already part of NAFTA. We view the contemporaneous flexibility of coalition formation mixed with the inter–temporal inflexibility of coalition formation as the appropriate setting for dynamic analyses of trade agreement formation.

3.2 Actions and strategies

We denote the set of countries generically as $N = \{i, j, k\}$. Given our assumption of one agreement per period, each period can be characterized by the network g that exists at the beginning of the period. Given the network at the beginning of a period is g, countries play a simultaneous move "announcement game" to determine which agreement forms in the period. Like Seidmann (2009), we refer to this announcement game as the subgame at network g.

For the subgame at network g, country i's action space $A_i(g)$ represents the set of announcements country i can make. For a coalition $S \subseteq N$, $A_S = \Pi_{i \in S} A_S(g)$ has an analogous interpretation. Letting $\varnothing$ and g^{FT} denote, respectively, the empty and free trade networks, Table 1 shows a country's action space consists of three types of announcements $a_i(g) \in A_i(g)$. First, a country can announce another country with whom it wants to form a PTA but has not yet done so (the superscript CU indicates announcement of a CU and absence of a superscript indicates announcement of an FTA). Second, given any CU expansion involves all three countries agreeing to global free trade, countries can announce a direct move to the free trade network, denoted FT, at CU insider-outsider networks.[23] Third, a country can choose to make no announcement, denoted ϕ. An agreement forms when all members of the proposed agreement announce in favor. For example, the FTA between i and j forms if and only if $a_i(g) = j$ and $a_j(g) = i$ while CU expansion occurs if and only if $a_i(g) = a_j(g) = a_k(g) = FT$.

Given the tight link between action profiles and resulting networks, we will often refer to a coalition S deviating from one network to another. Of course, formally speaking, the coalition S deviates from one coalitional action a_S to another a'_S. For example, the coalitional deviation by $S = ij$ from $a_S = (a_i, a_j) = (\phi, \phi)$ to $a'_S = (j, i)$ induces an FTA between i and j and so we refer to this as i and j deviating from $g = \varnothing$ to $g' = (ij)$.[24] We will also refer to

Roberts and Tybout (1997), Eichengreen and Irwin (1998) and Freund and McLaren (1999) for empirical support.

[23] Our main results are unchanged if we allow countries the option of moving directly to global free trade from any network in any period.

[24] Of course, formally, $S = ij$ is shorthand for $S = \{i, j\}$.

Network	Player action space		
	$A_i(g)$	$A_j(g)$	$A_k(g)$
$\varnothing$	$\{\phi, j, j^{CU}, k, k^{CU}\}$	$\{\phi, i, i^{CU}, k, k^{CU}\}$	$\{\phi, i, i^{CU}, j, j^{CU}\}$
(ij^{CU})	$\{\phi, FT\}$	$\{\phi, FT\}$	$\{\phi, FT\}$
(ij)	$\{\phi, k\}$	$\{\phi, k\}$	$\{\phi, i, j\}$
(ij, ik)	$\{\phi\}$	$\{\phi, k\}$	$\{\phi, j\}$
g^{FT}	$\{\phi\}$	$\{\phi\}$	$\{\phi\}$

Table 1: Action space for each subgame

the agreement resulting from the equilibrium action profile in a subgame as the equilibrium for the subgame.

Since our model is dynamic then whether the coalition $S = ij$ is "better off" or "worse off" in the above example under the new action profile a' compared to the initial action profile a depends on the comparison of continuation payoffs associated with g and g' rather than the one period payoffs. Since these continuation payoffs depend on the equilibrium path of trade agreements stemming from g and g', it will be useful to let $\langle g \rangle$ and $\langle g' \rangle$ denote these paths with $\langle g' \rangle \succ_S \langle g \rangle$ denoting that each member of S receives a higher continuation payoff under $\langle g' \rangle$ than $\langle g \rangle$.

Finally, we let $\langle g \rangle = g$ denote that the equilibrium path of agreements stemming from g actually remains at g forever. For example, $\langle (ij) \rangle = (ij)$ denotes that the FTA (ij) remains forever once it forms.

3.3 Equilibrium concept used to solve each subgame

The solution concept we use to solve the announcement game at each network (i.e. to solve each subgame) is equilibrium binding agreement (EBA; Ray and Vohra (1997), Diamantoudi (2003)). Having solved for the EBA in each subgame we will simply refer to the resulting equilibrium path of agreements as *the equilibrium path of agreements.*

The key idea behind an EBA is that a deviating coalition does not take the actions of other players as given but rather anticipates equilibrium reactions of other players. This idea is formalized as follows. Take an initial action profile a. Then, the action profile $a' = \left(a'_S, a'_{N\setminus S}\right)$ resulting after S deviates to a'_S (note, $a'_{N\setminus S} = a_{N\setminus S}$ is *not* imposed) must satisfy two properties:

1. a' is a Nash equilibrium between S as one player and all other players, $N \setminus S$, as the second player.[25]

[25] For clarity, suppose S is a two player coalition. Then, $a' = (a'_S, a'_{N\setminus S})$ is a Nash equilibrium between S

2. For any unilateral deviation by some player i from a'_i to a''_i there is a Nash equilibrium $a'' = \left(a''_i, a''_{-i}\right)$ that leaves i no better off than under a'.[26][27]

An action profile a' that satisfies properties 1 and 2 is an EBA between S and $N \setminus S$. Moreover, a deviation by S from a_S to a'_S is self enforcing if, for any $a' = (a'_S, a'_{N\setminus S})$ that is an EBA between S and $N \setminus S$, each member of S is better off under a' relative to a. Intuitively, a deviation by S is self enforcing if S wants to deviate given it anticipates (any) "equilibrium reactions" of the other players.[28] An action profile a is an EBA if it is Pareto optimal (i.e. it is a Nash equilibrium for N) and there is no self enforcing deviation by a coalition $S \subset N$. However, there may exist a self enforcing deviation from every action profile. In this case, an action profile is an EBA if it is an EBA between some S and $N \setminus S$ or, alternatively, it satisfies properties 1 and 2 for some S. If there is no EBA between any S and $N \setminus S$ then the EBAs are the Nash equilibria. Although, formally, an EBA is an action profile, we will refer to the agreement induced by an EBA action profile as an EBA. Similarly, we refer to an agreement induced by a Nash equilibrium as a Nash agreement.

The idea that a deviating coalition anticipates the equilibrium reactions of other players rather than taking the actions of other players as fixed is the key difference between an EBA and the well known concept of coalition proof Nash equilibrium (CPNE).[29] Nevertheless, despite the inherent logical appeal, an EBA is more complicated than a CPNE. Thus, why not solve a CPNE rather an EBA in every subgame? Indeed Bernheim et al. (1987) define this as a Perfectly CPNE. The fundamental problem is that CPNE non–existence arises in simple settings such as Condorcet paradox type situations and these situations arise in the model. This questions the fundamental validity of CPNE to explain strategic formation of trade agreements in dynamic contexts and naturally leads to similar but stronger concepts such as EBA.

For those reading the proofs of supporting Lemmas 6-9 in Appendix B (these Lemmas are

---

and $N \setminus S$ iff i) there is no $a'' = (a''_S, a'_{N\setminus S})$ that makes each member of S better off relative to a' and ii) there is no $a'' = (a'_S, a''_i)$ that makes $N \setminus S = i$ better off relative to a'.

[26] Given property 1 and our three player context, only unilateral deviations by members of the two player colaition (which could be either S or $N \setminus S$) need consideration in property 2.

[27] To be clear, $a''_{-i} = a'_{-i}$ is not imposed.

[28] For a given a'_S, there can be many action profiles $a' = (a'_S, a'_{N\setminus S})$ satisfying properties 1 and 2. Our definition says the deviating coalition S undertakes their deviation only if they prefer any such a' over the initial action profile a. This was proposed by Diamantoudi (2003) and differs from Ray and Vohra (1997) who require S merely prefer some such a' to a. Essentially, Diamantoudi (2003) assumes deviating coalitions anticipate "pessimistically" while Ray and Vohra (1997) assume they anticipate "optimistically".

[29] Another important similarity between EBA and CPNE is that both concepts view "stability" of an action profile not with respect to all possible deviations but only those that are themselves equilibria. This idea emerges above because an action profile satisfying properties 1 and 2 is an EBA between S and $N \setminus S$. The idea emerges in CPNE where, in the three player context (for example), consideration is given to whether a bilateral deviation would then induce a unilateral deviation by one of the initial deviators.

not presented in the main text), note that we begin Appendix B by outlining some notation that helps facilitate exposition of their proofs and will *only* be used in their proofs.

4 Equilibrium path of agreements under moderate market size asymmetry

Many papers in the trade agreements literature begin by presenting the equilibrium when all countries are symmetric. With a sufficiently low degree of market size and geographic asymmetry, our model makes predictions consistent with the existing literature: the unique equilibrium path of agreements yields global free trade. Indeed, a direct move to global free trade would be unique if we allowed such a move. However, since our main focus is on explaining the geographic characteristics of, and the prevalence of, FTAs relative to CUs, we immediately jump to considering a moderate degree of market size asymmetry.

Our definition of a moderate degree of asymmetry consists of a lower bound and an upper bound on α_l. The upper bound $\bar{\alpha}_{l,3}$ is defined as the (lowest) value of $\bar{\alpha}_{l,3}$ such that neither FTA nor CU formation is attractive enough to induce l's participation in liberalization when $\alpha_l > \bar{\alpha}_{l,3}$ despite the threat of being a CU outsider. Formally, CU formation is not attractive enough because

$$W_l\left(sm^{CU}\right) > \max\left\{W_l\left(ml^{CU}\right), W_l\left(g^{FT}\right)\right\} \tag{27}$$

for any τ when $\alpha_l > \bar{\alpha}_{l,3}$. That is, l prefers remaining a CU outsider over engaging in CU formation. Formally, FTA formation is not attractive enough because, letting β denote the discount factor,

$$\frac{1}{1-\beta}W_l\left(sm^{CU}\right) > W_l\left(ml\right) + \beta W_l\left(lh\right) + \frac{\beta^2}{1-\beta}W_l\left(g^{FT}\right) \tag{28}$$

for any β, τ when $\alpha_l > \bar{\alpha}_{l,3}$. That is, despite the threat of being a CU outsider, the continuation payoff associated with exploiting the FTA flexibility benefit and being the hub on the path to global free trade is not attractive enough to induce l's participation in liberalization.

Conversely, the lower bound $\bar{\alpha}_{l,1}$ is defined such that, when $\alpha_l \in (\bar{\alpha}_{l,1}, \bar{\alpha}_{l,3})$, there is some range of geographic asymmetry where an FTA is the only type of PTA attractive enough to induce l's participation given the threat of being a CU outsider. Formally, for some range of τ, (27) holds but (28) fails if and only if $\alpha_l \in (\bar{\alpha}_{l,1}, \bar{\alpha}_{l,3})$.

While the range $\alpha_l \in (\bar{\alpha}_{l,1}, \bar{\alpha}_{l,3})$ captures the essence of our definition of a moderate degree of market size asymmetry, we work with a slightly different range hereafter. Rather than use $\bar{\alpha}_{l,3}$ as the upper bound we use $\min\{\bar{\alpha}_{l,3}, \bar{\alpha}_l^t(\tau)\}$ to ensure non–negative external tariffs (see (13)). Rather than use $\bar{\alpha}_{l,1}$ as the lower bound we use $\bar{\alpha}_{l,2}$ where $\alpha_l > \bar{\alpha}_{l,2}$ ensures that m and l hold a "CU exclusion incentive" whenever PTA formation is more attractive for l than being a permanent CU outsider. By country $i = m, l$ holding a "CU exclusion incentive" we mean $W_i\left(ml^{CU}\right) > W_i\left(g^{FT}\right)$. Since m's CU exclusion incentive is the binding incentive, then, formally, $\bar{\alpha}_{l,2}$ is the (lowest) value of α_l such that $W_m\left(ml^{CU}\right) > W_m\left(g^{FT}\right)$ for any τ when $\alpha_l > \bar{\alpha}_{l,2}$ and either (28) fails or $W_l\left(ml^{CU}\right) > W_l\left(sm^{CU}\right)$.[30] This will help streamline our analysis because it will imply m's preferred PTA with l is always a CU. Condition 1 summarizes.

Condition 1 $\alpha_l \in (\bar{\alpha}_{l,2}, min\{\bar{\alpha}_{l,3}, \bar{\alpha}_l^t(\tau)\})$. *This means that i) for some range of τ, FTA formation but not CU formation is attractive enough to induce l's participation in PTA formation when faced with the threat of being a permanent CU outsider, and ii) whenever FTA or CU formation is attractive enough, m and l hold a CU exclusion incentive.*

We will exploit the area of the parameter space defined by Condition 1 to explain why all CUs are intra–regional yet FTAs are both inter and intra–regional. Thus, it is useful to understand why l might find CU formation more attractive than FTA formation or being a CU outsider once $\alpha_l < \bar{\alpha}_{l,2}$. First, a lower $\bar{\alpha}_{l,2}$ mitigates l's concerns about giving up domestic market access which makes CU formation more attractive relative to being a CU outsider. Second, given our optimal tariff discussion in Section 2.1.2, a lower $\bar{\alpha}_{l,2}$ moves the FTA external tariffs of m and l closer which increases the value of coordinating common external tariffs. From l's view, CU formation becomes more attractive relative to FTA formation. We now proceed to characterize the equilibrium path of agreements by using backward induction.

4.1 Subgames at hub–spoke and insider–outsider networks

The first step in using backward induction to solve for the equilibrium path of PTAs is to solve the EBA in subgames at hub–spoke networks. This task is simple. A pair of spokes j and k form the final FTA leading to global free trade if and only if $W_j\left(g^{FT}\right) > W_j(ih)$ and $W_k\left(g^{FT}\right) > W_k(ih)$. Under Condition 1, this always holds for a small close country but not necessarily for the large country. $W_l\left(g^{FT}\right) < W_l(mh)$ is possible because the benefit of market access to an additional small country may not compensate the large country for the preferential market access it gives up by entering an FTA. Lemma 1 summarizes this simple result (formally, see Lemma 1 of Lake (2013a)).[31]

[30] In our model, the upper bound on market size asymmetry is $\bar{\alpha}_l^t(1) \approx 1.2$ while $\bar{\alpha}_{l,1} \approx 1.08$, $\bar{\alpha}_{l,2} \approx 1.09$ and $\bar{\alpha}_{l,3} \approx 1.18$. Additionally, the definition of $\bar{\alpha}_{l,2}$ and $\alpha_l < \bar{\alpha}_l^t(\tau)$ imply a lower bound on τ is $\underline{\tau} = \frac{3}{5}$.

[31] Note that $W_m\left(g^{FT}\right) > W_m(lh)$ because $f_1(\tau, \alpha_l) = W_m\left(g^{FT}\right) - W_m(lh)$ is decreasing in τ and increasing in α_l but $f_1(1, \bar{\alpha}_{l,2}) > 0$.

Lemma 1 *Assume Condition 1 holds and consider a subgame at the hub–spoke network* (ij, ik)*. If* l *is a spoke and* $W_l(ih) > W_l(g^{FT})$*, the EBA is no agreement meaning* i *remains the hub. Otherwise, the EBA is* (jk) *which yields the free trade network.*

Rolling back to subgames at insider–outsider networks, the key issue is which country (if any) becomes the hub. The EBA for these subgames depend on three main trade offs. The first arises from FTA free riding incentives. To avoid triviality, suppose $W_i(g^{FT}) > W_i(kh)$ for each spoke so that global free trade emerges from hub–spoke networks. Then, i prefers to become a spoke rather than remain an outsider if and only if

$$W_i(kh) + \frac{\beta}{1-\beta} W_i(g^{FT}) > \frac{1}{1-\beta} W_i(jk). \tag{29}$$

Clearly (29) fails if $W_i(jk) > \max\{W_i(kh), W_i(g^{FT})\}$ which is true for l under Condition 1. Thus, l prefers to free ride on the external tariff liberalization of the FTA between s and m rather than form any subsequent FTAs with the small countries. As a result, s and m remain insiders forever if they become insiders. Conversely, (29) clearly holds if $W_i(g^{FT}) > W_i(kh) > W_i(jk)$ which, under Condition 1, is true for a small close country as an outsider. That is, regardless of the hub's identity, a small country wants to participate in FTA formation when it is an outsider.

Nevertheless, the potential emergence of a hub–spoke network in equilibrium and the identity of the hub also depend on incentives faced by insiders. The first incentive, which is the second main trade off alluded to above, arises from the potential for an FTA exclusion incentive. By FTA exclusion incentive, we mean $W_i(ij) > W_i(g^{FT})$: an insider prefers a bilateral FTA over global free trade, which is equivalent to a trilateral FTA, and thus wants to permanently exclude an outsider from a trilateral FTA.

Assuming (for now) spokes form the final FTA that takes a hub–spoke network to global free trade, an insider holding an FTA exclusion incentive faces a trade off. On one hand, becoming the hub is attractive because it affords sole preferential access to each spoke market. On the other hand, global free trade subsequently emerges when the spokes form their own FTA which erodes the value of preferential access enjoyed as the hub. Thus, an insider prefers becoming the hub rather than remaining an insider forever if and only if $W_i(ih) + \frac{\beta}{1-\beta} W_i(g^{FT}) > \frac{1}{1-\beta} W_i(ij)$ which reduces to the Free Trade–Insider (FT–I) condition:[32]

$$\beta < \frac{W_i(ih) - W_i(ij)}{W_i(ih) - W_i(g^{FT})} \equiv \bar{\beta}_i^{FT-I}(\theta). \tag{30}$$

[32] Formally, $\bar{\beta}_i^{FT-I}(\theta)$ depends on the identity of i's insider partner. However, l's FTA partners are (essentially) identical. Moreover, s and m remain insiders if they become insiders meaning the only relevant FT-I condition for s or m as insiders is with l as their insider patrner.

Country i's FT–I condition holds when β is low enough because then the lure of being the hub, albeit temporary, outweighs the subsequent preference erosion. Clearly, i's FT–I condition is only relevant if i has an FTA exclusion incentive. That is, given $W_i(ih) > \max\{W_i(ij), W_i(g^{FT})\}$, then $\bar{\beta}_i^{FT-I}(\theta) \in (0,1)$ if and only if $W_i(ij) > W_i(g^{FT})$. Moreover, because l has a stronger FTA exclusion incentive than smaller countries under Condition 1, it is less willing to participate in FTA expansion and $\bar{\beta}_l^{FT-I}(\theta) < \bar{\beta}_i^{FT-I}(\theta)$ for $i = s, m$.

Underlying the FT–I condition is the fear of preference erosion suffered as the hub which is generated by the anticipation of a spoke–spoke FTA. But what if spokes won't form their own FTA? As discussed above, small spokes always want to form an FTA. However, l refuses FTA formation as a spoke when $W_l(kh) > W_l(g^{FT})$. In this case, the small insider's FT–I condition is no longer relevant because it no longer fears preference erosion given it remains the hub forever upon becoming the hub. As such, l recognizes it will be a spoke forever if it does not become the hub. Thus, l wants to become the hub if and only if $W_l(lh) + \frac{\beta}{1-\beta} W_l(g^{FT}) > \frac{1}{1-\beta} W_l(kh)$. This is the third trade off alluded to above and reduces to the Free Trade–Spoke (FT–K) condition:

$$\beta < \frac{W_l(lh) - W_l(mh)}{W_l(lh) - W_l(g^{FT})} \equiv \bar{\beta}_l^{FT-K}(\theta). \tag{31}$$

l becomes the hub when β is sufficiently small because this puts sufficient (insufficient) weight on the benefit of sole preferential access as the hub (cost of ending up in global free trade). Given $W_l(lh) > W_l(mh)$, then, importantly, $\bar{\beta}_l^{FT-K}(\theta) < 1$ if and only if l refuses to form a spoke–spoke FTA, i.e. $W_l(mh) > W_l(g^{FT})$.

The EBA that emerges in the subgame at an FTA insider-outsider network where l is an insider (say with m) depends on the interaction between the FT–I conditions and l's FT–K condition. When l's FT–I condition holds, $\beta < \bar{\beta}_l^{FT-I}(\theta)$, then s and l find it Pareto dominant to form an FTA which is the EBA. However, when $\beta > \bar{\beta}_l^{FT-I}(\theta)$ the logic underlying the EBA depends on whether l refuses FTA formation as a spoke.

When l engages in FTA formation as a spoke then $\bar{\beta}_l^{FT-K}(\theta) > 1$ and global free trade is eventually attained if either l or m become the hub. Indeed, $\bar{\beta}_m^{FT-I}(\theta) > \bar{\beta}_l^{FT-K}(\theta) > 1$ given Condition 1 implies $\bar{\beta}_l^{FT-I}(\theta) < \bar{\beta}_l^{FT-K}(\theta) < \bar{\beta}_m^{FT-I}(\theta)$. Thus, despite the subsequent preference erosion, m wants to become the hub when $\beta > \bar{\beta}_l^{FT-I}(\theta)$. But, this threat of being discriminated against as a spoke actually induces l to become the hub and enjoy sole preferential access to the spoke markets. Hence, the FTA between s and l is the EBA even though, ideally, l wants to remain an insider.

Conversely, when l refuses FTA formation as a spoke then $\bar{\beta}_l^{FT-K}(\theta) < 1$ and l may not become the hub when $\beta > \bar{\beta}_l^{FT-I}(\theta)$. Of course, m wants to become the hub given it will never suffer preference erosion upon becoming the hub. But the threat of being a permanent spoke only induces l to become the hub when $\beta < \bar{\beta}_l^{FT-K}(\theta)$. Lemma 2 now summarizes.

Lemma 2 *Assume Condition 1 holds and consider a subgame at an insider–outsider network (ij). If s and m are insiders, the EBA is no agreement meaning s and m remain insiders. If l is an insider, say $i = l$, the EBA is (kl) if $\beta < \bar{\beta}_l^{FT-K}(\theta)$ meaning l becomes the hub but the EBA is (jk) if $\beta > \bar{\beta}_l^{FT-K}(\theta)$ meaning j becomes the hub.*

Before rolling back to the subgame at the empty network, we consider the subgame at the CU insider–outsider network. Like the subgame at hub–spoke networks, this subgame is simple. The only possibility of further liberalization following a bilateral CU is expansion to global free trade. However, expansion requires consent of CU insiders and the CU outsider. Given the attractiveness of market access in the large country, the large country and its smaller CU partner (say m) have a CU exclusion incentive. That is, m and l want to exclude s from CU expansion because $W_i\left(ml^{CU}\right) > W_i\left(g^{FT}\right)$ for $i = m, l$. As such, there is no further liberalization if l becomes a CU insider. In contrast, the attractiveness of market access in the large country means the small countries do not have a CU exclusion incentive when they form $\left(sm^{CU}\right)$. But, even though a CU between s and m may harm l, i.e. $W_l(\varnothing) > W_l\left(sm^{CU}\right)$, the cost of giving domestic preferential access to the small countries is large enough relative to the benefits of market access gained that l may refuse to participate in expansion of $\left(sm^{CU}\right)$ to global free trade. Thus, the only bilateral CU that expands to global free trade is $\left(sm^{CU}\right)$ but only when $W_l\left(g^{FT}\right) > W_l\left(sm^{CU}\right)$. Lemma 3 summarizes.

Lemma 3 *Assume Condition 1 holds and consider a subgame at a CU insider–outsider network $\left(ij^{CU}\right)$. If l is the CU outsider and $W_l\left(g^{FT}\right) > W_l\left(sm^{CU}\right)$, the EBA is global free trade. Otherwise, the EBA is no agreement meaning i and j remain CU insiders.*

4.2 Characterizing the equilibrium by solving subgame at empty network

In analyzing the subgame at the empty network, and thus the equilibrium path of agreements, we break the analysis into two cases depending on whether l's FT–K condition holds. When l's FT–K condition holds, i.e. Condition 2 below, l becomes the hub after forming an initial FTA with m because it knows m will become the hub otherwise.

Condition 2 $\beta < min\left\{\bar{\beta}_l^{FT-K}(\theta), 1\right\}$

4.2.1 The large country's FT–K condition holds

Before beginning our characterization of the equilibrium, we summarize some important preferences that countries have over paths of agreements. Given $\alpha_m = \alpha_s + \varepsilon$ for some arbitrarily small $\varepsilon > 0$, s and m's preferences are analogous in the limit as $\varepsilon \to 0$. Thus, we ignore the arbitrarily small range of the parameter space where s and m's preferences are not analogous. Moreover, all else equal, a country prefers to form a PTA with a larger country. Thus, letting $g^*_{i,j}$ denote i's preferred PTA with j and letting $\langle g \rangle$ denote the equilibrium path of agreements starting from g, we have (given the common distance from l to s or m): i) $\langle g^*_{l,m} \rangle \succ_l \langle g^*_{l,s} \rangle \succ_l \langle g^*_{m,l} \rangle$ when $g^*_{l,m} \neq g^*_{m,l}$ and ii) $\langle g^*_{l,m} \rangle \succ_l \langle g \rangle$ iff $\langle g^*_{l,s} \rangle \succ_l \langle g \rangle$. These properties are taken as given from now on.

Four facets of m's preferences over paths of agreements underlie our results. First, a permanent CU with l, i.e. $\langle (ml^{CU}) \rangle = (ml^{CU})$, is Pareto dominant for m. This follows because m can never exploit the FTA flexibility benefit and become the hub since l refuses FTA expansion as an FTA outsider (Lemma 2) while l becomes the hub after being an FTA insider (Condition 2). Second, apart from a permanent CU with l, the only path of agreements m may prefer over that induced by FTA formation with l, i.e. $\langle (ml) \rangle$, is that induced by CU formation with s, i.e. $\langle (sm^{CU}) \rangle$. This follows given m cannot become the hub. Third, m prefers $\langle (sm^{CU}) \rangle$ over a permanent FTA with s or a permanent status quo of no agreements, i.e. $\langle \varnothing \rangle = \varnothing$. Fourth, m prefers to form a permanent FTA with s rather than be a permanent CU outsider. Formally, Lemma 4 summarizes.

Lemma 4 *Assume Conditions 1–2 hold. Given Lemmas 1–3, country m has the following preferences: i) $\langle g^*_{m,l} \rangle = \langle (ml^{CU}) \rangle = (ml^{CU})$ is Pareto dominant, ii) $\langle g^*_{l,m} \rangle = \langle (ml) \rangle \succ_m \langle g \rangle$ for any $g \notin \{(ml^{CU}), (ml), (sm^{CU})\}$, iii) $\langle g^*_{m,s} \rangle = \langle (sm^{CU}) \rangle \succ_m \langle \varnothing \rangle$, and iv) $W_m(sm) > W_m(sl^{CU})$.*

Additionally, three facets of l's preferences over paths of agreements underlie our results. First, the permanent FTA between s and m, i.e. $\langle (sm) \rangle = (sm)$, is Pareto dominant. That is, l finds free riding on the FTA between s and m Pareto dominant. Second, l holds a CU exclusion incentive. Third, l prefers to participate in PTA formation rather than be a permanent CU outsider at least for some α_l and τ. Formally, Lemma 5 summarizes.

Lemma 5 *Assume Conditions 1–2 hold. Given Lemmas 1–3, country l has the following preferences: i) $\langle (sm) \rangle = (sm)$ is Pareto dominant, ii) $W_l(ml^{CU}) > W_l(g^{FT})$, and iii) $\langle g^*_{l,m} \rangle \succ_l \langle (sm^{CU}) \rangle$ for some α_l and τ.*

Given its preferences, l faces an interesting dilemma. On one hand, free riding on an FTA between the small countries is Pareto dominant. Moreover, l may even prefer the permanent status quo of no agreements over its preferred PTA with m (which could be a CU or an FTA). On the other hand, neither of these outcomes may arise if l refuses to participate in liberalization since s and m could form a CU. Indeed, the small countries prefer forming a permanent CU over a permanent FTA or a permanent status quo of no agreements. Thus, the threat of being a CU outsider can induce l's participation in PTA formation given l's preferred type of PTA with m is preferable, at least for some values of α_l and τ, to being a permanent CU outsider. So what is l's preferred PTA with m?

The trade off between the FTA flexibility benefit and the CU coordination benefit determines l's preferred type of PTA with m (as in Lake (2013a)). l's preferred type of PTA is an FTA if and only if $W_l\left(ml\right) + \beta W_l\left(lh\right) + \frac{\beta^2}{1-\beta} W_l\left(g^{FT}\right) > \frac{1}{1-\beta} W_l\left(ml^{CU}\right)$ which, upon rearranging, becomes:

$$\underbrace{\beta\left[\left(W_l\left(lh\right) - W_l\left(ml^{CU}\right)\right) + \frac{\beta}{1-\beta}\left(W_l\left(g^{FT}\right) - W_l\left(ml^{CU}\right)\right)\right]}_{\text{FTA flexibility benefit}} - \underbrace{\left[W_l\left(ml^{CU}\right) - W_l\left(ml\right)\right]}_{\text{CU coordination benefit}} > 0. \tag{32}$$

That is, l prefers an FTA over a CU if and only if the FTA flexibility benefit dominates the CU coordination benefit. Unlike FTA formation, CU formation affords members the opportunity to coordinate external tariffs. Thus, $W_l\left(ml^{CU}\right) - W_l\left(ml\right)$ represents the CU coordination benefit. Unlike CU formation, FTA formation affords an insider the flexibility to become the hub and thus have sole preferential access in each spoke market. Given the spokes will then form their own FTA, the square bracketed term represents the FTA flexibility benefit.

Solving (32), the FTA flexibility benefit dominates the CU coordination benefit iff $\beta \in \left(\underline{\beta}_l^{Flex}\left(\theta\right), \bar{\beta}_l^{Flex}\left(\theta\right)\right)$. Clearly, $\underline{\beta}_l^{Flex}\left(\theta\right) > 0$ only if the CU coordination benefit is positive. However, this is not always true. While CU formation enables external tariff coordination, market size asymmetry between CU members drives a wedge between their ideal external tariffs. Thus, l may prefer to set its external tariff independently. In this case, the FTA flexibility benefit dominates the CU coordination benefit for $\beta \in [0, \bar{\beta}_l^{Flex}\left(\theta\right))$. Conversely, the CU exclusion incentive implies $\bar{\beta}_l^{Flex}\left(\theta\right) < 1$. As β approaches 1, the part of the FTA flexibility due to having sole preferential access to each spoke market vanishes leaving $W_l\left(g^{FT}\right) - W_l\left(ml^{CU}\right) < 0$. Thus, the FTA flexibility benefit dominates the CU coordination benefit when β lies in an intermediate range since this places sufficient weight on the part of the FTA flexibility benefit stemming from having sole preferential access to the spoke markets as the hub.

In characterizing the equilibrium path of agreements, we break down the analysis according to the degree of geographic asymmetry.

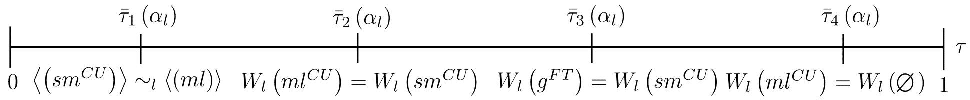

Figure 2: Critical values of transport costs τ

When intra and inter–regional agreements are possible

We begin with larger degrees of geographic asymmetry meaning τ is lower and the large country is further away from the smaller countries. To this end, define $\bar{\tau}_1(\alpha_l)$ such that any greater distance between the large and small countries is so great that, despite the prospect of being a CU outsider, the large country refuses PTA formation with the small countries. Formally, $\langle (sm^{CU}) \rangle \succ_l \langle g \rangle$ for $g \in \{(ml^{CU}), (ml)\}$ if and only if $\tau < \bar{\tau}_1(\alpha_l)$ (Figure 2 depicts all critical values of τ). Additionally, define $\bar{\tau}_2(\alpha_l)$ such that $\tau \in (\bar{\tau}_1(\alpha_l), \bar{\tau}_2(\alpha_l))$ reduces the distance between the large and small countries to the extent that the flexibility benefit afforded by FTAs, but not the coordination benefit afforded by CUs, could induce the large country's participation in PTA formation to ensure it is not a CU outsider. That is, $W_l(sm^{CU}) > W_l(ml^{CU})$ if and only if $\tau < \bar{\tau}_2(\alpha_l)$.

Formally, l prefers to form an FTA with m rather than remain a permanent CU outsider if and only if

$$W_l(ml) + \beta W_l(lh) + \frac{\beta^2}{1-\beta} W_l(g^{FT}) > \frac{1}{1-\beta} W_l(sm^{CU}). \tag{33}$$

Thus, analogous to (32) and $\beta \in \left(\underline{\beta}_l^{Flex}(\theta), \bar{\beta}_l^{Flex}(\theta)\right)$, we see that (33) holds and l prefers to form an FTA with m if and only $\beta \in \left(\underline{\beta}_l^{*Flex}(\theta), \bar{\beta}_l^{*Flex}(\theta)\right)$ because an intermediate β places sufficient weight on the hub benefits of sole preferential access to the spoke markets.[33] A partial characterization of the equilibrium now follows which is illustrated in Figure 3.

Proposition 1 *Assume Conditions 1–2 hold and $\tau < \bar{\tau}_2(\alpha_l)$. The equilibrium path of agreements is (sm^{CU}) if $\tau < \bar{\tau}_1(\alpha_l)$. For $\tau \in (\bar{\tau}_1(\alpha_l), \bar{\tau}_2(\alpha_l))$, the equilibrium path of agreements is (sm^{CU}) if $\beta \notin \left(\underline{\beta}^{*Flex}(\theta), \bar{\beta}^{*Flex}(\theta)\right)$ but (ml, sl, sm) if $\beta \in \left(\underline{\beta}^{*Flex}(\theta), \bar{\beta}^{*Flex}(\theta)\right)$.*

Proposition 1 says there exists a degree of geographic asymmetry, i.e. $\bar{\tau}_2(\alpha_l)$, above which any PTA involving the large country must be an FTA and, in this case, the large country will be the hub on the path to global free trade. Moreover, in the absence of any FTAs involving the large country, the small close countries form a CU. Since this result holds for sufficient

[33] $W_l(sm^{CU}) > W_l(g^{FT})$ follows from Lemma 5 and $\tau < \bar{\tau}_2(\alpha_l)$ because $W_l(sm^{CU}) > W_l(ml^{CU}) > W_l(g^{FT})$.

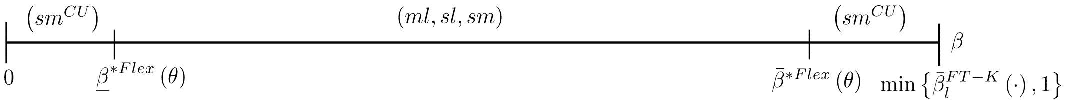

Figure 3: Equilibrium path of agreements. Moderate degree of market size asymmetry and $\tau \in (\bar{\tau}_1(\alpha_l), \bar{\tau}_2(\alpha_l))$

geographic asymmetry, there is a meaningful distinction between intra and inter–regional agreements. Thus, we interpret this result as matching the striking observations that i) all CUs observed in reality are intra–regional, ii) observed FTAs are both intra and inter–regional and iii) the empirical observation of Chen and Joshi (2010, p.244) that the large country enjoys the benefit of overlapping FTAs because the closer countries place significant value on market access to the large country.

The intuition behind this equilibrium structure is quite simple. Given $\tau < \bar{\tau}_2(\alpha_l)$, geographic asymmetry is large enough that CU formation is not attractive enough to induce the large country's participation in liberalization despite the threat of being discriminated against as a CU outsider. However, FTA formation may be attractive enough to induce the large country's participation.

Obviously, a necessary condition for FTA formation is that the large country finds FTA formation more attractive than CU formation. This is possible because of the FTA flexibility benefit: the large far country values the ability to have overlapping FTAs with the close countries (at least temporarily) because it gains sole preferential access to these markets. The large far country cannot achieve this flexibility via a CU. In addition to these incentives of the large country, equilibrium FTA formation requires the medium country prefers the inter–regional FTA with the large country over the intra–regional CU. Given $\tau < \bar{\tau}_2(\alpha_l)$ implies the large country refuses expansion of (sm^{CU}) to global free trade, an inter–regional FTA not only offers m preferential market access to the large country's market but also the eventual attainment of global free trade. Thus, the medium country prefers an inter–regional FTA that eventually leads to global free trade over an intra–regional CU.

In contrast, when the large country refuses to participate in PTA formation, the close countries form an intra–regional CU. CU formation allows the small countries to exploit the coordination benefit given the large country will not participate in any liberalization following an intra–regional CU or FTA.

All agreements are intra–regional

We now focus on the range of transport costs $\tau > \bar{\tau}_2(\alpha_l)$ which is where the trade off between the FTA flexibility and CU coordination benefits starts to bind. To this end, we introduce some more critical values of τ (see Figure 2). Because these conditions define a sufficiently low degree of geographic asymmetry, we now interpret all PTAs as intra–regional.

The first critical value, $\bar{\tau}_3(\alpha_l)$, plays an important role in our second main result below because it determines whether a CU between the small countries expands to global free trade. Thus, it affects whether (say) m can credibly threaten a PTA with s in response to l proposing an FTA rather than a CU with m. Specifically, $W_l\left(g^{FT}\right) > W_l\left(sm^{CU}\right)$ if and only if $\tau > \bar{\tau}_3(\alpha_l)$. The importance of the second critical value, $\bar{\tau}_4(\alpha_l)$, lies in determining whether $\left(ml^{CU}\right)$ is a Nash agreement which affects whether particular deviations are self enforcing. Specifically, $W_l\left(ml^{CU}\right) > W_l(\varnothing)$ if and only if $\tau > \bar{\tau}_4(\alpha_l)$.

We now proceed to consider the case where the FTA flexibility benefit dominates the CU coordination benefit. To characterize the equilibrium path of agreements, we introduce some critical values of β. First, $\bar{\beta}^m(\theta)$ is defined such that m prefers FTA formation with l over CU formation with s, i.e. $\langle(ml)\rangle \succ_m \left\langle\left(sm^{CU}\right)\right\rangle$, if and only if $\beta < \bar{\beta}^m(\theta)$. Second, $\bar{\beta}^s(\theta)$ is defined such that s prefers to be an FTA outsider rather than a permanent FTA insider with m, i.e. $\langle(ml)\rangle \succ_s \langle(sm)\rangle$, if and only if $\beta > \bar{\beta}^s(\theta)$. Third, l prefers FTA formation over the permanent status quo of no agreements, i.e. $\langle(ml)\rangle \succ_l \langle\varnothing\rangle$, if and only if $\beta \in \left(\underline{\beta}^l(\theta), \bar{\beta}^l(\theta)\right)$. Also, we let $G_1 \equiv \left\{(sm), \left(sm^{CU}\right), \left(ml^{CU}\right), (ml, sl, sm), (sl, ml, sm)\right\}$. Proposition 2 now follows which is illustrated in Figures 4–5.

Proposition 2 *Assume Conditions 1–2 hold and* $\tau > \bar{\tau}_2(\alpha_l)$. *Suppose* $\beta \in \left(\underline{\beta}^{Flex}(\theta), \bar{\beta}^{Flex}(\theta)\right)$ *so that the FTA flexibility benefit dominates the CU coordination benefit.*

i) The equilibrium path of agreements is (ml, sl, sm) *unless either* $\beta \in \left(\bar{\beta}^m(\theta), \bar{\beta}_l^{Flex}(\theta)\right)$ *or* $\beta \in \left(\underline{\beta}^l(\theta), \min\left\{\bar{\beta}^l(\theta), \bar{\beta}^s(\theta)\right\}\right)$.

ii) If $\beta \in \left(\underline{\beta}^l(\theta), \min\left\{\bar{\beta}^l(\theta), \bar{\beta}^s(\theta)\right\}\right)$, *the equilibrium paths of agreements are* $\{(ml, sl, sm), (sm)\}$.

iii) If $\beta \in \left(\bar{\beta}^m(\theta), \bar{\beta}_l^{Flex}(\theta)\right)$, *the equilibrium paths of agreements are* $\left(ml^{CU}\right)$ *if* $\tau \in (\bar{\tau}_3(\alpha_l), \bar{\tau}_4(\alpha_l))$ *and* G_1 *if* $\tau > \bar{\tau}_4(\alpha_l)$.

When the FTA flexibility benefit dominates the CU coordination benefit, the equilibrium path of agreements is unique for some intermediate range of β and, here, l becomes the hub on the path to global free trade. The two forces working against the role of the FTA flexibility benefit in delivering a unique equilibrium are: i) m's ability to credibly threaten l with formation of $\left(sm^{CU}\right)$ so that l offers m a CU rather than an FTA even though l prefers FTA formation, and ii) the ability of s and l to coordinate in a way that ensures s and m form an FTA.

Given l prefers FTA over CU formation with m yet m prefers CU over FTA formation with l, m and l have different views over the type of PTA they should form. As such, m

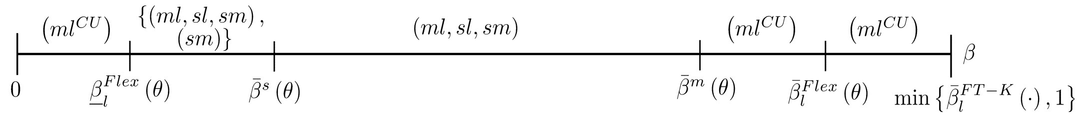

Figure 4: Equilibrium path of agreements. Moderate degree of market size asymmetry and $\tau \in (\bar{\tau}_2(\alpha_l), \bar{\tau}_4(\alpha_l))$.

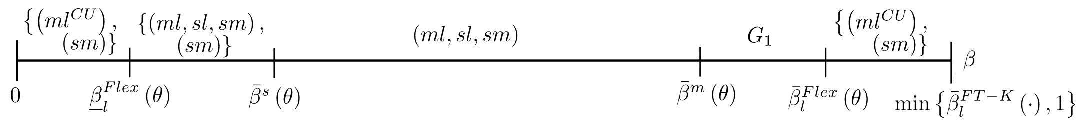

Figure 5: Equilibrium path of agreements. Moderate degree of market size asymmetry and $\tau > \bar{\tau}_4(\alpha_l)$.

would like to use the threat of forming a CU with s to induce l's participation in CU rather than FTA formation. Indeed, m can do this when $\beta \in \left(\bar{\beta}^m(\theta), \bar{\beta}_l^{Flex}(\theta)\right)$ because then m prefers CU formation with s over FTA formation with l. However, whether $\left(ml^{CU}\right)$ is the unique equilibrium path of agreements in this case depends on whether s and l have a self enforcing deviation from $\left(ml^{CU}\right)$ to (sl). Since s prefers $\langle\left(sm^{CU}\right)\rangle$ over $\langle(sl)\rangle$, their deviation is self enforcing if only if $\left(ml^{CU}\right)$ is a Nash agreement. That is, after s and l deviate from $\left(ml^{CU}\right)$ to (sl), s will not unilaterally deviate to $a_s(\varnothing) = m^{CU}$ if and only if the fear of $\left(ml^{CU}\right)$ as a Nash agreement deters such a deviation. Hence, $\left(ml^{CU}\right)$ is unique when $\beta \in \left(\bar{\beta}^m(\theta), \bar{\beta}_l^{Flex}(\theta)\right)$ and $\tau \in (\bar{\tau}_3(\alpha_l), \bar{\tau}_4(\alpha_l))$. But $\beta \in \left(\bar{\beta}^m(\theta), \bar{\beta}_l^{Flex}(\theta)\right)$ and $\tau > \bar{\tau}_4(\alpha_l)$ implies there is a self enforcing deviation from any action profile. Thus, there are multiple equilibrium paths of agreements because the EBAs for the subgame at the empty network are the EBAs between any two country coalition S and the third country $N \setminus S$.

The second force working against (ml, sl, sm) as the unique equilibrium path of agreements is that s and l may prefer a permanent FTA between s and m. Indeed, free riding on the external tariff liberalization between s and m is Pareto dominant for l. But, s prefers this only when $\beta < \bar{\beta}^s(\theta)$ because then the myopic benefit of not being discriminated against as an outsider outweighs the benefit of subsequent access to l's market as a spoke and under global free trade. Even if s and l benefit from this joint deviation to $a_l(\varnothing) = \phi$ and $a_s(\varnothing) = m$, and even though m's best response is $a_m(\varnothing) = s$, the deviation may not be self enforcing if s then wants to deviate unilaterally to $a_s(\varnothing) = m^{CU}$.

Despite s and m preferring $\langle\left(sm^{CU}\right)\rangle$ over $\langle(sm)\rangle$, the subsequent unilateral deviation by s will be deterred if a PTA between m and l is a Nash network since s will anticipate such an outcome and any such PTA makes s worse off relative to $\langle(sm)\rangle$. Indeed, given

$\bar{\beta}^m(\theta) > \bar{\beta}^s(\theta)$, (ml) is a Nash agreement when $\beta \in \left(\underline{\beta}^l(\theta), \bar{\beta}^l(\theta)\right)$. Thus, s and l have a self enforcing deviation from (ml) to (sm) when $\beta \in \left(\underline{\beta}^l(\theta), \min\left\{\bar{\beta}^l(\theta), \bar{\beta}^s(\theta)\right\}\right)$. While (ml) is not an EBA in this case, neither is (sm) because m has a self enforcing deviation from $a_m(\varnothing) = s$ to $a_m(\varnothing) = l$ given (ml) is an EBA between $S = sl$ and $N \setminus S = m$. Indeed, like the previous paragraph, there is a self enforcing deviation from any action profile. Nevertheless, (sm) and (ml) are the only EBAs between any two country coalition S and the third country $N \setminus S$ which delivers (sm) and (ml, sl, sm) as the equilibrium paths of agreements.

Given the equilibrium structure in Proposition 2, how does rising geographic asymmetry affect the extent to which FTAs arise in equilibrium? A key observation is that rising geographic asymmetry creates a discontinuity in the equilibrium structure through its effect on $\bar{\beta}^m(\theta)$. Proposition 2 says CU rather than FTA formation arises when $\beta \in \left(\bar{\beta}^m(\theta), \bar{\beta}_l^{Flex}(\theta)\right)$ because m prefers a CU with s over an FTA with l and, given m's credible threat of $\left(sm^{CU}\right)$, l offers m its preferred type of PTA which is a CU. However, whether m prefers a CU with s or an FTA with l depends on the degree of geographic asymmetry. Rising geographic asymmetry reduces l's incentive to participate in expansion of $\left(sm^{CU}\right)$ to global free trade and, once $\tau < \bar{\tau}_3(\alpha_l)$, l blocks expansion of $\left(sm^{CU}\right)$. From m's perspective, this increases the attractiveness of (ml) over $\left(sm^{CU}\right)$. Indeed, m now prefers (ml) over $\left(sm^{CU}\right)$.[34] Given m can no longer credibly threaten a CU with s in the face of an FTA offer from l, m accepts the FTA offer from l and FTA rather than CU formation occurs in equilibrium.

This role of geographic asymmetry in explaining FTA formation relative to CU formation is our second main result. Even though our first main result was an explanation for why CUs are intra–regional yet FTAs are both intra and inter–regional (see Proposition 1), that result can also be interpreted as providing a mechanism linking high degrees of geographic asymmetry with FTA rather than CU formation. The mechanism there is that, given sufficient geographic asymmetry, FTA formation is the only type of liberalization attractive enough to induce l's participation when faced with the threat of being discriminated against as a CU outsider. And the attractiveness of FTA over CU formation there stems from the FTA flexibility benefit. Our second main result complements this interpretation by providing a mechanism linking rising geographic asymmetry and the prevalence of FTAs relative to CUs when geographic asymmetry is small enough that all PTAs are intra–regional. The mechanism here relies on rising geographic asymmetry affecting l's incentive to participate in expansion of $\left(sm^{CU}\right)$ to global free trade and thus whether m prefers FTA formation with l or CU formation with s. Thus, the model links geographic asymmetry to the prevalence of

[34] That is, $\min\left\{W_m(ml), W_m\left(g^{FT}\right)\right\} > W_m\left(sm^{CU}\right)$ and even though $W_m(lh) < W_m\left(sm^{CU}\right)$ is possible, $\langle(ml)\rangle \succ_m \left\langle\left(sm^{CU}\right)\right\rangle$ always holds.

FTAs both when all PTAs are intra–regional and when PTAs are inter and intra–regional.

We now move on to Proposition 3 which characterizes the equilibrium path of agreements when the CU coordination benefit dominates the FTA flexibility benefit in. Figures 4–5 illustrate Proposition 3.

Proposition 3 *Assume Conditions 1–2 hold and* $\tau > \bar{\tau}_2(\alpha_l)$*. Suppose* $\beta \notin \left(\underline{\beta}^{Flex}(\theta), \bar{\beta}^{Flex}(\theta)\right)$ *so that the CU coordination benefit dominates the FTA flexibility benefit. Then, the equilibrium path of agreements are* $\left(ml^{CU}\right)$ *if* $\tau \in (\bar{\tau}_2(\alpha_l), \bar{\tau}_4(\alpha_l))$ *but* $\left\{\left(ml^{CU}\right), (sm)\right\}$ *if* $\tau > \bar{\tau}_4(\alpha_l)$*.*

When the CU coordination benefit dominates the FTA flexibility benefit, a CU between the large and one of the small countries is an equilibrium path of agreements but it is not always unique. The intuition determining whether $\left(ml^{CU}\right)$ is unique is the same intuition described above. s and l prefer prefer (sm) over $\left(ml^{CU}\right)$ and m's best response to $a_l(\varnothing) = \phi$ and $a_s(\varnothing) = m$ is to accept the FTA with s. However, whether this joint deviation by s and l is self enforcing depends on whether s will subsequently unilaterally deviate to $a_s(\varnothing) = m^{CU}$. Whether s unilaterally deviates depends on whether $\left(ml^{CU}\right)$ is a Nash agreement. If so, s will not subsequently deviate from $a_s(\varnothing) = m$ to $a_s(\varnothing) = m^{CU}$ because it anticipates $\left(ml^{CU}\right)$ will result which makes it worse off relative to (sm). However, s will deviate if $\left(ml^{CU}\right)$ is not a Nash agreement because then, given $a_s(\varnothing) = m^{CU}$, the unique Nash agreement is $\left(sm^{CU}\right)$. Thus, $\left(ml^{CU}\right)$ is the unique EBA, and equilibrium path of agreements, only for $\tau \in (\bar{\tau}_2(\alpha_l), \bar{\tau}_4(\alpha_l))$.

When $\tau > \bar{\tau}_4(\alpha_l)$, (sm) is not the unique EBA either because m has a self enforcing deviation from $a_m(\varnothing) = s$ to $a_m(\varnothing) = l^{CU}$ given $\left(ml^{CU}\right)$ is an EBA between $S = sl$ and $N \setminus S = m$. Indeed, like earlier, there is a self enforcing deviation from any action profile. Nevertheless, (sm) and $\left(ml^{CU}\right)$ are the only EBAs between any two country coalition S and the third country $N \setminus S$ which delivers (sm) and $\left(ml^{CU}\right)$ as the equilibrium paths of agreements.

4.2.2 The large country's FT–K condition fails

Now we consider the case where $\beta > \bar{\beta}_l^{FT-K}(\theta)$. That is, conditional on FTA formation with m, l refuses to become the hub despite knowing that m will thus become the hub. For exposition, this is recorded as Condition 3.

Condition 3 $\beta > \bar{\beta}_l^{FT-K}(\theta)$

For ease of illustration, we also assume that $\langle\varnothing\rangle \succ_l \left\langle g^*_{l,m}\right\rangle$ where $g^*_{l,m}$ denotes l's preferred type of PTA with m. We also define $\bar{\beta}_l^{CU-K}(\theta)$ such that $\frac{1}{1-\beta} W_l\left(ml^{CU}\right) > W_l(ml) +$

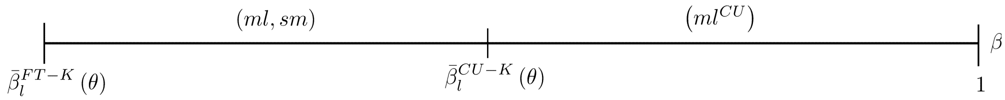

Figure 6: Equilibrium path of agreements. Moderate degree of market size asymmetry and $\beta > \bar{\beta}_l^{FT-K}(\theta)$.

$\frac{\beta}{1-\beta} W_l(mh)$, i.e. $\langle (ml^{CU}) \rangle \succ_l \langle (ml) \rangle$, if and only if $\beta > \bar{\beta}_l^{CU-K}(\theta)$. The following proposition presents a simple characterization of the equilibrium with the first part illustrated in Figure 6.

Proposition 4 *Assume Conditions 1 and 3 hold except that $g^*_{m,l} = (ml^{CU})$ or $g^*_{m,l} = (ml)$. If l prefers PTA formation with m over being a permanent CU outsider, i.e. $\langle g^*_{l,m} \rangle \succ_l \langle (sm^{CU}) \rangle = (sm^{CU})$, then the equilibrium path of agreements is (ml, sm) if $\beta < \bar{\beta}_l^{CU-K}(\theta)$ but (ml^{CU}) if $\beta > \bar{\beta}_l^{CU-K}(\theta)$. Otherwise, the equilibrium path of agreements is (sm^{CU}).*

Unlike earlier propositions, a small country can emerge as the hub in equilibrium. However, no further liberalization occurs once this happens. Even though a small outsider country prefers to form an FTA with the large rather than the other small country, the large country refuses to become the hub when $\beta > \bar{\beta}_l^{FT-K}(\theta)$. A necessary and sufficient condition for $\bar{\beta}_l^{FT-K}(\theta) < 1$ is $W_l(mh) > W_l(g^{FT})$. That is, when l refuses FTA formation as a spoke it may also choose to forego temporary sole preferential access in both spoke markets as the hub in order to ensure global free trade is not attained. In such cases, a smaller country becomes the hub given it faces no threat of preference erosion.

The logic underlying the equilibrium structure closely follows that of earlier propositions. If PTA formation is not attractive enough to induce l's participation in liberalization when threatened with being a permanent CU outsider, the small countries form their own CU. This logic follows Proposition 1. Conversely, when PTA formation is attractive enough the logic of the equilibrium structure follows that of Proposition 2 where (ml, sl, sm) is unique: l can force m to accept l's preferred PTA because m cannot respond by credibly threatening a CU with s. However, there is one twist in the logic. Unlike earlier, the lure of becoming the hub means m prefers an FTA rather than a CU with l. Indeed, m now prefers either PTA with l over any PTA with s. Nevertheless, $\langle \varnothing \rangle \succ_l \langle g^*_{l,m} \rangle$ implies neither type of PTA between m and l is a Nash agreement meaning s and l have no self enforcing deviation from (ml) or (ml^{CU}) to (sm). As such, the logic of the equilibrium structure follows that of Proposition 2 where (ml, sm, sl) is unique: the equilibrium path of agreements is (ml, sm) when $\beta < \bar{\beta}_l^{CU-K}(\theta)$ but (ml^{CU}) when $\beta > \bar{\beta}_l^{CU-K}(\theta)$.

So how does geographic asymmetry affect the equilibrium structure here? Via Proposition 4, the role of geographic asymmetry depends on how greater geographic asymmetry affects $\bar{\beta}_l^{CU-K}(\theta)$. Given the definition of $\bar{\beta}_l^{CU-K}(\theta)$, it follows that

$$\bar{\beta}_l^{CU-K}(\theta) = \frac{W_l(ml) - W_l\left(ml^{CU}\right)}{W_l(ml) - W_l(mh)}. \tag{34}$$

Given the discrimination faced as a spoke relative to an FTA insider implies $W_l(ml) > W_l(kh)$, then $\bar{\beta}_l^{CU-K}(\theta) > 0$ requires $W_l(ml) > W_l\left(ml^{CU}\right)$. That is, l prefers FTA over CU formation only if there is a negative CU coordination benefit for l. Indeed, this can hold because market size and geographic asymmetry drive a wedge between the ideal external tariffs of each CU member. As we discussed in Section 2.1.2, m sets a larger external tariff than l in the absence of geographic asymmetry but rising geographic asymmetry mitigates this effect. As such, rising geographic asymmetry weakens l's desire to independently set external tariffs which decreases $W_l(ml) - W_l\left(ml^{CU}\right)$. Moreover, rising geographic asymmetry magnifies the degree of discrimination faced by l as a spoke meaning $W_l(ml) - W_l(mh)$ rises. Thus, as Figure 6 illustrates, greater geographic asymmetry reduces $\bar{\beta}_l^{CU-K}(\theta)$ and thus decreases the extent that FTAs emerge in equilibrium.

5 Equilibrium path of agreements under large market size asymmetry

While our analysis focuses on the equilibrium path of agreements under a moderate degree of market size asymmetry, we finish by characterizing the equilibrium path of agreements when market size asymmetry is "large". By "large", we mean α_l exceeds the upper bound $\bar{\alpha}_{l,3}$ that we imposed in the previous section. Condition 4 records our definition but the essence is simple: market size asymmetry is so great that, regardless of the degree of geographic asymmetry, not even the threat of being a CU outsider will induce the large country's participation in liberalization.

Condition 4 *$\alpha > \bar{\alpha}_{l,3}$ meaning $\left\langle\left(sm^{CU}\right)\right\rangle \succ_l \langle g\rangle$ for $g \in \left\{\left(ml^{CU}\right), (ml)\right\}$ and for any τ.*

The equilibrium outcome here is rather obvious.

Proposition 5 *Assume Condition 4 holds. The equilibrium path of agreements is $\left(sm^{CU}\right)$.*

Since the large country refuses to participate in trade liberalization no matter the type of PTA formed by the small countries, the small countries form their preferred PTA. Since

l's refusal eliminates any FTA flexibility benefit, the small countries form a CU to exploit the CU coordination benefit.

6 Conclusion

We began our paper by describing two striking but often overlooked characteristics of PTA formation: i) unlike FTAs which are both inter and intra–regional, CUs are only intra–regional and ii) FTAs are far more prevalent than CUs. Our model provides mechanisms that help explain these observations and these mechanisms fundamentally rely on the model's dynamic nature.

With sufficient geographic asymmetry, a meaningful distinction between intra and inter–regional agreements exists. We show that when there is a moderate degree of market size asymmetry, there is a degree of geographic asymmetry above which the unique equilibrium is either an intra–regional CU or a path of inter followed by intra–regional FTAs. This matches the first overlooked characteristic just described. This result rests on the fact that, in this range of the parameter space, 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 permanent CU outsider. In turn, this results from an inherent dynamic flexibility benefit of FTAs in that, unlike individual CU members, individual FTA members have the flexibility to form their own subsequent agreements. As such, a path of inter followed by intra–regional FTAs emerge when the large country participates in liberalization which happens when this FTA flexibility is large enough. Otherwise, an intra–regional CU emerges.

This explanation also helps explain why FTAs are so prevalent relative to CUs which is the second overlooked characteristic of PTA formation described above. However, the model provides a separate mechanism linking geographic asymmetry and FTA prevalence when geographic asymmetry is below the threshold described above. Given the low degree of geographic asymmetry here, we interpret all agreements in this area of the parameter space as intra–regional. A necessary condition for FTA formation here is that a small close country prefers an FTA with the larger far country over a CU with the other small close country. However, this preference depends on the degree of geographic asymmetry. Rising geographic asymmetry reduces the far country's incentive to participate in expansion of a small–small CU to global free trade. In turn, the close country views an FTA with the far country as relatively more attractive than a CU with the other close country and, at some point, prefers an FTA with the far country. Thus, the model provides mechanisms linking higher degrees of geographic asymmetry with the prevalence of FTA formation in contexts where all agreements are intra–regional and where agreements are inter or intra–regional.

References

Aghion, P., Antrās, P., Helpman, E., 2007. Negotiating free trade. Journal of International Economics 73 (1), 1–30.

Appelbaum, E., Melatos, M., 2013. How does uncertainty affect the choice of trade agreements?

Bagwell, K., Staiger, R., 1997a. Multilateral tariff cooperation during the formation of customs unions. Journal of International Economics 42 (1), 91–123.

Bagwell, K., Staiger, R., 1997b. Multilateral tariff cooperation during the formation of free trade areas. International Economic Review 38 (2), 291–320.

Bagwell, K., Staiger, R., 1999. Regionalism and multilateral tariff cooperation. In: Pigott, J., Woodland, A. (Eds.), International trade policy and the Pacific rim. Macmillan.

Bagwell, K., Staiger, R. W., 2010. Backward stealing and forward manipulation in the WTO. Journal of International Economics 82 (1), 49–62.

Baier, S. L., Bergstrand, J. H., Clance, M. W., 2014. Preliminary examination of heterogeneous effects of free trade agreements. Mimeo.

Baier, S. L., Bergstrand, J. H., 2004. Economic determinants of free trade agreements. Journal of International Economics 64 (1), 29–63.

Bernheim, B., Peleg, B., Whinston, M., 1987. Coalition-proof Nash equilibria I. concepts. Journal of Economic Theory 42 (1), 1–12.

Bond, E. W., Riezman, R. G., Syropoulos, C., 2004. A strategic and welfare theoretic analysis of free trade areas. Journal of International Economics 64 (1), 1–27.

Broda, C., Limao, N., Weinstein, D. E., 2008. Optimal tariffs and market power: the evidence. The American Economic Review 98 (5), 2032–2065.

Chen, M., Joshi, S., 2010. Third-country effects on the formation of free trade agreements. Journal of International Economics 82 (2), 238–248.

Diamantoudi, E., 2003. Equilibrium binding agreements under diverse behavioral assumptions. Economic Theory 22 (2), 431–446.

Dutta, B., Ghosal, S., Ray, D., 2005. Farsighted network formation. Journal of Economic Theory 122 (2), 143–164.

Egger, P., Larch, M., 2008. Interdependent preferential trade agreement memberships: An empirical analysis. Journal of International Economics 76 (2), 384–399.

Eichengreen, B., Irwin, D., 1998. The role of history in trade flows. In: M. Canzoneri, W. J. E., Grilli, V. (Eds.), The Regionalization of the World Economy. University of Chicago Press.

Estevadeordal, A., Freund, C., Ornelas, E., 2008. Does regionalism affect trade liberalization toward nonmembers? The Quarterly Journal of Economics 123 (4), 1531–1575.

Facchini, G., Silva, P., Willmann, G., 2012. The customs union issue: Why do we observe so few of them? Journal of International Economics.

Feenstra, R. C., 2004. Advanced international trade: theory and evidence. Princeton University Press.

Freund, C., McLaren, J., 1999. On the dynamics of trade diversion: Evidence from four trade blocks. Board of Governors of the Federal Reserve System, International Finance Discussion Paper No. 637.

Furusawa, T., Konishi, H., 2007. Free trade networks. Journal of International Economics 72 (2), 310–335.

Gatsios, K., Karp, L., 1991. Delegation games in customs unions. The Review of Economic Studies 58 (2), 391–397.

Jackson, M., 2008. Social and economic networks. Princeton University Press.

Lake, J., 2013a. Dynamic endogenous formation of trade agreements: flexibility versus coordination. Mimeo (1303).

Lake, J., 2013b. Free trade agreements as dynamic farsighted networks. Mimeo (1304).

Ludema, R., 1991. International trade bargaining and the Most-Favored-Nation clause. Economics & Politics 3 (1), 1–20.

Ludema, R. D., 2002. Increasing returns, multinationals and geography of preferential trade agreements. Journal of International Economics 56 (2), 329–358.

McLaren, J., 2002. A theory of insidious regionalism. Quarterly Journal of Economics 117 (2), 571–608.

Melatos, M., Dunn, S., 2013. Flexibility in trade bloc design. Mimeo.

Melatos, M., Woodland, A., 2007. Endogenous trade bloc formation in an asymmetric world. European Economic Review 51 (4), 901–924.

Missios, P., Saggi, K., Yildiz, H., 2013. The implications of alternative forms of bilateralism for multilateralism: Free trade agreements vs. customs unions. Mimeo.

Mukunoki, H., Tachi, K., 2006. Multilateralism and hub-and-spoke bilateralism. Review of International Economics 14 (4), 658–674.

Ornelas, E., 2008. Feasible multilateralism and the effects of regionalism. Journal of International Economics 74 (1), 202–224.

Ornelas, E., Liu, X., 2012. Free trade agreements and the consolidation of democracy. Mimeo.

Ray, D., Vohra, R., 1997. Equilibrium binding agreements. Journal of Economic Theory 73 (1), 30–78.

Riezman, R., 1999. Can bilateral trade agreements help to induce free trade? Canadian Journal of Economics 32 (3), 751–766.

Roberts, M., Tybout, J., 1997. The decision to export in colombia: an empirical model of entry with sunk costs. American Economic Review 87 (4), 545–564.

Saggi, K., Woodland, A., Yildiz, H. M., 2013. On the relationship between preferential and multilateral trade liberalization: the case of customs unions. American Economic Journal: Microeconomics 5 (1), 63–99.

Saggi, K., Yildiz, H., 2010. Bilateralism, multilateralism, and the quest for global free trade. Journal of International Economics 81 (1), 26–37.

Saggi, K., Yildiz, H. M., 2009. Optimal tariffs of preferential trade agreements and the tariff complementarity effect. Indian Growth and Development Review 2 (1), 5–17.

Seidmann, D., 2009. Preferential trading arrangements as strategic positioning. Journal of International Economics 79, 143–159.

Soegaard, C., 2013. An oligopolistic theory of regional trade agreements. Tech. rep.

Syropoulos, C., 2003. Rules for the disposition of tariff revenues and the determination of common external tariffs in Customs Unions. Journal of International Economics 60 (2), 387–416.

WTO, 2011. World Trade Report 2011. The WTO and preferential trade agreements: From co-existence to coherence.

Zissimos, B., 2011. Why are trade agreements regional? Review of International Economics 19 (1), 32–45.

7 Appendix

A Welfare

We report welfare levels for country i under different networks g as a function of an arbitrary tariff vector $\mathbf{t}^g$ where, for any country i, $\mathbf{t}^g = (t_{ij}^g, t_{ik}^g)$. With a slight abuse of notation, we let (for example) $t_{ik}^g \equiv t_{ik}(g)$.

$$W_i(g) = \sum_z CS_i^z(g) + \sum_z PS_i^z(g) + TR_i(g),\ i = s, m, l$$

where

$$\begin{aligned}\sum_z CS_s^z(g) &= \frac{1}{2}[1-\tau(\frac{\tau^2(t_{ls}^g + t_{lm}^g) + \alpha_l}{(1+2\tau^2)} - t_{ls}(g))]^2 + \frac{1}{2}[1-\frac{\tau^2 t_{sl}^g + 1 + t_{sm}^g + \tau(\alpha_l - 1)}{(2+\tau^2)}]^2 \\ &+ \frac{1}{2}[1-\frac{\tau^2 t_{ml}(g) + 1 + t_{sm}^g + \tau(\alpha_l - 1)}{(2+\tau^2)} + t_{ms}^g]^2\end{aligned}$$

$$\begin{aligned}\sum_z CS_l^z(g) &= \frac{1}{2}[\alpha_l - \frac{\tau^2(t_{ls}^g + t_{lm}^g) + \alpha_l}{(1+2\tau^2)}]^2 + \frac{1}{2}[\alpha_l - \tau(\frac{\tau^2 t_{sl}^g + \tau(\alpha_l - 1) + 1 + t_{sm}^g}{(2+\tau^2)} - t_{sl}^g)]^2 \\ &+ \frac{1}{2}[\alpha_l - \tau(\frac{\tau^2 t_{ml}^g + \tau(\alpha_l - 1) + 1 + t_{ms}^g}{(2+\tau^2)} - t_{ml}^g)]^2\end{aligned}$$

and

$$\begin{aligned}\sum_z PS_s^z(g) &= [(1-\frac{\tau^2 t_{ml}^g + \tau(\alpha_l - 1) + 1 + t_{ms}^g}{(2+\tau^2)} + t_{ms}^g)][\frac{\tau^2 t_{ml}^g + \tau(\alpha_l - 1) + 1 + t_{ms}^g}{(2+\tau^2)} - t_{ms}^g] \\ &+ \tau[1-\tau(\frac{\tau^2(t_{ls}^g + t_{lm}^g) + \alpha_l}{(1+2\tau^2)} - t_{ls}^g)][\frac{\tau^2(t_{ls}^g + t_{lm}^g) + \alpha_l}{(1+2\tau^2)} - t_{ls}^g] \\ &+ [\frac{\tau^2 t_{ml}^g + \tau(\alpha_l - 1) + 1 + t_{ms}^g}{(2+\tau^2)} - t_{ms}^g]^2 + \tau^3[\frac{\tau^2(t_{ls}^g + t_{lm}^g) + \alpha_l}{(1+2\tau^2)} - t_{ls}^g]\end{aligned}$$

and

$$\sum_z PS_l^z(g) = \tau[\alpha_l - \tau(\frac{\tau^2 t_{sl}^g + \tau(\alpha_l - 1) + 1 + t_{sm}^g}{(2+\tau^2)} - t_{sl}^g)][\frac{\tau^2 t_{sl}^g + \tau(\alpha_l - 1) + 1 + t_{sm}^g}{(2+\tau^2)} - t_{sl}^g]$$
$$+\tau[\alpha_l - \tau(\frac{\tau^2 t_{ml}^g + \tau(\alpha_l - 1) + 1 + t_{ms}^g}{(2+\tau^2)} - t_{ml}^g)][\frac{\tau^2 t_{ml}^g + \tau(\alpha_l - 1) + 1 + t_{ms}^g}{(2+\tau^2)} - t_{ml}^g]$$
$$+[1-\alpha_l + \tau(\frac{\tau^2 t_{sl}^g + \tau(\alpha_l - 1) + 1 + t_{sm}^g}{(2+\tau^2)} - t_{sl}^g)]\tau^2[\frac{\tau^2 t_{sl}^g + \tau(\alpha_l - 1) + 1 + t_{sm}^g}{(2+\tau^2)} - t_{sl}^g]$$
$$+[1-\alpha_l + \tau(\frac{\tau^2 t_{ml}^g + \tau(\alpha_l - 1) + 1 + t_{ms}^g}{(2+\tau^2)} - t_{ml}^g)]\tau^2[\frac{\tau^2 t_{ml}^g + \tau(\alpha_l - 1) + 1 + t_{ms}^g}{(2+\tau^2)} - t_{ml}^g]$$

$$TR_s(g) = t_{sm}^g(\frac{\tau^2 t_{sl}^g + \tau(\alpha_l - 1) + 1 + t_{sm}^g}{(2+\tau^2)} - t_{sm}^g) + \tau t_{sl}^g[1-\alpha_l + \tau(\frac{\tau^2 t_{sl}^g + \tau(\alpha_l - 1) + 1 + t_{sm}^g}{(2+\tau^2)} - t_{sl}^g)]$$

$$TR_l(g) = \tau^2 t_{ls}^g(\frac{\tau^2(t_{ls}^g + t_{lm}^g) + \alpha_l}{(1+2\tau^2)} - t_{ls}^g) + \tau^2 t_{lm}^g(\frac{\tau^2(t_{ls}^g + t_{lm}^g) + \alpha_l}{(1+2\tau^2)} - t_{lm}^g)$$

Using the welfare equations reported above and tariff levels reported in the text, we can easily obtain the formulae for welfare levels under all possible regimes.

B Proofs

The following lemmas will be used in the proposition proofs. These lemmas exploit a preference structure that slightly generalizes that given in Lemmas 4 and 5. This slight generalization is given in Condition 5.

Condition 5 *Assume Conditions 1–2 and the EBAs in subgames at hub–spoke, insider–outsider and CU insider–outsider networks abide by Lemmas 1–3. Additionally, assume countries have the following preferences. For country m, i) $\langle g_{m,l}^* \rangle$ is Pareto dominant, ii) $\langle g_{l,m}^* \rangle \succ_m \langle g \rangle$ for $g \notin \{g_{m,l}^*, g_{l,m}^*, g_{m,s}^*\}$, iii) $\langle g_{m,s}^* \rangle = \langle g_{s,m}^* \rangle = \langle (sm^{CU}) \rangle \succ_m \langle \varnothing \rangle$, and iv) $W_m(sm) > W_m(sl^{CU})$. For country l, i) $\langle (sm) \rangle = (sm)$ is Pareto dominant, ii) $W_l(ml^{CU}) > W_l(g^{FT})$ and iii) $\langle g_{l,m}^* \rangle \succ_l \langle g \rangle$ for $g \notin \{g_{l,m}^*, (sm), \varnothing\}$.*

As noted at the end of Section 3.3, we now present some notation used in the proofs of Lemmas 6-9. Let $G(P, g)$ be the set of networks $g' = g + \ell$ in the subgame at network g where ℓ is an EBA given the coalition structure P.[35] Specifically, $P = P^* \equiv \{\{i\}, \{j\}, \{k\}\}$ is the singletons coalition structure, $P = P_S \equiv \{\{S\}, \{N \setminus S\}\}$ is the coalition structure with S and $N \setminus S$ as the two coalitions and $P = N$ is the coalition structure with the grand

[35] $g + \ell$ is standard network notation indicating that the agreement (or, link(s)) ℓ is added to the network g.

coalition. Thus, for example, $G(P_S, g)$ is the set of networks $g' = g + \ell$ in the subgame at network g where ℓ is an EBA between S and $N \setminus S$. Similarly define $\gamma(P, g)$ as the set of networks $g' = g + \ell$ in the subgame at network g where ℓ is a Nash agreement given the coalition structure P. For example, $\gamma(P_S, g)$ is the set of networks $g' = g + \ell$ in the subgame at network g where ℓ is a Nash agreement between S and $N \setminus S$.

Lemma 6 now characterizes the EBA in the subgame at the empty network when m and l disagree on their preferred type of PTA (i.e. (ml) or $\left(ml^{CU}\right)$) but m can credibly threaten to form a PTA with s if l attempts to force m to accept l's preferred type of PTA.

Lemma 6 *Suppose Condition 5 holds and* $\left\langle g^*_{m,s}\right\rangle = \left\langle g^*_{s,m}\right\rangle \succ_m \left\langle g^*_{l,m}\right\rangle \neq \left\langle g^*_{m,l}\right\rangle \succ_l \left\langle g^*_{m,s}\right\rangle$. *If* $\langle\varnothing\rangle \succ_l \left\langle g^*_{m,l}\right\rangle$, *the EBA in the subgame at the empty network is* $g^*_{m,l}$. *If* $\left\langle g^*_{m,l}\right\rangle \succ_l \langle\varnothing\rangle$ *then the EBAs in the subgame at the empty network are* $G^{EBA} = \left\{g^*_{m,s}, g^*_{m,l}, g^*_{l,s}, g^*_{l,m}, (sm)\right\}$ *if* $g^*_{l,m} = \left(ml^{CU}\right)$ *or* $\langle(sm)\rangle \succ_s \left\langle g^*_{l,m}\right\rangle$ *but are* $G^{EBA} \setminus (sm)$ *otherwise.*

Proof. First, suppose $\left\langle g^*_{m,l}\right\rangle \succ_l \langle\varnothing\rangle$. In this case, the proof follows from three observations: i) $g^*_{m,s} \in G(P_{sm}, \varnothing)$, ii) $g^*_{m,l} \in G(P_{ml}, \varnothing)$ and iii) $g^*_{l,s} \in G(P_{sl}, \varnothing)$. For now we take these as given and establish them later. These observations imply $G(N, \varnothing)$ is empty because i) s and m have a self enforcing deviation from $g \in \left\{\varnothing, (sm), g^*_{l,s}, g^*_{l,m}\right\}$ to $g^*_{m,s} \in G(P_{sm}, \varnothing)$, ii) m and l have a self enforcing deviation from $g \in \left\{\left(sm^{CU}\right), g^*_{s,l}\right\}$ to $g^*_{m,l} \in G(P_{ml}, \varnothing)$ and iii) s and l have a self enforcing deviation from $g^*_{m,l}$ to $g^*_{l,s} \in G(P_{sl}, \varnothing)$. Hence, the EBAs are $G^{EBA} \equiv \cup_{S \subset N} G(P_S, \varnothing)$ and $G^{EBA} \supseteq \left\{g^*_{m,s}, g^*_{m,l}, g^*_{l,s}\right\}$.

We now establish that $G^{EBA} = \left\{g^*_{m,s}, g^*_{m,l}, g^*_{l,s}, g^*_{l,m}, (sm)\right\}$. To see this note that i) $g^*_{s,l} \notin G^{EBA}$ because m or l have a self enforcing deviation to, respectively, $g^*_{l,m} = \gamma(P^*, \varnothing)$ or $g^*_{m,l} = \gamma(P^*, \varnothing)$, and ii) $\varnothing \notin G^{EBA}$ because $\left\langle\left(sm^{CU}\right)\right\rangle \succ_{sm} \langle\varnothing\rangle$, $\left\langle g^*_{s,l}\right\rangle \succ_{sl} \langle\varnothing\rangle$ and $\left\langle g^*_{l,m}\right\rangle \succ_{ml} \langle\varnothing\rangle$. Moreover, $g^*_{l,m} \in G(P_{ml}, \varnothing)$ because $g^*_{m,s} \in \gamma(P^*, \varnothing)$ deters l's deviation to $a_l(\varnothing) = \phi$ while $g^*_{l,s} \in \gamma(P^*, \varnothing)$ or $g^*_{s,l} \in \gamma(P^*, \varnothing)$ deters m's deviation to $g^*_{m,l}$ or and $g^*_{m,s}$. Finally, given $\langle(sm)\rangle$ is Pareto dominant for l, $(sm) \in G(P_{sl}, \varnothing)$ iff $g^*_{l,m} = \left(ml^{CU}\right)$ or $\langle(sm)\rangle \succ_s \left\langle g^*_{l,m}\right\rangle$ because then $\left(ml^{CU}\right) \in \gamma(P^*, \varnothing)$ or $g^*_{l,m} \in \gamma(P^*, \varnothing)$ deters any deviation by s.

To conclude the case when $\left\langle g^*_{m,l}\right\rangle \succ_l \langle\varnothing\rangle$, we prove the three observations we have so far taken as given. First, $g^*_{m,s} \in G(P_{sm}, \varnothing)$ because $g^*_{l,s} \in \gamma(P^*, \varnothing)$ deters m's deviation to $g^*_{m,l}$ and $g^*_{l,m} \in \gamma(P^*, \varnothing)$ deters s's deviation to $g^*_{s,l}$. Second, $g^*_{m,l} \in G(P_{ml}, \varnothing)$ because $\left\langle g^*_{m,l}\right\rangle$ is Pareto dominant for m while $g^*_{m,s} \in \gamma(P^*, \varnothing)$ deters any deviation by l. Third, $g^*_{l,s} \in G(P_{sl}, \varnothing)$ because $g^*_{l,m} \in \gamma(P^*, \varnothing)$ or $g^*_{m,l} \in \gamma(P^*, \varnothing)$ deter s's deviations to $g^*_{s,l}$ or $g^*_{m,s}$ while $g^*_{m,s} \in \gamma(P^*, \varnothing)$ deters any deviation by l.

Now consider the second case by letting $\left\langle g^*_{l,m}\right\rangle \succ_l \langle\varnothing\rangle \succ_l \left\langle g^*_{m,l}\right\rangle$. Following the logic for the previous case, $G(N, \varnothing) \subseteq g^*_{m,l}$ because $g^*_{m,s} \in G(P_{sm}, \varnothing)$ and $g^*_{m,l} \in G(P_{ml}, \varnothing)$.

However, unlike that case, $g^*_{l,s} \notin G(P_{sl}, \varnothing)$ because s has a self enforcing deviation to $g^*_{m,s} = \gamma(P^*, \varnothing)$ given that $g^*_{m,l} \notin \gamma(P^*, \varnothing)$. Indeed, s and l have no self enforcing joint deviation from $g^*_{m,l}$ to any $g \in G(P_{sl}, \varnothing)$. Even though $\langle g \rangle \succ_l \langle g^*_{m,l} \rangle$ iff $g \in \widetilde{G} \equiv \{g^*_{l,s}, g^*_{l,m}, (sm), \varnothing\}$, $g \notin G(P_{sl}, \varnothing)$ for any $g \in \widetilde{G}$ because s has a self enforcing deviation from any such g to $g^*_{m,s} = \gamma(P^*, \varnothing)$. Moreover, $g^*_{m,l} \in G(P_{ml}, \varnothing)$ and $g^*_{m,l} \in G(P_{ml}, \varnothing)$ imply that, respectively, s nor l have a unilateral self enforcing deviation from $g^*_{m,l}$ to, respectively, any $g \in G(P_{ml}, \varnothing)$ or $g \in G(P_{sm}, \varnothing)$. Thus, given $g^*_{m,l}$ is Pareto dominant for m, $G(N, \varnothing) = g^*_{m,l}$.

Finally consider the second case by letting $\langle \varnothing \rangle \succ_l \langle g^*_{l,m} \rangle$. The proof follows from three observations. First, l's preferences imply $\gamma(P^*, \varnothing) \subseteq \{(sm), (sm^{CU}), \varnothing\}$. Second, $G(P_{sm}, \varnothing) = g^*_{m,s}$ because i) s has a self enforcing deviation from (ml) and (ml^{CU}) to $a_s(\varnothing) = m^{CU}$ and $(sm^{CU}) = \gamma(P^*, \varnothing)$, ii) similarly, m has a self enforcing deviation from (sl) and (sl^{CU}) to $a_m(\varnothing) = s^{CU}$ and $g^*_{m,s} = \gamma(P^*, \varnothing)$, and iii) $\langle (sm^{CU}) \rangle \succ_{sm} \langle g \rangle$ for $g \in \{\varnothing, (sm)\}$. Third, given the first observation, $g^*_{m,l} \in G(P_{ml}, \varnothing)$ because $\langle g^*_{m,l} \rangle$ is Pareto dominant for m while $g^*_{m,s} \in \gamma(P^*, \varnothing)$ deters any deviation by l. The second observation implies $g \notin G(N, \varnothing)$ for $g \in \{\varnothing, (sm), g^*_{l,s}, g^*_{l,m}\}$ because s and m have a self enforcing deviation from g to $g^*_{m,s} = G(P_{sm}, \varnothing)$. The third observation implies $g \notin G(N, \varnothing)$ for $g \in \{(sm^{CU}), g^*_{s,l}\}$ because m and l have a self enforcing deviation from g to $g^*_{m,l} \in G(P_{ml}, \varnothing)$. Thus, $G(N, \varnothing) \subseteq g^*_{m,l}$. Moreover, following the logic when $\langle g^*_{l,m} \rangle \succ_l \langle \varnothing \rangle \succ_l \langle g^*_{m,l} \rangle$, s and l have no self enforcing joint or unilateral deviation from $g^*_{m,l} \in \gamma(N, \varnothing)$. Hence, given $\langle g^*_{m,l} \rangle$ is Pareto dominant for m, $G(N, \varnothing) = g^*_{m,l}$. ■

Lemma 7 now characterizes the EBA in subgames at the empty network when m and l disagree on their preferred type of PTA but m can no longer credibly threaten to form a PTA with s if l attempts to force m to accept l's preferred type of PTA.

Lemma 7 *Suppose Condition 5 holds and $\langle g^*_{l,m} \rangle \succ_m \langle g^*_{m,s} \rangle = \langle g^*_{s,m} \rangle$. Then, the EBAs for the subgame at the empty network are $g^*_{l,m}$ unless $\langle g^*_{l,m} \rangle \succ_l \langle \varnothing \rangle$ and $\langle (sm) \rangle \succ_s \langle g^*_{l,m} \rangle$ in which case they are $G^{EBA} = \{(sm), g^*_{l,m}, g^*_{m,l}\}$ or, if $\langle g^*_{l,m} \rangle \succ_s \langle g^*_{m,l} \rangle$, $G^{EBA} = \{(sm), g^*_{l,m}\}$.*

Proof. To begin, suppose that $\langle g^*_{l,m} \rangle \succ_l \langle \varnothing \rangle$. The proof follows from three observations. First, $G(P_{sl}, \varnothing) \subseteq \{(sm), g^*_{l,m}\}$ because l has a self enforcing deviation from $g \notin \{(sm), g^*_{l,m}\}$ to $g^*_{l,m} = \gamma(P^*, \varnothing)$. In particular, $g^*_{l,m} \in G(P_{sl}, \varnothing)$ but $(sm) \in G(P_{sl}, \varnothing)$ if $\langle (sm) \rangle \succ_s \langle g^*_{l,m} \rangle$ given i) $(sm^{CU}) \in \gamma(P^*, \varnothing)$ deters l's deviation from $g^*_{l,m}$ to $a_l(\varnothing) = \phi$, ii) $\langle (sm) \rangle$ is Pareto dominant for l and iii) $g^*_{l,m} \in \gamma(P^*, \varnothing)$ deters any deviation by s from $g^*_{l,m}$ and, if $\langle (sm) \rangle \succ_s \langle g^*_{l,m} \rangle$, from (sm). Second, using similar logic, $G(P_{ml}, \varnothing) \subseteq \{(sm), g^*_{l,m}\}$ but now $G(P_{ml}, \varnothing) = g^*_{l,m}$ given $\langle g^*_{l,m} \rangle \succ_m \langle g^*_{m,s} \rangle$ and m's self enforcing deviation from (sm) to $g^*_{l,m} = \gamma(P^*, \varnothing)$. Third, $G(P_{sm}, \varnothing) \subseteq \{g^*_{l,m}, g^*_{m,l}\}$ and $g^*_{l,m} \in G(P_{sm}, \varnothing)$ because i) m has a self enforcing deviation from $g \notin \left\{g^*_{l,m}, g^*_{m,l}\right\}$ to $g^*_{l,m} = \gamma(P^*, \varnothing)$, and ii) $g^*_{l,s} \in \gamma(P^*, \varnothing)$ deters m's deviation from $g^*_{l,m}$ to $g^*_{m,l}$ and $g^*_{l,m} \in \gamma(P^*, \varnothing)$ deters any deviation by s.

The first and third observations imply $G(N, \varnothing) \subseteq g^*_{l,m}$ because m has a self enforcing deviation from (sm) to $g^*_{l,m} \in G(P_{sl}, \varnothing)$ and l has a self enforcing deviation from $g \notin \left\{(sm), g^*_{l,m}\right\}$ to $g^*_{l,m} \in G(P_{sm}, \varnothing)$. The only possible self enforcing deviation from $g^*_{l,m} \in \gamma(N, \varnothing)$ is by s and l to $(sm) \in G(P_{sl}, \varnothing)$ but this is self enforcing iff $\langle (sm) \rangle \succ_s \left\langle g^*_{l,m} \right\rangle$. Thus, $G(N, \varnothing) = g^*_{l,m}$ if $\left\langle g^*_{l,m} \right\rangle \succ_s \langle (sm) \rangle$ but $G(N, \varnothing)$ is empty if $\langle (sm) \rangle \succ_s \left\langle g^*_{l,m} \right\rangle$. In this latter case, the EBAs are $G^{EBA} \equiv \cup_{S \subset N} G(P_S, \varnothing)$. $G^{EBA} = \left\{(sm), g^*_{m,l}, g^*_{l,m}\right\}$ unless $\left\langle g^*_{l,m} \right\rangle \succ_s \left\langle g^*_{m,l} \right\rangle$ in which case $G^{EBA} = \left\{(sm), g^*_{l,m}\right\}$ because $g^*_{m,l} \notin G(P_{sm}, \varnothing)$ given $g^*_{m,l} \notin \gamma(P^*, \varnothing)$ when s attempts to deviate from $g^*_{m,l}$ to $g^*_{l,s}$ and $g^*_{l,m} \in \gamma(P^*, \varnothing)$ won't deter this deviation.

Now suppose that $\langle \varnothing \rangle \succ_l \left\langle g^*_{l,m} \right\rangle$. The proof follows from four observations. First, l's preferences imply $\gamma(P^*, \varnothing) \subseteq \left\{(sm), \left(sm^{CU}\right), \varnothing\right\}$. Second, $g \notin G(P_{sm}, \varnothing)$ for $g \in \left\{(sm), g^*_{m,l}\right\}$ since s has a self enforcing deviation from g to $a_s(\varnothing) = m^{CU}$ and $\left(sm^{CU}\right) = \gamma(P^*, \varnothing)$. Third, $G(P_{ml}, \varnothing) \subseteq \left\{g^*_{l,m}, g^*_{m,l}, g^*_{m,s}\right\}$ with $g^*_{l,m} \in G(P_{ml}, \varnothing)$ because i) m has a self enforcing deviation to $g^*_{m,s} = \gamma(P^*, \varnothing)$ from $g \in \left\{\varnothing, (sm), g^*_{s,l}\right\}$, ii) $\left\langle g^*_{l,m} \right\rangle \succ_{ml} \left\langle g^*_{l,s} \right\rangle$ and iii) $\left\langle g^*_{l,m} \right\rangle \succ_m \langle g \rangle$ for any $g \in \gamma(P^*, \varnothing)$ while $\left(sm^{CU}\right)$ deters any deviation by l from $g^*_{l,m}$. Fourth, by similar logic, $G(P_{sl}, \varnothing) \subseteq \left\{g^*_{l,s}, g^*_{s,l}, g^*_{l,m}, g^*_{m,s}\right\}$ with $g^*_{l,s} \in G(P_{sl}, \varnothing)$.

These observations imply $G(N, \varnothing) \subseteq g^*_{l,m}$ because i) the second observation implies s and m have a self enforcing deviation from (sm) and $\varnothing$ to $\left(sm^{CU}\right) \in G(P_{sm}, \varnothing)$, ii) the third observation implies m and l have a self enforcing deviation from $g \in \left\{g^*_{s,l}, g^*_{m,s}, g^*_{l,s}\right\}$ to $g^*_{l,m} \in G(P_{ml}, \varnothing)$ and iii) the fourth observation implies s and l have a self enforcing deviation from $g^*_{m,l} \in \gamma(N, \varnothing)$ to $g^*_{l,s} \in G(P_{sl}, \varnothing)$. Moreover, given $\cup_{S \subset N} G(P_S, \varnothing)$, there are no unilateral or joint self enforcing deviations from $g^*_{l,m} \in \gamma(N, \varnothing)$. Thus, $G(N, \varnothing) = g^*_{l,m}$. ■

Lemma 8 now characterizes the EBA in the subgame at the empty network when m and l agree on their preferred type of PTA.

Lemma 8 *Suppose Condition 5 holds and* $\left\langle g^*_{m,l} \right\rangle = \left\langle g^*_{l,m} \right\rangle \succ_m \left\langle g^*_{m,s} \right\rangle = \left\langle g^*_{s,m} \right\rangle$. *When* $\left\langle g^*_{l,m} \right\rangle \succ_l \langle \varnothing \rangle$, *the EBAs for the subgame at the empty network are* $g^*_{l,m}$ *if* $\left\langle g^*_{l,m} \right\rangle \succ_s \langle (sm) \rangle$ *but* $G^{EBA} = \left\{(sm), g^*_{l,m}\right\}$ *otherwise. When* $\langle \varnothing \rangle \succ_l \left\langle g^*_{l,m} \right\rangle$, *the EBA for the subgame at the empty network is* $g^*_{l,m}$.

Proof. For the case where $\left\langle g^*_{l,m} \right\rangle \succ_l \langle \varnothing \rangle$, the proof follows from two observations. First, like the proof of Lemma 7, $G(P_{sl}, \varnothing) = \left\{(sm), g^*_{l,m}\right\}$ if $\langle (sm) \rangle \succ_s \left\langle g^*_{l,m} \right\rangle$ and, otherwise, $g^*_{l,m} \in G(P_{sl}, \varnothing)$ and $G(P_{sl}, \varnothing) \subseteq \left\{(sm), g^*_{l,m}\right\}$. Second, $G(P_{ml}, \varnothing) = G(P_{sm}, \varnothing) = g^*_{l,m}$ because i) $g^*_{l,m} \in \gamma(P_{mj}, \varnothing)$ for $j = s, l$ and m has a self enforcing deviation from $g \neq g^*_{l,m}$ to

$g_{l,m}^* = \gamma(P^*, \varnothing)$, ii) $g_{l,m}^* \in \gamma(P^*, \varnothing)$ deters any deviation by s and iii) $g_{m,s}^* \in \gamma(P^*, \varnothing)$ deters l's deviation to $a_l(\varnothing) = \phi$. These observations imply that $G(N, \varnothing) \subseteq g_{l,m}^*$ because m has a self enforcing deviation from $g \neq g_{l,m}^*$ to $g_{l,m}^* \in G(P_{sl}, \varnothing)$. If $\langle g_{l,m}^* \rangle \succ_s \langle (sm) \rangle$, there are no unilateral or joint self enforcing deviations from $g_{l,m}^* \in \gamma(N, \varnothing)$ to any $g \in G(P_S, \varnothing)$ which implies $G(N, \varnothing) = g_{l,m}^*$. However, $\langle (sm) \rangle \succ_s \langle g_{l,m}^* \rangle$ implies s and l have a self enforcing deviation from $g_{l,m}^* \in \gamma(N, \varnothing)$ to $(sm) \in G(P_{sl}, \varnothing)$ which implies $G(N, \varnothing)$ is empty. In turn, the EBAs for the subgame are $G^{EBA} \equiv \cup_{S \subset N} G(P_S, \varnothing) = \{(sm), g_{l,m}^*\}$.

For the case where $\langle \varnothing \rangle \succ_l \langle g_{l,m}^* \rangle$, the proof follows from three observations. First, l's preferences imply $\gamma(P^*, \varnothing) \subseteq \{(sm), (sm^{CU}), \varnothing\}$. Second, following directly from the first observation, we have $g_{m,s}^* \in G(P_{sm}, \varnothing)$, $g_{l,m}^* \in G(P_{ml}, \varnothing)$ and $g_{l,s}^* \in G(P_{sl}, \varnothing)$. Third, $g \notin G(P_{sl}, \varnothing)$ for $g \in \{\varnothing, (sm)\}$ because s has a self enforcing deviation from g to $a_s(\varnothing) = m^{CU}$ and $(sm^{CU}) = \gamma(P^*, \varnothing)$. Thus, $G(N, \varnothing) \subseteq g_{l,m}^*$ because the second observation implies i) m and l have a self enforcing deviation from $g \notin \{\varnothing, (sm), g_{l,m}^*\}$ to $g_{l,m}^* \in G(P_{ml}, \varnothing)$ and ii) s and m have a self enforcing deviation from $g \in \{\varnothing, (sm)\}$ to $g_{m,s}^* \in G(P_{sm}, \varnothing)$. Indeed, $G(N, \varnothing) = g_{l,m}^*$ because, given the second and third observations, there are no unilateral or joint self enforcing deviations from $g_{l,m}^*$ to any $g \in G(P_S, \varnothing)$. ■

Lemma 9 now characterizes the EBA in the subgame at the empty network when l refuses to participate in liberalization despite the threat of being a CU outsider.

Lemma 9 *i) If $\langle g_{m,s}^* \rangle = \langle g_{s,m}^* \rangle = \langle (sm^{CU}) \rangle \succ_{sm} \langle \varnothing \rangle$ and $\langle g \rangle \succ_l \langle g_{l,m}^* \rangle$ for $g \in \{\varnothing, (sm), (sm^{CU})\}$, the EBA for the subgame at the empty network is (sm^{CU}). If $\langle (il) \rangle = (il) \succ_l \langle (il, sm) \rangle \succ_l \langle (il, jl) \rangle$ and $\langle (il, sm) \rangle \succ_{sm} \langle (il) \rangle$ for $i = s, m$, the EBA for the subgame at the insider–outsider network (il) is (sm) which yields the hub–spoke network (il, sm).*

Proof. Part i) follows from the observation that $G(P_{ij}, \varnothing) = (sm^{CU})$ for any i, j. Taking the observation as given, there are self enforcing deviations to $(sm^{CU}) = G(P_{sm}, \varnothing)$ by l (unilaterally) from $g \notin \{\varnothing, (sm), (sm^{CU})\}$ and by s and m (jointly) from $g \in \{\varnothing, (sm)\}$. Additionally, by definition, there is no self enforcing deviation from (sm^{CU}) to some $g \in G(P_S, \varnothing)$. Thus, $G(N, \varnothing) = (sm^{CU})$. To see the observation is true, note that l's preferences imply $\gamma(P^*, \varnothing) = \{(sm), (sm^{CU}), \varnothing\}$. Thus, $\gamma(P_{sm}, \varnothing) \subseteq \gamma(P^*, \varnothing)$ and, in turn, $G(P_{sm}, \varnothing) = (sm^{CU})$ given s and m's preferences. Moreover, for $i = s, m$, i) l deviates from $g \in \gamma(P_{il}, \varnothing)$ to $a_l(\varnothing) = \phi$ if $g \notin \{\varnothing, (sm), (sm^{CU})\}$ while ii) i deviates from $g \in \gamma(P_{il}, \varnothing)$ to $(sm^{CU}) = \gamma(P^*, \varnothing)$ if $g \in \{\varnothing, (sm)\}$ and iii) there is no self enforcing deviation from (sm^{CU}) to any $g \in \gamma(P^*, \varnothing)$.

Part ii) follows by similar logic. ■

Proof of Lemma 2

The first part of the lemma follows from Lemma 7 of Lake (2013a) given $W_l(sm) > \max\{W_l(g^{FT}), W_l(m$
To see this, we establish $W_l(sm) > W_l(ml^{CU}) > W_l(g^{FT})$ and $W_l(sm) > W_l(mh)$. These inequalities hold because $f_1(\tau, \alpha_l) = W_l(sm) - W_l(ml^{CU})$, $f_2(\tau, \alpha_l) = W_l(ml^{CU}) - W_l(g^{FT})$ and $f_3(\tau, \alpha_l) = W_l(sm) - W_l(mh)$ are increasing in α_l and minimized at yet $f_n(1, \bar{\alpha}_{l,2}) > 0$ for $n = 1, 2, 3$.

For the second part of the lemma, note $f_4(\tau, \alpha_l) = W_s(lh) - W_s(mh)$ is increasing in α_l and minimized at $f_4(1, \bar{\alpha}_{l,2}) > 0$. Thus, $\langle(ml, sl)\rangle \succ_s \langle(ml, sm)\rangle$. Moreover, $\bar{\beta}_m^{FT-I}(\theta) > \bar{\beta}_l^{FT-I}(\theta)$ and $\bar{\beta}_m^{FT-I}(\theta) > \bar{\beta}_l^{FT-K}(\theta)$ when $\alpha_l < \bar{\alpha}_{l,3}$. This follows because $f_5(\tau, \alpha_l) = \bar{\beta}_m^{FT-I}(\theta) - \bar{\beta}_l^{FT-I}(\theta)$ and $f_6(\tau, \alpha_l) = \bar{\beta}_m^{FT-I}(\theta) - \bar{\beta}_l^{FT-K}(\theta)$ are decreasing in τ and minimized at $f_n(1, \bar{\alpha}_{l,3}) > 0$ for $n = 5, 6$. Thus, even though $W_l(ml) > W_l(g^{FT})$ implies $\bar{\beta}_l^{FT-I}(\theta) < 1$, Lemma 4 of Lake (2013b) establishes the result since $\beta < \bar{\beta}_l^{FT-K}(\theta)$ implies $\beta < \bar{\beta}_m^{FT-I}(\theta)$ and hence $\langle(ml, sm)\rangle \succ_m \langle(ml)\rangle = (ml)$.

Lemma 9 establishes the third part of the lemma given the definition of $\bar{\beta}_l^{FT-K}(\theta)$ together with $W_m(mh) > W_m(ml)$, $W_s(mh) > W_s(sm)$ and $W_l(ml) > W_l(mh)$. $f_7(\tau, \alpha_l) = W_s(mh) - W_s(ml)$ is increasing in α_l and minimized at $f_7(1, \bar{\alpha}_{l,2}) > 0$ while $f_8(\tau, \alpha_l) = W_m(mh) - W_m(ml)$ is decreasing in α_l and minimized at $f_8(1, \bar{\alpha}_{l,3}) > 0$.■

Proof of Lemma 3

This follows directly from Lemma 1 of Lake (2013a) upon three observations. First, $W_l(ml^{CU}) > W_l(g^{FT})$ was established in the proof of Lemma 2. Second, $W_l(g^{FT}) \gtreqless W_l(sm^{CU})$. Third, $W_m(g^{FT}) > W_m(sm^{CU})$ and $\min\{W_m(ml^{CU}), W_m(sm^{CU})\} > W_m(\varnothing)$ because i) $f_1(\tau, \alpha_l) = W_m(sm^{CU}) - W_m(g^{FT})$ and $f_2(\tau, \alpha_l) = W_m(ml^{CU}) - W_m(sm^{CU})$ are increasing in α_l and minimized at $f_n(1, \bar{\alpha}_{l,2}) > 0$ for $n = 1, 2$ and ii) $f_3(\tau, \alpha_l) = W_m(sm^{CU}) - W_m(\varnothing)$ is decreasing in τ and minimized at $f_3(1, \bar{\alpha}_{l,3}) > 0$.■

Proof of Lemma 4

We first establish that $\langle(ml)\rangle \succ_m \langle g\rangle$ for $g \notin \{(ml), (ml^{CU}), (sm^{CU})\}$. $\langle(ml)\rangle \succ_m \langle g\rangle$ for $g \in \{(sl), (sm), (sl^{CU})\}$ and $W_m(sm) > W_m(sl^{CU})$ because $f_1(\tau, \alpha_l) = W_m(ml) - W_m(sl)$, $f_2(\tau, \alpha_l) = W_m(ml) - W_m(sm)$, $f_3(\tau, \alpha_l) = W_m(lh) - W_m(sm)$, $f_4(\tau, \alpha_l) = W_m(g^{FT}) - W_m(sm)$, and $f_5(\tau, \alpha_l) = W_m(sm) - W_m(sl^{CU})$ are increasing in α_l and minimized at $f_n(1, \bar{\alpha}_{l,2}) > 0$ for $n = 1, 2, 3, 4$ and $f_n(\underline{\tau}, \bar{\alpha}_{l,2}) > 0$ for $n = 5$. Moreover, $\langle(sm)\rangle \succ_m \langle\varnothing\rangle$ because $f_6(\tau, \alpha_l) = W_m(sm) - W_m(\varnothing)$ is decreasing in τ and minimized at $f_6(1, \bar{\alpha}_{l,3}) > 0$.

Now, given i) $\beta < \bar{\beta}^{FT-K}(\alpha_l)$, ii) $W_m(ml^{CU}) > W_m(g^{FT})$ when $\alpha > \bar{\alpha}_{l,2}$, and iii) $W_m(ml^{CU}) > W_m(sm^{CU}) > W_m(\varnothing)$ from Lemma 3, then $\langle(ml^{CU})\rangle$ is Pareto dominant for m because $W_m(ml^{CU}) > W_m(ml) > W_m(lh)$. This follows because $f_7(\tau, \alpha_l) = W_m(ml^{CU}) - W_m(ml)$ and $f_8(\tau, \alpha_l) = W_m(ml) - W_m(lh)$ are increasing in α_l and minimized at $f_n(\underline{\tau}, \bar{\alpha}_{l,2}) > 0$ for $n = 7, 8$. Finally, $(sm^{CU}) = g^*_{s,m} = g^*_{m,s}$ because $f_9(\tau, \alpha_l) =$

$W_m\left(sm^{CU}\right) - W_m(sm)$ is increasing α_l and minimized at $f_9(\underline{\tau}, \bar{\alpha}_{l,2}) > 0$.■

Proof of Lemma 5

Part iii) follows by definition of $\bar{\alpha}_{l,1}$ and $\bar{\alpha}_{l,2}$ and part ii) follows from the proof of Lemma 2 which established $W_l(sm) > W_l\left(ml^{CU}\right) > W_l\left(g^{FT}\right)$. For part i), note this ranking and that $W_l(sm) > \max\left\{W_l(\varnothing), W_l\left(sm^{CU}\right)\right\}$ follows given $f_1(\tau, \alpha_l) = W_l(sm) - W_l(\varnothing)$ and $f_2(\tau, \alpha_l) = W_l(sm) - W_l\left(sm^{CU}\right)$ are increasing in τ and minimized at $f_1(\underline{\tau}, \bar{\alpha}_{l,3}) > 0$ and $f_2(\underline{\tau}, \bar{\alpha}_{l,2}) > 0$.[36] Finally, $\langle(sm)\rangle \succ_l \langle(ml)\rangle$ iff $f_3(\beta, \tau, \alpha_l) = (W_l(ml) - W_l(sm)) + \beta(W_l(lh) - W_l(ml)) + \beta^2\left(W_l\left(g^{FT}\right) - W_l(lh)\right) < 0$. To see $f_3(\beta, \tau, \alpha) < 0$, note that $f_3(\cdot)$ is strictly concave in β and maximized at $f_{13}(\beta^*, 1, \bar{\alpha}_{l,2}) < 0$ where $\beta^* \equiv \frac{1}{2}\frac{W_l(lh)-W_l(ml)}{W_l(lh)-W_l(lh)}$ solves $\frac{\partial f_{12}(\cdot)}{\partial \beta} = 0$.■

Proof of Proposition 1

For subgames at hub–spoke networks $g = (ij, ik)$, Lemma 1 implies the EBA is (jk) which takes the world to the free trade network unless l is a spoke and $W_l(ih) > W_l\left(g^{FT}\right)$ in which case the EBA is no agreement meaning i remains the hub. For subgames at insider–outsider networks $g = (ij)$, Lemma 2 implies the EBA is no agreement if $g = (sm)$ meaning s and m remain insiders but, letting $i = l$ and given Condition 2, the EBA is (ik) otherwise yielding the hub–spoke network (ij, ik) with $i = l$ as the hub. For subgames at CU insider–outsider networks $g = \left(ij^{CU}\right)$, Lemmas 3 and 5 imply the EBA is no agreement meaning i and j remain CU insiders. We now determine the EBA in the subgame at the empty network $g = \varnothing$.

Given the definition of $\bar{\tau}_1(\alpha_l)$ and $\bar{\tau}_2(\alpha_l)$, Lemma 9 implies the EBA is $\left(sm^{CU}\right)$ when $\tau < \bar{\tau}_1(\alpha_l)$ or $\tau \in (\bar{\tau}_1(\alpha_l), \bar{\tau}_2(\alpha_l))$ and $\beta \notin \left(\underline{\beta}^{*Flex}(\theta), \bar{\beta}^{*Flex}(\theta)\right)$. Thus, $\left(sm^{CU}\right)$ is the unique equilibrium path of agreements in these cases. Given the definition of $\bar{\tau}_2(\alpha_l)$, Lemma 7 implies the EBA is (ml) for $\tau \in (\bar{\tau}_1(\alpha_l), \bar{\tau}_2(\alpha_l))$ and thus the equilibrium path of agreements is (ml, sl, sm).■

Proof of Proposition 2

The EBAs for subgames at hub–spoke and FTA insider–outsider networks follow that in the proof of Proposition 1. For subgames at CU insider–outsider networks, Lemma 3 implies the EBA is g^{FT} iff l is a CU outsider and $\tau > \bar{\tau}_3(\alpha_l)$; otherwise the EBA is as in the proof of Proposition 1. We now determine the EBA for the subgame at the empty network $g = \varnothing$.

First, suppose $\beta \in \left(\underline{\beta}^{Flex}(\theta), \bar{\beta}^{Flex}(\theta)\right)$ but $\beta \notin \left(\underline{\beta}^{l}(\theta), \bar{\beta}^{s}(\theta)\right)$ and $\beta < \bar{\beta}^{m}(\theta)$. Then, $\langle(ml)\rangle = \left\langle g^*_{l,m}\right\rangle \succ_m \left\langle g^*_{s,m}\right\rangle = \left\langle\left(sm^{CU}\right)\right\rangle$ and either i) $\langle\varnothing\rangle \succ_l \left\langle g^*_{l,m}\right\rangle$ or ii) $\left\langle g^*_{l,m}\right\rangle \succ_l \langle\varnothing\rangle$ but $\left\langle g^*_{l,m}\right\rangle \succ_s \langle(sm)\rangle$. Thus, Lemma 7 implies the EBA is $g^*_{l,m} = (ml)$ and the equilibrium path of agreements is (ml, sl, sm).

[36] Footnote 30 defines $\underline{\tau}$.

Second, suppose $\beta \in \left(\underline{\beta}^l(\theta), \bar{\beta}^s(\theta)\right)$. Then, given $\bar{\beta}^s(\theta) < \bar{\beta}^m(\theta)$, we have $\left\langle g^*_{l,m}\right\rangle \succ_m \left\langle g^*_{m,s}\right\rangle$, $\left\langle g^*_{l,m}\right\rangle \succ_l \langle\varnothing\rangle$ and $\langle(sm)\rangle \succ_s \left\langle g^*_{l,m}\right\rangle$. Thus, Lemma 7 implies the EBAs are $G^{EBA} = \cup_{S\subset N} G(P_S, N) = \{(sm), (ml)\}$ which, in turn, implies the equilibrium paths of agreements are (sm) and (ml, sl, sm).

Third, suppose $\beta \in \left(\bar{\beta}^m(\theta), \bar{\beta}_l^{Flex}(\theta)\right)$. Then Lemma 6 implies the EBA is $g^*_{m,l} = \left(ml^{CU}\right)$ when $\tau \in (\bar{\tau}_2(\alpha_l), \bar{\tau}_4(\alpha_l))$ and the equilibrium path of agreements is $\left(ml^{CU}\right)$. Additionally, Lemma 6 implies the EBAs are $G^{EBA} = \left\{g^*_{m,s}, g^*_{m,l}, g^*_{l,s}, g^*_{l,m}, (sm)\right\}$ when $\tau > \bar{\tau}_4(\alpha_l)$ which implies the equilibrium paths of agreements are $\left(ml^{CU}\right)$, $\left(sl^{CU}\right)$, (ml, sl, sm), (sl, ml, sm) and (sm).■

Proof of Proposition 3

The EBAs for subgames at hub–spoke networks and FTA and CU insider–outsider networks follow that in the proof of Proposition 2. Given the definition of $\tau_2(\alpha_l)$ and $\tau_4(\alpha_l)$, Lemma 8 implies the EBAs for the subgame at the empty network are $\left(ml^{CU}\right)$ for $\tau \in (\tau_2(\alpha_l), \tau_4(\alpha_l))$ and $\left\{\left(ml^{CU}\right), (sm)\right\}$ for $\tau > \tau_4(\alpha_l)$. Thus, respectively, the equilibrium paths of agreements are $\left(ml^{CU}\right)$ and $\left\{\left(ml^{CU}\right), (sm)\right\}$.■

Proof of Proposition 4

For subgames at hub–spoke networks, the FTA insider–outsider network (sm), or CU insider–outsider networks where l is a CU insider, the EBAs are as discussed in the proof of Proposition 2. For subgames at FTA insider–outsider networks (ij) where $i = l$ is an insider, Lemma 2 and Condition 3 imply the EBA is (ik) yielding the hub–spoke network (ij, ik) with $i = l$ as the hub if $\beta < \bar{\beta}_l^{FT-K}(\theta)$ but is (jk) yielding the hub–spoke network with j as the hub otherwise. For the subgame at the CU insider-outsider network $\left(sm^{CU}\right)$, Lemmas 3 and 5 imply the EBA is no agreement if $\left\langle\left(sm^{CU}\right)\right\rangle \succ_l \left\langle g^*_{l,m}\right\rangle$. We now determine the EBA in the subgame at the empty network.

First, let $\left\langle g^*_{l,m}\right\rangle \succ_l \left\langle\left(sm^{CU}\right)\right\rangle$. Given $\left\langle g^*_{l,m}\right\rangle \succ_m \left\langle g^*_{m,s}\right\rangle$ and $\langle\varnothing\rangle \succ_l \left\langle g^*_{l,m}\right\rangle$, Lemma 7 or 8 imply the EBA is $g^*_{l,m}$ which is (ml) if $\beta < \bar{\beta}_l^{FT-K}(\theta)$ and $\left(ml^{CU}\right)$ otherwise. Thus, the respective equilibrium paths of agreements are (ml, sm) and $\left(ml^{CU}\right)$. Second, let $\left\langle\left(sm^{CU}\right)\right\rangle \succ_l \left\langle g^*_{l,m}\right\rangle$. Then, Lemma 9 implies the EBA is $\left(sm^{CU}\right)$ and yielding the equilibrium path of agreements $\left(sm^{CU}\right)$.■

Proof of Proposition 5

Given $\left\langle g^*_{m,s}\right\rangle = \left\langle g^*_{s,m}\right\rangle = \left\langle\left(sm^{CU}\right)\right\rangle \succ_{sm} \langle\varnothing\rangle$ and $\langle(sm)\rangle \succ_l \left\langle g^*_{l,m}\right\rangle$ still hold, the proof follows directly from Lemma 9.■